DIPLOMA IN REGISTERED NURSING

eLEARNING TRAINING PROGRAM

Course Title: Pharmacology I

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COURSE INTRODUCTION

Hello, you are welcome to pharmacology course. This course talks about medicines that are used to prevent and treat diseases, how they work and how they produce the unwanted effects. This course is divided into two parts, thus pharmacology I and II. This course starts with an introduction to pharmacology and goes on to explain the history of pharmacology. It also looks at the legal, ethical and cultural aspects of pharmacology. You will also look at the drugs acting on different systems of the body, their routes of administration, their mode of action, side effects, the nursing implications as well as drug interactions. The course also looks at how you will work with the doctor and the pharmacist in helping the patients/clients collect the right drugs for their conditions.

As you know medicines (drugs) play an important role in the prevention and treatment of ailments.It is through the study of medicines that we get to know their effects on the disease-causing organisms and how the body utilizes these drugs. This course is aimed at equipping you with knowledge and understanding of pharmacology so that you will be able to give appropriate treatment to patients with various conditions.

Why must you study pharmacology as a 'nurse'?

There are three categories of trained healthcare providers who directly handle the patient's drugs namely; the doctor, nurse and pharmacist. Among these the nurse handles the drug in terms of storage, administration and observations of its effects and side effects. Since you stay with the patient for 24 hours, you play a major role in ensuring that the doctor prescribes the right drugs to the patient through the accurate administration, observation and recording.

It is therefore imperative for you to study pharmacology so that:

1. You know which drugs are suitable for which disease.
2. You know how certain drugs are administered and why administering in that way,
3. You know the side effects of the drugs,
4. You know how to identify symptoms of adverse drug reaction
5. You know what to do in case of adverse drug reactions.
6. You know the contraindications of certain drugs so that patients' lives are safe
7. You know the correct dosage for a particular patient
8. You educate the patient concerning the nature of disease; prescribed drugs and to be able to answer certain drug-related questions.
9. You know the storage conditions of various drugs and why they are stored in that way.

COURSE AIM

The aim of the pharmacology course is to equip you with knowledge and skills in pharmacology.

COURSE OBJECTIVES

By the end of this course, you should be able to:

1. Acquire knowledge and identify commonly used drugs and their routes of administration.
2. Explain the evolution of drug therapy and the implications of the National Drug Policy in Zambia.
3. Explain the legal, ethical and cultural aspect of pharmacology.
4. Explain the actions, side effects and contra-indications of commonly used drugs.
5. Demonstrate skills in calculating, measuring, preparing and administering drugs.
6. Prescribe and dispense commonly used drugs.
7. Explain the responsibilities of the nurse in drug administration

COURSE CONTENT

This course is divided into two parts that is, Pharmacology I which has 9 units and Pharmacology II which has 7 units.

PHARMACOLOGY I

UNIT 1: INTRODUCTION TO PHARMACOLOGY

In this unit you will look at the history of pharmacology and principles of clinical pharmacology where you will be required to explain the terminologies and abbreviations used in pharmacology.

UNIT 2: LEGAL, ETHICAL AND CULTURAL ASPECTS OF PHARMACOLOGY

This unit discusses the importance of considering the Acts and regulations of drugs as passed by Parliament. These laws/regulations apply during your training and after qualification as a nurse so that you are not in conflict with laws of the country. You will also look at the legal, ethical and cultural aspects of pharmacology, as well as drug dependence and addiction and their implications to nursing.

UNIT 3: ORDERING AND CONTROL OF DRUGS (LOGISTIC MANAGEMENT SYSTEM)

This unit discusses what you will be required to observe in the principles of administration of drugs. This includes drug dosages, strength, solutions and their preparations, ordering and storage of drugs and the correct routes of administering them. It will also equip you with the knowledge and skills of insertion and commencement of intravenous fluids and administration of controlled drugs.

UNIT 4: CLASSIFICATION OF DRUGS

In this unit, you will be equipped with the knowledge on various drug classifications and the conditions/infections in which these drugs are used with the aim of helping you to rationalize drugs and prevent drug resistance.

UNIT 5: DRUGS ACTING ON THE GASTRO INTESTINAL TRACT

In this unit you will review different drugs that are used on patients with various gastro intestinal tract (GIT) disorders. You will also review different types of diarrhoea and their specific treatment to avoid wasting drugs (rational drug use).

UNIT 6: DRUGS ACTING ON THE CARDIOVASCULAR SYSTEM

This unit discusses different types of drugs that act on the cardiovascular system. You will explore different drugs that are used to treat patients with various cardiovascular system conditions.

UNIT 7: DRUGS ACTING ON RESPIRATORY SYSTEMS

In this unit you will gain knowledge on drugs acting on the respiratory system. Respiratory conditions can be fatal (deadly) if time is lost in deciding which drug to use hence the importance of equipping you with the necessary knowledge on these specific drugs.

UNIT 8: CYTOTOXIC DRUGS

In this unit, you will be equipped with knowledge on the use of cytotoxic drugs (anti-neoplastic or anti-cancer drugs) which are used for cancer therapy. You will explore other cancer treatment modalities and your role in treating cancer patients. You will also be equipped with knowledge on palliative care and your relationship with the patients and their relatives.

UNIT 9: DRUGS USED IN TREATMENT OF TUBERCULOSIS

This unit discusses the importance of prompt treatment of patients with tuberculosis. It equips you with knowledge of drugs used in the treatment of tuberculosis, the available treatment regimens and tuberculosis drugs interaction with other drugs such as Anti-retroviral drugs (ARVs).

LEARNING TIPS

It will probably take you a minimum of 90 hours to work through this whole course. The time should be spent on studying the Course and the readings, doing the activities and self-help questions and completing the assessment tasks. Be informed that sections are not all the same in length; therefore, plan your work and pace to have adequate time to complete all of them. For example, units 3, 4, 5 and 6 have heavy reading schedules. Pharmacology also requires you to review and understand the basic concepts of anatomy and physiology in order to appreciate the course. Therefore, take keen interest to update yourself with anatomy and physiology involved for a particular unit.

ACTIVITIES, SELF-HELP QUESTIONS AND CASE STUDIES

You will find activities, self-help questions and case studies in this course. These are intended to help you make your learning experience more interesting, active and effective. They will help you to engage with ideas and check your own understanding. It is important that you take the required time to complete them. Make sure you write full answers to the activities, or take notes of the discussions.

READINGS

There is a list of Further Reading at the end of this Course. This includes books, web sites and articles referred to in the Course and there are suggestions in case you wish to explore topics further. You are encouraged to read as widely as possible during and after the course.

ASSESSMENTS

Your work in this Course will be assessed in the following three ways:

Continuous Assessment which is divided into two has 40%.

Tests 1 and 2	-	20%
Assignments 1 and 2	-	20%
Final Written Exam	-	60%

UNIT 1: INTRODUCTION TO PHARMACOLOGY

1.1 Introduction

Hello, welcome to the first unit in our pharmacology course. This is an interesting and friendly lesson and you are urged to participate fully. In the earlier introduction to this course, it was mentioned that pharmacology involves the study of drugs and their action on living organism. You also noted the importance of pharmacology in relation to disease prevention and treatment. In this unit we will define pharmacology, discuss the brief history of pharmacology, describe the principles of clinical pharmacology, terminologies and abbreviations used in pharmacology. It is therefore important that you pay utmost attention for you to appreciate the unit.

1.2 Objectives

By the end the unit, you should be able to:

1. Define pharmacology
2. Explain the history of pharmacology.
3. Explain the terminologies and abbreviations used in pharmacology.
4. Describe the principles of clinical pharmacology.

1.3 Definition of Pharmacology

Merriam-webster dictionary defines pharmacology as the study of properties and reactions of drugs especially with relation to their therapeutic value. It is the science of drugs, including their origin, composition, uses, and effects on living organism.

1.4 History of Pharmacology

The word pharmacology is derived from a Greek word (pharmakos, which means medicine or drug; and logos, which mean study). It is a broad science that includes all aspects of the subject of chemical substances that act upon body cells. Pharmacology studies the effects of drugs and how they exert their effect on the body. Practically it is the study of drugs and how they act.

As early as the 19th centuary or even before, the Egyptians, Arabs and the Latin knew how to use medicines though they were totally ignorant about pharmacology. The Egyptian used Sienna for the treatment of constipation and the Arabs used opium for

the treatment of minor disorders but both did not understand the effect of drugs until much later.

Historically, synthetic organic chemistry was born in 1828, when Friedrich Wohler synthesized urea from inorganic substances and thus demolished the vital force theory. The birth date of pharmacology is not as clear-cut. In the early 19thcentury, physiologists performed many pharmacologic studies.

However, Oswald Schmiedeberg (1838–1921) is generally recognized as the founder of modern pharmacology. He obtained his medical doctorate in 1866 with a thesis on the measurement of chloroform in blood. He worked at Dorpat under Buchheim, succeeding him in 1869. In 1872, he became professor of pharmacology at the University of Strassburg, receiving generous government support in the form of a magnificent institute of pharmacology. In 1869, Schmiedeberg showed that muscarine evoked the same effect on the heart as electrical stimulation of the vagus nerve.

Next, let us look at the terminologies and abbreviations used in pharmacology.

1.5 Terminologies and abbreviations used in pharmacology

You have just finished learning about the history of pharmacology. This lesson will help you to understand some of the terminologies and abbreviations used in pharmacology.

The following are some of the terminologies you must know;

Half-Life:

This refers to the time required for the body to eliminate 50% of the drug. Knowledge of the half-life of a drug is important in planning the frequency of dosing. For example, drugs with a short half-life (2–4 hours) need to be administered frequently, whereas a drug with a long half-life (21–24 hours) requires less frequent dosing. Although half-life is fairly stable, patients with liver or kidney disease may have problems excreting a drug. Difficulty in excreting a drug increases the half-life and increases the risk of toxicity. For example, digoxin (Lanoxin) has a long half-life (36 hours) and requires once-daily dosing. However, aspirin has a short half-life and requires frequent dosing. Older patients or patients with impaired kidney or liver function require frequent diagnostic tests measuring renal or hepatic function.

Drug:

A drug is a chemical or substance used in the diagnosis, cure and in the prevention of diseases.

a) General Anaesthetic drugs: These are the medicines that depress the cerebral function by inducing unconsciousness. They are usually administered intravenously and others through inhalation.

b) Local Anaesthetic drugs: - are medicines that block the impulses of sensory nerve fibres producing instant relief of pain on the area of administration but do

not interfere with consciousness. They are usually administered through the intradermal or subcutaneous route.

c) Intrathecal anaesthetic drugs: are the local anaesthetic drugs injected into the spinal column usually at the lumbar region to block sensory impulses below the lumbar region. They are commonly used for major surgical operations for example, on the genital urinary system. They do not interfere with consciousness and are usually given together with major narcotic drug for example, Morphine.

2. Diuretics: are drugs that decrease sodium and water reabsorption by the renal tubules thereby increasing the solute and its excretion resulting in the increased amount of urine. They are usually described or named according to action for example;

a) The Osmotic diuretics: these will increase the urinary output volume but will reduce the loss of sodium/salt.

b) **The Potassium sparing diuretics:** these are diuretic that reduce the loss of potassium but increase the loss of sodium (Na) and Water (H2O).

3. Steroids: Anti-inflammatory steroids: These suppress all the inflammatory processes in the body. Therefore, they should be used with caution because inflammation is the body's method of dealing with pathogenic bacterial inversion and if the inflammatory process is suppressed the bacteria will spread to all parts of the body. As glucocorticoids, steroids are capable of stimulating the production of sugar from protease in the body thereby reduce sensitivity to insulin. As Minerocorticoids they cause retention of Na and water leading to oedema and development of hypertension.

4. Tranquillizers: Are drugs that calm patients who present with hyperactivity, excitement or confusion. These drugs include:

a) Minor tranquillizers: Have relaxing and tranquillizing effects in patients with anxiety, tension and fears.

b) Major tranquillizers: Are used in patients where a patient presents with severe symptoms of anxiety, tension and especially where a state of confusion occurs.

5. Anti-depressants: Drugs used in the treatment of depression and illness that might occur as a result of unfortunate domestic and social condition.

6. **Emetics and anti-emetics**

a. Emetics: These are drugs that provoke vomiting and are divided into two groups:

- **Reflex emetics:** These induce vomiting by irritating the stomach for example, warm salt water, mustard one tea spoon to one pint of warm milk.

- **Central emetics:** These induce vomiting by irritating the vomiting centre direct in the brain for example apple morphine (No analgesic effect).

b. Anti-emetics: Drugs used to stop vomiting for example, Plasil.

7. Anti-histamine and Histamine

a) **Histamine:** Drugs that stimulate gastric secretion and cause vasodilation of capillaries and arterioles.

b) **Antihistamines:** - Drugs that antagonise the action of histamines and most of them have some anti-emetic effects. Some anti-histamine will cause drowsiness.

8. Laxatives, purgatives and Aperients: Drugs which loosen the stools while other increase peristaltic movement of bowels thereby promoting bowel evacuation. These are commonly abused drugs and are classified into 3 groups:

a) Bulky purgatives: - These include high residue foodstuffs for example, mangoes.

b) Emollient purgatives: These usually include orals like liquid paraffin

c) Irritant purgatives: for example, Castor oil

9. Anti-fungal agents: Are drugs used in the treatment of fungal infections and most of them are topically applied but few of them are systemic drugs.

10. Anti-helmetics: Are drugs used in the treatment of worm infestation. They are a diverse group of substances with widely differing properties.

11. Antimalarial drugs: Are drugs used in the treatment of malaria. They can be given orally, intramuscularly (IM) or intravenously (IV).

12. Vaccines and antisera: are drugs that give protection against certain communicable diseases. They are divided into 3 categories.

a) Toxoid: Are given to bring about active immunity and once given, the person produces antibodies against the bacteria or toxin. They are used mainly for prophylaxis measures.

b) Sera: Are preparations that are given in order to bring about passive immunity and are usually given for treatment for example tetanus toxoid 0.5mls IM.

c) Antigens: Are used for diagnostic purposes.

13. Antituberculosis drugs (Anti TB Drugs): Are drugs used in the treatment of tuberculosis.

Treatment of tuberculosis is divided into two phases for both children and adults.

Below are some of the abbreviations related to the frequency of drug administration. Although they are internationally accepted, you are not allowed to use them in your examinations both oral and written. You are only allowed to use them on the drug charts.

Table 1: Abbreviations used in pharmacology

a.c	before meals	**po**	per os/orally/by mouth
p.c	after meals	**prn**	repeat when necessary
ad	right ear	**qh**	every hour
as	left ear	**qwk**	every week
all	both ears	**qod**	every other day
hs	hour of sleep	**q2h**	every 2 hours
i.m	intramuscularly	**tab**	tablet
i.v	intravenously	**ths**	teaspoon
inhal	inhalation	**sc**	subcutaneously
it	intratheral	**subconj**	subconjuctiva
i & o	intake and output	**pr**	per rectum
gutt	drops	**ml**	millilitre
gm	grams	**tid**	three times in the day
l	litre	**bid**	brought in dead
mg	milligrams	**bd**	twice daily
od	once a day/ right eye	**qid**	Every six hours in a day
os	out of stock/ left eye	**nocte**	at night

You have just finished looking at the terminologies and abbreviations used in pharmacology.You will definitely appreciate what you have learnt as you progress with your learning. In the next sub topic you will learn about principles of clinical pharmacology before then do the activity that follows.

Self-Assessment Test: MCQ

Choose the most appropriate answer

1. An anti-emetic is:
    a. Is a drug that stops diarrhoea
    b. Is a drug that induces diarrhoea
    c. Is a drugs that induces micturition
    d. Is a drug that stops vomiting

2. Pharmacology is defined as:
    a. The medical science that deals with how drugs are procured
    b. The medical science that deals with how drugs work to prevent and cure diseases
    c. The medical science that deals with the processes involved in the production of medicines

ANSWER

1. D
2. B

1.6 Principles of Clinical Pharmacology

A sound knowledge of basic pharmacologic principles is essential for you to safely administer medications and to monitor patients who receive these medications. The administration of a drug is your fundamental responsibility as a nurse. That is why it is important for you to understand the basic concepts of administering drugs so that you can perform this task safely and accurately. In addition to administering the drug, you will be required to monitor the therapeutic response and report adverse reactions. You are also responsible for teaching the patient and family members the necessary information to administer drugs safely in an outpatient setting.

The knowledge you acquired from the terminologies and abbreviations used in pharmacology will enable you to learn about the principles of pharmacology for you to effectively understand the importance of the course.

There are nine principles of pharmacology which you need to understand. These principles are:

i. Pharmacotherapeutics.
ii. Pharmacodynamics.
iii. Pharmacognosy
iv. Pharmacovigilance
v. Prescribing: Principles; Rational prescribing and rational use of drugs; Cost effectiviness; Placebo; Mathematical calculations and Drug interactions

vi. Dispensing

vii. Adverse drug reaction

viii. Neonatal, paediatric and gedriatric considerations in drug administration.

Let us discuss each principle in detail below.

Phamacotherapeutics

This is the scientific study of the use of drugs in the treatment of disease. In this lesson you are urged to know the therapeutic effects of one agent as compared with those of another on the basis of ability to halt a disease or disease process.

Pharmacodynamics

This is the study of the biochemical and physiological effects of drugs and their mechanisms of action. Most drugs bind to receptors to bring about the effect. When drugs bind to these receptors, there is a cascade of chemical reactions that follows in order for it to achieve the effect in a specified duration. However, you should be aware that all drugs produce more than one effect in the body. The primary effect of a drug is the desired or therapeutic effect. Secondary effects are all other effects, produced by the drug whether desirable or undesirable. Most drugs have an affinity for certain organs or tissues and exert their greatest action at the cellular level on those specific areas, which are called target sites.

You will discover that there are two main mechanisms of action and these are:

- Alteration in cellular environment
- Alteration in cellular function

Pharmacokinetics is a term derived from the Greek word 'kinesis' meaning a movement. It deals with the time course of drug absorption, distribution, metabolism and excretion. In other words, it means ‘What the body does to the drug’. In order to achieve the desired pharmacological response, a drug must first be available in a suitable form and then be given by an appropriate route. The processes involved in pharmacokinetics are as outlined:

- **A**bsorption – is the process by which a substance entering the blood circulation.
- **D**istribution - the dispersion or dissemination of substances throughout the fluids and tissues of the body.
- **M**etabolism - is the process by which complex molecules are broken down into simple molecules.
- **E**xcretion – is the removal of the substances from the body.

This means that you have to know the half-life of the administered drug for you to avoid giving an overdose. The half-life of a drug is the measure of the rate at which half of the drug is removed from the body as mentined in the terminologies earlier .

Pharmacognosy

This is a term derived from the Greek word 'gnosis' which means knowledge. It is a branch of pharmacology that deals with the composition, use, and development of

medicinal substances of biological origin and the sources of drugs derived from plants and animals.
It was necessary for pharmacists to have extensive knowledge in this area because many crude (crude drugs are the dried, unprepared material of plant, animal or mineral origin, used for medicine) medicinal products were obtained from plants. In most industrialized countries, however, chemical manufacturing processes have replaced plants

Pharmacovigilance
Pharmacovigilance (PV) is defined as the science and activities relating to the detection, assessment, understanding and prevention of adverse effects or any other drug-related outcomes. The aims of PV are to enhance patient care and patient safety in relation to the use of medicines; and to support public health programmes by providing reliable, balanced information for the effective assessment of the risk-benefit profile of medicines.
You are required to observe the patient for any unwanted effects after giving the drugs to enhance pharmacovigilance.

Prescribing
Prescribing is the power given to the health practitioner who is by law licensed to prescribe drugs.A prescription can be written on paper as long as all necessary legal elements are present. Therefore, as a nurse you are also equipped with knowledge to prescribe and use drugs in a rational way.

Principles of prescribing: While prescribing the following principles should be considered:

- Prescription should be legible and signed clearly for optimal communication between the prescriber and other members of the health care team. (Pharmacist and other nurses).
- Prescription should contain sufficient information to permit a pharmacist or a nurse to discover possible errors before the drug is dispensed or administered. A valid prescription should include the following: date, patient's name, name of the drug, dose of the drug, route of administration, frequency of taking the drug, duration of treatment, name and signature of the prescriber.
- Take account of any allergies
- Prescription should have generic drug name
- Avoid abbreviations
- Avoid multiple route prescribing (that is, intramuscular /subcutaneous /per oral)
- State dose as grams, milligram, microgram.

a. Rational prescribing and rational drug use

This is your judgement of correct drug use to avoid waste, with right prescription and right diagnosis. You are required to do this in order to achieve good prescribing, dispensing and compliance in all treatment at lowest possible cost.
This will enable you to:

- Ensure rational use of drugs measurable by various indicators.
- To ensure that all access to drugs is accompanied by adequate information necessary for rational drug use.
- To eradicate unnecessary and inappropriate drug use at all levels in the society.

b. Cost effectiveness

Applies to cost-benefit, cost-minimization, and cost-utility analyses to compare the economics of different pharmaceutical products or to compare drug therapy to other treatments.

c. Placebo

A placebo is a substance containing no medication and prescribed or given to reinforce a patient's expectation to get well. It is also defined as an inactive substance or preparation used as a control in an experiment or test to determine the effectiveness of a medicinal drug.
A placebo is intended to deceive the recipient. Sometimes patients given a placebo treatment will have a perceived or actual improvement in a medical condition, a phenomenon commonly called the placebo effect. Placebos are widely used in medical research and are given as control treatments and depend on the use of measured deception.

However, the use of placebos as treatment in clinical medicine (as opposed to laboratory research) is ethically problematic as it introduces deception and dishonesty into the doctor or nurse patient relationship. This means that you have to use placebos only on non-life threatening situations. For example a patient who is complaining of severe pain just after receiving Pethidine injection to relieve pain may be given water for injection to calm him/her.

d. Mathematical calculations

Patients may be prescribed doses of a drug which are not precisely equivalent to a single tablet, ampoule or a 5ml spoonful. It is necessary to calculate the quantity of drug preparation which will contain the prescribed dose; this is a common source of error in drug administration.

It is important that you know proper calculation of drug dosages. Before you get to acquint yourself with these calculations, here are the standard measurements used in drug preparations.

Weights and Measures
Weight

- 1000 milligrams (mg) = 1 gram (g)

- 1000 micrograms (mcg) = 1 milligram (mg)
- 1,000,000 micrograms (mcg) = 1 gram (g)
- 1000 grams (g) = 1 kilogram (kg)
- 1000 nanograms (ng) = 1 microgram (mcg)

Capacity

- 1 millilitre (ml) = 1 cubic centimetre (cc)
- 1000 millilitres (ml) = 1 litre (l)
- = 1000 cubic centimetres (cc)
- 100 millilitres (ml) = 1 decilitre (dl)
- 1 litre of water at 4℃ weighs 1 kilogram

Domestic measures

- 1 teaspoonful = 5ml
- 1 dessertspoonful = 7.5ml
- 1 tablespoonful = 15ml
- 1 tumblerful = 250mls
- 1 pint = 2 cups
- 1 cup = 8 ounces

Infusion sets

- Standard giving set-
- 20 drops deliver 1ml
- 15 drops for blood deliver 1ml

Calculation of Drugs

The nurse should know how to calculate dosage because the amount prescribed is not as stored.
The formular to be used is as follows:

Divide the amount required by amount available and multiply by volume in stock. Thus:

$$\frac{\textbf{Required}}{\textbf{Available}} \textbf{ X Volume}$$

Here is an example to illustrate this:
Calculate the amount of cortisone to be administered when 100mg is prescribed and the available stock is 250mgs in 10mls

$$\frac{100\text{mgs}}{250\text{mgs}} \text{ X } 10\text{mls} = 4\text{mls}$$

i. Calculation of dosage of oral tablets or capsules medicines

Doses may be in tablet or capsule form and sometimes are prescribed according to mass for example, grams (gms), milligrams (mgs), micrograms (mcg). The formular is:

Required
Available

Example: The doctor prescribed ampiciliin 500mg and the stock available is 250mgs per capsule.

Calculate the number of capsules required.

Required 500mg = 2 capsules
Available 250mg

ii. Medicine Calculations in Children

Children generally require smaller dosages than adults. Most drug dosages are based on weight of the patient.

Example:
Erythromycin is prescribed for a child. The recommended dosage is 40mg/kg body weight per day. The child requires 4 doses daily. If the Child's weight is 15kg, calculate the size of a single dose.

$$\frac{40\text{mg} \times 15\text{kg}}{4} = 150\text{mg}$$

Clark's Rule

This is the most popular method for determining the dose for children based on child's body weight. It states that;

The child's dose is equal to weight of child over weight of adult multiply by adult dose. Thus:

$$\text{Child's dose} = \frac{\text{Weight of child}}{\text{Weight of Adult}} \times \text{Adult dose}$$

For example, if the adult dose of paracetamol is 500mg, what is the dose for a 10kg child? We assume normal adult weight is 70kg.

$$\text{Child's dose} = \frac{10\text{kg}}{70\text{kg}} \times 500\text{mg} = 71\text{mg}$$

iii. Arithematic IV infusion

The fluids are being infused from flask into a drip chamber. A drip chamber has fixed drops and adjustable rate of flow. There two main drip chambers in general use; One breaks 15 drops per ml another 60 drops per mls:

Formular: Drops per minute $= \frac{\text{volume to be given} \times \text{number of drops per ml (drop factor)}}{\text{Time} \times 60}$

Example:

A boy is to receive 400mls of 5% dextrose in 8 hours and the IV set delivers 60 drops /ml. calculate the rate of drops per minute.

$$\text{Drops per minute} = \frac{400\text{mls} \times 60}{8 \times 60}$$

$$= 5 \text{ hours}$$

e. Drug interaction

When one drug administered in combination with or shortly after another drug alters the effect of one or both drugs, this is known as a drug interaction. Usually the effect of one drug is increased or decreased, for example, one drug may inhibit or stimulate metabolism or excretion of the other or it may release another from plasma protein binding sites freeing it for further action.

Combination therapy is based upon drug interaction. One drug may be given to potentiate another for example probenecid which blocks the excretion of penicillin is sometimes given with penicillin to maintain adequate blood levels of penicillin for longer periods.

Drug interaction can be in the following ways:

i. **Additive:** Two drugs with similar action are given together precisely because of the additive effect they produce. For example Aspirin and codeine can be given together and they provide greater relief of pain than when given alone.

ii. **Antagonist:** Drugs are given to prevent or antagonize certain side affect for example hydrochlorothiazide and spironolactone, both diuretics are often administered in combination because the former is potassium depleting and the latter is potassium sparing.

iii. **Synergism:** This is the cooperative/combined action of two or more drugs whose combined effect is greater than the sum of their separate effects. The combined effect of two drugs is greater than the sum of the effect of each drug given alone. For example Aspirin + codeine = much greater analgesic effect. Not all drug interactions are beneficial. Multiple drugs sometimes produce harmful or undesirable effects.

iv. **Antagonistic effect:** One drug interferes with the action of another for example Tetracycline + antacid = decreased absorption of the tetracycline

v. **Displacement:** The displacement of the first drug by a second drug increases the activity of the first drug. For example Warfarin + valproic acid= increased anticoagulant effect.

vi. **Interference:** The first drug inhibits the metabolism or excretion of the second drug, causing increased activity of the second drug for example Probenecid + spectinomycin = prolonged antibacterial activity from spectinomycin due to blocking renal excretion by probenecid.

vii. **Incompatibility:**The first drug is chemically incompatible with the second drug, causing deterioration when both drugs are mixed in the same syringe or solution; incompatible drugs should not be mixed together or administered together at the same site; signs of incompatibility are haziness, a precipitate, or a change in color of the solution when the drugs are mixed for example Ampicillin + gentamicin = ampicillin inactivates gentamicin

Dispensing

Dispensing referestothe preparation, packaging, labeling, record keeping, and transfer of a prescription drug to a patient or an intermediary, who is responsible for administration of the drug (Mosby's Medical Dictionary, 8th edition. © 2009, Elsevier).

Dispensing is when a client is given medication for administration at a later time. Examples of dispensing include when the client is leaving the facility but needs to continue medication while away.This means that as a nurse you are bound by law to give the patient the right drugs for the patients presenting condition.

Principles of dispensing

As you dispense drugs you need to meet the following expectations:

1. Dispense medications when it is in the best interest of the client.
2. Dispense medications only to clients under your care.

When taking steps to ensure pharmaceutical and therapeutic suitability, always:

- Review the order for completeness and appropriateness (for example drug, dosage, route and frequency of administration).
- Review the client's medication history and other personal health information.
- Consider potential drug interactions, contraindications, allergies, therapeutic duplications and any other potential problems (for example adverse side effects)
- Consider the client's ability to follow the medication regimen.

Adverse drug reaction

This is an unpredictable reaction of the body to the drug that is not the reason for which the drug was given for. For example, drugs used in the treatment of cancer are very toxic and are known to produce adverse reactions in many patients receiving them. These are usually harmful effects which you must watch out for and you are required to take prompt measures if detected.

These can happen because:

- The patient is allergic to the drug
- The dose is too large for the patient
- Several drugs combine in the body when taken together and produce a harmful effect.
- The drug is not taken as prescribed by the doctor
- The drug itself may be harmful chemical compositions, for example Aspirin which is acidic.

Neonate, paediatric and geriatric considerations in drug administration

Drug doses prescribed for children are calculated in terms of body weight and not by age. This is so because children of any age may vary in weight. Therefore, you should at all times have working sets of scales in all clinics/wards/hospitals where children are treated to avoid administering wrong doses.

When you are prescribing or administering drugs to the neonate, paediatric and geriatric you need to consider the following:

i. **Age:** The younger a patient, the smaller the dose. Children are usually given smaller doses than adults. The very elderly also should have smaller doses.
ii. **Weight:** The lesser the weight, the smaller the dose.
iii. **Route:** The dose is not necessarily the same for all routes. Larger doses are often given orally as compared to parenteral routes.
iv. **Severity of the condition or disease:** The more serious the condition, the larger dose. .
v. **Loading dose:** This is the first dose and it is usually larger than the following doses. This is done to achieve increased bioavailability of the drug to combat an infection
vi. **Sex:** In females certain drugs are either avoided or prescribed at lower doses especially in pregnant or breast-feeding mothers. If higher doses are given, they can be harmful to the foetus or to the infant.
vii. **Time of administration:** This depends on the frequency or time that is after meals or before meals.

Drug interactions and dependency

Drugs have several ways in which they interact and depend on each other. You should therefore learn how drugs interact with each other or with food before the drugs are ordered. Two or more drugs administered simultaneously or sequentially may either act independently of each other or may interact to augment or diminish the expected response or to cause unanticipated toxicity.

The following are some of the common actions in which they interact or depend on each other:

i. **Synergism**: Certain drugs may produce the same general effects when given together or may produce an exaggerated effect out of proportion to the amount of drug each given. Such drugs are said to be synergist.
ii. **Potentiation**: When you administer two drugs together and one intensifies the action of the other by the same mechanism of action is said to potentiate the other.
iii. **Additive effect**: When half a dose of a drug and another half of a similar acting drug are given to produce the full effect of the drug. These are said to have an additive effect.

You have come to the end of the topic and I hope you found it interesting. Let us review what you have learnt.

1.7 Summary

In this unit you have learnt about the history of pharmacology, the principles of clinical pharmacology and the common terminologies used in pharmacology. I hope this session has prepared you to open up your mind and be able to administer drugs competently without endangering patients' lives.

In the next unit you are going to learn about the legal, ethical and cultural aspects of pharmacology. This will help you not to violate the country's laws and cultural beliefs of the patients as you administer drugs to them. But before then, test your understanding of this unit by doing the following self-test.

1.8 Self-Assessment Test

MULTIPLE CHOICE QUESTIONS

Choose the most appropriate answer

1.Pharmacodynamics is:

a. What the body systems do to the the drug
b. What the drug does to the body
c. How drugs are produced
d. How drugs undergo tests on animals before being administers to humanbeings

2.Side effect is defined as:

a. The nausea and vomiting produced by the drug
b. The therapeutic effect of the drug
c. The unwanted but expected effects of the drug
d. The unforeseen effects of the drug

ANSWERS:

1. B
2. C

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UNIT 2: LEGAL, ETHICAL AND CULTURAL ASPECTS OF PHARMACOLOGY

2.1 Introduction

You are welcome to unit two of pharmacology. In the previous unit you learnt the principles of clinical pharmacology and you also looked at the terminologies used in pharmacology. In this unit you are going to learn about the legal, ethical and cultural aspects of pharmacology. This will help you not to violate the laws of the country and cultural beliefs of the patients as you administer drugs to them.

2.2 Objectives

By the end of this unit you should be able to:

1. Explain the Pharmacy and Poisons Act and Regulations
2. Explain the National Drug Policy
3. Explain the Therapeutic and Substance Act
4. Explain the Nurses and Midwives Act
5. Explain the Controlled Drug Act
6. Explain the National Drug Formulary
7. Drug list for nurses and midwives
8. Describe the Zambia medicines Regulatory Authority
9. Discuss Legal and Ethical Issues and Implications to Nursing
10. Discuss cultural aspects in pharmacology
11. Discuss Drug Dependence and Addiction

2.3 Pharmacy and Poisons Act and Regulations

Drugs are substances which are not to be given any how by any one. They should be prescribed and administered by qualified personnel to prevent abuse. As such you are expected to follow the laid down regulations of the storage and the sale of drugs when you qualify.

The act provides for the control of the profession of pharmacy and the trade in drugs and poisons. It also stipulates that only licensed personnel are authorized to store and sell such drugs (poisons). If you violate this Act, it will be regarded as malpractice and you can be deregistered if convicted.

2.4 National Drug Policy

These are guidelines that govern the management and regulation of drugs in Zambia. They were formulated between December 1995 and October 1996. The vision for this policy states that 'the government is committed to the provision of equity of access to all Zambians to good quality, safe and efficacy drugs or medicines which are affordable and rationally used, as close to the family as possible' (MoH,National drug policy, 1995). The final copy was adopted in 1996 by the ministry of health. The aim of the policy includes drug legislation and regulation to ensure that all drugs in Zambia conform to the agreed standards of quality, efficacy and safety.

The vision of the National Drug Policy is for all Zambians to access quality, safe efficacius drugs which are affordable and rationally used as close to the family as possible.

The policy ensures that there is quality assurance and the government has finances to procure or produce, store and distribute the drugs to its citizens. In this vain you must ensure that the health institution you work for has all the essential drugs by ordering in time.

Self-Assessment Test: TRUE OR FALSE

Indicate true (T) or false (F) against the following statements in the spaces provided

1. It is punishable by law to drug in medicines with a written permit from a regulatory authority ….
2. The National Drug Policy provides for enough stocks of drugs in health facilities ….

ANSWERS:

1. T
2. T

Drugs and Therapeutic Committee (DTC)

The Drug and Therapeutics Committee (DTC) is an essential component of a health care system's which deals with medicine selection, use, and distribution program. This committee has many different functions which contribute to the goal of improving medicine selection and rational use of medicines.

DTCs are forums which bring together all stakeholders involved in decisions about drug use. They may exist at any level within the health-care system; at district level (overseeing primary health-care facilities such health centre and health posts), in hospitals, or at the national level. In developed countries hospital DTCs have been shown to be very effective in safeguarding and promoting efficient and rational use of medicines (Crawford and Santell 1994, Weekes and Brookes 1996) by, for example:
Rational drug use requires that the patients receive drugs appropriate to their clinical needs in doses that meet their individual requirements (right dose, right intervals and right duration). These drugs must be of acceptable quality, and available and affordable,

at the lowest cost to patients and the community. When there is irrational use of medicines, there are often undesirable health and/or economic outcomes. The outcomes include insufficient therapeutic effect, adverse drug reactions, preventable side-effects and interactions from medicines, and increasing resistance of bacterial pathogens to antimicrobial medicines; these may all result in increased or prolonged hospital admissions, which are expensive.

This committee is therefore very important because without it, there may be inefficiency and irrational drug use which include:

i. Poor selection of medicines, without consideration for relative efficacy, cost-effectiveness or local availability
ii. Inefficient procurement practices, resulting in non-availability, inadequate quality, wastage, or use of unnecessarily expensive medicines
iii. Prescribing not in accordance with standard treatment protocols
iv. Poor dispensing practices resulting in medication errors, and patients' lack of knowledge about dosing schedules
v. Patients not adhering to dosing schedules and treatment advice. Inefficient use of medicines affects the safety and quality of therapeutic care and wastes resources. (WHO Essential Medicines and Health Products Information 2013):

Goals and objectives of the DTC

The goal of a DTC is to ensure that patients are provided with the best possible cost-effective and quality of care through determining what medicines will be available, at what cost, and how they will be used.

In order to achieve this goal a DTC will have the following objectives:

i. To develop and implement an efficient and cost-effective formulary system which includes consistent standard treatment protocols, a formulary list and formulary manual
ii. To ensure that only efficacious, safe, cost-effective and good quality medicines are used
iii. To ensure the best possible drug safety through monitoring, evaluating and thereby preventing, as far as possible, adverse drug reactions (ADRs) and medication errors
iv. To develop and implement interventions to improve medicine use by prescribers, dispensers and patients; this will require the investigation and monitoring of medicine use.

Functions of the DTC

There are many possible functions of a DTC, and the committee must decide which to undertake as a priority and this decision may depend on local capacities and structure.

The most important functions of DTC are:-

1. **Advisory committee to medical staff, administration and pharmacy**

The DTC is a valuable resource that can **provide advice** to medical staff, nurses, administration, pharmacy and other departments and groups within the hospital. The DTC can advise on all issues, policies and guidelines concerning the selection, distribution and use of medicines. DTC provides advice while an executive body, usually the pharmacy or hospital management, implements it.

2. **Development of drug policies**

The DTC is the most appropriate body to **develop drug policies** within a hospital or group of health facilities, since the committee members have the most experience and training in drug therapy and supply. Policies and procedures are the primary activity within a DTC, as they provide the foundation for other recommendations that may later arise from the DTC. Drug policies may vary in different hospitals and countries, but all hospitals have specific policies concerning:

- Criteria for inclusion of medicines on the formulary list (essential medicines list (EML)
- Standard treatment guidelines and treatment algorithms, which should be the basis of formulary selection
- Periodic use of medicines not on the formulary list, for example restricting their use to specified prescribers on a named patient basis only, or only allowing 10% of the hospital medicines budget to be spent on them
- Expensive or dangerous medicines, such as third-generation antibiotics or oncological drugs, which are restricted to certain practitioners, departments or patients (structured order forms are used to implement this policy)
- Drugs that are under investigation for safety or efficacy
- Generic substitution and therapeutic interchange
- Drug representatives and promotional literature.

3. **Evaluating and selecting medicines for the formulary list**

Perhaps the most important function of a DTC at national level is the evaluation and selection of medicines for the essential medicines list or formulary list. Drugs should be selected on the basis of the standard treatment guidelines or protocols that have been developed or adapted for use in given country's health facilities. The evaluation of medicines requires significant expertise and time commitment and a rigorous, transparent approach. Documented evidence for the efficacy, safety, quality and cost of all drugs under consideration for inclusion in the formulary list must be examined. Periodic review is necessary because of changing costs and indications, new information on safety, and the emergence of new medicines. The documents reviewed

will depend upon the expertise of the committee and may include reputable textbooks, published treatment guidelines and formularies, newsletters and primary drug literature.

4. Developing standard treatment guidelines

Standard treatment guidelines (STGs) or protocols are a proven way to promote rational use of medicines provided they are:

- Developed in a participatory way involving end-users
- Easy to read and up to date

Furthermore, STGs provide a yardstick of optimum treatment in the monitoring and audit of drug use. A DTC should either develop STGs from scratch or adapt them from elsewhere for use in their own hospital. Development of STGs from scratch will result in greater local ownership and acceptance, but is difficult and will consume time and resources. Adaptation or adoption of STGs from elsewhere is much easier and quicker, but will result in less local ownership and acceptance.

5. Assessing medicine use to identify problems

Appropriate changes within the formulary list or other interventions may correct a number of problems in how medicines are used. It is important for the DTC to identify the priority problems and make appropriate recommendations. Appropriate methods to identify drug use problems include:

- Monitoring indicators of medicine use, including adherence to standard treatment guidelines.
- Drug use evaluation (DUE), also known as drug utilization review.
- Monitoring adverse drug reactions and medication errors.
- Antimicrobial resistance surveillance.

6. Conducting effective interventions to improve medicine use

The DTC is the main body within a hospital, or group of health facilities, responsible for ensuring that drug information is provided to health staff and also for conducting interventions to promote more rational drug use. Monitoring and supervision, audit and feedback, educational programmes, in-service training, use of standard treatment guidelines, provision of unbiased drug information, prescribing restrictions and automatic stop orders are some important interventions used to promote the rational use of medicines.

7. Managing adverse drug reactions

Adverse drug reactions (ADRs) are serious in terms of patient harm (morbidity and mortality) and avoidable economic costs. One large meta-analysis estimated that ADRs cause 3-4% of all hospital admissions in the USA and that in 1994 the incidence of

ADRs was 6.7% (2.2 million events) with 106 000 fatalities (Lazarou et al. 1998). These estimates should be viewed with caution because of the heterogeneity among studies and small biases in the sample, but the data nevertheless suggest that ADRs are a large and serious problem. Adverse drug reactions may be due to the unknown effects of new (or older) drugs, unknown drug combinations and interactions, or poor drug quality. DTCs are therefore responsible for ensuring that patients are treated as safely as possible.

8. Managing medication errors

Medication errors occur in all health-care settings, no matter how good the health-care staffs are at prescribing, dispensing and administering medicines. Even if there is no error on the part of health-care staff, patients may take drugs incorrectly. Causes are numerous and include lack of knowledge, tiredness of staff, careless work attitudes, poor procedures, lack of policies, unfamiliar dosage forms and human error. DTCs can reduce such errors by monitoring, analysing, reporting errors and implementing corrective action (see section 5.1).

9. Information dissemination and transparency

The DTC must disseminate information about its activities, decisions and recommendations to the staff who must implement the DTC's decisions. This may seem obvious, but it is often forgotten. Inadequate dissemination of information leads to a loss of credibility. It is also very important that the DTC operates in such a way as to ensure transparency of all its decisions and to avoid conflict of interest. In particular, members should either have no relationship with pharmaceutical companies or declare it openly so that conflicts of interest can be avoided. The only acceptable contact with pharmaceutical companies is to ensure the flow of information about their drug products in a way that is as unbiased as possible.

DTCs can be strengthened by:-

i. Establishing documented rules and policies for all aspects of drug management including the selection of formulary list medicines and agreement of treatment protocols
ii. Conducting continuing education, audit and feedback, drug utilization review and monitoring of adverse drug reactions and medication errors.

Self-Assessment Test: MCQ

Choose the most appropriate answer

1. The following are functions of the Drugs and Therapeutics Committee (DTC) EXCEPT:
   a. Developing treatment guidelines
   b. Developing drug policies

c. Developing drugs
d. Monitoring adverse drug reactions

2. Who should sit on the DTC committee at health facility level:
   a. Doctor
   b. Pharmacist
   c. Nurse
   d. All of the above

ANSWERS:

1. C
2. D

2.5 Therapeutic Substance Act

It is an Act to control the importation, exportation, possession, sale, distribution and use of certain therapeutic substances which you must adhere to as you practice.

The pharmacy and poisons Act was repealed in 2004 by the pharmaceutical ACT of 2004. The pharmaceutical act was enacted by parliament to establish the pharmaceutical regulation authority.

The function of the pharmaceutical regulation authority is to provide the following;-

i. Registration and regulation of pharmacies
ii. Registration and regulation of medicines intended for home and animal use
iii. Regulation and control of manufacturing, importation, possession, storage, distribution, supply, promotion and use of medicine herbal medicine and allied substances.

The act is subdivided into eleven parts as explained below.

PART I: PRELIMINARY

This contains definitions and their interpretation for example:

'Pharmacy and Poisons Board' means the Board established under the provisions of section *three* of Pharmacy Cap. 299 and Poisons Act;

'Administer' means to give a substance to a human being on an animal orally or by injection introducing into the body in another or by external application whether by direct contact with the bod not and any reference and administering a substance is reference to administer it in its existing form.

'Allied substances' include cosmetics, disinfectants; food supplements food adittives, medical surgical sundries, medical devices condoms and blood products.

'Preparation' includes compound, mixture and salt

PART II: CONTROL OF IMPORTATION, EXPORTATION, POSSESSION, SALE, DISTRIBUTION AI USE OF CERTAIN THERAPEUTIC SUBSTANCES

Its functions are; - overseeing and powers of authority

PART III: Registration Of Pharmacies

i. No person is allowed to carry out the business of pharmacists unless he/she is registered the regulatory authority.
ii. A registered pharmacist clause 17.
iii. Exemption of hospital pharmacy ,provided by minister or recommenced of authority such as other person not recognized with related qualifications registered

PART IV: Licences

The regulatory authority provides licenses for:

i. Manufacturing
ii. Wholesaling
iii. Distribution
iv. Importing and exporting.

PART V:

It is concerned with registration of medicines, herbal medicines and allied substances categories such as:-

1. Medicine only prescription
2. Pharmacy medicine
3. General sale medicine
4. Advertising
5. Labelling; No substance shall be sold, or offered for sale, unless it is contained in a sealed container labelled with the following particulars;
   (a) The name and address of the maker;
   (b) The recognised name of the substance, in letters no less conspicuous than those in which the proprietary name, if any, is stated, which should appear immediately after or under such proprietary name;
   (c) A distinctive batch number, being the number by reference to which the details of manufacture and tests carried out by the manufacturer on the substance contained in such container are recorded;
   (d) The expiry date, that is to say, the date up to which a preparation may be expected to retain its potency if stored in accordance with any special instructions shown on the label;

(e) Special storage instructions if any.

PART VI: Herbal Medicine

This Act provides for:

i. Licenses for herbal medicine
ii. Importation and exportation, sale and distribution and herbal medicine

PART VII: Clinical Trials and Animal Test

The Act provides for human and animal clinical trials for various research purposes

PART VIII: Poisons

The Act provides a list of poisons, distribution sale, supply and use of poisons.

PART IX: The National Drug Quality Control Laboratory

The Act provides for:

i. Quality drug control
ii. Analysis of seized narcotics
iii. National quality assurance system.

PART X: Inspection

Powers of search and inspection by any Government Medical Officer, any police officer or any other person duly authorised in writing in that behalf by the pharmaceutical regulation authority may, for the purpose of securing compliance with the Act carry an inspection.

PART XI: General Provisions

The Act provides for

i. Manufacturing of patented (original) products
ii. Prohibition of harmful cosmetics

2.6 Nurses and midwives Act

This is an Act for Nurses and Midwives which was passed by Parliament in 1997 to regulate the training of nurses and Midwives as well as their professional practice. It provides for nurses and Midwives to prescribe and dispense drugs. It provides guidance on which nursing categories among the nurses should handle particular drugs. As a Registered Nurse, you are authorized to handle Controlled Drugs key and ensure that these drugs are not abused at any time.

2.7 Controlled Drug Act

Drug stores dealing in Controlled Drugs are licensed under this provision. The misuse regulation of 1985 came into force on April 1st 1986, replacing the 1973 regulation. It is law in Zambia to control the sale and use of drugs that cause addiction and dependence. The controlled drugs are listed in five schedules of regulations which are

arranged in decreasing order of the severity of the side effects they produce. The schedules are as follows; the severity of control.

Schedule 1: This t schedule contains of drugs such as Cannabis, lysevide and others which are not used as medicines. There supply is prohibited except in accordance with the Ministry of Home Affairs.

Schedule 2: This schedule consists of drugs such as Heroine, Morphine, Pethidine, Cocaine and Opium etc. These are subject to strict requirements on safe custody, prescription, writing and accurate record keeping.

Schedule 3: This schedule includes drugs such as phenabarbitone, franol, meprobanate and a number of other drugs which are not to be misused though not so harmful as those in schedule 2.

Schedule 4: Control of these drugs is very minimal and most of these drugs are the Benzodiazepines such as diazepam (valium), DF118, Lorazepam etc.

Schedule 5: This schedule consists of preparations of certain controlled drugs such as codeine, pholcodeine, procaine and morphine preparation which are exempted from full control. Most of these drugs are found as cocktails of analgesia and cough preparations

2.8 National Drug Formulary

Many governments have produced national treatment guidelines that are intended to improve rational use of drugs and encourage good practice in HIV/AIDS-related treatment. In addition, many Non-Governmental Organisations (NGOs)/Community Based Organisations (CBOs) have developed their own treatment guidelines.
In addition, many Non-Governmental Organisations (NGOs)/Community Based Organisations (CBOs) have developed their own treatment guidelines.

Treatment guidelines provide information about different health problems and the necessary advice for treating them. They will tell you about diagnosis and management of health problems as well as what alternative treatments can be used. They do not usually give complete information about each drug, but just what is necessary for use, such as the dose and length of treatment.

A prescribing manual (sometimes called a formulary) contains detailed information about each drug that is available for different health problems. This includes the dose, side-effects, necessary precautions and other special requirements for using the drug. It is usually arranged in the same way as an essential medicines list, with the drugs listed alphabetically under the types of disease that they can treat.

These key resource treatment guidelines and prescribing manuals, alongside essential medicines lists, can be used together to answer key questions about providing effective management of many conditions including HIV/AIDS-related treatment. It is therefore important that you must have a national drug formulary for effective drug prescription.

These can be obtained from Pharmaceutical Regulatory Authority (PRA) or can be purchased from bookshops dealing with medical book.

2.9 Drug list for Nurses and Midwives

Table 2: Drug list for nurses and midwives

SERIAL NO:	NAME OF DRUG
1	Acetylsalicylic Acid
2	Ferrous Sulfate 200mg, Sugar coated
3	Follic Acid 5mg
4	Aluminium Hydroxide 120mg + Magnesium Trisilicate 250mg
6	Paracetamol 500mg
7	Phenoxymethylpenicillin 250mg
8	Paracetamol 100mg
9	Metronidazole 200mg
10	Salbutamol 4mg
11	Mebendazole 100mg
12	Doxycycline 100mg , as Hyclate
13	Sulfadoxine 500mg + pyrimethamine 25mg
14	Nitrofurantoin 50mg
15	Chlorphenamine Maleate 4mg
16	Erythromycin 250mg, as Stearate
17	Amoxycillin 250mg
18	Ferrous Sulfate 50mg ,as sugar coated
19	Zinc Sulfate 20mg (Dispersible tablet)
20	Quinine Sulphate 300mg, film-coated
21	Multivitamin , film coated
22	Nystatin 100.000 IU, Vaginal tablet
23	Hydrocortisone 100mg as sod. Succinate, powder for injection
24	Oxytocin 10 IU/ml , 1ml
25	Water for inj., 5ml
26	Procaine penicillin 3M IU, powder for injection
27	Benzypenicillin Sodium 5ML IU, powder for injection
28	Diazepam 5mg/ml, 2ml
29	Promethazine HCI 25mg/ml,2ml
30	Water for injection, 10ml
31	Benzathine Benzylpenicillin 2.4M IU(vital size 20ml) , PFI
32	Lidocaine 2%, 10ml
33	Benzylpenicillin Sodium 1M IU, powder for injection
34	Dextrose (Glucose) 50% 20ml
35	Nystatin 100.000 IU/ml, 30ml suspension. Liq.
36	Oral Rehydration Salts 20.5g , WHO mod
37	Hydrocortisone 1%,15m, ointment
38	Silver Sulphadiazine 1% 20g,Cream

39	Clotrimazole 1%,20mg, cream
40	Chloramphenicol 0.5% , 5ml, eye drop
41	Tetracycline HCI 1% 5g, eye ointment

Source: Adopted from the health centre drug kit (GRZ -EDP)

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1 Nurses and Midwives' Act of 1997 provides for registration of herbal medicines ….

2 Nurses are allowed, by Law, to prescribe certain drugs ….

ANSWERS:

1. F
2. T

2.10 Zambia Medicines Regulatory Authority

The Zambia Medicines Regulation Authority is the regulatory agency responsible for the administration of the provisions, related to pharmacies. The pharmacy related provisions of the Act deal with the following:

i. Register conversional medicines, herbal medicines and license allied substances
ii. Register pharmacies and license pharmacy premises (both in the private and public sector), pharmacy businesses, and pharmacy services providers (sole proprietors, pharmacy companies and pharmacy trusts) and pharmacy depots.
iii. Regulates and control the manufacture, importing, exporting, distribution and sale of conversional medicines, herbal medicines and allied substances.
iv. Regulates and controls the advertising and promotion of conversional medicine, herbal medicines and allied substances
v. It serves and protects the public interest in all matters relating to the sale of conversional medicine, herbal medicines and allied substances.
vi. It regulates and monitors the conduct of clinical trials on human beings and animals.

2.11 Legal and ethical issues and implications to Nursing

The patient is the centre of all nursing activities. Therefore, despite the conditions or circumstances surrounding your patient, you as a nurse must not compromise in your practice or how your view the patient.

The ethical and legal issues you must address in your practice boarders on decisions you make and observing the rights of your patient.

Ethical and Legal Concerns

The ethical decisions that you make as a nurse must at all times be about care delivery and patient advocacy in planning and providing safe patient care. The legal implications of nursing practice are tied to licensure and a public expectation that you practice at a high professional standard. The nurse's education, license and nursing standard provide the framework by which nurses are expected to practice. When a nurse's practice falls below acceptable standards of care and competence, this exposes the nurse to trial.

The following ethical and legal principles must be balanced in displaying an attitude of care and compassion while recognizing and maintaining safe practicing boundaries:

1. **Legal Standards**: They are guidelines which may be deemed right or wrong by laws
2. **Nursing Ethics:** These are standards for professional behaviour guide to identify our conduct in relation to patients, fellow nurses, health care team, our community and our profession.
3. **Licensure**

When you qualify you are expected to have a current license indicating the scope of practice. When you qualify, you will be committed to fulfil legal responsibility, accountable to meet ethical / moral obligations of your practice. You will have to accept assignments form your supervisors, know your limitations and function accordingly to work for the good of the patient (You are the patients' advocate).

4. **Negligence**

You are expected to work within the framework of the nursing process failure to which you will be cited for negligence. Negligence (breach of duty) is failure of an individual to provide care that a reasonable person would ordinarily use in a similar circumstance. Therefore any failure or omission to conduct your duty in nursing the patient will be regarded as negligence on your part and subjects you to disciplinary action.

5. **Malpractice**

Malpractice refers to the behaviour of a professional person's wrongful conduct, improper discharge of professional duties, or failure to meet the standards of acceptable care which result in harm to another person. As such you are not at any time in your professional career expected to conduct yourself in an improper or unethical manner which can endanger the patients' lives.

6. **Confidentiality**

This principle relates to the concept of privacy. Information obtained from an individual will not be disclosed to another without the patients consent. Confidentiality therefore, is an element of respect for persons. Therefore as a nurse you are expected to keep in confidence what you know about the patient.

Self-Assessment Test: TRUE OR FALSE

State true (T) or false (F) against the following statements in the spaces provided

1 Nurses and Midwives are allowed to disclose information regarding patient's treatment ….
2 Nurses and Midwives have the obligation to refuse giving wrong treatment to the patient ….

ANSWERS:

1. F
2. T

2.12 Cultural aspects in pharmacology

You are expected to respect the culture of patients who are under your care in order for you not to have problems with the community. However you must explain to the patient the benefits of accessing treatment which may be culturally wrong for them in order for them to make uninformed choice.

2.13 Drug dependence and addiction

The terms drug dependence and drug addiction are often used interchangeably, but this practice leads to confusion among professionals regarding the diagnostic implications of these terms and also contributes to misunderstanding the underlying causes of substance use.

You must know the difference and these are as follows:

Drug dependence means that a person needs a drug to function normally. In this case, the individual is dependent upon the drug for normal physiological functioning. Abstinence from the drug produces withdrawal reactions which constitute the only evidence for dependence. Drug dependence can involve disturbances in general bodily (that is, somatic) function such as vomiting, diarrhoea, sweating, and the resulting symptoms indicate a physical dependence syndrome which is usually specific for a given class of drugs.

Drug addiction is the compulsive use of a substance, despite its negative or dangerous effects. However, a person may have a physical dependence on a substance without having an addiction. For example, certain blood pressure medications do not cause addiction but they can cause physical dependence. Other drugs, such as cocaine, cause addiction without leading to physical dependence.

Hello, we have come to the end of our unit on legal ethical and cultural aspects of pharmacology and I hope you found it interesting. Let us now review what you have learnt.

2.14 Summary

In this unit you have learnt about the different legal provisions that regulate pharmacology in our country. We have discussed various pharmacy acts and regulations such as the pharmacy and poisons act as well as the national drug policy. With this knowledge that you have gained you can handle situations bordering on legal, ethical and cultural aspects of pharmacology.

In the next unit you will learn about ordering and controlling of drugs. Why is it important to order and control drugs? All the queries will be answered in the next topic. But before then, complete the following self-test.

2.15 Self-Assessment Test

Multiple Choice Questions

Choose the most appropriate answer:

1. The authority which regulates the import and export of drugs is
    a. Nurses and Midwives Authority
    b. Drug and Poisons Authority
    c. Therapeutic Substances Authority
    d. Zambia Medicines Regulatory Authority.
2. Drug dependence means?
    a. One abstains from abuse of drugs
    b. One consistently abuses drugs
    c. One cannot do without the influence drugs
    d. One consistently prescribes drugs

ANSWERS:

1. D
2. B

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UNIT 3: ORDERING AND CONTROL OF DRUGS

3.1 Introduction

You are welcome to this topic. In the previous topic you learnt about the legal, ethical and cultural aspects of pharmacology. You looked at laws that regulate drug usage. With the knowledge gained previously, you can now order, store and control drugs in your ward. In this topic you will learn about ordering and controlling of drugs.

3.2 Objectives

At the end of the unit you should be able to:

1. Explain the principles of administration and ordering of drugs
2. Illustrate the calculation of dosages, strengths of drugs and solutions
3. Describe the ordering and storage of drugs
4. Mention the routes of administering drugs
5. Describe the insertion and commencement of intravenous fluids to a client
6. Describe the administration of controlled drugs

Activity 3.1

Why do you think it is important to order and control drugs?

Write your suggested answers in your note book

Good. Hope your answers will outline key areas of concern in regard to ordering and control of drugs.

3.3 Principles of administration and ordering of drugs

General principles of ordering of drugs

A principle is a rule or belief governing personal behaviour (Concise Oxford English dictionary, 11th Ed). In this case a principle is a guide on how an activity should be conducted or performed. In pharmacology, there are principles that should be followed as you order and administer drugs. These are principles which apply to all types of medication (Oral or injectable medication). The purpose of learning pharmacology is to enable you have factual knowledge of each drug given to the patient, the reasons for using that drug, its general action, the common adverse reactions associated with the drug, special precautions in administration (if any), and the normal dose ranges. You

must therefore ensure that you order adequate drugs for your ward stocks and store the drugs in a lockable cupboard for easy access as well as to prevent drug from pilfering.

The following are golden rules of ordering and control of drugs;

It is important to take into account the e patients' drug history (allergy history, previous adverse reaction, patient comments), and change in patient's condition..

If the patient makes any statement about the drug or if there is any change in the patient's condition, you must carefully consider these situations before the drug is given. Examples of situations that require consideration before a drug is given include:

a. Problems that may be associated with the drug, such as nausea, dizziness, ringing in the ears, and difficulty walking. Any comments made by the patient may indicate the occurrence of an adverse reaction. In this case you must withhold the drug until references are consulted and the primary caregiver contacted. **The decision to withhold the drug must have a sound rationale and must be based on knowledge of pharmacology.**

b. Comments stating that the drug looks different from the one previously received, that the drug was just given by another nurse, or that the patient thought the primary care provider discontinued the drug therapy.

c. A change in the patient's condition, a change in one or more vital signs, or the appearance of new symptoms. Depending on the drug being administered and the patient's diagnosis, these changes may indicate that the drug should be withheld and the primary care provider contacted.

Activity 3.2

What do you think you must do as a nurse before you administer a drug?

Write your answers in your note book. Your answers must bring out activities you must do before giving the drugs.

Good. You answered very well. Keep it up.

Preparing a drug for administration

When you are preparing a drug for administration, you must observe the following guidelines:

i. You must always check the health care provider's written orders and verify any questions with the primary health care provider.
ii. You must prepare drugs for administration in a quiet, well-lit area.
iii. You must always check the label of the drug three times: (1) when the drug is taken from its storage area, (2) immediately before removing the drug from the container, and (3) before returning the drug to its storage area.
iv. You must never remove a drug from an unlabelled container or from a container whose label is illegible.
v. You must always wash hands immediately before and after preparing a drug for administration.

vi. You must **NOT** let your hands touch capsules or tablets. To remove an oral drug from the container, the correct number of tablets or capsules is shaken into the cap of the container and from there into the medicine cup or use a spoon.
vii. You must always observe aseptic technique when handling syringes and needles.
viii. Be alert for drugs with similar names. Some drugs have names that sound alike but are very different.
ix. Remember to always replace the caps of drug containers immediately after the drug is removed.
x. Return drugs requiring special storage to the storage area immediately after you have prepared the drug for administration. This rule applies mainly to the refrigeration of drugs but may also apply to drugs that must be protected from exposure to light or heat.
xi. Never crush tablets or open capsules without first checking with the pharmacist. Some tablets can be crushed or capsules can be opened and the contents added to water to allow for administration to patients who cannot swallow or be given through a feeding tube. Some tablets have a special coating that delays the absorption of the drug. Crushing the tablet may destroy this drug property and result in problems such as improper absorption of the drug or gastric irritation.
xii. Never give a drug that someone else has prepared. The individual preparing the drug must administer the drug.

If you follow the above mentioned drug preparatory rules, you will never be a danger to the patient but a life saver.

General principles for administration of drugs

These principles apply to oral as well as injectable medications.

i. Any change in colour, odour or consistency of a medicine should be reported and a fresh supply obtained.
ii. To 'discard' or waste a drug, throw it down a drain in a sink (or toilet) and run some water down the drain. Do not throw in a rubbish bin where it could be retrieved and taken by someone.
iii. You must not return medicines into their original container after pouring them. If they will not be used, discard them safely. (Half tablets may be saved.)
iv. Avoid handling medicines with fingers. If a tablet or capsule is dropped on the floor, discard it and pour another.
v. You must never leave the medicine cupboard open and unattended to.
vi. You must never leave the medicine trolley unattended when it is set for medication rounds.
vii. The medicine cupboard key must always be kept by a person qualified to give medicines. If you are assigned to medicines you must keep the medicine cupboard key at all times. It should never be left lying around.

A) Pouring Medications

i. Never pour or give medicines in the dark or in dim light.

ii. The label should be read three (3) times as shown below to ensure that the correct drug and amount are being given. This applies to both oral and injectable medications.
    - Before picking up the container from the trolley
    - Before pouring the medicine
    - After pouring the medicine

iii. Never give medicine from an unlabelled container.

iv. Always know the drug being given. Look it up if necessary, first. This will prevent errors and enable health teaching to be done and/or to know any special precautions.

B) Administration of oral medications

The administration of oral drugs is a clean procedure and instruments used should be clean at all times. You must do a quick round noting the drugs that are supposed to be given at that particular time. This helps to avoid setting for drugs that patients are not on and also helps in avoiding omission of important drugs that are supposed to be given at that particular time. During this survey you must inform the patient that you are about to give drugs and find out whether any of the patients' needs assistance before drug administration.

You must always administer the drugs you pour and sign for it. Never allow a patient to carry medicine to another patient. Never give medicine that someone else has poured.

i. Do not give oral medicine to an unconscious patient. Notify the Ward Manager. The medicine will either be discontinued or advised to be given parenterally.

ii. When medicine is not given to a patient, always notify the Ward Manager. This may happen when a patient refuses medicine or for some other reasons the medicine was not able to be given.

iii. Any mistake in giving a drug should be reported immediately to the Ward Manager.

FOR CHILDREN

1. Do not mix liquid medicines for children. You should give the sweetest drug last.
2. If having difficulty giving the medicine, use a teaspoon after first measuring the amount in the medicine cup.
3. Allow the mother to give the medicine to the child but you must remain with them to make sure that the child has taken the medicine. Assist and/or instruct the mother when necessary.
4. Do not force children to drink medicine as they could easily aspirate.

Procedure for Giving Medication

1. Before giving medication, make sure you have identified the right patient. Ask the patient his name politely and check the chart, especially if the patient is not competent or if you are new to the ward.

2. Ensure that the patient has plenty of water to drink with the medicine for example, 1/2 cup. Pour the water for the patient as necessary.
3. Remain with the patient to be sure he has swallowed the medication.

Charting medication

1. Chart the medicine(s) that you have just given to that patient.
2. Check the patient's chart for name, both on the doctor's advice sheet and on the current medication sheet. Make sure you are charting on the correct date.
3. Chart medicines in the medication column, including the name of the drug, dose, route and time. Your signature is not necessary,but use your initials.

Self-Assessment Test:

TRUE OR FALSE

State true (T) or false (F) against the following statements in the spaces provided

3 Always document and sign for the drugs you have given ….
4 Drugs can be administered by any route, other than the one prescribed ….

ANSWERS:

1. T
2. F

3.4 Dosages and strengths of drugs and solutions

Drugs, solutions and fluids

According to the medical dictionary, a Drug is any chemical compound used in the diagnosis, treatment, or prevention of disease or other abnormal condition**.** It is also defined as mixture ofl substances that affects the processes of the mind or body

The word drug comes from a Dutch word Droog that means dry and is derived from the early use of dried plants leaves as a source of medicine. The terms drugs and medicine are used interchangeably though nowadays the word drug is commonly used for substance abuse whereas the word medicine is for therapeutics.

Sources of medicines

1. Plants and roots for example, Digitalis
2. Animal tissues for example, Insulin
3. Moulds for example, Penicillin
4. Laboratory (synthetic or man-made) for example, Gantrisin.

General purposes of drugs

1. **Prevention or Prophylaxis**

Drugs can be given to prevent the occurrence of a disease or to lessen the severity of the disease if it should occur, for example Vaccines, daraprim

2. Diagnostic

Drugs can be used to aid the doctor in deciding the cause of the patient's symptoms. They are also helpful in locating the exact area of the body affected, for instance Intravenous Pyelography dye.

3. Therapeutic

Drugs are used in the treatment of many diseases.

a) Curative: Drugs are used to remove the causative agent of the disease. Sometimes the drug is effective against only one disease; in other cases, against several. For example, antibiotics

b) Palliative or Symptomatic: Drugs can be used to relieve the undesirable symptoms of a disease. The disease may not be cured but its severity is decreased and/or its progress slowed down. For example, analgesics

c) Supportive: Drugs are used to sustain the patient until other measures can be instituted which will either cure or alleviate the condition. For example, intravenous electrolytes (especially potassium)

d) Restorative: Drugs are used to return the body to its normal, healthy state. For example, iron preparations

Take Note 3.1

Medicines are only one method of therapy. Other forms of therapy include surgery, diet, nursing care (for example, back care), physical therapy and others.

Drug Preparations

1. Aqueous Solutions - One or more substances dissolved in water.

2. Aqueous Suspension - Mixed with, but not dissolved in water, a suitable liquid vehicle (sometimes may already be mixed, sometimes you have to add the liquid) - must be well-shaken before use.

3. Spirits - Concentrated alcoholic solution of volatile substances (also known as 'essences'). Spirits contain about 5-20% of active drug, which may be solid, liquid, or gaseous. The alcohol is the preservative. Usually these preparations are all potent and therefore the dosage is usually small (for example, 2-4 mls).

4. Elixirs - Aromatic, sweetened, alcoholic preparations, frequently used as flavoured vehicles, or as active medicinal agents.

5. Tinctures - An alcohol solution containing 10-20g of drug to 100mls of tincture. The alcohol content improves their stability and facilitates absorption of drugs that are poorly soluble in water.

6. Fluid extracts - Alcoholic liquid extracts of vegetable drugs made so that 1ml. of the extract contains 1g. of the drug. They are the most concentrated of any of the fluid preparations, being of 100% strength and 10 times stronger than potent tinctures. May precipitate in light, and should be kept in dark bottles and not used if precipitate has formed. Usually these preparations are all potent and therefore the dosage is usually small (for example, 2-4 mls).

7. Extracts - Concentrated preparations of a drug obtained by removing the active ingredient with its solvent and evaporating all or part of the solvent. They can be liquid, pressed masses, or powder. This form is used for purposes of making other forms of the drug, such as tablets or pills (by a pharmacist or drug company).

8. Capsules - More expensive to produce but usually used in the beginning with new drugs until such problems as bad taste, disintegration, stability, etc. have been solved by the manufacturers. They dissolve readily in the stomach and the contents are quickly available for absorption. Capsules are usually made of gelatin. Some are enteric coated, which means they are coated with a substance that resists action of gastric juices and so they don't dissolve until they reach the alkaline secretions of the intestine. Some capsules allow for gradual and continued release of the drug and are called spansules, time-released capsules, etc. These work by way of particles of the drug being coated with varying amounts of a covering that require different amount of time to dissolve. Spansules may release the drug for as long as up to 10-12 hours after ingestion

9. Tablets - Preparations of powdered drug that are compressed or molded into small disks and are without a diluent. These may be scored so they can be easily divided in half, depending on the doctor's advice. They may be enteric coated with a colour sugar or chocolate, for one of five possible reasons:

i. More attractive to patients
ii. Easier to swallow
iii. Identifiable by a distinctive colouring and/or imprinting
iv. To protect drug from gastric secretions
v. To prevent irritation of stomach from drug

10. Troches or lozenges - Are preparations that are held in the mouth until they dissolve, liberating the drug involved.

11. Pills - Technically speaking, pills are different from tablets or capsules, though the term is often mistakenly used as a general term for these. In actuality, pills are mixtures of drug/drugs with some cohesive agent, molded into a shape convenient for swallowing. Very few true ‘pills’ are, in fact, on the market today. For example contraceptives for family planning.

12. Powders - Finely divided solid drugs or mixtures of drugs for external or internal use (so fine that they are like powder).

13. Ampoules and Vials - Containers of sterile, powdered or liquid drugs - usually intended for injection. Ampoules are sealed glass containers, usually with one dose, and vials are also glass but have a rubber stopper and contain multiple doses. Powders must be dissolved in sterile distilled water or isotonic saline solution ('isotonic' means same electrolytes as fluid it is going into, that is blood, so that osmotic pressure is the same).

14. Disposable Syringes or Cartridges to fit in a 'tube' holder for administration) - Pre-packaged drug to be given by injection and, then, the container discarded.

15. Liniments - Liquid suspensions intended for external application - applied to the skin by rubbing - usually used for muscle pain, swollen joints, sport injuries etc.

16. Lotions - Liquid suspensions for external use which are applied to skin but not rubbed in. Are usually used to soothe, cool, reduce itching, etc.

17. Ointments - Semi-solid preparations of drug in a base of petroleum and lanolin, intended for external use. The base is such that it does not wash off easily and so keeps the drug on the skin for a long time. Ophthalmic ointments are sterile and the base must be non-irritating and allow the drug to pass into the secretions of the eye.

18. Pastes–These are for external use and are usually thick and stiff and do not melt at body temperature. May protect or soften skin (for example, Zinc Oxide paste around an ostomy).

19. Plasters – These are solid preparations that are applied to the body and stick to it. Aspirin may be given this way, in combination with a rubber plaster that sticks to the area where it is applied and, as such, it is used as a counter-irritant.

20. Suppositories - A mixture of a drug in a firm base that can be moulded for insertion into a body cavity, where the base melts with body heat and the drug is released (rectum, vagina (pessaries), or urethra).

21. Poultices – These are soft, moist preparations used for purposes of supplying moist heat to a skin area.

Medication calculations

Why do you think it is important for you to calculate the drug you need to give the patient?

1.To calculate the amount of medicine to be given to a patient (Number of tablets), two items need to be considered;

i. The dose required (the doctor's advice/order)
ii. The amount of medicine in one tablet (what you have/stock strength).

2. Make sure the drug ordered and the amount to be given is in the same measurement for example, both in grams or milligrams. If they are not in the same unit, then you must convert in one unit.
3. Make two equations and cross-multiply
    i. One using the Number of tablets required (this will contain x)
    ii. The second using the bottle label. (What you have per tablet)
4. The answer will be the number of tablets to be given to the patient.

Take Note: 3.2

If you are dealing with millilitres (mls), then multiply by the volume of the container to get the number of mls required which will contain the required dosage

For tablets whose answers have decimals?

a) For tablets, you may give the whole tablet, half tablet (0.5) or possibly quarter tablet (0.25).

b) For liquid, round off the answer to one decimal place. For calculations of medicine dosage by weight of the patient, you need to appreciate that the dosage of certain medications must be calculated very precisely according to the weight of the patient. The bigger the patient, the higher the dose to be given to the patient and therefore the information needed to calculate the correct dosage is as follows:

i) The exact weight of the patient

ii) The amount of medication to be given for every kg of body weight for example, 10mg/kg.

From the above information, make two equations and cross-multiply. Make sure that the same measurements are used in both equations.The answer will be the amount of medication to be given to the patient according to the weight of the patient.

Example:

A patient may have 10mg of Panadol for every kg of body weight. This may be given as often as every four hours. (Panadol 10 mg/kg/q4h) The weight of the child is 8 kg.

10 mg = 1 kg

X mg = 8 kg. Therefore X = 80 (The answer indicate that this child may have 80mg of Panadol q4h).

Other formulae for drug calculations are as follows:

Desired Over Available Method

This method combines the conversion of ordered units into available units and the computation of drug dosage into one step. The general equation for doing this is:

(Caps, tabs, etc.) = x (quantity to give)

Quantity available

Sometime written as; Dr's order x volume
Stock strength

For example, the order reads: sulfadiazine 1.0 gram 6 hourly for 3 days. Sulfadiazine comes in 300mg or 500mg tablets. Using simplified equation and converting from milligram to grams

Dose desired x Drug form = number of tabs or caps per dose

Dose available (tablets or capsule)

(Dose desired) 1.0 gm . X 1 tablet = no. of tablets per dose

(Dose available) 500mg (0.5gm)

1.0gm x 1 = 2 tablets

0.5gm

For injectables use the same methods

Dose desired x Dilution volume
Dose available

For example, Digoxin 0.2mg IM. The drug is available as 0.5mg/ml

Dose Desired 0.2mg x 1ml = x
Dose Available 0.5mg

2 x 1ml = 0.4ml
5

Clark's Rule

This is the most popular method for determining the dose for children based on child's body weight.

It states that; the child's dose is equal to weight of child over weight of adult multiply by Adult dose

Child's dose = $\frac{\text{weight of child}}{\text{Weight of Adult}}$ x Adult dose

For example, if the adult dose of paracetamol is 500mg, what is the dose for a 10kg child? We assume normal adult weight is 70kg.

Child's dose = $\frac{\text{weight of child}}{\text{Weight of adult}}$ x Adult dose

Child's dose = $\frac{10\text{kg}}{70\text{kg}}$ x 500mg = 71mg

Self Assessment Test: MCQ

Choose the most appropriate answer

1. A doctor prescribes 1000mg of Paracetamol to be given to the patient under your care TID for 3 days. 1 tablet of Paracetamol is 250mg. How many tables will your patient be taking at a time?
   a. 4 tablets
   b. 2 tablets
   c. 1 tablet
   d. 3 tablets
2. The following are different form of drug preparation
   a. Elixir, Tablets and nuts
   b. Elixirs, Tablets and minces
   c. Elixirs, tablets and paessaries
   d. Elixirs, creams and parrafins

ANSWERS:

1. A
2. C

3.5 Ordering and storage of drugs

The pharmacist is responsible for the dispensing and supplying of drugs to the wards. He formulates rules and regulations on how the drugs should be ordered and when. As a ward nurse, you are required to order antibiotic drugs per chart. This means that supply of drugs is specifically for the admitted patient and the drugs should not be

shared with other patients. This avoids overstocking of drugs by a particular ward thereby avoid creating an artificial shortage of drugs from the main pharmacy.

However, other drugs for ward stock are ordered using a requisition book. If you use requisition book, it should be filled in triplicate so that the original copy is retained in pharmacy. The second copy should be filed in the ward file. The third remains in the book. The information needed include the name of the ward, date, name of the drug, dose, number of tablets (for example, panadol 500mg x 1000 tablets or Ampicillin 250mg x 20 vials etc.). The ward stock should also be indicated for instance, stock available equals 2 or nil. The person who orders writes his or her full names in the space indicating 'requested by', then signs. The ward manager authorizes the order for the pharmacist to dispense the drugs.

When collecting drugs and other supplies from the pharmacyensure that you, check carefully if all the ordered items have been supplied. You can then sign the requisition book for the items that have been supplied and take them to the ward for storage according to manufactures instructions.

Drugs must be kept in the locked cupboard and keys kept by the most senior nurse on duty. The must be kept away from direct sunlight to control temperature and preferably in the original well labelled containers to prevent accidental administering of wrong drugs. The ward manager may have an extra cupboard where he/she might keep some essential drugs but must ensure that the ward stock is well balanced on daily basis.
Some drugs may be stored in the refrigerator depending on the manufacturer's instructions for example, Insulin and vaccines, while other drugs are always kept on the emergency trolley near the nurses' station. Most hospitals have a group of drugs and supplies grouped together in one place where they are readily available for emergencies such as severe dyspnoea, apnoea, cardiac failure, shock, convulsions, etc. These supplies are usually kept at a place in the hospital where emergencies are most likely to occur, such as theatre, wards and delivery room.

Take Note 3.3

The drug cupboard must always be locked and the key kept by the most senior person on duty. This measure helps to secure drugs from being pilfered by undersigned hospital staff and members of the public.

3.6 Routes of administering drugs

Activity 3.3

i. List six routes through which drugs may be given to the patient.

ii. Write your answers in your note book and then compare with the listed ways of giving drugs.

iii. Well done, you know the routes patients can be given their drugs.

You must be able to determine the appropriate routes of administering drugs for the effects of the drug to reach the intended site of action for example. There are some drugs which when you give via a wrong route, their effect cannot be achieved and the patient cannot be helped. Therefore, you must be aware of the various routes of drug administration and nursing implications of each method. The following are common methods of drug administration;

i. Oral route
ii. Parenteral route
iii. Topical route
iv. Instillation
v. Inhalation route
vi. Others which are not commonly used are Rectal and vaginal routes

When you want to administer a drug to a patient, you assume the responsibilities for that procedure. Responsibility entails preparing and administering the prescribed drug. You are therefore supposed to observe the six 'rights' in the administration of drugs. You must ensure that you it is the:

- Right patient
- Right drug
- Right dose
- Right route
- Right time
- Right documentation

Considerations in drug administration

Drug Errors are defined as any occurrence that can cause a patient to receive the wrong dose, the wrong drug, a drug by the wrong route, or a drug given at the incorrect time.

Errors may occur in transcribing drug orders, when the drug is dispensed, or in administration of the drug. Nurses serve as the last defence against detecting drug errors. When a drug error occurs, you report immediately so that any necessary steps to counteract the action of the drug or any observation can be made as soon as possible. Drug errors occur when one or more of the six 'rights' has not been followed. Each time you prepare and administer a drug, the six rights must be part of the procedure. In addition to consistently practicing the six rights, you should adhere to the following precautions to help prevent drug errors:

i. You must confirm any questionable orders.
ii. When calculations are necessary, verify them with another nurse.
iii. You must listen to the patient when he or she questions a drug, the dosage, or the drug regimen. Never administer the drug until the patient's questions have been adequately researched.
iv. Concentrate on only one task at a time to avoid errors that can be during administration of the drug. Errors most commonly occur because of a failure to

administer a drug that has been ordered, administration of the wrong dose or strength of a drug, or administration of the wrong drug.

v. You must have factual knowledge of each drug given, the reasons for use of the drug, the drug's general action and the common adverse reactions associated with the drug, special precautions in administration (if any), and the normal dose ranges.

vi. It is also important for you to take patient considerations, such as allergy history, previous adverse reactions, patient comments, and change in patient condition, into account before administering the drug.

vii. If the patient makes any statement about the drug or if there is any change in the patient, these situations are carefully considered before you give the drug. Examples of situations that require consideration before a you give the drug:

- Problems associated with the drug, such as nausea, dizziness, ringing in the ears, and difficulty walking.
- Any comments made by the patient may indicate the occurrence of an adverse reaction.

viii. You must withhold the drug until references are consulted and the primary caregiver contacted. The decision to withhold the drug must have a sound rationale and must be based on knowledge of pharmacology.

ix. Comments stating that the drug looks different from the one previously received, that the drug was just given by another nurse, or that the patient thought the primary care provider discontinued the drug therapy.

x. A change in the patient's condition, a change in one or more vital signs, or the appearance of new symptoms. Depending on the drug being administered and the patient's diagnosis, these changes may indicate that the drug should be withheld and the primary care provider contacted.

Preparing a drug for administration (see section on preparing a drug for Administration)

1. Administration of drugs by the oral route

The oral route is the most frequent route of drug administration and rarely causes physical discomfort to in patients.

Oral drug forms include tablets, capsules, and liquids. Some capsules and tablets contain sustained release drugs, which dissolve over an extended period of time. Administration of oral drugs is relatively easy for patients who are alert and can swallow. When ingested the drugs come in contact with the mucous membranes lining in the digestive tract, either in the stomach or intestines. Some drugs are 'coated' so they will only dissolve in the stomach or intestines. Some act directly on the membrane of the stomach or intestines. Others are absorbed into the blood stream and have a systemic effect. They come in powder, tablet, pill or capsule form as well as liquid form. Some drugs are designed for immediate action, some for delayed action and some for prolonged action over a given period of time.

Figure 1: A patient getting oral drugs from a container

Nursing Responsibilities

You must observe the following points when giving an oral drug:

i. Place the patient in an upright position. It is difficult and dangerous, to swallow a solid or liquid when lying down. Make sure that you have a glass full of water readily available for the patient.
ii. Assess the patient's need for assistance by removing the tablet or capsule from the container, holding the container, a medicine cup, or holding a glass of water. Some patients with physical disabilities cannot handle or hold these objects and may require assistance.
iii. Advise the patient to take a few sips of water before placing a tablet or capsule in the mouth.

Certain drugs are also given by the sublingual (placed under the tongue) route. These drugs must not be swallowed or chewed and must be dissolved completely before the patient eats or drinks. For example,Nitroglycerin is commonly given sublingually.

2. **Administration of drugs by the parenteral route**

Parenteral drug administration is the giving of a drug by the subcutaneous (SC), intramuscular (IM), intravenous (IV), or intradermal route. This method requires some special equipment and you must be skilled to administer the drugs. This route is preferred because the rate of absorption is much quicker than the oral route. Some drugs may not be absorbed through the gut while others are easily destroyed by the gastric juices so that their only route of administration would be through an injection. Other routes of parenteral administration that may be used by the doctor are; intralesional (into a lesion), intra-arterial (into an artery), intracardiac (into the heart),

and intra-articular (into a joint) and intrathecal route (into the subarachnoid space as in spinal anaesthesia).

Nursing Responsibilities

You must observe the following points when giving a drug by the parenteral route:

i. Wear gloves for protection from the potential of a blood spill when giving parenteral drugs especially intravenously. The risk of exposure to infected blood is increasing for all health care workers. The Centres for Disease Control and Prevention (CDC) recommends that you must wear gloves when touching blood or body fluids, mucous membranes, or any broken skin area. This recommendation is referred to as Standard Precautions, which combine the Universal Precautions for Blood and Body Fluids with Body Substance Isolation guidelines.

ii. After selecting the site for injection, cleanse the skin. Most hospitals have a policy regarding the type of skin antiseptic used for cleansing the skin before parenteral drug administration. Cleanse the skin with a circular motion, starting at an inner point and moving outward.

a. Intra muscular, subcutaneous and intravenous

After inserting the needle for IM administration, pull back the syringe barrel to aspirate the drug. If blood appears in the syringe, remove the needle so that the drug is not injected. Discard the drug down the drain, while the needle, and syringe in the sharp box and prepare another injection. If no blood appears in the syringe, inject the drug. Aspiration is not necessary when giving an intradermal or SC injection.

After inserting a needle into a vein for IV drug administration, pull back the syringe barrel. Blood should flow back into the syringe. After a backflow of blood is obtained, it is safe to inject the drug.

After removing the needle from an IM, SC, or IV injection site, place pressure on the area. Patients with bleeding tendencies often require prolonged pressure on the area.

Do not recap syringes and dispose them according to institutional policy. Discard needles and syringes into clearly marked, appropriate containers. Most institutions have a ‘sharp’ container located in each room for immediate disposal of needles and syringes after use.

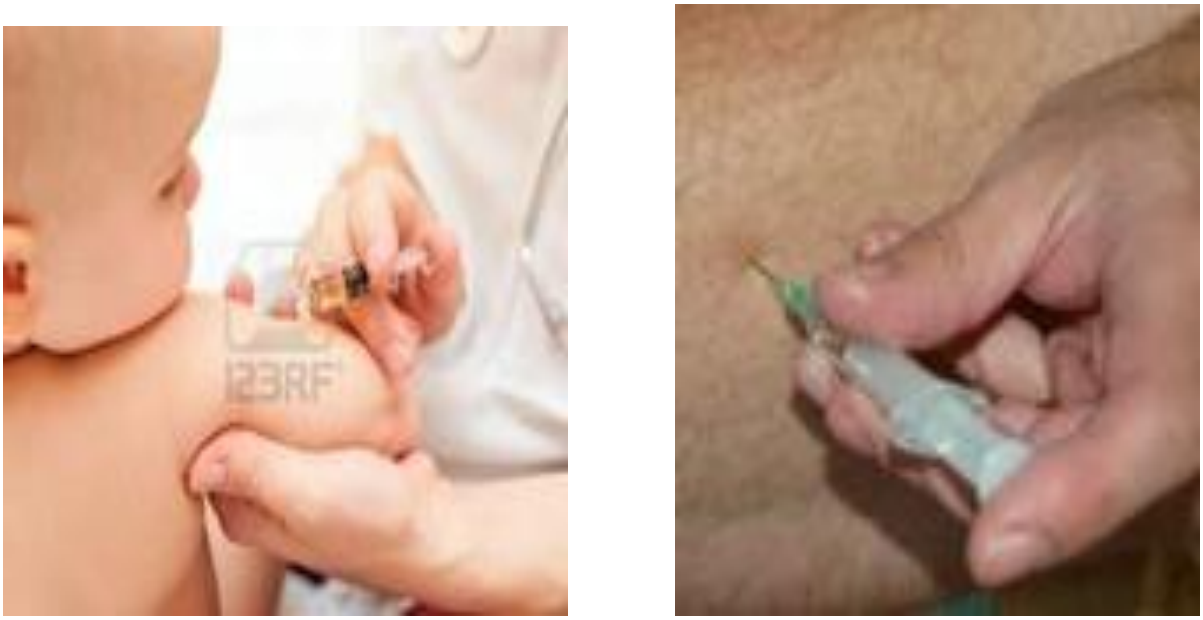

Figure 2: Images showing patient receiving intramuscular injections

3. Subcutaneous Route

A subcutaneous (SC) injection places the drug into the tissues between the skin and the muscle. Drugs administered in this manner are absorbed more slowly than are intramuscular injections. Heparin and insulin are two drugs most commonly given by the SC route.

Nursing Responsibilities

You must observe the following points when giving a drug by the subcutaneous route:

A volume of 0.5 to 1 mL is used for SC injection. Larger volumes (for example, >1 mL) are best given as IM. If a volume larger than 1 mL is ordered through the SC route, the injection is given in two sites, with separate needles and syringes.

The sites for SC injection are the upper arms, the upper abdomen, and the upper back. Rotate injection sites to ensure proper absorption and to minimize tissue damage.

When giving a drug by the SC route, insert the needle at a 45-degree angle. However, to place the drug in the SC tissue, select the needle length and angle of insertion based on the patient's body weight. Obese patients have excess SC tissue, and it may be necessary to give the injection at a 90- degree angle. If the patient is thin or cachectic, there usually is less SC tissue. For such patients, the upper abdomen is the best site for injection. Generally, a syringe with a 23- to 25-gauge needle that is ½ to ⅝ inches in length is most suitable for an SC injection.

4. Intramuscular Route

An intramuscular (IM) injection is the administration of a drug into a muscle. Drugs that are irritating to SC tissue can be given via IM injection.

Drugs given by this route are absorbed more rapidly than drugs given by the SC route because of the rich blood supply in the muscle. In addition, a larger volume (1–3 mL) can be given at one site.

Nursing Responsibilities

The nurse should observe the following points when giving a drug by the IM route:

If an injection is more than 3 mL, divide the drug and give it as two separate injections. Volumes larger than 3 mL will not be absorbed properly.

A 22-gauge needle that is 1½ inches in length is most often used for IM injections.

The sites for IM administration are the deltoid muscle (upper arm), the ventrogluteal or dorsogluteal sites (hip), and the vastuslateralis (thigh; the vastuslateralis site is frequently used for infants and small children because it is more developed than the gluteal or deltoid sites. In children who have been ambulating for more than 2 years you can use the ventrogluteal site.

When giving a drug by the IM route, insert the needle at a 90-degree angle. When injecting a drug into the ventrogluteal or dorsogluteal muscles, it is a good idea to place the patient in a comfortable position, preferably in a prone position with the toes pointing inward. When injecting the drug into the deltoid, a sitting or lying down position may be used.

5. Intravenous Route

A drug administered by the intravenous (IV) route is given directly into the blood by a needle inserted into a vein. Drug action occurs almost immediately. You must always ensure that drugs administered via the IV route are given slowly, over 1 or more minutes.

You can only give IV drugs rapidly by:

Piggyback infusions (drugs are mixed with 50–100 mL of compatible IV fluid and administered during a period of 30–60 minutes piggybacked onto the primary IV line)

An existing IV line (the IV port)

Into an intermittent venous access device called a heparin lock (a small IV catheter in the patient's vein connected to a small fluid reservoir with a rubber cap through which the needle is inserted to administer the drug)

Reasons for giving drugs parenterally

i. To assure rapid action.
ii. To prevent the drug from being destroyed by gastric juices.
iii. To give a drug when the patient is unable to take it orally. For example, unconscious, vomiting or mentally disturbed patients.
iv. To prevent irritation of the mucous membrane lining of the gastro-intestinal tract.
v. Some drugs are not absorbed well by the digestive tract.

Nursing Responsibilities after drug administration

After you have administered any type of drug, you are responsible for documentation of the administered drug. You must complete this task as soon as possible. This is particularly important when PRN drugs (especially narcotics) are given to prevent repeatedly giving the drug.

6. Topical route

This is the process of administering a drug to treat infections affecting the skin mucous membranes by directly applying the drug on the affected site.

Topical drugs are administered through the following ways;

a. Spraying or painting on the skin may be done for direct action at the point of contact. Watery solutions, lotions, alcoholic solutions or tinctures may be used.

b. Inunction is the rubbing of a drug into the skin. It can be used for a local action or systemic effect.

c. Ointments are oily preparations which you can be rubbed in or applied to the skin for local action on skin lesions of various kinds.

d. Creams and water-soluble substances which you can be rubbed in or applied to the skin for local action on skin lesions of various kinds.

e. Liniments are rubbed in and applied to the skin. They have the property of a counter-irritant (heat producing).

f. Plasters and poultices containing medicine plus other ingredients which are usually warmed and wrapped in material or heavy paper and applied to the patient. They can have a local action or the substances are absorbed and affect other areas of the body.

g. Compresses (moist dressings) and soaks (local baths) usually have a local effect though some water is supposed to hold substances that affect the general health of a person.

Take Note 3.4

Medications in form of instillations and drops are applied topically

Drugs Acting On the Skin

There are several creams or ointments that can be used to treat skin infections. Below are some drugs which are applied topically.

Antibacterial preparations

Bacterial infection of the skin can be treated with topical antibacterial to combat infection.

a) **Neomycin Plus Bacitracin Ointment**
Indications: Skin infections

Administration: Apply tid

Side Effects: Local hypersensitivity reactions

Caution: Contraindicated in large open wounds

b) **Tetracycline**
Presentation: Ointment 3%

Indications: Impetigo, infected burns and abrasions. Apply 1-2 x/day

Nursing Responsibilities

i. You must observe if the patient has reacted to the topical drugs applied by looking out for rash, blisters and if the patient is complaining of itching sensation.

You must ensure that the nozzle of the applicator does not touch the patients' eye, ear or nose when instilling the drug if one drug is use on many patients to prevent contamination. Figure 3 that follows illustrates topical application of drugs.

Figure 3: Patients applying drugs topically

7. Instillation

Drugs that are used to treat eye and ear infections are either in liquid of paste form. Drugs that are in liquid form are the ones that are instilled. The figures that follow illustrate instillation of drugs.

A) Patient Instilling Ear Drops **B) Patient Instilling Eye Drops**

A B

Figure 4: Instilling ear and eye drops

An example of a class of drugs that is instilled is mydriatics. Here is a description of that drug**.**

Mydriatics (for example, Atropine)

Action: Dilates the pupil and paralyses the ciliary muscle

Presentation:1% Eye drops/ointment

Indication: Inflammatory conditions of the eye and when examining the eye, Iritis, iridocyclitis, keratitis, corneal ulcers and sclero keratitis - dilates pupil, prevent adhesions, pre-op for cataracts

Side effects: Raised intra-ocular pressure and transient stinging, hyperaemia, local irritation and oedema may occur after prolonged use.

Contraindications: Give with caution in very young and very old clients as it causes toxic systemic reactions.

Nursing Implication/Your responsibilities: You must advise the client if they drive to rest for 1-2 hours after instillation of the drug to prevent accidents.

8. Inhalation

This is the administration of drugs through the respiratory tract by breathing in. Drugs administered through this route include:

a) Sprays or nebulae contain fine particles of drug suspended or dissolved in oil or water. These are then inhaled. They are used in the treatment of conditions of the nose, throat and lungs. They may have local or systemic effects.

Figures 5, 6 and 7 that follows illustrates drug administration through inhalation.

Figure 5 : A patient inhaling fine particles of drug

b) Aerosols are suspensions of fine solid or liquid particles in air or gas. These may be drawn into the lungs or forced in on a flow of gas such as oxygen from a cylinder.

Figure 6: Aerosols

c) Steam can be used to carry drugs into the lungs. The water vapour itself may be the important substance or it may carry the needed drugs.

Figure 7: A patient inhaling steam

d) Medicine could also be burned and the smoke inhaled

Nursing responsibilities

i. You must ensure that the patient is closely observed for improved breathing patterns.
ii. Ensure safety of the patient when using steam inhalation to prevent burns.

Self Assessment Test: MATCHING ITEMS

Match the routes of drug administration in Column I with their most appropriate therapeutic rationale in Column II

Column I Column II

1. ……. Oral A. Best suited for unconscious patients
2. …… IV B. Drug is prepared in in form of cream
3. …… Topical C. Drug can withstand action of digestive enzymes

D. Drug can be denatured by digestive enzymes

ANSWERS**:**

1. C
2. A
3. B

3.7 Insertion and commencement of intravenous fluids

There are several reasons why a patient might need to have fluids administered intravenously. This typically involves opening a vein with a cannula and injecting fluid through a vein, usually on the arm.
During your clinical placements on the wards, you will be required to canulate patients who need fluids. Kindly take the opportunity to sharpen your skills in canulation.

Fluids used are water with either salt, sugar, or medications added in concentrations that depend on the individual.

Figure 8: A patient receiving intravenous fluids

Intravenous (IV) treatments include:

i. Rehydration after being dehydrated from illness or excessive activity.
ii. Antibiotics to treat an infection.
iii. Chemotherapy drugs for cancer treatment.
iv. Medications for the treatment of pain.

Rate and quantity of intravenous fluid depends on medical condition, body size, and age. Regulation ensures the correct amount of fluid drips from the bag down the tube into the vein at the correct rate.

Complications can result from receiving too much, too quickly, or not enough, too slowly.

Intravenous fluid regulation

There are two ways to regulate the amount and rate of fluids given during intravenous therapy.

i. **Manual Regulation:** The rate of fluid dripping from a bag into an IV can be regulated through a manual technique. You can increases or decreases the pressure that a clamp puts on the IV tube to either slow or speed the rate of flow. You must count the number of drops per minute to make sure the rate of flow is correct, and adjust as needed.

ii. **Pump Regulation:** The rate is modulated with an electric pump. In this case you program the pump to deliver the desired amount of fluid into the IV at the correct rate. Whether done manually or with a pump, IVs must be checked regularly to be sure the patient is getting the correct amount of fluid.

3.8 Administration of controlled drugs

Do you remember what you learnt concerning controlled drugs in topic 2.5? What are controlled drugs and when are they used?

Well, Controlled drugs are drugs which are liable to misuse and are controlled by the CDA Act. These drugs can only be administered upon being prescribed by a registered medical doctor. They are controlled because they are addictive.

The following are the rules for administration and storage of CDA drugs:

1. They must be prescribed by an authorized clinician.

2. They must be kept in the hospital in a double locked cupboard.

3. The keys to the double locked cupboard must be kept by a Registered Nurse (ZRN).

4. A register must be kept with separate sections for each drug. Ink must be used.

5. The nurse giving the drug plus a Registered Nurse sign out the drug from the CDA cupboard.

Your responsibilities

i. Any drug which is wasted must also be recorded, marked wasted and signed for.
ii. The Controlled Drug Register must be kept for 2 years following the last entry.

Take Note 3.5

The register is locked up together with the drug in the CDA cupboard. Once the new stock is acquired, it must be entered in the register and the balance must be recorded accurately.

You have come to the end of this unit. I hope you have leant many things from it. Let us review what you learnt

3.9 Summary

In this unit you learnt about ordering and control of drugs. I am confident that you can now order any kind of drugs and control their usage. You further learnt various routes of drug administration and the importance of choosing the right route before administering any drugs.

In the next unit you are going to classify drugs such as those that act against bacteria, fungi and viruses. This will help you to avoid wastage of drugs by using the correct class for specific disease causing organisms.

3.10 Self-Assessment

Multiple Choice Questions

Choose the most appropriate answer

1. The following are indications for insertion and commencement of intravenous fluids EXCEPT?
    a. Drug administration
    b. Blood transfusion
    c. Unconsciouness
    d. All of the above
2. Which of the following is a controlled drug?
    a. Acetylsalicylic acid (Aspirin)
    b. Pethidine
    c. Ibuprofen
    d. Indomethacin

ANSWERS:

1. D
2. B

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UNIT 4: CLASSIFICATION OF DRUGS

4.1 Introduction

Welcome to this unit. In the previous unit you learnt about ordering and control of drugs. You further learnt about the route of drug administration and the importance of choosing the right route before administering any drugs. In this unit you will look in detail on the classification of drugs. Why do you think drugs are classified? Well, find out further the importance of drug classification and enjoy the unit.

4.2 Objectives

At the end of this unit you should be able to:

1. Define a drug
2. Describe the Classification of Analgesics
3. Outline the Classification of Antibiotics
4. Outline the Classification of Antiviral agents
5. Outline the Classification of Antifungals
6. Outline the Classification of Antiprotozoa
7. Descibe disinfectants/Antiseptics

4.3 Definition of drug

Activity 4.1

- What is a drug?
- Do you know of any class of drugs?
- Write down the classes of drugs you know in your note book..

Excellent, you are doing well. Keep it up. Now compare with the notes to internalize your work.

A drug is a chemical of substance used in the diagnosis, cure and in the prevention of diseases. Drugs are classified according to the properties they have and the types of disease causing organisms they target. When you know the classes of drugs, you will have acquired the knowledge of how to treat conditions accurately hence you will hasten the treatment of the patients and subsequently serve lives in time.

There are many classifications of drugs but for the sake of your study, drugs have been categorized in 6 (six) main classes as:

4.4 Analgesics

An analgesic is a drug used to relieve pain. They are divided into three group's namely non-opioid analgesics, opioid analgesics and co-analgesics. These drugs are classified like this because of the way they act to elicit an effect in the body.

However, you must know that there are two primary types of analgesics: narcotic (opioid) and non-narcotic (non-opioid) analgesics.

Types of Analgesics

Table 3: Narcotics and non narcotics

ANALGESIA	
NARCOTICS	**NON-NARCOTICS**
Examples Morphine, Codeine and Pethidine	Examples, Paracetamol (Panadol) and non-steroidal anti-inflammatory drugs (NSAIDs) for example, Aspirin
These are used to treat moderate to severe pain	These are used to treat Mild to moderate pain

Table 4: Primary differences narcotic and non-narcotic analgesics at a glance

NARCOTIC ANALGESICS	**NON-NARCOTIC ANALGESICS**
Act centrally	Act peripherally
Cause addiction/dependence	Not habit-forming
Schedule II/III controlled drugs	Not controlled drugs
Notable adverse effects: sedation, respiratory depression	Notable adverse effects: gastric irritation, bleeding problems
No anti-inflammatory effect	Anti-inflammatory effect

A.Non-opioid analgesics

Non-opioid analgesics also called Non-narcotic analgesics have principally analgesic, antipyretic, and anti-inflammatory properties. They act primarily in peripheral tissues to inhibit the formation of pain-producing substances such as prostaglandins. Non-opioids do not bind to opioid receptors and are not classified under the Controlled Substances. They are milder forms of the pain relieving drugs.

Properties of non-opioid analgesics

Drugs such as paracetamol commonly known as panadol, has analgesic and antipyretic properties only, while non-steroidal anti-inflammatory drugs (NSAID) such as aspirin have analgesic, antipyretic and anti-inflammatory properties.

Mode of action of non opioid analgesics

Non-opioid analgesics act by inhibiting the production of prostaglandins, which are chemical mediators responsible for the initiation of pain transduction (conversion of mechanical-chemical stimulus to neural action potential).This is achieved by inhibiting the action of the enzyme cyclooxygenase (COX) which converts arachidonic acid into prostaglandins and other related substances. Cyclooxygenase enzyme catalyses the conversion of arachidonic acids to endoperoxide which results into production of prostaglandins and thromboxane

Examples of Non-opioid Analgesics

1. Paracetamol (Panadol)

The exact mechanism of action of paracetamol/acetaminophen is uncertain but appears to act centrally in the brain rather than peripherally in nerve endings.

Indications: mild to moderate pain and in febrile illnesses

Dose

It is given 10-15mg/ kg body weight in children rectally/orally;r adults 500mg-1000mg three times daily orally .

Side effects

Paracetamol has few side effects and is regarded as generally safe, although excess or sustained use can lead to potentially life-threatening liver damage and occasionally kidney damage.

Nursing consideration/implication

i. This drug is only for short –term use. Tell patients to consult a doctor if administering to children for more than 5 days or adults for more than 10 days.

ii. Warn patient that high doses can cause hepatic damage.

iii. Do not use for self –medication of marked fever (39.5ºc) fever persisting longer than 3 days.

2. Aspirin (Acetylsalicylic Acid)

Indications

i. Anti-inflammatory effects: Anti -oxidant property (free radical scavenge, rheumatoid arthritis and rheumatoid fever)

ii. Analgesic effects: Used for mild to moderate pain secondary to inflammation for example, arthritis, dysmenorrhea and post- partum pain.

iii. Antipyretic effect: It reduces the production of prostaglandins which is generated in response to inflammatory pyogens.
iv. Anti-platelet effect**:** It leads to irreversible inhibition of COX enzymes in platelet leading to inhibition of thromboxane synthesis and platelet aggregation. It is used in prophylaxis of transient ischemic attacks, myocardial infarction and unstable angina.

Dose

- Anti-inflammatory 400-800mg per day orally
- Analgesia 300mg-600mg PRN orally
- As an antiplatelet 75mg -150 mg daily orally

Side effects

Aspirin predispose to peptic ulcers, renal failure, allergic reactions, and occasionally hearing loss, and they can increase the risk of hemorrhage by affecting platelet function.

The use of aspirin in children under 16 suffering from viral illness has been linked to Reye's syndrome, a rare but severe liver disorder.

3. **Brufen (Ibuprofen)**

This is a non steroidal anti infliammatory drug (NSAID)

Presentation: Tablet containing 200mg, 400mg. Syrup containing 100mgg/5mls.
Indications: Fever, and pain in children, mild to moderate pain in dysmenorrhoea and postoperative analgesia.
Dose: Oral 200-400bg tds after food. Children 20mg/Kg body weight
Side effects: As for asprin
Caution: As for asprin
Contraindications: Hypersensitivity to NSAID and children less than 7 years

4. **Diclofenac**

This is a non steroidal anti inflammatory drug (NSAID)
Presentation: Tablet containing 25mg and injection containing 25mg/ml
Indications: Pain and inflammation in rheumatic disease, musculoskeletal disorders, acute gout and postoperative pain.
Dose: By mouth 75mg-150mg, im injection 75mg, in ureteric pain 75mg then 75mg after 30 minutes
Side effects: As for asprin, if suppositories rectal irritation and injection causes site reactions
Caution: Breastfeeding and as for asprin
Contraindications: Porphyria. For IV contraindicated in concomitant use with anticoagulants, history of haemorrhagic disorders.

5. Indomethacin (indocid)

Presentation: Capsule, injection, suppositories
Mode of action: as for aspirin

Indications: Moderate to severe arthritis, acute gout
Dosage: 25mg p.o bd or tds

Nursing consideration/ implication

i. Tell patients to take NSAIDs with food, milk or antiacid if gastro intersinal upset occurs
ii. Monitor carefully for bleeding and for reduced urine output. Discontinue the drug and notify the doctor immediately.
iii. Decrease dose if headache persists
iv. Monitor for weight gain and increase blood pressure in patients with hypertension due to sodium retention.

B. Opioid Analgesics

Opioid analgesics also referred to as narcotic analgesics are drugs that relieve moderate to severe pain, that may cause numbness and induce a state of unconsciousness. Some narcotics are more potent than others. They also have the tendency to cause tolerance and dependence as they have no analgesic ceiling.

Mechanism of action

Opioid analgesics act on the brain by activating opioid receptors. By activating these receptors, they increase the release of the neurotransmitter dopamine. The increase in dopamine causes the intense feeling of happiness and pleasure (euphoria) that people feel when they use these drugs.Further opioid analgesics act on the brain by interfering with the transmission of pain impulses to the brain.*Overall, narcotic analgesics reduce neuronal excitability in the pain carrying pathway.*opioids also supresses the cough reflex by direct acting on the cough centre in the medulla and reduce motility of gastrointestinal tract. Examples of opioid drugs are morphine, pethidine, codeine and diamorphine.

Short-term side effects

The short-term effects of opioid analgesics may include relaxation, drowsiness, itching, sweating and dilated pupils. Others are visual problems, nausea, vomiting, lack of concentration, constipation, anxiety, slowed breathing, fatigue and decreased appetite.

Long-term side effects

The long-term effects of opioid analgesics may include depression, insomnia, tolerance, and death from respiratory depression, decreased concentration and decreased pain threshold.

Examples of Opioid Analgesics

1. Pethidine (synthetic opioids)

Presentation: Tab 25, 50mg; Inj 50mg or 100mg/ml

Dose: 0.5mg/kg body weight in Paeds

Major side effect: Suppression of respiratory centre, increase intracranial pressure, sedation, nausea and vomiting

Caution: Not to be used in acute pain or repeated as dependence and tolerance occurs

Contra-indication: head injury, severe abdominal pain, bronchial asthma, hypersensitivity to the drug, alcoholism.

Drug interaction: Tranquilizers, CNS depressants, ethanol, sedatives

2.Morphine (natural opioids)

Presentation: Oral solution, injection

Onset: one hour after oral dose and 10 – 30 minutes after im dose.

Dose: 5 to 10 mg IM 6 hourly 10- 30 mg per oral

Indication: moderate to severe pain

Side effects, drug interaction, and contra indication: as for pethidine

3.Codeine phosphate (Natural opioids)

Presentation; oral solution 15 mg/5mls tablets 30mg, 60mg

Indication: moderate to severe pain, diarrahoea

Dosage: 15mg to 60mg p.o

Side effects, contra indication, and drug interaction: as for pethidine

Nursing consideration/ implementation

i. Monitor circulatory, respiratory, bladder and bowel functions carefully. Drug may cause constipation and patient may need a laxative.

ii. Warn out patients to avoid driving and other potentially hazardous activities that require mental alertness

iii. For full analgesics effect take or give drug before patient has intense pain.

iv. Drug is an antitussive and should not be used when cough is a valuable diagnostic

v. Keep narcotic antagonist (naloxone) available when giving this drug IV.

Self Assessment Test: MATCHING ITEMS

Match the analgesic drugs in Column I with their mechanism of action in Column II

Column I

1. ……. Paracetamol
2. .....Pethidine

Column II

A. Act centrally to enhance pain modulation

B. Inhibit pain transduction in the mechanism of pain sensation

C. Mechanism of action is not well understood

ANSWERS:

1. B
2. A

4.5 Antibiotics

You have just been equipped with important knowledge on analgesics. I hope you have found the class of drugs very interesting.

Well, let's look at another class of drugs .This time you will learn about antibiotics. From your high school, you studied about antibiotics. Do you remember who the father of antibiotics is?

Activity 4.2

In your own words what are antibiotics?

List 5 antibiotic drugs that you know and what they are used for. Write your answers in your note book.

Well done. Now look at the notes for you to know more about the drugs you have just written.

Antibiotics, also known as antibacterials, are types of medications that destroy or slow down the growth of bacteria. The Greek word anti means ‘ against’ , and the Greek word bios means ‘life’ (bacteria are life forms). Antibiotics are used to treat infections caused by bacteria.

Their target mainly is bacteria and they are not effective against fungi, parasites and viruses.

However, if antibiotics are overused or used incorrectly there is a chance that the bacteria will become resistant meaning the antibiotic becomes less effective against that type of bacterium. This is the reason why you are learning about antibiotics classification.

Antibiotics are classified in two groups namely:

a) Bacteriocidal: These are antibiotics that kill the bacteria

b) Bacteriostatic: These are antibiotics that prevent the growth and multiplication of bacteria.

There are so many antibiotics and are discussed under many classifications or groups for example sulphonamides, penicillins and tetracyclines.

You are going to look at only a few antibiotics and others you will read on your own in the Zambian National Formularly.

Before selecting an antibiotic, you must consider the following:

- The patient’s profile for example history of allergy
- Known or likely causative organism.
- Underlying conditions such as renal and hepatic dysfunction.
- Resistance of the drug to the infection.
- Severity of illness.
- Ability to tolerate drugs by mouth

PENICILLINS

They are bactericidal and act by interfering with bacterial wall synthesis (causing weakening and breakdown of the bacterial cell wall). They diffuse well into body tissues and fluids but penetration into the blood brain barrier is poor except when the meninges are inflamed. Penicillins are active against gram positive organisms and gram negative cocci. The following are types of Penicillins. Penicillins are generally divided intonarrow spectrum and broad spectrum penicillins. Broad spectrum penicillins are active against most gram positive and gram negative bacteria while narrow spectrum penicillins are active against gram positive bacteria with less activity against gram-negative bacteria.

Benzylpenicillin (Crystalline penicillin, Penicillin G)- narrow spectrum

Presentation: Vial containing injectable powder 5mu to be diluted with sterile water for injection 8-10mls or as per manufacturers' instruction

Indications: Tonsillitis, otitis media, streptococcal endocarditis, meningococcal and pneumococcal meningitis

Dose: Adult; IM or slow IV or infusion, 2-4mu in 4-6 divided doses.

Child; 1 month-12 years, 100, 000-150, 000iu/kg daily in four divided doses

Side Effects: Sensitivity reactions including urticaria, fever, joint pains, anaphylactic shock in hypersensitive patients

Contra-Indications: Penicillin hypersensitivity

Procaine Penicillin (Benethamine penicillin or Triplope)- narrow spectrum

Presentation: Injection, Benethamine penicillin 475mg, Procaine penicillin 250mg, Benzyl penicillin sodium 300mg

Indications: Penicillin-sensitive infections

Dose: 75mg-600mg deep IM once daily.

Benzathine penicillin (Retarpen)- narrow spectrum

Presentation: vial containing injectable powder 2.4mu to be diluted with sterile water for injection 8-10mls or as per manufacturer's instructions

Indications: Penicillin sensitive infections particularly syphilis; rheumatic fever prophylaxis

Dose: Adult; single dose of 2.4 mega units IM, Rheumatic fever prophylaxis 1.2 mega units IM, monthly.

Side Effects: Caution: Contra-Indications: As for Benzyl penicillin.

Phenoxymethyl Penicillin (Pen V)- narrow spectrum

Presentation: tablet containing 250mg or suspension containing 125mg/5mls

Indications: Upper respiratory tract infections, tonsillitis, otitis media, sinusitis

Dose: Adult; 250-500mg every 6 hours, at least 30 minutes before food

Child; up to 1 year 62.5mg, 1-5 years 125mg, 6-12 years 250mg

Side Effects: As for Benzyl penicillin

Ampicillin- broad spectrum

Presentation: capsule containing 250mg, suspension containing 125mg/5mls or injectable powder containing 250mg to 1000mg per vial.

Indications: Urinary tract infections, otitis media, chronic bronchitis, invasive salmonellosis

Dose: Adult; by mouth 250-500mg qid at least 30 minutes before food. It can also be given IM or IV. Children 50-100mg/kg in 4 divided doses.

Side Effects: Rashes, diarrhoea

Cautions; Contra-Indications: As for Benzyl penicillin

Amoxycillin (Amoxil) - broad spectrum

Presentation: tablet or capsule containing 250mg or suspension containing 125mg/5mls

Indication: Similar to Ampicillin. It is more active than Ampicillin

Dose: 250-500mg every 8 hours p.o. Child dose as for ampicillin

Side Effects: Similar to Ampicillin but diarrhoea less common

Penicillinase Resistant Penicillins

Activity 4. 3

In your own words, describe the mechanism of action for penicillins antibiotics.

Outline side effects of penicilinase drugs and the role of the nurse.

Write in your note book.

Examples of penicillinase resistant penicillins

Amoxycillin and Clavulanic Acid (Augmentin, Co-amoxiclav)

Presentation: Presentation: capsule containing 250/125mg, 500/250mg or suspension containing 125mg/5ml

Indications: Similar to Ampicillin including resistant strains of Staph aureus, E. Coli, H. Influenza, and Bactericides

Dose: 250/125 - 500/250 mg every 8 hours per oral.

Side Effects: Similar to Amoxicillin

Cloxacillin (Orbenin)

Presentation: Capsule containing 250mg or suspension containing 125mg/5ml or injectable powder containing 250 t0 500mg per vial.

Indications: Infection due to penicillinase producing bacteria

Dose: Adult; by mouth 250-500mg every 6 hours at least 30 minutes before food.

By IM injection 250mg-500mg every 4 to 6 hours (poorly absorbed).

By IV injection 500mg every 4 to 6 hours, doses may be doubled in severe infections.

Child; any route, under 2 years quarters (1/4) adult dose, 2-10 years half (1/2) adult dose

Side Effects: As for Benzyl penicillin oral administration may produce diarrhoea and pruritiis ani.

Contra-Indications: As for Benzyl penicillin

Nursing consideration/ implication

i. Ask the patient about any allergic reactions to penicillin
ii. Obtain specimen for culture and sensitivity tests before first dose
iii. Tell patient to take entire quantity of medication exactly as prescribed even after he feels better
iv. Give with food to prevent gastrointestinal distress
v. Warn the patient never to use left over penicillins for new illness or to share it with with family and friends
vi. Tell the patient to call the doctor if rash, fever or chills develop

Activity. 4 4

In your own words mention at least five (5) nursing implications when administering penicillins to a patient.

Write your answers in your note books.

TETRACYCLINES

The tetracyclines are broad spectrum antibiotics whose value has decreased owing to increased bacterial resistance. They have activity against many gram-positive and gram-negative bacteria and in infections caused by rickettsiae, amoeba, chlamydial, psitti, trachomatis etc.

Their mode of action is that of bacteriostatic and inhibit bacterial protein synthesis by binding irreversibly to 30s subunit of ribosomes.

Side effects for tetracyclines

i. Nausea, vomiting and epigastric discomfort
ii. Permanent yellow-brown discolouration in growing children as they cause chelating with Calcium and some cases cause enamel hypoplasia and they should be avoided in later half of pregnancy and children below 12 years.
iii. Uraemia in patient with renal impairment
iv. Benign intracranial hypertension causes headache and visual disturbance

Nursing implications for tetracyclines

i. Provide and encourage patient to take plenty of fluids.
ii. Encourage the patient to take the drug after meals.
iii. Rule out pregnancy before administering the drug to females patients who are in the reproductive age group

Tetracycline

Presentation: Tablet or capsule containing 250mg

Indications: Exacerbations of chronic bronchitis; infections due to brucella, chlamydia, mycoplasma, and rickettsia; acne vulgaris, cholera

Dose: By mouth, 250-500mg every 6 hours. Early syphilis, 500mg qid for 14 days. Non-gonococcal urethritis, 500mg qid for 21 days

Side Effects: as above

Caution: Breast feeding; avoid giving with milk, calcium products and antacids.

Contra-Indications: Renal failure, pregnancy; not to be used in children under 12 years of age.

Doxycycline (Vibramycin)

Presentation: tablet containing 100mg

Indications: Similar to Tetracycline

Dose: Initial 200 mg P.o. then 100 mg bid P.o.

Side Effects: Similar to Tetracycline

Contraindications: Similar to Tetracycline

AMINOGLYCOSIDES

Aminoglycoside antibiotics had been the mainstay of treatment of serious infections due to aerobic gram-negative bacilli, but the drugs have serious toxic effects. The drugs are produced from two amino sugars.

Mechanism of action

Aminoglycosides are potent rapidly bactericidal antibiotics that act by creating fissures in the outer membrane of the bacterial cell resulting in leakage of intracellular contents and enhanced antibiotic uptake. This rapid action at the outer membrane probably accounts for most of the bactericidal activity. Bacterial killing is concentration-dependent, but residual bactericidal activity persists even after the serum concentration has fallen below the minimum inhibitory concentration. These properties account for the efficacy of once-daily dosing regimens.

The drugs are active against many gram-negative bacteria (including pseudomonas species) and gram-positive organisms but are inactive against anaerobics, as these species of bacteria are unable to take up the aminoglycosides into their cells.

Side effects of aminoglycosides

These are dose related and many are reversible.

i. Ototoxicity
ii. Renal damage (nephrotoxicity)
iii. Acute neuromuscular blockade if given with anaesthesia

Nursing implications for aminoglycosides

i. Take of patients complaints regarding hearing impairments.
ii. Rule out pregnancy before administering the drug to females patients who are in the reproductive age group
iii. Give with caution in patients with renal function impairment**.**

Gentamycin

Presentation: Injectable liquid in an ampule 40mg/1ml or 80mg/2mls

Indications: Septicaemia and neonatal sepsis; meningitis and other central nervous system infections; biliary tract infection; acute pyelonephritis or prostatitis, endocarditis

Dose: Average dose 40mg every 8 hours. Child up to 2 weeks 3mg/Kg b.d, 2 weeks -12 years 2mg/Kg tds.

Side Effects: As above. Irreversible partial or total deafness and vestibular disturbances, reversible kidney damage, infrequently purpura, anaemia and convulsions.

Caution: Impaired renal function. Should not be used in combination with streptomycin

Contraindications: Renal impairment, hearing impairment and pregnancy

Streptomycin

Presentation: Powder containing 1g
Indications: Solely kept for second line treatment of tuberculosis in Zambia

Dose: It is given/ Kg body weight 60 injections in TB treatment o.d as national guidelines.
Side effects: Seizures, confusion, hypotension, myocarditis, ototoxicity, nephrotoxicity
Caution: Neonates, mild renal disease, myasthenia gravis, lactation, hearing deficits.
Contraindications: Pregnancy, renal disease, hypersensitivity.

Other aminoglycosides include Amikacin, Neomycin and Kanamycin

MACROLIDES

These are a group of antibiotics with a macrocyclic lactone structure. These were and are still second choice drugs in people reacting to penicillins

The mode of action for these drugs is that they bind to a site on 50S subunit of the bacterial ribosome, thus inhibiting the translocation steps of the protein synthesis. They are generally considered to be bacteriostatic and but they are bacteriocidal at higher doses.

Pharmacokinetics

The erythromycin base is destroyed by gastric gas, thus they are coated tablets. Adequate absorption is achieved on oral administration. The drugs are well distributed in all body fluids especially erythromycin. The drugs are mainly excreted in bile.

Side effects

i. Epigastric distress
ii. Cholestatic jaundice
iii. Ototoxicity

Contraindication: Patients with hepatic dysfunction

Examples of macrolides

Erythromycin
Presentation: Tablet or capsules containing 250mg, 500mg or suspension containing 125mg/5mls
Indications: Alternative to penicillin sensitive patients, campylobacter enteritis, pneumonia, legionnaires disease, syphilis, non-gonococcal urethritis, chronic prostatitis, diphtheria, whooping cough as prophylaxis.
Dose: Oral adult and child above 8 years 250-500mg qid or 0.5g-1g every 12 hours
Side effects: Diarrhoea, urticarial, rashes, allergic reactions, reversible hearing loss and cardiac effects.
Caution: Renal and hepatic impairment, cardiac arrhythmias

Azithromycin
Presentation: Capsule containing 250mg or tablet 500mg and oral suspension containing 200mg/5mls

Indications: Respiratory tract infections, otitis media, skin and soft tissue infections, trachoma, uncomplicated genital chlamydial infections and non-gonococcal urethritis.
Dose: 500mg o.d for 3 days, child over 6 month 10mg/Kg o.d for 3 days
Side effects: Dizziness, headache, drowsiness, photosensitivity, hepatitis, interstitial nephritis, acute renal failure, hepatic necrosis.

Clarithromycin
Presentation: Film coated tablet containing 250mg, 500mg or suspension containing 250mg/5mls.
Indications: Respiratory tract infections, mild skin and soft tissue infections, otitis media.
Dose: Orally 250mg b.d for 7 days, child underweight 8kg 7.5mg/Kg twice daily.
Side effects: Confusion, psychosis, vertigo, convulsions, hypoglycaemia.

Nursing implications

i. For best absorption, instruct the patient to take oral form of drug with full glass of water 1 hour before or 2 hours
ii. Tell the patient not to drink fruit juice with drug
iii. Treat streptococcal infections for 10 days
iv. Monitor liver function test

THE QUINOLONES

The fluorinated 4-quinolones, such as ciprofloxacin (CIPRO), moxifloxacin (AVELOX), and gatifloxacin (TEQUIN), are orally effective for the treatment of a wide variety of infectious diseases and have relatively few side effects.

Mechanism of action

The mechanism of action for quinolones is not well understood however it is understood that they act as antibacterial agents by inhibiting DNA gyrase enzymes needed for DNA replication in bacteria. Ultimately quinolones are bacteriocidal in action andhave good activity against staphylococci but not against methicillin-resistant strains.

Side effects for quinolones

- GIT upsets- nausea, vomiting, diarrhoea
- CNS effect- dizziness, headache, tremors, rarely convulsions
- Photosensitivity skin rashes
- Pain and inflammation in tendons

Nursing implications

Assess patient for: previous sensitivity reaction; bowel pattern daily; urine output and if decreasing notify prescriber

Examples of quinolones

Ciprofloxacin

Presentation: tablet containing 250mg, 500mg and 750mg, intravenous injectable 500mg/100ml bottle.

Indications: Many systemic infections, typhoid, respiratory and UTI, bone & joint infections

Dose: 250-750 mg p.o and 100-200 mg I.V.,250 mg p.o. as single dose for gonorrhoea

Side Effects: Nausea, diarrhoea, rash pruritus

Special precaution: Adequate fluid intake is necessary to avoid crystaluria

Other quinolones include: Nalidixic Acid, Levofloxacin, Norfloxacin, Cinoxacin and Nitrofurantoin.

SULPHONAMIDES AND TRIMETHOPRIM

Sulfonamide and trimethoprim are broad spectrum anti-microbial agents which are used to prevent treat infections such as urinary tract infections, bronchitis, middle ear infection, and traveler's diarrhoea. In Zambia a combination of sulfamethoxazole and trimethoprim (Septrin) is strictly used in patients with HIV related infections for therapeutic and prophylactic purposes against opportunistic infections such as Pneumocystis Jirovencii Pneumonia formerly known as Pneumocystis carinii pneumonia (PCP).

Mechanism of action

Sulphonamides act by inhibiting biosynthesis of folic acid resulting in bacterial cell wall death, hence they are bacteriocidal in action.

Side effects of sulphonamides

- Crystaluria
- Hypersensitivity reactions
- Haematological disorders and hepatic damage
- Stevens-Johnson Syndrome
- Nursing implications
- Encourage patient to take plenty of fluids
- Observe patient for any allergic reactions
- Discontinue drug if symptoms of Stevens-Johnson syndrome appear

Examples of sulphonamides

Sulphamethoxazole and Trimethoprim (septrin)

Presentation: Tablet containing 400mg sulphamethoxazole and 80mg trimethoprim or suspension containing 200mg sulphamethoxazole and 40mg trimethoprim.

Indications: In PCP, toxoplasmosis, nocardiosis (lung infection by nocardia), acute bronchitis, urinary tract infections, otitis media with good reasons.

Dose: Oral adult 960mg b.d increased to 1.44g in severe infections. 480mg if treated for more than 14 days. Child 6 weeks- 5 months, 120mg b.d, 6 months to 5 years 240mg b.d and 6-12 years 480mg b.d. in PCP high doses are required of 120mg/Kg body weight in divided doses for 14 days. Prophylaxis in children born to HIV positive mothers 240mg daily until status is known.

Side effects: As above

Contraindications: Pregnancy, children under 6 weeks, severe hepatic or renal insufficiency, blood dyscrasias and concomitant therapy with Allopurinol

Miscellaneous antibiotics

Chloromphenical

Presentation: capsule containing 250mg or injectable powder 500-1000mg per vial.

Indications: Typhoid fever, whooping cough haemophilus, meningitis and anaerobic infections. **Do not use for trivial infections**.

Dose: Adult; 250-500mg orally every 6 hours or IV 500-1000mg qid (poorly absorbed IM).

Side Effects: Aplastic anaemia, sensitisation, gastro-intestinal disturbances

Contra-Indications: Pregnancy, breast feeding, active immunisation

Nursing implications: observe patients for signs of anaemia and monitor blood indices.

Self Assessment Test: MATCHING ITEMS

Match the antibiotic drugs in Column I with their classification in Column II

Column I Column II

1. ……. Amoxicillin A. Macrolide
2. …… Ciprofloxacin B. Penicillin
3. …… Erythromycin C. Tetracycline

D. Quinolone

E. Quinolone

ANSWERS:

1. B
2. D
3. A

4.6 Antiviral Agents

Viral infections are usually self-limiting and resolve on their own and do not require specific therapy. In this discussion the focus is on drugs that are used in Herpes simplex, varicella zoster infections and Cytomegalovirus (CMV).

Mechanism of action
The drug belongs to Nucleoside Analogue DNA Polymerase Inhibitors that inhibit the synthesis of viral DNA. It is activated by conversion to monophosphate following phosphorylation of the drug by herpes thymidine kinase. The monophosphate is then converted to a triphosphate derivative by other intracellular enzymes. The triphosphate derivatives are potent inhibitors of viral DNA polymerase and results into termination of DNA synthesis and thus inhibit viral replication.

Take Note 4.1

Drugs used in HIV/AIDS management will be discussed separately at a later stage.

Examples of antiviral drugs

Acyclovir

Presentation: tablet containing 200mg, 400mg, 800mg. Infusion vial containing 250mg and 500mg. Sugar free suspension containing 200mg/5ml, 400mg/5ml. Cream containing 5% in 2g and10g tube. An eye ointment containing 3% 4.5g tube.
Indications: Herpes simplex and varicella zoster.
Dose: Oral- Herpes simplex 200mg (400mg in immune compromised or impaired absorption 5 times daily for 5 days, child under 2 years half adult dose). Prevention of recurrence 200mg 4 times daily or 400mg b.d and interrupted every 6-12 days. For Prophylaxis in immune compromised 200mg-400mg 4 times daily.Varicella and herpes zoster treatment 800mg 5 times daily for 7 days, child 20mg/Kg 4 times daily for 5 days.
For IV infusion give over an hour in herpes simplex and varicella zoster 5mg/Kg every 8 hours.
Side effects: Rashes, GIT disturbances, rise in bilirubin and liver enzymes, increase in blood urea and creatinine, decreases in haematological indices, neurological reactions such as dizziness, convulsions and psychosis.
Caution: maintain hydration, renal impairment, pregnancy and breast-feeding.
Other drugs in this group include Valacyclovir and Idoxuridine.

Nursing implications

i. Advise patient to add baking soda to the bath water to relieve pruritis
ii. If given IV, monitor the insertion site for oedema or pain.
iii. Assess patient's hydration status as diaphoresis may be serious side effect.

Gancyclovir

The drug is related to acyclovir but more active against CMV and is also more toxic and therefore it is only to be given when benefit outweighs risk.

Presentation: Capsule containing 250mg and IV infusion powder containing 500mg.
Indication: life and sight threatening CMV infections in the immune compromised individuals.
Dose: by IV over an hour induction 5mg/Kg every 12 hours for 14-21 days. 7-14 days for prevention, maintenance dose 6mg/Kg for 5 days per week
Side effects: Leucopenia, thrombocytopenia, less frequent anaemia, fever, rash, infections, GIT haemorrhage, dizziness.
Caution: Monitor closely blood counts, history of cytopenia.
Nursing implications: As for acyclovir

Agents that inhibit the transcription of the viral genome are DNA polymerase inhibitors and reverse transcriptase inhibitors. Protease inhibitors inhibit the post-translational events. Other antiviral agents inhibit the virus from attaching to or penetrating the host cell. Immunomodulators induce production of host cell enzymes, which stop viral reproduction. Integrase strand transfer inhibitors prevent integration of the viral DNA into the host DNA by inhibiting the viral enzyme integrase. Neuraminidase inhibitors block viral enzymes and inhibit reproduction of the viruses. Now procced to take the following activity.

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Acyclovir is active against HIV virus ….

2. Antiviral drugs are effective against all starins of virus …..

ANSWERS:

1. F

2. F

4.7 Antifungals

Antifungal drugs are used to treat infections caused by fungus and to prevent the development of fungal infections in patients with weakened immune systems.
A fungus is a living organism that can cause infection when it grows in the human body. In healthy people, fungal infections tend to be mild and treatable. For cancer patients, however, fungal infections can become severe and must be treated quickly.

Common side effects of antifungals

Antifungal drugs that are applied topically rarely cause side effects unless the patient is allergic to the drug. Side effects are more common when drugs are taken orally or intravenously. The most common reactions from azole drugs are nausea, diarrhoea and other gastrointestinal symptoms. These symptoms usually affect less than 10% of patients. Caspofungin also produces few side effects. The most common side effect is a rash.

Treatment

The nature of treatment depends on two important factors. These are:

1. Type of fungus
    - A mould- is a fungus that grows in the form of multicellular filaments called hyphae. Moulds are a large.
    - Yeast- any of various small, single-celled fungi of the phylum Ascomycota that reproduce by fission or budding, the daughter cells often remaining attached
    - Dimorphic- fungi which can exist as mould filamentous form or as yeast.
2. The location of the infection- nails, hair, skin or systemic fungal infection which is an indication of serious immunologic compromise.

In treatment of superficial fungal infections, it is generally recommended that oral medication should be supplemented with topical antifungal cream or ointment in order to achieve better results and treatment to minimum of four to six weeks.

Antifungals are classified as

i. Polyene
ii. Imidazole
iii. Triazole/azoles
iv. Penicillin derived
v. Fluorinated pyrimidine derivatives
vi. Others e.g Echinocandins

Polyenes

Polyenes are drugs that work by attaching to the sterol component found in the fungal membrane, causing the cells to become porous and die. The two polyenes most commonly used are nystatin (Mycostatin) and amphotericin B (Fungizone).

Examples of polyene antifungal

Nystatin

It is often used as a topical agent to treat superficial infections, or is taken orally to treat candidal infections such as oral or esophageal candidiasis. These drugs, called lipid formulations, cause fewer side effects than traditional amphotericin B.

Presentation: Oral suspension 100,000 units/ml

Indications: Oral Candidiasis, vaginal candidiasis

Doses: Adults; by mouth, intestinal candidiasis 500,000 units every 6 hours doubled in severe infections

Child; 100,000 unit's qid

Vaginal pessaries 100,000 units: two tablets inserted vaginally daily for two weeks

Side effects: Nausea, vomiting, diarrhoea with high doses

Contra-Indications: Sensitisation

Nursing Implication/considerations

i. Monitor vital signs every 15-30 minutes during first infusion and note changes in pulse and blood pressure.
ii. Monitor blood studies Hb, Hct, K, Na Ca, and Mg every two weeks.
iii. Monitor weight of the patient weekly, as oedema is likely to ensue
iv. Monitor for renal toxicity; increase in BUN and creatinine and if BUN is >40mg/dl or if creatinine is >3mg/dl drug may be stopped or reduce dosage.
v. Monitor for Hepatoxicity; increasing AST/ASL alkaline phosphatase and bilirubin
vi. Monitor for allergic reactions; dermatitis, rash, drug should be discontinued.

Imidazole Antifungals

This group includes clotrimazole, econazole. Isoconazole, ketaconzole and tioconazole. They have active against a wide range of fungi and yeasts. Their major indication is in the treatment of vaginal candidiasis and dermatophyte infections.

Clotrimazole
Presentation: Pessaries containing 100mg, 500mg. Lozenges 1%, Cream 1%, topical 505, vaginal cream 1%, lotions 1% and solutions 1%.
Indications: vaginal and vulval candidiasis
Dose: Insert 2 pessaries at night for 3 nights, oral pessaries for 6 nights. For oral drops after meals 3 times and for fungal dermatosis apply twice daily.
Side effects: Occasional local irritation.
Caution: Antibiotic therapy, oral contraceptives, pregnancy, diabetes mellitus may affect the clinical effectiveness of clotrimazole.
Contraindications: Hypersensitivity.

Ketoconazole

Presentation: Tablet containing 200mg, suspension containing 100mg/5mls.
Indications: Systemic mycosis, serious chronic resistant mucocutanous candidiasis, serious GIT mycosis, resident dermatophyte of the skin and finger nails (not for toes).
Dose: Adult 200mg o.d daily with food usually for 14 days. If response is poor after 14 days continue until at least 1 week after symptoms have cleared and culture becomes negative. Maximum dose 400mg daily. Child: 3mg/Kg body weight. In chronic vaginal candidiasis 400mg daily with food for 5 days.
Side effects: Nausea, vomiting, abdominal pain, rashes, urticarial, thrombocytopenia rarely, gynaescomatia, fatal liver damage if given more than 14 days.
Caution: Monitor LFT's, avoid in porphyria and pregnancy
Contraindications: Liver impairment.

Nursing Implications

i. Assess for signs and symptoms of infection; drainage, sore throat, urinary pain, haematuria and fever.
ii. Obtain cultures for sensitivity tests before beginning treatment.
iii. Monitor for Hepatoxicity; increased AST, ALT, alkaline phosphatase, bilirubin, drug is discontinued if hepatotoxicity occurs.

Triazole/Azoles Antifungals

This group includes fluconazole and itraconazole which are absorbed by mouth. They are indicated for the treatment of local and systemic candidiasis and cryptococcal infections, also indicated in the treatment of aspergillosis and histoplasmosis.

Fluconazole

Presentation: Capsules containing 50mg, 150mg and 200mg. Suspension containing 50mg/5mls, 200mg/5mls. IV infusion containing 2mg/ml.
Indications: acute and recurrent vaginal candidiasis, tinea pedis, mucosal candidiasis, corporis cruris and dermal candidiasis, systemic candidiasis, cryptococcal infections including meningitis.

Used also in the prevention of cryptococcal meningitis in AIDS, in immune-compromised patients after cytotoxic treatment or radiotherapy.
Dose: Vaiginal candidiasis single dose 150mg, mucosal candidiasis 50-100mg for 7-14 days. Tinea pedis, corporis cruris and dermal candidiasis oral 50mg for 2-4 weeks.
In systemic candidiasis infusion 400mg initially then 200mg daily and continued according to patient response. In cryptococcal meningitis 800mg daily. Child over 1 year oral or IV 2mg/Kg body weight. Systemic and life threatening infections 3-6mg/Kg body weight and can be increased up to 12mg/Kg body weight in child aged 5-13 years.
Caution: Renal impairment, pregnancy, breastfeeding, children (only if no alternative), raised liver enzymes.
Side effects: Vestibular and auditory damage, nephrotoxicity, antibiotic associated colitis, nausea, vomiting, rash.
Contraindications: Child under 1 year.

Nursing Implications

i. Assess for signs and symptoms of infection: clearing of CSF culture during treatment, obtain culture and sensitivity baseline and during treatment.
ii. Monitor for hepatotoxicity; increased AST and ALT, alkaline phosphatase, bilirubin, drug may be discontinued if toxicity occurs.

Penicillin Derived Antifungals

In this group is Griseofulvin and other drugs are selectively concentrated on keratinized tissue. This makes Griseofulvin to be the drug of choice for widespread or intractable dermatophyte infection. It is well absorbed by mouth but inactive when applied topically.

Griseofulvin

Presentation: Tablet containing 125mg, 500mg. Suspension containing 125mg/5mls.
Indications: Treatment of ringworm infections of the skin, hair, nails namely tinea corporis, tinea pedis, tinea cruris, tinea barbae, and tinea capitis.
Dose: Adult 500mg daily in divided doses or as a single dose. Child 19mg/Kg body weight in divided doses or as a single dose.
Side effects: Headache, nausea, vomiting, rashes, photosensitivity, dizziness, fatigue, agranulocytosis, leucopenia, lupus erythematous, toxic epidermal necrolysis, peripheral neuropathy, confusion and impaired coordination.
Caution: In breastfeeding, enhances the effects of alcohol and may impair performance of skilled tasks for example driving.
Contraindications: Hypersensitivity, hepatocellular failure, lupus erythematosis, and in pregnancy.
Nursing Implications

i. Administer the drug with high fat meal.
ii. Monitor INR Warfarin effectiveness may be compromised.

Fluorinated Pyrimidine Derivative Antifungals

These include flucytosine. This is a synthetic drug which is only active against yeast and has been used for the treatment of systemic candidiasis, crptococcosis and toruplopsosis.

Flucytosine

Indications: Systemic yeast and fungal infections and as an adjunct to amphotericin, cryptococcal meningitis.
Dose: By IV oner 20-40 minutes adult and child 200mg/Kg daily in 4 divided doses usually for not more 7 days. In extremely sensitive organism100-150mg/Kg daily and treat for at least 4 months in cryptococcal meningitis.
Side effects: Rare but may have nausea, vomiting, diarrhoea, rashes, less frequently confusion, hallucinations, convulsions, headache, sedation, vertigo, altered liver function tests, blood disorders including thrombocytopenia and aplastic anaemia.
Caution: Renal impairment, elderly, blood disorders, pregnancy and breastfeeding.

Nursing implications

i. Evaluate haematologic profiles before each dose.
ii. Do not crush tablet.
iii. Inform patient to fall pregnant while taking the drug.

OTHERS

Echinocandins

Echinocandins are a new class of antifungal drugs that work by disrupting the wall that surrounds fungal cells. Caspofungin (Cancidas) is the first of this new class of drugs to be approved. It is an effective treatment for severe, systemic fungal infections, and is given to patients who do not respond to other therapies.

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Cotrimoxazole is a potent antifungal ….
2. Antifungals are derived from a variety of substances …..
3. Diflucan is the other name for Fluconazole …….

ANSWERS:

1. F
2. T
3. T

4.8 Antiprotozoa

Protozoan infections are parasitic diseases formerly classified in the Kingdom Protozoa.

They include organisms Entamoeba histolytica, Plasmodium (some of which cause malaria), and Giardia lamblia Trypanosoma brucei, transmitted by the tsetse fly and the cause of African sleeping sickness, and Amoebozoa, Excavata.

Protozoa are eukaryotes and unicellular organisms, and they have metabolic processes similar to those of human host than procaryotic bacterial pathogens.

They are single celled beings, which also cause diseases in humans, which can be mild to life threatening.

The most common diseases caused by protozoa are: Malaria, Amoebiasis,Sleeping Sickness,Toxoplasmosis and Trichomoniasis

Anti-Protozoal drugs are medicines or drugs used to treat infections or diseases caused by Protozoa. These drugs destroy protozoa or prevent their growth and ability to reproduce. They are available in liquid, tablet, and injectable forms. These drugs are to be taken only with a doctor's prescription.

The commonly used antiprotozoal drugs are metronidazole (Flagyl), eflornithine (Ornidyl), furazolidone (Furoxone), hydroxychloroquine (Plaquenil), iodoquinol (Diquinol, Yodoquinol, Yodo.

Metronidazole

Metronidazole is active against a wide range of pathogenic micro-organisms notably species of bacteroidea, clostridia, anaerobic cocci, gardnerella vaginalis,trachomonas,entamoeba hystolytica and giardia lambila

Mechanism of action: It penetrates the protozoan cell where the intro group is reduced to a hydroxyl or amine group which reacts with the DNA and stops nucleic acid synthesis.

Presentation: Tablet containing 200mg, 400mg or suspension containing 200mg/5ml. IV infusion contains 500mg/100ml, Suppositories containing 500mg.

Indications: Treatment of all forms of amoebiasis, trachomonas vaginalis, balantidis leishmaniasis, and giardiasis, acute dental pericoronitis. It is also used for post-operative infection.

Treatment of malaria

Malaria is acknowledged to be by far the most important tropical protozoal parasitic disease, causing great suffering and loss of life.

More than two billion people, nearly 40% of the world's population are at risk.

The major load of morbidity and mortality due to malaria is borne by young children before they have developed certain degree of immunity to the disease.

The treatment of malaria has to keep pace with the evolution of resistance acquired by malarial parasites.

Examples of antimalarial drugs

Artemether-Lumefantrine (coartem)

Presentation: tablet containing 20mg artemether and 120mg lumefantrine
Action: the drug interfers with conversion of haem, a toxic intermediate produced during haemoglobin breakdown to non-toxic haemozoin malarial pigment. Lumefantrine interferes with the polymerisation process while artemether generates reactive metabolites as a result of interaction between its peroxide bridge and haem-iron. Both drug elements inhibit nucleic acid and protein synthesis with the malarial parasite. In short the drug is a blood schizonticide.

Indications: malaria caused by plasmodium falciparum.

Table 5: Dosage of coartem

Dose: WEIGHT	IMMEDIATE	AFTER 8 HOURS	DOSE NEXT DAY	DOSE DAY 2	COARTEMÂ (A + L)/ DOSE	TOTAL TABLETS
>35Kg	4	4	4 BD	4 BD	80mg A + 480mg L	24
25-24Kg	3	3	3BD	3 BD	60mg A + 360mg L	18
15-24Kg	2	2	2 BD	2 BD	40mg A + 240mg L	12
10-14Kg	1	1	1 BD	1 BD	20mg A + 120mg L	6
<10Kg	<1	Not recommended	N/A	N/A	N/A	N/A

Side effects: anorexia, sleep disorders, headache, dizziness, palpitations, cough, vomiting, diarrhoea, rash, arthralgia, increased LFTs, and hypersensitivity.

Caution: not to be used in cerebral malaria, malaria prophylaxis, and other types of malaria

Contraindication: hypersensitivity, severe malaria, first trimester of pregnancy, those taking drugs that affect the QT wave, disturbed electrolyte balance.

Nursing implications

i. Give drug with fatty foods
ii. For those unable to swallow tablets (infants, children), tablets may be crushed and mixed with a small amount of water.
iii. If vomiting occurs within 1–2 hrs after administration, a repeat dose should be taken. If the repeat dose is vomited, give the client an alternative anti-malarial drug.
iv. Store tablets from 15–30°C (59–86°F).

Fansider (Sulfadoxine-Pyrimethamine (SP)

Presentation: Tablet containing 500mg sulfadoxine and 25mg pyrimethamine.

Action: Inhibits folic acid metabolism in the parasite, and prevents transmission by stopping growth of the fertilized gametes. It is a schizonticide.

Indication: Used in prevention of malaria antenatally (Intermittent Presumptive Treatment (IPT).
Dose: 3 tablets after 16 weeks of gestation, 3 tablets after 4 weeks and finally 3 tablets after another 4 weeks in the second and third trimester respectively.
Side effects: Cutaneous reactions (Stevenson Johnson Syndrome), toxic epidermal necrolysis, nausea, vomiting, and stomatitis.
Caution: Blood dyscrasias, seizures, disorders, G6PD, hepatic, renal diseases
Contraindications: Hypersensitivity, and hepatic dysfunction
Nursing interventions

i. Monitor serum uric acid which may be elevated and cause gout symptoms.
ii. Monitor liver function weekly- AST, ALT, decreased appetite, hepatic status etc.
iii. Monitor renal before therapy and month after month.
iv. Monitor mental status- affect, mood and behavioural changes.

Quinine

Presentation: Tablet (coated) containing 200 and 300mg, injection containing 150mg, 300mg/2mls.
Action: Inhibits parasite transcription of DNA to RNA by forming complexes with DNA of parasite. Ultimate effect schizonticide.
Indications: Plasmodium falciparum malaria
Dose: Adult 600mg every 8 hours for 5-7 days. IM 10mg/Kg diluted in saline or water for injection repeated after 4 hours then 8 hourly. IV loading dose 20mg/Kg body weight adult dose over 4 hours in half litre dextrose 5% with resting period of 4 hours then 10mg/Kg 8 hourly in half litre Dextrose 5% over 4 hours. Children 10mg/Kg body weight diluted in saline or water for injection.
Side effects: Tinnitus, headache, hot and flushed skin, nausea, abdominal pains, rashes, visual disturbance, confusion, hypersensitivity, thrombocytopenia, intravascular coagulation, acute renal failure, hypoglycaemia.
Caution: Atrial fibrillation, conduction defects, heart block, G6PD deficiency.
Contraindications: Hypersensitivity to quinine, G6PD deficiency, optic neuritis, thrombocytopenic purpura, tinnitus
Nursing interventions

i. Monitor BP, pulse and watch for hypotension and tachycardia.
ii. Assess liver function weekly AST, ALT, bilirubin.
iii. Blood studies need to be done
iv. Assess for cinchonism: nausea, blurred vision, vomiting, tinnitus, headache etc.
v. Educate the patient on visual changes that may occur as he/she is medication.
vi. Teach patient to insect repellents and ITNs.

Other antimalarial drugs used for treatment and prophylaxis

Amodiaquine

Presentation: Tablet containing 200mg and 600mg and 600mg amodiaquine base as HCL or 153.1mg base as chlorohydrate. Suspension containing 10mg/ml base.
Indication: Treatment of uncomplicated malaria.
Dose: 25-35mg base/Kg body weight over 3 days for both children and adults.
Side effects: Leucopenia, agranulocytosis, nausea, vomiting, abdominal pains, diarrhoea, itching.
Contraindications: Hepatic disorders, hypersensitivity. Not recommended for prophylaxis.

Proguanil

Action: Inhibits plasmodial dihydrofoliate reductase mainly through its active metabolite. This inhibits folate production in both pre-erythrocytic and erythrocytic parasites. Usually given in combination with Chloroquine as prophylaxis
Presentation: Tablet containing 100mg
Indication: Chemoprophylaxis of malaria
Dose: 200mg once daily
Side effects: Mouth ulcer, epigastric discomfort, stomatitis, skin reactions and hair loss.
Caution: Renal impairment, pregnancy and foliate deficiency
Contraindications: Hypersensitivity

Primaquine

Action: Its intermediate act as oxidants that are responsible for schizonticidal action as well as for haemolysis and methemoglobinaemia encountered as toxicities.
Presentation: Tablet containing 26.2mg primaquine phosphate (1.5mg primaquine base).
Indications: Adjunct in the Rx to eliminate the liver stages of infestation of Plasmodium vivax and ovale.
Dose: Adult 15mg daily for 14-21 days; child 0.25mg/Kg body weight daily for 12-21 days. Given after treatment with other antimalarials.
Side effects: Nausea, vomiting, abdominal pain, haemolytic anaemia especially in G6PD deficiency.
Caution: G6PD deficiency, pregnancy, breastfeeding.
Contraindications: Patients undergoing quinacrine therapy, acutely ill patients with systemic diseases that present with agranulocytopenia (rheumatoid arthritis, lupus erythema).

Self Assessment Test: MATCHING ITEMS

Match the antimalarial drugs in Column I with their mechanism of action in Column II

Column I

1. ……. Co-artem
2. …… Quinine
3. …… Fansidar

Column II

A. Inhibits parasite transcription of DNA to RNA by forming complexes with DNA of parasite

B. This inhibits folate production in both pre-erythrocytic and erythrocytic parasites

C. Inhibits folic acid metabolism in the parasite

D. Inhibits the conversion of haem, a toxic intermediate produced during haemoglobin breakdown to non-toxic haemozoin malarial pigment

ANSWERS:

1. B
2. A
3. D

4.9 Antiseptics and Disinfectants

These drugs are primarily intended for the prevention of infections by destroying bacteria or preventing their growth. The differences among them are based primarily on degree of activity and how they are used; antiseptics suppress the growth of microorganisms and are used topically; ger-micides kill susceptible organisms; and disinfec- tants are agents used on inanimate objects and are primarily germicidal in their action.

All of these agents are for external use only unless other- wise indicated. Phenol (Carbolic Acid) Historically one of the first antiseptic agents used, phenol is the standard by which all other antiseptic, disinfectant, and germicidal agents are measured in their effectiveness. Because of its highly caustic nature, it must be handled with care. The effect of phenol is coincident with the concentration; high concentrations are germicidal and can cause tissue destruction; lower concentration are antiseptic. Phenol is inactivated by alcohol. Because more effective and less damaging agents have been

developed, phenol is no longer used extensively. Never use phenol to disinfect rubber, cloth, or plastic

You have come to the end of this topic. Let us now review what you have learnt and then do the activity that follow.

4.10 Summary

In this unit you were looking at classification of drugs. You further learnt on the importance of classifying drugs to enable you make accurate selection of drugs. Choosing the right class of drugs prevents development of drug resistance. I hope this session has prepared you to open up your mind and be able to make right drug selections for patients.

In the next unit you are going to learn about drugs acting on the gastrointestinal tract. However, drug classification continues but in this case on the drugs acting on the intestinal tract. I hope you will enjoy the topic. But before then, test your understanding of this unit by doing the following self-test.

4.11 Self Assessment Test

Identify two (2) more antiseptics and disinfectants you know and state their functions. Write your answers in your book.

Well done!

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UNIT 5: DRUGS ACTING ON THE INTESTINAL TRACT

5.1 Introduction

Welcome to yet another interesting unit. In the previous topic you learnt about drug classification and the importance of knowing the classes. In this unit you will learn about drugs acting on the gastrointestinal tract. Drug classification however continues but in this case on the drugs acting on the intestinal tract. I urge you pay special attention to the topic so that your choice of drug selection may help patient suffering from various gastrointestinal tract (GIT) problems.

5.2 Objectives

By the end of this unit you should be able to describe and give examples of the following drugs that act on the intestinal tract

1. Antiacids
2. Emetics
3. Anti-emetics
4. Anticholinergic agents
5. Laxatives and Purgatives
6. Anti-diarrheals
7. Suppositories
8. Rectal infusions
9. Antihelminthics
10. Drugs used in the treatment of Schistosomiasis

5.3 Antiacids

Activity 5.1

Which drugs do you think act on the GIT to relieve any GIT problems? Write down you suggested answers in your note book then compare your answers to the notes in the module.

You have done very well. Keep it up.

Well, these are drugs that are used to treat conditions/infections of the gastro intestinal tract (GIT) after the cause has been isolated. There are many agents that can be used

to manage GIT conditions/infections some of which are; antiacids, emetics, antiemetics, laxatives and anticholinergics.

These are drugs which work by neutralizing gastric acid to relieve pain caused by hyperacidity in cases of peptic ulcer, gastritis and oesophagitis.

Absorbable antacids such as sodium bicarbonate raise the alkalinity of the blood when taken frequently and may cause renal damage with an excessive milk intake. Non-absorbable antacids are preferable. These include aluminum and magnesium hydroxide and magnesium trisilicate.

They are best given when symptoms occur or are expected, usually between meals and at bedtime, four or more times daily; additional doses may be required up to once an hour to reduce gastric acidity throughout the day.

Antacids should not be given at the same time with drugs like tetracycline, chloroquine and rifampicin as they may impair their absorption.

Action

They work by neutralizing some of the excess gastric acid and by increasing the gastric pH, they diminish the activity of pepsin in the gastric secretion. In this way further erosion of the mucosa membrane on the ulcer is inhibited.

Properties of good antiacids

They must be insoluble and neutral in aqueous solution but capable of neutralizing the acid. They must work rapidly, effective and maintain their effectiveness and their effects for several hours. They should not be able to disturb the acid-base balance of the blood and cause alkalosis or make the urine alkaline with the danger of causing calculi (stone) in the urinary tract. They must be Non-irritant to the stomach and intestines and not cause diarrhoea and constipation. They should not produce acid rebound.

Examples of antiacids

Aluminium hydroxide

Presentation: Tablet chewable 500mg, Mixture 250mg/5ml, Gel 4% of aluminum oxide

Indication: Hyperacidity, peptic ulcers

Dose: Chew 1-2 tablets half an hour before and after meals or 2-3 teaspoonful (Mixture: 10-20 mls) repeated as required.

Side effects: Constipation

Caution: Impaired renal function

Nursing implications

1. Assess pain symptoms, location duration, intensity, alleviating and precipitating factors.
2. Monitor constipation and increase bulk in diet if needed.

Magnesium hydroxide

Presentation: Tablet containing 250mg Mg and dried Ag120mg. A mixture of 10mls containing Mg trisilicate 500mg, sodium bicarbonate 500mg, concentrated peppermint emulsion 0.25ml double strength chloroform water 5ml

Indications: Hyperacidity, peptic ulcer and constipation in infants

Dose: Adult**:** 10 to 20 ml/dose. Infants: 0.5ml/kg dose

Side-Effects: Diarrhoea

Caution: Impaired

Nursing implications

1. Assess intake and output and check for decrease in urine output.
2. Assess Mg toxicity; thirst, confusion and decrease in reflexes.

Magnesium trisilicate (MMT)

Presentation: Compound tablets and mixture; MMT 250mg, aluminium hydroxide 120mg.

Action: Reduces total acid load in GIT. It also reduces pepsin activity which increases gastric Ph and Strengths gastric mucosa barrier

Indications: Hyperacidity, peptic ulcer

Dose: 1-2 tablets chewable as required, mixture 10-20mls as required.

Side effects: Diarrhoea

Nursing implications: With prolonged use and renal impairment, watch for symptoms of hypermagnesia (hypotension, nausea, vomiting, depressed reflexes, respiratory depression and coma).

H2-Receptor Antagonists

They inhibit histamine H2 receptors of the gastric parietal cells, resulting in reduced gastric acid secretion, gastric volume, and hydrogen ion concentrations and prevent the increase that occurs in response to a number of secretory stimuli. They reduce acid secretion by about 60%.

Nursing implications for H2-Receptor Antagonists

1. Assess patient with ulcers or suspected ulcers. Epigastric or abdominal pain, haematemesis, occult blood I stool, blood in gastric aspirate before and throughout treatment.
2. Monitor intake and output ratio, BUN, creatinine, FBC periodically

Examples of H_2- receptor antagonists

Cimetidine (Tagamet)

Presentation: Tablet s containing 200mg, 400mg, 800mg. Syrup/suspension containing 200mg/5mls Injection containing 100mg/ml.

Action: Selective inhibitor of histamine induced gastric acid secretion.

Indication: Gastric and duodenal ulcerations, and Zollinger-Ellison Syndrome

Dose: 400mg mg b.d/tid p.o., I.M. or I.V.or 800mg nocte

Side Effects: Diarrhea, dizziness, rash.

Contraindications: Hypersensitivity

Ranitidine (Zantac)

Presentation: Tablet containing 150mg, 300mg. Oral solution containing 75mg/ml, injection containing 25mg/ml and effervescent tablet containing 150mg, 300mg.

Action: Competitively inhibits histamine at the H2 receptors of gastric parietal cells, resulting in reduced gastric acid secretion, gastric volume, and reduced hydrogen concentrations.

Dose; 150 mg PO bid or 300 mg PO qhs; not to exceed 300 mg/day 50 mg/dose IM/IV, 6 – 8 hrly

<12 years: Not established

>12 years: 1.25-2.5 mg/kg/dose PO 12hrly; not to exceed 300 mg/day

0.75-1.5 mg/kg/dose IV/IM, 6 – 8hrly; not to exceed 400 mg/day

Side effects: Vertigo, malaise, blurred vision, jaundice, leucopenia

Contraindication: Hypersensitivity

Take Note 5.1

Drug interaction may decrease effects of ketoconazole and itraconazole; may alter serum levels of ferrous sulphate and diazepam

Proton Pump Inhibitors

Mechanism of action

Since the proton pump is the final pathway for acid secretion in the gastric parietal cells, inhibition of the pump can completely block acid secretion. Proton pump inhibitors are irreversible inhibitors of H^+/K^+- ATPase.

They relieve symptoms of active duodenal ulcers. Physicians may prescribe for up to 8 weeks to treat all grades of erosive esophagitis

Side effects of proton pump inhibitors

i. GIT upset such as epigastric discomfort, nausea, vomiting and diarrhoea.
ii. Headache
iii. Skin rashes
iv. Gastric atrophy with prolonged use.

Nursing implication for proton pump inhibitors

i. Assess GIT system, bowel sounds and abdominal pains and swelling and anorexia
ii. Monitor hepatic enzymes for example, AST, ALT and increased alkaline phosphate during treatment.
iii. Advise patient to report severe diarrhoea of which drug may be discontinued.

Examples of proton pump inhibitors

Omeprazole

Presentation: Capsule containing 10mg, 20mg, 40mg enteric coated granules. Tablet containing 10mg, 20mg and 40mg. IV infusion containing 40mg and IM injection containing 40mg.

Indications: Gastric and duodenal ulcers. NSAIDs associated gastric and duodenal ulcers, duodenal erosions and prophylaxis in patient with the above.

Dose: Oal 20mg for both gastric and duodenal ulcers od for 4 weeks in duodenal and 8 weeks in gastric ulcerations. Increase dose in severe or recurrent to 40mg and maintenance dose of 20mg od. In duodenal ulcers associated with helicobacter pylori 20mg, gastric ulcer associated with helicobacter pylori 40mg daily.

Side effects: GIT disturbances, headache, hypersensitivity, pruritus, dizziness, peripheral oedema, muscle and joint pains, malaise, blurred vision, depression and dry mouth. Increased risk of GIT infection due to decreased acidity.

Caution: Liver disease, pregnancy, and breastfeeding, in suspected liver cancer as these mask the symptoms

Esomeprazole

Presentation: Tablet containing 20mg, 40mg esomeprazole magnesium trihydrate.

Indications: Duodenal ulceration associated with helicobacter pylori, gastro-oesophageal reflux disease.

Dose: Duodenal ulcers associated with helicobacter pylori 20mg bd daily. In gastro-oesophageal reflux disease 40mg o.d for 4 weeks followed by further 4 weeks if symptoms persist.

Side effects: GIT disturbances, headache, hypersensitivity, pruritus, dizziness, peripheral oedema, muscle and joint pains, malaise, blurred vision, depression and dry mouth. Increased risk of GIT infection due to decreased acidity.

Caution: Lliver disease, pregnancy, and breastfeeding, in suspected liver cancer as these mask the symptoms

Other drugs in the class include Lansoprazole, Pantoprazole and Rabeprazole

Self-Assessment test: TRUE OR FALSE: Indicate the true or false to the following statements.

1. One of the modes of action of anti-acids is to inhibit the gastric acid secretions.
    a. Visual disturbance is not a side effect of Esomeprazole drug.
    b. Hypersensitivity ia a contraindications to the drug Cemetidine
    c. Esomeprazole belongs to a group of drugs called' proton pump inhibitors'.

ANSWERS

1. T
2. F
3. T
4. T

5.4 Emetics

They are drugs that induce vomiting and are divided into 2 groups.

i. **Reflex emetics:** These induce vomiting by irritating the stomach for example warm salt water, mustard one tea spoon to one pint of warm milk.

ii. **Central emetics:** These induce vomiting by irritating the vomiting centre (chemorecepter trigger zone) direct in the brain for example apple morphine (No analgesic effect).

Note that they are rarely used.

Indications

i. In poisoning when gastric lavage is not possible (Avoid in corrosive chemicals)
ii. Acute indigestion due to excessive constipation of food.
iii. Classified as local irritants, reflex emetics (producing vomiting reflexes) and central emetics (chemoreceptor trigger zone)

Take Note 5.2

Inducing vomiting is not recommended practice especially in cases of ingestion of corrosive chemicals and petroleum products due to increased risks of aspiration leading to chemical pneumonia

Self- Assessment test: MCQ

Choose the most appropriate answer

1. The following drugs are used for treatment of nausea and vomiting
    a. Promethazine (phenergan)
    b. Metoclopromide (plasil, maxolon)
    c. Omeprazole
    d. Chlopromazine (lagactil),
    e. Prochlorperazine
2. The difference between the reflex and central emetics is that.....
    a. Reflex emetic indulce vomiting by irritating the vomiting centre
    b. Reflex emetics indulces vomiting by irritating the stomach
    c. Central emetics indulce vomiting by irritating the stomach
    d. Central emetics indulce vomiting by irritating the nerves

ANSWERS

1. C
2. B

5.5 Antiemetics

These are drugs (agents) that prevent or relieve nausea and vomiting that can result from various factors as indicated below:

i. Surgery
ii. Vestibular disorders
iii. Poisoning

Mechanism of action

Phenothiazine derivatives are dopamine antagonists and act centrally by blocking the chemoreceptor trigger zone.

Antiemetics should be prescribed only when the cause of vomiting is known particularly in children. Otherwise the symptomatic relief that they produce may delay or mask diagnosis.

Examples of antiemetic drugs

Metoclopromide (Plasil, Maxolon)

Is an effective antiemetic and has positive effect on gastrointestinal motility and gastric peristalsis is increased leading to an increase in the gastric emptying rate.

Mechanism of action

Blockade of dopamine receptors centrally on the chemoreceptor trigger zone (a part of the brain which when stimulated by neurotransmitter dopamine evokes vomiting).

Indications: Nausea and vomiting, particularly in gastro-intestinal disorders or during treatment with cytotoxic drugs

Presentation: tablets 5mg and 10mg, Mixture 5mg/ml and Injection 5mg/ml

Dose: Adult; 10mg tid before meals or 10mg IM or IV, 10mg t.i.d 1-2 min after vomiting, 5mg t.i.d in young adults (15-19yrs)

Children up to 1yr (up to 10kg) 0.5mg t.i.d.

1-3yrs (10-14kg) 1mg t.i.d

3-5yrs (15-19kg) 2mg 2-3 times daily

5-9yrs (20-29kg) 2.5mg t.i.d

9-14yrs (30kg and above) 5mg t.i.d

Side effects

i. Extrapyramidal symptoms especially in children.
ii. Mutism
iii. Hypokinesia
iv. Tardive dyskinesia (involving movements)
v. Chewing,tongue protrusion,tremors of limbs
vi. Drowsiness
vii. Diarrhoea, constipation, drowsiness, nystagmus.

Contraindications: Pregnancy, undiagnosed nausea and vomiting especially in children and young adults.

Nursing implications

i. Never the mix the drug with penicllins, sodium bicarbonate, cephalosporins and calcium gluconate due to imcompatibility.

ii. Assess for extrapyramidal effects such tardive dyskinesia, rigidity, grimacing, shuffling gait etc.

iii. Assess mental status for symptoms of depression, anxiety and irritability during treatment

Phenothiazines

Drugs which include chlopromazine (lagactil), prochlorperazine, trifluoperazine, perphenazine, are used for symptomatic relief of nausea from underlined disease.

Mechanism of action

Phenothiazines are dopamine antagonists and act centrally by blocking the chemoreceptor trigger zone. They are of value for prophylaxis and treatment of nausea and vomiting associated with cancer diseases, radiation sickness emesis, cytotoxic and genaral anaesthetics.

Nursing implication s for phenothiazines

i. Assess respiratory status that is rate, rythym, increase in bronchial secretions, wheezing, chest tightness and provide fluid 1-2ltr /day to decrease secretion thickness.

ii. Monitor intake and output and look out for urinary retention.

iii. Monitor full blood count (FBC) during long term therapy as blood dyscrasia may occur.

Examples of phenothiazines

Promethazine (Phenergan)

Presentation: Tablet containing 10mg, 25mg and injectable containing 5mg/5**mls**

Action: As above but also acts as an antihistamine, antiemetic and sedative

Indication: Various allergic conditions, nausea, and vomiting

Dose: 25 - 75 mg p.o., I.M. every 4-6 hours, 25 mg I.V.

Side Effects: Dry mouth, blurred vision, drowsiness

Contraindications: Liver Disease

Self-test questions: MCQ: Choose the most appropriate answer

1. The anti-emetic drugs are useful medications which are commonly used in all of the following conditions except.....
   a. Nausea and vomiting
   b. Allergic conditions
   c. Liver disease
   d. During treatment with cyto toxic drugs

2. All of the following are side effects of promethazine except.....
    a. Dry mouth
    b. Drowziness
    c. Blurred vision
    d. Joint pains

ANSWERS

1. C
2. D

5.6 Anticholinergic Agents

These drugs are **anti-spasmodic** and are used in combination with anti-acids to treat peptic ulcers. Anti-spasmodic drugs reduce spasms of gastrointestinal tract muscles. Their use in the treatment of peptic ulcers is not helpful unless in large doses.

Mechanism of action

These drugs reduce gastric secretions and mortality by blocking the action of parasympathetic nervous system and largely dependent on the stimulation of parasympathetic nerve which controls the motility of the gastrointestinal tract.

Side effects of anti-cholinergics

i. Dry mouth
ii. Dilatation of pupils
iii. Blurred vision
iv. Heart palpitation
v. Dry skin
vi. Dizziness
vii. confusion
viii. constipation
ix. urinary retention

Nursing implications for anticholinergics

i. Atropine should never be given to patients with intraocular lenses.
ii. Monitor intake and output and be particular with urinary retention.
iii. Monitor ECG for ectopic ventricular beats.
iv. Monitor bowel sound and note constipation and abdominal distension as possible outcomes when on these drugs.

Examples of anticholinergics

Atropin

Presentation: Injection containing 0.05, 0.1, 0.3, 0.4, 0.5, 0.8 and 1mg/ml.
Action: As above

Indication: Used for patient with irritable bowel syndrome and dysphasia.
Dose: IM 0.4 – 0.6mg, qid in adults, 0.01mg/kg in children, 4 – 6 times/day.
Side effect: Headache, hypotension, dry mouth, GIT disturbances, anorexia, vomiting and diarrhoea. Dry mouth, low urine output, dry eyes.
Caution: Renal disease, gastric ulcers, hyperthyroidism etc.
Contraindications: Hypersensitivity to belladonna alkaloids, GIT obstruction, asthma etc.

Buscopan (hyosine bromide)

Presentation: Tablet containing 10mg or injection containing 20mg/ml
Indication: Gastrointestinal spasms
Dose: When used in diagnostic purposes like in endoscopy adult 20mg qid; children 10mg tid**.** Dose in patients with acute spasms of gastrointestinal spasms is given 20mg IV.
Side effects: Drowsiness, dry mouth, dizziness, blurred vision, difficulty in micturation.
Caution: Elderly, urinary retention, cardiovascular disease, gastrointestinal obstruction, hepatic and renal impairment, porphyria and breastfeeding.
Contraindications: Closed angle glaucoma, hypersensitivity, and children under 6 years because they are more sensitive to it.

Other drugs in the group include probantine bromide, methoscoplolamine bromide

Self-Assessment test: MCQ: Choose the most appropriate answer

1. All of the following are side effects of anti-cholirnergic drugs except.....
    a. Confusion
    b. Constipation
    c. Urinary retention
    d. Yellowish stools
2. Which one of the following is the contra-indication to hyoscine bromide?
    a. Glaucoma
    b. Gastro-intestinal spasms
    c. Achalasia
    d. Childern above 6 years

ANSWERS

1. D
2. A

5.7 Laxatives and Purgatives

Laxatives and purgative can be classified into various categories.

A. Bulky forming laxatives

These drugs loosen the bowels thereby promoting evacuation as a result of soft formed stool.

They act by retaining water in the colon thus increasing stool bulk and stimulating bowel movements to produce soft stool for example spagila husk and bran. They are neither digested nor absorbed

They should be taken with plenty of fluids. Failure to do so may result in faecal impaction or intestinal obstruction. They take about 2-3 days to exert an effect.

Contra-Indications: generally these drugs are not to be given in anal fissure, proctitis and ulcerative colitis and haemorrhoids

Liquidparaffin

Indications: Chronic constipation and painful ano-rectal conditions

Dose: Adults; 10-30ml

Side-Effects: Seepage from anus and perianal irritation after prolonged use.

Stimulant laxatives

These act by stimulating the nerve endings of the nerve plexus in the gut wall, causing irritation and increased peristalsis in small and large bowels.

Senna glycosides (Senokot)

This takes several hours to act (8-12 hrs).

Presentation: 7.5mg

Action: Promotes fluid accumulation. Used for preparation for delivery, surgery, rectal and bowel examination.

Indication: Constipation, bowel evacuation before abdominal radiological procedures, endoscopy, surgery etc.

Side-Effects: Abdominal colic and flatulence.

Bisacodyl (dulcolax)

Presentation: 10mg, 5mg tablets and suppositories

Action: Acts directly on intestines by increasing motor activity; thought to irritate colonic intramural plexus; and increase water retention in the colon**.**

The drug is best given at night to encourage bowel action. Suppositories act more rapidly within 1hr.

Take Note 5.3

Stimulant laxatives increase intestinal motility and often cause abdominal cramps.

They should not be used in intestinal obstruction. They cause smooth muscle atony in the colon and potassium loss.

Contraindications:

The drug should not be given in patients with nausea, vomiting, abdominal pains, faecal impaction and intestinal obstruction.

Nursing considerations: Give with caution in patients with rectal bleeding.

B. Saline Purgatives (Emollient Purgatives)

Mechanism of action

These lubricate the gastrointestinal tract by retaining fluids within bowels lumen resulting in soft stool and stimulating peristalsis. The osmotic purgatives act by osmosis that is the osmotic pressure of salt in solution retains sufficient fluids within the gut which should be isotonic with body fluids.

Examples of saline purgatives

Magnesium sulphate (Epsom salt)

Is a typical saline purgative and has a bitter taste and may be given with orange juice.

Caution: Use with caution in elderly and renal impairment.

Other mild purgatives include; magnesium citrate and magnesium hydroxide.

Self-Assessment test: TRUE OR FALSE: Indicate whether the following statements are true or false.

1. Chronic constipation is one of the indications for bulky forming laxatives
2. Epsom salt is an example of the bulky forming purgatives
3. Bisacodyl should not be given in patients with intestinal obstruction
4. Senna glycosides act by stimulating the nerve endings in the gut wall

ANSWERS

1. T
2. F
3. T
4. T

5.8 Anti-Diarrheals

Diarrhoea is an increase in the frequency and volume of stool with an alteration in its consistency. It can either be acute or chronic. Acute is sudden onset, short lived, self-limiting and mostly caused by indigestion or infection.

Chronic diarrhoea refers to diarrhoea that persists for more than two weeks and stool must be taken for investigations.

Management is by fluid infusion. However some drugs can be used to control and stop it.

Loperamide (Imodium)

Presentation: 2mg capsule

It is a sympathetic agent which bears some chemical structure resemblance to morphine and probably reduces bowel motility in a similar way.

Mechanism of action

Probably by reducing the effects of acetylcholine on gut receptors on the circular and longitudinal muscles of the intestinal wall and this reduces peristaltic activity.

Indication

Adjunct in the management of acute non-specific diarrhoea and chronic diarrhoea with dehydration.

Used in inflammatory bowel disease.

Dose: Initial dose of 4mg followed by 2mg after each loose stool. Do not exceed a daily dose of 16mg.

Side effects: Abdominal cramps, skin reactions, anticholinergic effects, respiratory depression, euphoria, numbness of the extremities, nausea and vomiting.

Caution: Do not use in children under 4 years.

Self- Assessment test: TRUE OR FALSE: Indicate whether the following statements about ani-diarrheals are true or not

1. The mechanism of action is by reducing the effects of acetylcholine on the gut receptors.
2. Respiratory depression is one of the side effects of Loperamide
3. The drugs should not be used in children over the 4 years of age
4. The initial dose of loperamide is 16mg

ANSWERS

1. T
2. T

3. F
4. F

5.9 Suppositories

These are solid preparations each containing one or more medicaments.
They are usually administered for single dose as local action or systemic absorption in disease treatment. The shape, volume and consistence of suppositories are such that the preparation is suitable for rectal administration.

Suppositories usually weigh between 1-4g.

The medicament is dispensed in a suitable base which may melt at suitable temperature (body temperature). Suppositories may be kept in a well closed place and stored at temperatures not exceeding more than 30^0c, usually refrigerated.

Anal, perineal pruritis, sores and excoriation are best treated by application of ointments and suppositories. These conditions occur in patients suffering from hemorrhoids, fistula and proctitis.

Anusol (Bismuth Subgallate)

Presentation: Suppositories and cream.

Indication: Symptomatic relief of haemorrhoids.

Dose: Insert 1 suppository at night and in the morning and after defecation. Patient is advised to clear anal region with warm water and soap. Apply cream twice a day.

Proctosedyl

Presentation: Suppositories and contains cinchocaine hydrocortisone.

Indication: Haemorrhoids.

Dose: Insert 1 suppository at night, 1 in the morning and repeat after a bowel movement.

Self-Assessment test: MCQ: Choose the most appropriate answer.

1. The other name for Bismuth Sulphate drug is.....
    a. Proctosedyl
    b. Anusol
    c. Loparamide
    d. Senokot

2. All of the following are not uses of the drug proctosedyl except....
    a. Diarrhea
    b. Bowel obstruction
    c. Haemorrhoids
    d. Fistulas

ANSWERS

1. B
2. **C**

5.10 Rectal Infusions

Enemas

These are aqueous or oily solutions or suspensions for rectal administration.

They are given for their anthelminthic, anti-inflammatory, nutritive, purgative or sedative effects or for x-ray examination of the lower bowels. Retention enemas should be inserted after defecation

.

They should be administered slowly with the patient lying on one side. The patient should lie in prone position to retain the enema for at least 30min to allow distribution and absorption of the medicament. Large volume enemas should be warmed to body temperatures before administration.

Self- Assessment test: TRUE OR FALSE: Indicate wether the following statements are true or false.

1. Rectal infusions should not be administered slowly
2. The rectal infusions are mainly aqueous solutions
3. Rectal infusions can not be given as anti-inflammatory drugs
4. After administration of rectal infusions, the patient should lie in a prone position to

retain the drug.

ANSWERS

1. F
2. T
3. F
4. T

5.11 Antihelminthics

These are drugs used to treat diseases caused by worms.

Mode of action

These drugs are generally called benzimidazoles. They act by binding to tubulin, preventing its polymerisation into cytoskeletal microtubules. The effect is selective for parasitic tubulin and the drugs are active against the adults, larvae and eggs.

Mebendazole (vermox)

Presentation: Tablet containing 100mg and suspension 500mg/5ml
Indications: In trichuris trichura (whipworm), enterobius vermicularis (pinworm), threadworms, ascaris lumbricoides (roundworm), and ancylostoma duodenal (common hookworm).
Dose: Threadworm adult and child over 2 years 100mg single dose, whipworm adult and child over 2 years 100mg twice daily for 3 days or 500mg single dose, roundworm adult and child 100mg twice daily for 3 days, hookworm adult 100mg daily for 3 days.
Side effects: Abdominal pain, diarrhoea, hypersensitivity reactions- erythema, rash, urticarial and angioedema
Caution: Pregnancy especially in first trimester, breastfeeding, safety in children less than 2 years not established.
Contraindications: Hypersensitivity.
Nursing Implications

i. Initiate second course of treatment if cure does not occur within 3 week.
ii. Examine and treat all family members simultaneously because pinworms are readily transmitted from person to person.

Albendazole

Presentation: 200 mg tablets
Actions: Albendazole is a broad-spectrum oral anthelmintic agent. It is the only anthelmintic drug active against all stages of the helminth life cycle (ova, larvae, and adult worms). Its mechanism of action is unclear, but it appears to cause selective degeneration of cytoplasmic microtubules in the intestinal cells of the helminths and

larvae. In general Albendazole ultimately causes decreased ATP production in the helminths, resulting in energy depletion, which kills the worms.
Indications: Treatment of neurocysticercosis caused by the larval form of pork tapeworm (*Taenia solium*), hydatid disease caused by the larval form of dog tapeworm (*Echinococcus granulosus*).
Dose:

Neurocysticercosis
*Adult/Child:***PO***>6 y,* weight <60 kg, 15 mg/kg/d divided b.i.d. for 8–30 d cycle (max: 800 mg/d); weight ≥60 kg, 400 mg b.i.d. for 8–30 d cycle

Hydatid Disease

*Adult/Child:***PO***>6 y,* weight <60 kg, 15 mg/kg/d divided b.i.d. (max: 800 mg/d); weight ≥60 kg, 400 mg b.i.d. for 28 d cycle (then 14 d without drug & repeat regimen for 3 cycles)

Side Effects: Hypersensitivity reactions. **CNS:** Headache, dizziness, vertigo, increased intracranial pressure, meningeal signs, alopecia (reversible), fever. **GI:** Abnormal liver function tests, abdominal pain, nausea, vomiting. **Hematologic:** (Rare) Reversible leukopenia, granulocytopenia, pancytopenia, agranulocytosis. **Skin:** Rash, urticaria.

Contraindications: Hypersensitivity to the benzimidazole class of compounds or any components of albendazole; pregnancy (category C).

Nursing Implications

i. Lab tests: Monitor WBC count, absolute neutrophil count, and liver function tests at start of each 28-d cycle and q2wk during cycle.
ii. Withhold drug and notify physician if WBC count falls below normal or liver enzymes are elevated.
iii. Give with meals. Absorption is significantly increased with a fatty meal.
iv. Do not exceed maximum total daily dose of 800 mg.
v. Store at 20°–25° C (68°–77° F).

Take Note 5.4

Patients should be concurrently treated with appropriate steroid and anticonvulsant therapy

Piperazine

Presentation: syrup 750mg/5mls, oral powder 4g

Mechanism of action

The drug competitively inhibits the effect of acetylcholine on the smooth muscle of worm, producing a reversible flaccid paralysis.

The only piperazine treatment available is pripsen powder sachets which is piperazine combined with a mild laxative (senna). Piperazine works by paralysing the worms which are then evacuated by the laxative action of the senna. A second dose of Piperazine is given after 14 days to ensure that any worms that were unhatched at the time of the first dose will be cleared from the system. Pripsen Powders are the only drug treatment for threadworms which can be given to children under the age of two years old (from 3 months of age).

Indications: Threadworm and roundworm

Dose: Threadworms stirred in milk/water adult and child 6years and above content of 1 sachet as a single dose at bed time repeated after 14 days. In roundworms same dose as for threadworms and repeated at monthly intervals for 3 months.

Side effects: Nausea, vomiting, colic, diarrhoea, local spasms, colonic contractions in patient with neurological or renal abnormalities.

Pyrantel Pamoate (Combantrin)

Presentation: 125mg tabs, 250mg/5ml suspension.

Indication: Hookworms, round worms, thread worms.

Action: Paralyses worms and dislodges them from the gastrointestinal

Dose: 5mg-10mg per kg bwt. For hook worms repeat on 3 consecutive days. Children of up to 2 years give 1 tab or 2.5mls suspension as a single dose. 9-17 years, 4 tabs or 10ml suspension.

Side effects: GIT upset, headache, dizziness.

Contraindication: Not to be given with piperazine and in pregnancy.

Activity 5.2

Read and write notes on the nursing implications for Combantrin and Piperazine

Self- Assessment test: True or false: Indicate whether the following statements are true or false.

1. The loperamide is used in the treatment of gastro intestinal worm infestations
2. The drug pyrantel pamoate is used in the treatment of worm infestations.
3. The other name for combantrin is pyrantel pamoate
4. Peperazine can not be used in the treatment of round worms.

ANSWERS

1. F
2. T

3. T
4. F

5.12 Drugs used in the treatment of schistosomiasis

These are drugs used in the treatment of schistosomiasis commonly known as bilharzia.

Mode of action

These are known to interfere with Calcium homeostasis in the parasite causing muscular paralysis and increasing cell membrane permeability or they increase the cell permeability to calcium in Schistosomes, causing strong contractions and paralysis of worm musculature leading to detachment of suckers from the blood vessel walls and to dislodgment.

Praziquantel (Biltricide)

Presentation: Tablet containing 600mg
Mechanism of action: as above
Indications: Schistosoma japonicum, haematobium and mansoni
Dose: S. haematobium and mansoni adult 40mg/Kg body weight. S.japonicum 60mg/Kg body weight
Side effects: Malaise, headache, dizziness, abdominal discomfort with nausea, rarely urticarial.
Caution: Safety in children under 4 not established.
Contraindications: Hypersensitivity.
Nursing implications: Tablets can be halved or quartered

Oxaminiquine (vansil)

Presentation: Capsule containing 250mg.
Mechanism of action: As above
Indications: All stages of *Schistosoma mansoni* infection, including acute and chronic phases with hepatosplenic involvement.
Dose: oral 15mg/Kg in adults and 10-15mg/Kg in children
Side effects: **CNS:** Transitory dizziness, drowsiness, headache*;* persistent fever (in patients being treated in Egypt); EEG abnormalities, convulsions (rare). **GI:** Anorexia, nausea, vomiting, abdominal pain, elevated liver enzyme concentrations. **Hematologic:** Increased erythrocyte sedimentation rate, reticulocyte count, and increased or decreased leukocyte count. **Skin:** Urticaria. **Urogenital:** Red-orange urine.
Contraindications: Safe use during pregnancy (category C), lactation, or in children is not established.
Caution: history of convulsions.

Nursing Implications

i. Supervise ambulation and use other safety precautions because >30% of patients experience dizziness or drowsiness.
ii. If patient has a history of seizures, the possibility of seizures is increased because of drug action (occurs within hours of drug administration).
iii. Use caution while driving or performing other tasks requiring alertness because drug can cause dizziness or drowsiness.
iv. Be aware that drug may change the normal urine colour to a harmless orange-red.
v. Do not breast feed while taking this drug without consulting physician.

Metrifonate (Bilarcil)

Presentation: Tablet containing
Action: The drug is an organophosphorus cholinesterase inhibitor that results into schistosomicide action.
Indication: S. haematobium
Dose: 7.5-10mg/kg once after a 2 week interval in 3 does
Side effects: mild Git disturbance, abdominal pain, diarrhoea, flatulence, nausea, leg cramps and slight decrease in heart rate and vertigo.
Contraindications: GIT, heart and glaucoma disorders
Overdosage (antidote): Atropine sulfate (for adults, 1 mg every 6 hours) may be used as a specific antidote to relieve symptoms of cholinergic activity. This does not impair the antiparasitic action.
Nursing implications
i. Metrifonate tablets should be kept in tightly closed containers and stored at a temperature not exceeding 25 °C, preferably in a refrigerator.
ii. Discoloured tablets should be discarded.
iii. Avoid drug in pregnancy as the drug is teratogenic or embryotoxic
iv. Not to given to breastfeeding mother as drug is excreted in breast milk.

5.13 Summary

In unit we have looked at drugs acting on the gastrointestinal tract. We have looked at antacids, antiulcer drugs, emetic and antiemetics, anticholinergics. Laxatives and purgatives are among the drugs that we have discussed. We also took time to discuss drugs used in the destruction of worms and other parasitic infestations such as schistosomiasis.

In the next you will be learning about drugs that exert their effect on the cardiovascular. But before looking at the next unit below is a self-test which you must answer.

5.14 Self- Assessment test

Cross-matching

Cross-match the following drugs in column I with their side effects in column II.

Column I

1. Metrifonate.....
2. Oxanmiquine.....
3. Praziquante.....

Column II

A.Dizziness

B. Headache

C. Abdominal pain

ANSWERS

1.C

2. A

5.15 References

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UNIT 6: DRUGS ACTING ON THE CARDIO-VASCULAR SYSTEM

6.1 Introduction

Welcome to this unit. In the previous unit you learnt about drugs that act on the gastrointestinal tract. As you may have noticed these drugs are used to treat various conditions of the gastrointestinal tract. In this next unit you will learn about drugs acting on the cardio vascular system.

The cardiovascular system is composed of the heart which pumps blood and blood vessels, through which blood circulates to all parts of the body. Hypertension is the most common cardiovascular disease. In a survey carried out in 2000, hypertension was found in 28% of American adults. According to a Framingham study of blood pressure trends in middle-aged and older individuals, approximately 90% of Caucasian Americans will develop hypertension in their lifetime(Basic and clinical pharmacology,2006).Due to diseases, the heart may not be able to work as required. In this case drugs must be administered to achieve its normal function.

6.2 Objectives

By the end of this unit you should be able to;

1. Describe the uses of Cardiac-glycosides
2. Describe the uses of Anti-arrhythmic agents
3. Describe the uses of Anti-angina agents
4. Describe the uses of Anti-hypertensive agents
5. Describe the uses of Haematological drugs
6. Describe Fluid and Electrolyte Balance

6.3 Cardiac-Glycosides

Digitalis compounds are potent inhibitors of cellular Na+/K+-ATPase. This ion transport system moves sodium ions out of the cell and brings potassium ions into the cell. This transport function is necessary for cell survival because sodium diffusion into the cell and potassium diffusion out of the cell down their concentration gradients would reduce their concentration differences (gradients) across the cell membrane over time.

Cardiac glycosides are a small group of drugs that improve contractility of the heart. They also reduce the heart rate in other conditions of the heart. They occur widely in nature and they can also be prepared synthetically. Examples of these drugs are; Digoxin, Digitoxin, Gitoxin and Gitalin (Basic and clinical pharmacology, 2006).

Mechanism of action

Digoxin has two mechanisms of action that is:

i. Direct

ii. Indirect action

i) Direct action

Digoxin acts directly on the heart muscles to strengthen them and this is called Positive Inotropic effect. This increases the contractility of the heart and increases output of heart

ii) Indirect action

At lower doses digoxin slows the heart rate through activation of the parasympathetic divisions of the autonomic nervous system (vagal activation) which slows it down and is called Negative chlonotropic effect. This is vital especially in arterial fibrillation because the slowing of the heart allows for slower and more regular contractions which increases cardiac output.

Side effects of cardiac glycosides

The major side effect of digitalis compounds is cardiac arrhythmia, especially atrial tachycardias and atrioventricular block.

Nursing implications for cardiac glycosides

Cardiac glycosides are potentially toxic drugs and patients must be closely observed during initial therapy before treatment is started. Patient should be assessed properly, vital signs monitored to serve as baseline data for comparison. Most important is the blood pressure and radio-apical pulse rate. Auscultation of the lungs should be done and abdominal sounds reported. Inspect patient for oedema. Inspect the jugular veins; check the patient's body weight for the colour and consistency. The skin and mucous membrane should be inspected for cyanosis. Doctors should request laboratory investigation before administering treatment.

Before administration of treatment, pulse rate must be counted for a full minute.

If the pulse rate is 60 minutes or below the drug should **not** be given; the doctor should be notified immediately. Drug should not be given if there is irregularity of the pulse. Drug should not be given if there is a marked decrease in the pulse rate.

If the drug is given intravenously, then it should be given very slowly; if being given intramuscularly then sites should be changed. During digitalization the blood pressure and pulse should be checked ½ hourly depending on condition. Patient should be warned of the side effect of the drug.

Inform them that the drug should be weighed on daily basis.

Examples of glycosides

Digoxin (Lanoxin)

Presentation: Tablet containing 0.25mg, 0.125mg and injection containing 0.25mg
Action:
Indications: Heart failure, supraventricular arrhythmias

Dose: In cardiac heart failure **initial dose**: 0.125mg – 0.25mg/day
Arterial fibrillation with rapid ventricular response.

Dose: Loading dose 1mg (0.25mg) for 2 hours QID for six hours then followed by maintenance dose of 0.125mg daily.

Side effects: Anorexia, nausea, vomiting, diarrhoea, abdominal pain, visual disturbance, headache, fatigue.
Drug interactions: The action of digoxin is increased by verapamil, diltazem and amiodarone so the dose should be halved to prevent toxicity.

Caution: Recent infarction, hypothyroidism, reduce doe in elderly and renal impairment

Contraindications: Supraventricular arrhythmias caused by Wolff-Parkinsonism-white Syndrome

Digitoxin

Presentation: Tablet containing 100mcg.
Action: As above
Indication: Heart failure supraventricular arrhythmias
Dose: Maintemnace 100mcg daily or on alternate days.
Side effects: As above
Caution: As above
Contraindications: As above

Self- Assessment test: TRUE OR FALSE: Indicate whether the following statements are true or false.

1. Beta- Blockers are drugs that bind to beta-adrenoceptors and block the binding of norepinephrine.
2. Beta-Blockers do not pose the membrane stabilizing activity.
3. Supraventricular arrhythmias are indications for the drug digoxin.
4. Side effects of cardiac glycosides include cardiac arrhythmias.

ANSWERS

1.T

2. F

3. T

4. T.

6.4 Anti-Arrhythmic Agents

Beta-Blockers

Beta-blockers are drugs that bind to beta-adrenoceptors and thereby block the binding of norepinephrine and epinephrine to these receptors. This inhibits normal sympathetic effects that act through these receptors. Therefore, beta-blockers are sympatholytic drugs. Some beta-blockers, when they bind to the beta-adrenoceptor, partially activate the receptor while preventing norepinephrine from binding to the receptor. These partial agonists therefore provide some 'background' of sympathetic activity while preventing normal and enhanced sympathetic activity. These particular beta-blockers (partial agonists) are said to possess intrinsic sympathomimetic activity (ISA). Some beta-blockers also possess what is referred to as membrane stabilizing activity (MSA).

Effects of Beta-Blockers

- Decrease contractility (negative inotropy),
- Decrease relaxation rate (negative lusitropy)
- Decrease heart rate (negative chronotropy)
- Decrease conduction velocity (negative dromotropy)

Nursing implications for beta-blockers

i. Teach patients that they should not suddenly stop therapy because of the risk of rebound tachycardia and hypertension.

ii. Beta blockers can cause transient increases in serum lipid and glucose levels.

iii. Monitor for symptoms of hypoglycemia in patients with diabetes who use insulin.

iv. Some older beta blockers such as propranolol can cause bronchoconstriction and asthma symptoms.

Examples of beta-blockers used in control of arrhythmias

Atenolol

Action: cCmpetitively blocks stimulation of B-adrenergic receptor within vascular smooth muscle, produces chronotropic, inotropic activity (decreases rate of Sino-atrial node discharge and increases time), slows conduction of atrio-ventricular node, decreased heart rate which decreases oxygen consumption in myocardium and also supresses' renin-aldosterone-angiotensin system at high doses and inhibits B-receptors in bronchial system.
Presentation: Tablet containing 25mg, 50mg 100mg. Injection containing 500mcg/ml.
Indication: Hypertension, angina and arrhythmias.
Dose: Oral for arrhythmias 50-100 daily and IV 2.5mg at a rate of 1mg/ minute repeated at 5 minutes intervals to maximum of 5mg. By infusion 150mcg/Kg body weight over 20 minutes repeated every 12 hour if needed.
Side effects: Bradycardia, heart failure, conduction disorders, bronchospasms, peripheral vasoconstriction, GIT disturbances, sleep disorders, fatigue.
Caution: Reduce dose in renal impairment, late pregnancy and breastfeeding. Avoid abrupt withdraw in angina, diabetes and myasthenia gravis.

Contraindications: Asthma and hx of obstructive airways diseases, uncontrolled heart failure, marked bradycardia and cardiogenic shock.

Propranolol

Action: Competitively blocks stimulation of B-adrenergic receptor within vascular smooth muscle, produces chronotropic, inotropic activity (decreases rate of Sino-atrial node discharge and increases time), slows conduction of atrio-ventricular node, decreased heart rate which decreases oxygen consumption in myocardium and also supress renin-aldosterone-angiotensin system at high doses and inhibits B-receptors in bronchial system.
Presentation: tablet containing 10mg, 40mg, 80mg. Solution containing 5mg/5ml, 50mg/5ml and injection containing 1mg/ml
Indication: Hypertension, arrhythmias
Dose: In arrhythmias 10-40mhg daily
Caution: Check under antihypertensives
Contraindication: Check under antihypertensives.

Other antiarrhythmic agents include:
Lignocaine

Action: Increases electrical stimulation threshold of ventricle and His-Purkinje system which stabilizes cardiac membrane and decreases automaticity
Presentation: Infusion 0.1%, containing 1mg/ml; 0.2% containing 2mg/ml and 5% containing 50mg/ml all in glucose intravenous infusion. Injection containing 1% (10mg/ml and 2% (20mg/ml).
Indication: Arrhythmias
Dose: 1mg/Kg body weight by slow IV injection given 1-2 minutes repeated after 10-20 minute a loading dose of 1-2mg/Kg body weight may be given followed by 0.1-0.2% infusion at 1-2mg per minute for 12-48 hours.
Side effects: Dizziness, paraesthesia, drowsiness, confusion, respiratory depression, convulsions, hypotension and bradycardia and hypersensitivity.
Caution: Lower doses in congestive cardiac failure, hepatic impairment, following cardiac surgery.
Contraindications: Heart block, porphyria

Quinidine

Action: The drug prolongs action potential duration and effective refractory period thus decreasing myocardial excitability and has anticholinergic properties.
Presentation: Tablet containing 250mg quinidine bisulphate
Indications: Ventricular arrhythmias and supraventricular tachycardia.
Dose: 250-500mg 3-4 times daily
Side effects: Nausea, diarrhoea, ventricular arrhythmias, thrombocytopenia, haemolytic anaemia, cinchonism, granulomatous hepatitis
Caution: Test for hypersensitivity by giving 200mg test dose initially
Contraindications: heart block

Calcium Channel Blockers (Ccb)

The antiarrhythmic properties (Class IV antiarrhythmics) of CCBs are related to their ability to decrease the firing rate of aberrant pacemaker sites within the heart, but more importantly are related to their ability to decrease conduction velocity and prolong repolarization, especially at the atrioventricular node. This latter action at the atrioventricular node helps to block re-entry mechanisms, which can cause supraventricular tachycardia.

Examples of CCB are:

Amlodipine
Dose: 5-10mg daily
Side effects: Peripheral oedema, headache, flushing, dizziness, nausea, marked hypotension.
Interaction: When the drug interacts with digoxin, it increases digoxin levels, bradycardia and congestive cardiac failure. With quinidine it decreases effects of amlodipine.
Contraindications: hypotension

Other drugs include: felodipine and isradipine, nifedepine, nicardipine, diltizazem, felodipine, isradipine, lacidipine and verapamil.

Nursing implications

i. Tell patients to report dizziness and symptoms of an irregular heart rate.
ii. Teach your patients to avoid grapefruit juice because it inhibits the hepatic metabolism of calcium channel blockers and may lead to increased blood drug levels and increased pharmacologic effects.
iii. All calcium channel blockers should be used cautiously in patients with heart failure.

Self- Assessment test: MCQ

1. The side effects for the drug 'Amlodipine' includes all of the following except.....
    a. Peripheral oedema
    b. Marked hypotension
    c. Headache
    d. Marked hypertension
2. One of the following conditions is a contraindication for lignocaine.
    a. Hyperventricular tarchycardia
    b. Ventricular arrythmias
    c. Heart block

d. Ventricular systole

ANSWERS

1. D
2. C

6.5 Anti-Angina agents

Angina pectoris refers to a recurring chest pain or discomfort that happens as a result of myocardial (heart muscle) ischemia (restriction in blood supply) caused by an imbalance between myocardial blood supply and oxygen demand. Angina is a symptom of coronary heart disease (CHD), which occurs when arteries (that carry blood to the heart) become narrowed and blocked due to atherosclerosis (deposition of fat along the walls of arteries).

Management depends on the type of angina and may include drug treatment, coronary artery bypass surgery, or percutaneous transluminal coronary angioplasty.

The three main types of angina are:

i. **Stable angina** (angina of effort), where atherosclerosis (deposition of fat in the blood vessels) restricts blood flow in the coronary vessels; attacks are usually caused by exertion and relieved by rest

ii. **Unstable angina** (acute coronary insufficiency), which is considered to be an intermediate stage between stable angina and myocardial infarction.

iii. **Prinzmetal angina** (variant angina), caused by coronary vasospasm, in which attacks occur at rest.

Types of Anti-angina drugs

There are three classes of agents that relieve anginal pain: organic nitrates and calcium channel antagonists are indicated in spasmatic and chronic stable angina, while β-adrenergic antagonists are primarily for exertion-induced angina. Anti-angina agents mainly alleviate pain by reducing the oxygen requirements of the heart, thereby reducing angina pain. Each class of anti-angina agenst utilizes a distinct mechanism for reducing the heart workload and consequently may be simultaneously used to increase the therapeutic effect.

Stable Angina

Drugs are used both for the relief of acute pain and for prophylaxis to reduce further attacks; they include organic nitrates, beta-adrenoceptor antagonists (beta-blockers), and calcium-channel blockers.

Nitrates

Organic nitrates have a vasodilating effect; they are sometimes used alone, especially in elderly patients with infrequent symptoms. Tolerance leading to reduced anti-angina

effect is often seen in patients taking prolonged-action nitrate formulations. Evidence suggests that patients should have a 'nitrate-free' interval to prevent the development of tolerance. Adverse effects such as flushing, headache, and postural hypotension may limit nitrate therapy but tolerance to these effects also soon develops. The short-acting sublingual formulation of glyceryl trinitrate is used both for prevention of angina before exercise or other stress and for rapid treatment of chest pain. A sublingual tablet of isosorbide dinitrate is more stable in storage than glyceryl trinitrate and is useful in patients who require nitrates infrequently; it has a slower onset of action, but effects persist for several hours.

Examples of nitrates

Nitroglycerin

Presentation: Injection containing 1mg or 5mg/ml

Mechanism of action: as above

A prototypical nitrate with large first-pass effect with PO forms

Indications

The drug is indicated in the symptomatic treatment of ischemic heart conditions (angina) and also for the control blood pressure in perioperative hypertension. The drug can also be used in the management of ischemic pain and pulmonary oedema associated with myocardial infarction.

Nursing implications

i. Assess pain level, location, duration, intensity and pattern.

ii. Ask when the last dose of nitrates was taken and what degree of relief was obtained.

iii. Intravenous form of the drug should be administered in intensive care unit

Other antianginal agents in this class of drugs include, isosorbide dinitrate, isosorbide mononitrate

Beta-Blockers

Beta-adrenoceptor antagonists (beta-blockers), such as atenolol, block beta-adrenergic receptors in the heart, and thereby decrease heart rate and myocardial contractility and oxygen consumption, particularly during exercise. Beta-blockers are first-line therapy for patients with effort-induced chronic stable angina; they improve exercise tolerance, relieve symptoms, reduce the severity and frequency of angina attacks, and increase the anginal threshold.

Please withdraw Beta-blockers gradually to avoid precipitating an anginal attack; they should not be used in patients with underlying coronary vasospasm (Prinzmetal angina).

Beta-blockers may precipitate asthma and you should not sue them in patients with asthma or a history of obstructive airways disease. Some, including atenolol, have less effect on beta 2 (bronchial) receptors and are therefore relatively cardioselective.

Although they have less effect on airways resistance they are not free of this effect and should be avoided.

You should use Beta-blockers with caution in diabetes since they may mask the symptoms of hypoglycaemia, such as rapid heart rate. Beta-blockers enhance the hypoglycaemic effect of insulin and may precipitate hypoglycaemia.In this case before administering the drugs get the proper medical history of the patient.

Atenolol

Atenolol is a representative beta-adrenoceptor antagonist.

Presentation:

Tablets, atenolol 50 mg, 100 mg

Injection (Solution for injection), atenolol 500 micrograms/ml, 10-ml ampoule.

Indication:

Atenolol is used to treat angina and myocardial infarction; arrhythmias, hypertension migraine prophylaxis

Dose:

For Angina, by mouth, **Adult** 50 mg once daily, increased if necessary to 50 mg twice daily or 100 mg once daily

For Myocardial infarction (early intervention within 12 hours), by intravenous injection over 5 minutes,

Adult: 5 mg, then by mouth 50 mg after 15 minutes, followed by 50 mg after 12 hours, then 100 mg daily.

Side effects: Bradycardia, heart failure, conduction disorders, bronchospasms, peripheral vasoconstriction, gastrointestinal disturbances, sleep disorders, fatigue.

Contraindications:

Always find out the medical history of a patient before prescribing any drug.

Do not give atenolol to patients with asthma or history of obstructive airways, uncontrolled heart failure, Prinzmetal angina, marked bradycardia, hypotension, sick sinus syndrome, second- and third-degree atrioventricular block, cardiogenic shock; metabolic acidosis; severe peripheral arterial disease; phaeochromocytoma (unless used with alpha-blocker)

Calcium-Channel Blockers

A calcium-channel blocker, such as verapamil, is used as an alternative to a beta-blocker to treat stable angina. Calcium-channel blockers interfere with the inward movement of calcium ions through the slow channels in heart and vascular smooth

muscle cell membranes, leading to relaxation of vascular smooth muscle. Myocardial contractility may be reduced, the formation and propagation of electrical impulses within the heart may be depressed and coronary or systemic vascular tone may be diminished. Calcium-channel blockers are used to improve exercise tolerance in patients with chronic stable angina due to coronary atherosclerosis or with abnormally small coronary arteries and limited vasodilator reserve.

You can use calcium-channel blockers in patients with unstable angina with a vasospastic origin, such as prinzmetal angina, and in patients in whom alterations in cardiac tone may influence the angina threshold.

Example of calcium channel blockers

Verapamil

Presentation: Tablet containing 40mg, 80mg, 120mg and 180mg. Oral solution containing 40mg/5ml and injection containing 2.5mg/ml

Action: As above

Dose: 80-120mg t.i.d

Side effects: Constipation, allergic reactions, arthralgia, hypotension, prolactaemia.

Contraindications: Hypotension, bradycardia, cardiogenic shock

Nursing implications

i. Tell patients to report dizziness and symptoms of an irregular heart rate.

ii. Teach your patients to avoid grapefruit juice because it inhibits the hepatic metabolism of calcium channel blockers and may lead to increased blood drug levels and increased pharmacologic effects.

iii. All calcium channel blockers should be used cautiously in patients with heart failure.

Unstable Angina

Unstable angina requires prompt aggressive treatment to prevent progression to myocardial infarction (death of heart muscles). Initial treatment is with acetylsalicylic acid to inhibit platelet aggregation, followed by heparin. Nitrates and beta-blockers are given to relieve ischaemia; if beta-blockers are contraindicated, verapamil is an alternative, provided left ventricular function is adequate.

Prinzmetal angina

Treatment is similar to that for unstable angina, except that a calcium-channel blocker is used instead of a beta-blocker.

Self- Assessment test: TRUE OR FALSE:

Indicate whether the following statements are true or false.

1. Prinzimetal is a group of stable angina drugs.

2. Prolactenaemia is one of the side effects of verapimil
3. Atenolol is a representative of beta-adrenoceptor agonist
4. Nitroglycerine is an example of unstable angina drugs

ANSWERS

1. F
2. T
3. T
4. F

6.6 Anti-Hypertensive agents

These are drugs that are used to lower elevated blood pressure in a number of ways. Three classes of drug are used for first-line treatment of hypertension: thiazide diuretics, beta-adrenoceptor antagonists (beta-blockers), and angiotensin-converting enzyme (ACE) inhibitors. Calcium-channel blockers are considered first-line in specific populations only for example africans or the elderly. Other classes of drugs may be used in certain situations. Anti-hypertensive agents help to:

- Lower the total peripheral resistance
- Lower cardiac output
- Reduce blood volume and body Na+ stores
- Act centrally (In the CNS).

Thiazide diuretics, such as hydrochlorothiazide have been used as first-line antihypertensive therapy, and are particularly indicated in the elderly. They have few adverse effects in low doses, but in large doses they may cause a variety of unwanted metabolic effects (principally potassium depletion), reduced glucose tolerance, ventricular ectopic beats and impotence; they should be avoided in gout. These effects can be reduced by keeping the dose as low as possible; higher doses do not produce an increased reduction in blood pressure. Thiazides are inexpensive and, when used in combination, can enhance the effectiveness of many other classes of antihypertensive drug.

Activity 6.1: Scenario

A patient is diagnosed with un stable angina, the doctor decides to first manage her with acetylsalicylic acid, followed by heparin and later added a beta-blocker.

Give reasons why the doctor decided to manage the patient as above and write them in your note book.

Well done! Now proceed and look at what diuretics are.

Diuretics

These agents act by promoting renal excretion of salt and water by blocking tubular reabsorption of sodium and chloride. The resulting loss of fluid reduces ventricular filling pressure (pre-load) and produces consistent haemodynamic and sympathetic benefits in the patient with congestive cardiac failure and rapidly relieves dyspnoea and peripheral oedema.

They decrease blood pressure by depleting body Na+ stores thereby reducing blood volume. They are used as monotherapy in mild to moderate BP. Diuretics are used in fluid retention resulting from cardiac, renal or hepatic failure. They cause electrolyte loss especially potassium and sodium in addition to water. They should not be used in conditions like kwashiorkor. Different types of diuretics are available. The potency varies according to the site of action. They are combined with vasodilators in severe BP.

General nursing implications for diuretics

- Diuretics can increase serum glucose and cholesterol levels, monitor for hyperglycemia and hypercholesterolemia.
- Teach patients to take diuretics in the morning to avoid nocturnal diuresis and urination.
- Caution patients to stand up slowly to minimize the risk of dizziness from orthostatic hypotension.
- Monitor for signs of hypokalemia, such as muscle weakness and changes in mental status, including confusion and irritability.
- Patients taking a potassium-sparing diuretic are at risk for hyperkalemia. The risk is especially high in patients also taking an angiotensin-converting enzyme (ACE) inhibitor.
- Weigh patients daily at the same time using the same scale. Report a significant weight gain, 3 pounds in 3 days.
- Remind your patient that even if he feels fine, he should keep appointments with the healthcare provider because renal function must be monitored.

Activity 6.2

Outline two types of diuretics and indicate their side effects and your responsibility in drug administration. Write your answers in your note book.

Examples of diuretics

Thiazides

Thiazides are a more frequently used class of diuretics because they are effective at a low dose and usually combined with K- sparing diuretics.

Loop Diuretics

They act at the beginning of the distal convoluted tubule and are moderately potent diuretics. Small doses of thiazides are used long-term to control hypertension alone in mild hypertension,

Hydrochlorothiazide (Esidrex)

Presentation: tablet containing 25mg

Indications: Oedema, hypertension

Dose: 25mg daily, can be increased to 100mg daily if necessary

Side Effects: Hypokalaemia - muscle weakness, cardiac arrhythmias, and sensitisation

Contra-Indications: Hypercalcaemia, renal failurend with other drugs in more severe hypertension.

Fursemide (Lasix)/Furosemide

Presentation: Tablet containing 20mg or injection containing 20mg

Mechanism of action

The drug acts by reducing sodium and chloride reabsorption in the ascending limb of the loop of henle. These edges produces marked potassium loss and promote hyperuriaemia (increase uric acid in blood).

Indications: Oedema due to CCF, oliguria due to renal failure

Dose: Adult; 20-80mg daily po, IM, slow IV with slow K 600mg daily

Contra-Indications: Oliguria due to hypokalaemia, fluid depletion

Side Effects: Dehydration, Hypokalaemia

Spironolactone (a Potassium Sparing Diuretic)

This is a specific competitive antagonistic to aldosterone,producing a weak diuresis with a K+ SPARING ACTION act at the distal tubule preventing K+ excretion in exchange of Na2. These are weak diuretics but are useful in combination with more powerful loop diuretics. However they should be avoided in patients with renal failure and those taking ACE Inhibitors.

Examples of K^+ Sparing diuretics

Spironolactone
Presentation: Tablet containing 50-100mg
Mechanism of action: It is an aldosterone antagonist potassium sparing diuretic.
Dose: 100-200mg daily
Side effects: Impotence, gynaecomastia, menstrual irregularities, lethargy, hyperkalaemia.

Interactions: ACE Inhibitors and antagonists lead to hyperkalaemia
Contraindications: Hyperkalaemia, hyponatraemia and addison's disease.

Other drugs include eplerenone, amiloride, triamterene.

Amiloride and Hydrochlorothiazide (Moduretic)

Presentation: Tablets, amiloride hydrochloride 5mg, hydrochlorothiazide 50mg

Indications: Oedema and mild hypertension

Dose: 2-4 tablets daily in two divided doses

Contra-indications: Diabetes mellitus and hyperkalaemia

Aldactone

Action: Potassium sparing diuretic

Indication: Oedema due to CCF, cirrhosis of liver, nephrotic syndrome

Dose: 20-200 mg daily p.o. with food

Side Effects: Nausea and vomiting

Beta-Adrenoceptor

Beta-adrenoceptor antagonists (beta-blockers) such as atenolol are effective in all grades of hypertension, and are particularly useful in angina and following myocardial infarction; they should be avoided in asthma, chronic obstructive pulmonary disease, and heart block.

Nursing Implications: For both agents

- Assess for manifestation of heart failure
- Check the pulse rate regularly
- Do not withdraw the drug suddenly in patient with heart disease.

(i) **Atenolol Tablet**

Dosage: 50-100mg OD or BD

Side Effects: Bradycardia, fatigue, insomia, sexual dysfunction

(ii) **Propranolol Tablet**

Dosage: 40mg OD

Side Effects: Brochospasms, bradycardia, nightmares, insomia, postural hypotension

Angiotensin-Converting Enzyme Inhibitors (Ace Inhibitors)

Activity 6.3

Review the rennin-angiotensin-aldosterone mechanism.Write down the amswers in your note book.

Angiotensin-converting enzyme inhibitors (ACE inhibitors) such as enalapril are effective and well tolerated by most patients. They can be used in heart failure, left ventricular dysfunction and diabetic nephropathy, but should be avoided in renovascular disease and in pregnancy. The most common adverse effect is a dry persistent cough.

These drugs inhibit ACE which in turn inhibits the formation of angiotesin II (vasoconstrictor) and blocks the release of aldosterone which in turn promotes sodium retention and potassium excretion. When aldosterone is blocked sodium is excreted with water and potassium is retained. ACE Inhibitors are primarily used in the treatment of hypertension while some agents are also effective in treating heart failure.

Generally side effects of ACE Inhibitors are:

- Constant irritating cough
- Nausea and vomiting
- Diarrhoea
- Headache
- Dizziness
- Fatigue
- Insomnia
- Hyperkalaemia and
- Tachycardia.

Nursing implications for ACE inhibitors

i. Assess patient for hyperkalemia.

ii. Rare adverse effects include: agranulocytosis, proteinuria, glomerulonephritis, acute kidney failure, and angioedema.

iii. Assess for angioedema, which can lead to airway swelling and requires emergent treatment.

iv. A history of angioedema contraindicates the use of ACE inhibitors.

Examples of ACE Inhibitors

Enalapril Maleate (Vasotec)

Presenation: Tablet containing 5-10mg
Indications: Hypertension and cardiac failure.
Dose: Oral 5mg daily and maintenance of 10-40mg daily. IV 1.25mg every 6 hours.

Side effects: Palpitations, arrhythmias, angina, chest pains, CVA, exfoliative dermatitis etc.
Interaction: Potassium sparing diuretic lead to hyperkalaemia
Contraindications: Hypersensitivity, pregnancy and renovascular disease.

Other drugs in this group include Capitopril, benzapril, lisinopril, fosinopril, perindopril, ramipril etc

Angiotensin II Receptor Antagonists (ARB)

These are a new group of Antihypertensives. This group is similar to ACE Inhibitors in that they prevent the release of aldosterone. They act on the renin-angiotensin system. The difference between ACE Inhibitor and these drugs is that ARBs block the angiotensin II from the AT_1 receptors found on many tissues whereas ACE Inhibitorsinhibit the angiotensin-converting enzyme in the formation of angiotensin II. The ARBs cause vasodilation and decrease peripheral resistance

Generally side effects include:

- Symptomatic hypotension
- Dizziness
- Hyperkalaemia and
- Angioedema.

Nursing implications for ACE antagonists

i. Assess patient for hyperkalemia.
ii. Rare adverse effects include: agranulocytosis, proteinuria, glomerulonephritis, acute kidney failure, and angioedema.
iii. Assess for angioedema, which can lead to airway swelling and requires emergent treatment.
iv. A history of angioedema contraindicates the use of ACE inhibitors.

Examples:

Losartan Potassium (Cozaar) - combined with hydrochlorothiazide
Dose: 25-50mg daily in single dose or 2 divided doses, maximum dose 100mg daily
Side effects: dizziness, insomnia and occasional cough.
Interaction: Potassium sparing diuretics lead to hyperkalaemia.
Contraindications: pregnancy, renal and hepatic impairment

Other drugs in this group include: Canderstan, eprosartan, and ibesartan etc.

Calcium-Channel Blockers

These agents effectively reduce the BP by help relaxing the muscles of the blood vessels. Some slow the heart rate there by reducing the force of the cardiac contraction.

Drugs such as Nifedipine are useful for isolated systolic hypertension, in populations unresponsive to other antihypertensives (for example Africans) and in the elderly where thiazides cannot be used.

Short-acting formulations of Nifedipine should be avoided as they may evoke reflex tachycardia and cause large variations in blood pressure.

Nursing implications for Calcium Channel Blockers

i. Tell patients to report dizziness and symptoms of an irregular heart rate.
ii. Teach your patients to avoid grapefruit juice because it inhibits the hepatic metabolism of calcium channel blockers and may lead to increased blood drug levels and increased pharmacologic effects.
iii. All calcium channel blockers should be used cautiously in patients with heart failure.

Examples of Calcium Channel Blockers

Amlodipine
Dose: 5-10mg daily
Side effects: Peripheral oedema, headache, flushing, dizziness, nausea, marked hypotension.
Interaction: Interaction with digoxin, the drug increases digoxin levels, bradycardia and CHF, with quinidine decreases effects of amlodipine.
Contraindications: Hypotension

Nifedipine (Adalat)

Presentation: Capsule containing 5mg and 10mg

Dosage: 10mg Sublingual/Orally OD

Side Effects: Dizziness, Fatigue, Nausea, Headache, Oedema

Contraindications: As for Amlodipine

Other drugs include: Nicardipine, diltizazem, felodipine, isradipine and verapamil.

Peripheral Vasodilators

Drugs acting on the central nervous system are also effective antihypertensive drugs. In particular, methyldopa is effective in the treatment of hypertension in pregnancy.

These act by relaxing the smooth muscles of blood vessels mainly the arteries, causing vasodilation. These generally promote an increase in blood flow to the brain and kidneys. With vasodilation the blood pressure decreases and sodium and water are retained resulting in peripheral oedema. Diuretics can be given with direct acting vasodilators to decrease oedema.

Side effects of peripheral vasodilator are:

- Tachycardia
- Palpitations
- Oedema
- Nasal congestion
- Headache
- Dizziness
- GIT bleeding
- Tingling and numbness,
- Excessive hair growth.

Nursing implications

i. Assess BP every on 1-4 hours
ii. Monitors electrolytes and other blood studies before staring the medication.
iii. Monitor weight gain as the drugs cause oedema.

Examples of peripheral vasodilators

Hydralazine (Apresoline)

Presentation: Injection containing 25mg

Dose: Oral 25mg B.D, IV 5-10mg diluted with 10mls Sodium Chloride 0.9% and may be repeated after 20-30 minutes and intravenous infusion 200-300mcg/minute.

Side effects: As above

Contraindications: Hypersensitivity, mitral vulvular rheumatic heart disease

Diazoxide

The drug is chemically similar to thiazide diuretics but has no diuretic effect; however it is a potent dilator of arteries. It exerts direct vasodilator effect by opening arteriolar potassium channels and this has the effect of stabilizing the muscle cell membrane at resting levels. The drug is plasma protein bound which extends its half-life in circulation.

Indications: Hypertensive emergency.

Side effects: Hypotension, reflex tachycardia, increases in cardiac output, angina, and insulin inhibition.

Contraindications: Ischaemic heart disease, hyperglycaemia.

Chemical Name: Methyldopa
Tablet/Injection
Dosage: 250 Orally TDS

Side Effects: Drowsiness/Sedation, General Body Weakness, Impotence.

Nursing Implications:

i. Advise not to operate machine
ii. Men should not use it for a long time it may cause impotence

Centrally Acting Antihypertensives

These drugs decrease the sympathetic response from the brainstem to the peripheral vessels. They stimulate the alpha$_2$ receptors which in turn decrease sympathetic activity, increase vagus activity, decrease cardiac output and decrease serum epinephrine, norepinephrine and renin release. All these actions result in reduced peripheral vascular resistance.

Examples of centrally acting antihypertensives

Methyldopa (Aldomet)
Dose: 250mg 2-3 times daily initially and increased at intervals of 2 or more day's maximum of 3g. In elderly patients 125mg B.D daily increased gradually maximum of 2g daily.
Side effects: Dry mouth, Stomatitis, bradycardia, postural hypotension, headache, psychosis, arthralgia etc.
Interactions: iIduces CNS depression if taken with alcohol, increases hypotension, with haloperidol the drug increases psychosis.
Contraindications: Depression, active liver disease, phaeochromocytoma.

Nursing implications
i. Monitor blood studies before commencing the drug
ii. Monitor oedema in feet, legs daily and weigh the patient.
iii. Monitor CNS symptoms especially in the elderly, depression and change in mental status.

Other drugs in this group include Clonidine hydrochloride and monoxidine.

Self- Assessment test: MCQ: Choose the most appropriate answers.

1. An example of a centrally acting anti-hypertensive is.....
   a. Atenolol
   b. Methyldopa
   c. Enalapril
   d. Nifedipine

2. The best anti-hypertensive drug in pregnancy is.....
    a. Nifedipine
    b. Enalapril
    c. Atenolol
    d. Methyldopa

ANSWERS

1. B
2. **D**

6.7 Hematological Drugs

Haematinics

A hematinic is a medicine that increases the haemoglobin content of the blood. Haematinics are used to treat iron-deficiency anaemia. Haematinics are usually vitamins or minerals that are essential for normal erythropoiesis. Recently, they have been used in conjunction with folic acids to help your body produce and maintain new cells and prevent malignant DNA changes.

Examples of Haematinics include folic acid, vitamin B12, and iron. In addition, vitamin D, which helps maintain the health of bones—the reservoirs of new blood cells—may also have a role in protecting haemoglobin and in stimulating the formation of new blood cells.

However, indiscriminate treatment by the use of haematinics (drugs that stimulate production of red cells or haemoglobin) can be dangerous.

Examples of haematinics

Ferrous sulphate (Iron)

Presentation: Tablet containing 200mg and paediatric mixture containing 60mg/5mls.
Action: Replaces iron stores needed for red blood cell development, energy and oxygen transport, utilization. The drug is available as ferrous fumarate, gluconate, sulphate, carbonyl and polysaccharide.
Indications: Iron deficiency anaemia and prophylaxis for iron deficiency in pregnancy
Dose: 600mg-800mg tds oral adult. Maintenance 200-400mg daily after food. Child up to 1 year 5ml well diluted with water tds, 1-5 years 10mls well diluted in water tds
Side effects: GIT disturbances, black stool
Contraindications: aplastic anaemia and megaloblastic anaemia.

Folic acid

Presentation: Tablet containing 5mg
Action: Need for erythropoiesis, increases RBC, WBC and platelet formation in megaloblastic anaemia.
Indications: Prevention and treatment of folic acid deficiency

Dose: 5-20mg od oral
Side effects: Flushing and bronchospasms.
Contraindications: Sub-acute combined degeneration of spinal cord

Hydroxocobalamin (vitamin B_{12})
Presentation: Injection containing 1mg/ml
Action: Vitamin B12 exists in four major forms referred to collectively as cobalamins; deoxyadenosylcobalamin, methylcobalamin, hydroxocobalamin, and cyanocobalamin. Two of these, methylcobalamin and 5-deoxyadenosyl cobalamin, are primarily used by the body. Methionine synthase needs methylcobalamin as a cofactor. This enzyme is involved in the conversion of thamino acid homocysteine into methionine. Methionine in turn is required for DNA methylation. 5-Deoxyadenosyl cobalamin is a cofactor needed by the enzyme that converts L-methylmalonyl-CoA to succinyl-CoA. This conversion is an important step in the extraction of energy from proteins and fats. Furthermore, succinyl CoA is necessary for the production of haemoglobin, the substances that carries oxygen in red blood cells. http://www.drugbank.ca/drugs/DB00200
Indication: Pernicious anaemia
Dose: Initially 1mg IM repeated 5 times at intervals of 2-3 days. Maintenance dose is1mg every three months. Child dose as for adult dose.
Side effects: Nausea, headache, dizziness, fever, hypersensitivity injection site pain, hypokalaemia

Anti-Coagulants

Activity 6. 4

Well done! What is an anti-coagulant in your own words?

I hope you included the key words to describe it.

Compare you answer with the definition below.

An anticoagulant is a substance that prevents clotting of blood (thrombus formation or the extension of an existing thrombus). Anticoagulants therefore reduce the ability of the blood to clot so that unnecessary blood clots are not formed.

Antiplatelet drugs also help to inhibit thrombus formation by decreasing platelet aggregation.

Thrombolytics (fibrinolytics) such as streptokinase are used to break up thrombi; they are used to treat acute myocardial infarction, extensive deep vein thrombosis, major pulmonary embolism and acute arterial occlusion.

Nursing implications for anticoagulants

i. The dose of anticoagulants is critical; therefore the correct dose must be taken at the correct time.

ii. Over dosage is dangerous, any evidence of bruising or bleeding must be reported immediately. In hospital the urine must be tested daily for blood.
iii. As for as possible patients should not alter their lifestyle, but even one night of heavy drinking may alter efficacy of oral anticoagulants.
iv. There are many interactions with other drugs. These (even those obtained over the counter) should not be taken without medical advice.

All patients on oral anticoagulants should carry a card and attend regularly for estimates of prothrombin time.

Examples of anticoagulants

Heparin

Presentation: Injection containing 1000 units, 5000 units and 25000 units.
Action: It forms a complex with circulating protein antithrombin and induces a conformation change to activate it. The activated heparin-antithrombin complex interacts with and neutralizes activated clotting factors.
Indications: Deep vein thrombosis (DVT), disseminated intravascular coagulation (DIC) pulmonary embolism, prophylaxis in orthopaedic and general surgery, myocardial infarction and angina.
Dose: by IV injection loading dose of 5000 units followed by continuous infusion of 1000 units every hour over 24 hours. In pregnancy 10, 000 units over 12 hours. Deep vein thrombosis initially 10, 000 units to 20, 000 units every 12 hours or 2, 500 units/10kg every 12 hours.
Side effects: haemorrhage, osteoporosis and thrombocytopenia
Contraindications: haemophilia, thrombocytopenia peptic ulcer, recent cerebral haemorrhage, severe hypertension, severe liver disease, recent surgery/trauma, acute bacterial endocarditis.

Warfarin

Presentation: tablet containing 1mg, 3mg and 5mg.
Action: the drug antagonises vitamin K abd acts by inhibiting the hepatic reductase enzyme that converts vitamin K to its active form, thus impairing hepatic synthesis of vitamin K dependent clotting factors II, VII, IX and X.
Indications: prophylaxis and treatment of venous thrombosis and thromboembolism.
Dose: initially 10-30mg and maintenance dose according to prothrombin time
Side effects: haemorrhage, teratogenicity, urticaria
Contraindications: early and late pregnancy, peptic ulcer and severe hypertension.

Blood Derivatives

Activity 6.5

Do you know of any blood derivative? Write down the blood derivatives you know and compare with the one written down.

A blood (derivative) product is any component of the blood which is collected from a donor for use in a blood transfusion. Whole blood is uncommonly used in transfusion medicine these days. Most blood products consist of specific processed components such as red blood cells, blood plasma, or platelets. They serve many different functions, including transport of lipids, hormones, vitamins and electrolytes in the circulatory system and the regulation of a cellular activity and functioning and in the immune system. Other blood proteins act as enzymes, complement components, protease inhibitors or kinin precursors.

i. Albumins: maintains colloid osmotic pressure; create oncotic pressure and transport insoluble molecules.
ii. Globulins: participate in immune system
iii. Fibrinogen: needed for blood coagulation
iv. Regulatory proteins: regulation of gene expression
v. Clotting factors: conversion of fibrinogen into fibrin

Thrombolytic Enzymes

These are drugs which are used to dissolve (lyse) blood clots (thrombi). Blood clots can occur in any vascular bed; however, when they occur in coronary, cerebral or pulmonary vessels, they can be immediately life-threatening. Coronary thrombi are the cause of myocardial infarctions, cerebrovascular thrombi produce strokes, and pulmonary thromboemboli can lead to respiratory and cardiac failure. Therefore, it is important to rapidly diagnose and treat blood clots.

Mechanisms of Thrombolysis

Thrombolytic drugs dissolve blood clots by activating plasminogen, which forms a cleaved product called plasmin. Plasmin is a proteolytic enzyme that is capable of breaking cross-links between fibrin molecules, which provide the structural integrity of blood clots. Because of these actions, thrombolytic drugs are also called ‘plasminogen activators’ and ‘fibrinolytic drugs’.

Thrombolytics act on plasminogen, converting it into the active enzyme plasmin. Plasmin then shears up fibrin in the blood clot thereby breaking the clot apart. This then restores blood flow to the myocardium served by the thrombosed coronary artery.

There are three major classes of fibrinolytic drugs: tissue plasminogen activator (tPA), streptokinase (SK), and urokinase (UK). While drugs in these three classes all have the ability to effectively dissolve blood clots, they differ in their detailed mechanisms in ways that alter their selectivity for fibrin clots.

Tissue plasminogen activator produces clot lysis through the following sequence:

1. tPA binds to fibrin on the surface of the clot
2. Activates fibrin-bound plasminogen

3. Plasmin is cleaved from the plasminogen associated with the fibrin
4. Fibrin molecules are broken apart by the plasmin and the clot dissolves.

Plasmin is a protease that is capable of breaking apart fibrin molecules, thereby dissolving the clot. However, it is important to note that plasmin also breaks down other circulating proteins, including fibrinogen. But because of the relative fibrin specificity of tPA, clot dissolution occurs with less breakdown of circulating fibrinogen than occurs with SK and UK. Although tPA is relatively selective for clot-bound plasminogen, it activates circulating plasminogen thereby releasing plasmin, which can lead to the breakdown of circulating fibrinogen and cause an unwanted systemic fibrinolytic state. In summary, although tPA is relatively selective for clot-associated fibrin, it can produce systemic lytic state and undesirable bleeding.

SK forms a complex with plasminogen that releases plasmin. It does not bind preferentially to clot-associated fibrin and therefore binds equally to circulating and non-circulating plasminogen. Therefore, SK produces significant fibrinogenolysis along with clot fibrinolysis. For this reason, tPA is generally preferred as a thrombolytic agent over SK, especially when used for dissolving coronary and cerebral vascular thrombi.

It is important to note that the efficacy of thrombolytic drugs depends on the age of the clot. Older clots have more fibrin cross-linking and are more compacted; therefore, older clots are more difficult to dissolve. For treating acute myocardial infarction, the thrombolytic drugs should ideally be given within the first 2 hours. Beyond that time, the efficacy diminishes and higher doses are generally required to achieve desired lysis.

Specific Thrombolytic Drugs

Tissue Plasminogen Activators

These thrombolytic drugs are used in acute myocardial infarction, cerebrovascular thrombotic stroke and pulmonary embolism. For acute myocardial infarctions, tissue plasminogen activators are generally preferred over streptokinase.

- Alteplase (Activase®; rtPA) is a recombinant form of human tPA. It has a short half-life (~5 min) and therefore is usually administered as an intravenous bolus followed by an infusion.
- Retaplase (Retavase®) is a genetically engineered. It is usually administered as IV bolus injections. It is used for acute myocardial infarction and pulmonary embolism.
- Tenecteplase (TNK-tPA) has a longer half-life, it can be administered by IV bolus. It is only approved for use in acute myocardial infarction.

Streptokinase

Streptokinase is used in acute myocardial infarction, arterial and venous thrombosis, and pulmonary embolism. This compound is antigenic because it is derived from streptococci bacteria.

Natural streptokinase (SK) is isolated and purified from streptococci bacteria lacks fibrin which makes it a less desirable thrombolytic drug than tPA compounds because it produces more fibrinogenolysis.

Anistreplase is a complex of SK and plasminogen has more fibrin specificity and has a longer activity than natural SK and causes considerable fibrinogenolysis.

Urokinase

Urokinase (UK) is sometimes referred to as urinary-type plasminogen activator (uPA) because it is formed by kidneys and is found in urine. It has limited clinical use because, like SK, it produces considerable fibrinogenolysis; however, it is used for pulmonary embolism. One benefit over SK is that UK is non-antigenic; however, this is offset by a much greater cost.

Adverse Effects and Contraindications

Common adverse effects of all the thrombolytic drugs is bleeding complications related to systemic fibrinogenolysis and lysis of normal haemostatic plugs. The bleeding is often noted at a catheterization site, although gastrointestinal and cerebral haemorrhages may occur.

Self-Assessment test: TRUE OR FALSE: Indicate whether the following statements are true or false.

1. Streptokinase is an antigenic compound which is derived by streptococci bacteria.
2. Plasmin is a proteolytic enzyme that is capable of breaking cross-links between fibrin molecules.
3. A blood (derivative) product is any component of the blood which is collected from a donor for use in a blood transfusion.
4. Bleeding is not a common contraindication to thrombotic drugs.

ANSWERS

1. T.

2.T

3.T

4.F

6.8 Fluid and Electrolyte Balance

Electrolytes and replacement solution

Electrolyte

It is an ionic compound in solution of water; it is called an electrolyte because it can conduct electricity. Electrolytes are important body constituents because:

- Some conduct electricity; essential for muscle and nerve function.
- Some exert osmotic pressure, keeping body fluids in their own compartments.
- Some function in acid-base balance, as buffers to resist PH changes in body fluids.

Electrolyte replacement solutions provide both electrolytes (like sodium, potassium, and so forth) and fluid to the patient. Special electrolyte replacement solutions can be prepared in order to meet the needs of particular patients.

Examples of Electrolyte Replacement Solutions

Below are two of the solutions commonly used to replace electrolytes:

1) Lactated Ringer's solution (LR, Ringer's lactate, RL, Hartmann's solution). This product is a solution of electrolytes in water. It contains sodium, potassium, calcium, chloride, and lactate ions. The lactate ion in the product has an alkalizing effect. The lactate ion is metabolized in the liver to glycogen and ends up as carbon dioxide and water. Lactated Ringer's solution is used as a fluid replacement and as an electrolyte replacement. Lactated Ringer's is the preferred solution for heat injuries

2) Lactated Ringer's solution with 5% dextrose. This product is a combination of lactated Ringer's solution and 5% dextrose (D5RL) solution. The dextrose supplies 170 calories per 1,000 millilitres of solution. Lactated Ringer's solution with 5% dextrose is used as a fluid replacement, electrolyte replacement, and as a source of energy.

Sodium Chloride Solution (Normal Saline)

This product is a solution of sodium and water. Each 100 millilitres of solution contains 0.9 gram of sodium chloride. Nine-tenths percent Sodium chloride solution contains 154 milliequivalents of sodium and 154 milliequivalents of chloride in each 1,000 millilitres of solution. This product is used to provide fluid replacement and to replace moderate losses of the sodium ion (Na+). Normal saline is often used in trauma patients as a volume expander before blood products are available. However, colloid solutions are preferred for volume replacement in trauma patients on the battlefield.

Take Note 6.1

Sodium chloride solutions are also available in other concentrations. For example, 0.45 percent sodium chloride solution is commonly seen

Acidifiers and Alkalinizes

The optimum pH level is maintained by the balance between acids and bases produced by cells. Bases are substances that accept (or bind) hydrogen ions and when dissolved in water they produce an alkaline solution. Buffers are substances such as phosphates, bicarbonates and some proteins that maintain the [H+] within normal, but narrow, limits.

Some buffers 'bind' hydrogen ions and others 'bind' hydroxyl ions, reducing their circulating levels and preventing damaging changes.

For example, if there is sodium hydroxide (NaOH) and carbonic acid (H2CO3) present, both will ionise to some extent, but they will also react together to form sodium bicarbonate (NaHCO3) and water (H.OH). One of the hydrogen ions from the acid has been 'bound' in the formation of the bicarbonate radical and the other by combining with the hydroxyl radical to form water.

NaOH + H2CO3 = NaHCO3 + H2O

(Sodium Hydroxide) (Carbonic acid) (Sodium bicarbonate) (Water)

The substances in the complex buffer system that ‘bind‘ hydrogen ions are called the alkali reserve of the blood. When the pH is below 7.35, and all the reserves of alkaline buffer are used up, the condition of acidosis exists. When the reverse situation pertains and the pH is above 7.45, and the increased alkali uses up all the acid reserve, the state of alkalosis exists. The buffer systems maintain homeostasis by preventing dramatic changes in the pH values in the blood, but can only function effectively if there is some means by which excess acid or alkali can be excreted from the body. The organs most active in this way are the lungs and the kidneys.

Thank you very much for you attention.

You have come to the end of the topic. I hope you found it helpful. Here is a review of what you have learnt.

6.9 Summary

In this unit you have learnt about drugs which act on the cardiovascular system. Among these we discussed cardiac glycosides, anti-arrythmic agents, anti-angina agents, anti-hypertensive agents, drugs used in the treatment of anaemias and maintenance of fluids and electrolyte balance.We have also discussed modes of action for these drugs and how they interact with other drugs.

With this knowledge that you have gained, you can now handle patients who have been diagnosed with heart problems.

In the next unit you will learn about drugs that act on the respiratory system. But before then, complete the following self-test

6.10 Self-Assessment Test

Write True or False to the following statements

1. The following are examples of blood derivatives which maintain osmotic pressure
    a) Albumins
    b) Globulins
    c) Fibrinogen
    d) Plasma proteins
    e) fibrinogen

Answers to the Self-Assessment Test

Write True or False to the following statements

1. The following are examples of blood derivatives which maintain osmotic pressure

A. Albumins…….T

B. Globulins…….F

C. Fibrinogen……F

D. Plasma proteins…..F

E. Fibrinogen…….F

6.11 References

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UNIT 7: DRUGS ACTING ON THE RESPIRATORY SYSTEM

7.1 Introduction

Welcome to yet another interesting session. In the previous unit you were looking at drugs acting on the cardiovascular system. You gained knowledge on the classes and combinations of drugs that act on the heart and their adverse effects. In this session you are going to learn about drugs that act on the respiratory system.

The human respiratory system is a series of organs responsible for taking in oxygen and expelling carbon dioxide. The human body needs oxygen to sustain itself. A complete lack of oxygen is known as anoxia and a decrease in oxygen is known as hypoxia. If hypoxia sets in for four to six minutes brain cells are destroyed and an extended period of hypoxia which may lead to anoxia leads to brain damage and ultimately death. It is against this background that you must learn about drugs that act on the respiratory system in order to serve lives without causing any damage to the brain cells.

7.2 Objectives

By the end of this topic you should be able to describe and give examples of:

1. Antihistamines
2. Broncho-dilators
3. Expectorants and Anti-tussives
4. Decongestants
5. Oxygen

Activity : 7.1

Draw a well labelled diagram of the respiratory system

Well done, hope you drew a good diagram. Let us now learn about the drugs that affect the respiratory system

7.3 Antihistamines

Histamine is an important body chemical that is responsible for the congestion, sneezing, runny nose, and itching that a patient experiences with an allergic attack or an infection.

A histamine antagonist (commonly called an antihistamine) is a pharmaceutical drug that inhibits the action of histamine by either blocking its attachment to histamine receptors, or inhibiting the enzymatic activity of histidine decarboxylase; catalysing the transformation of histidine into histamine (atypical antihistaminics). It is commonly used for the relief of allergies caused by intolerance of proteins. Histamine produce increased vascular permeability, causing fluid to escape from capillaries into tissues, which leads to the classic symptoms of an allergic reaction such as a runny nose and watery eyes. Histamine also promotes angiogenesis (Development of new blood vessels).

Antihistamines are used to treat rash, hives, watery eyes, runny nose, itching, and sneezing due to allergies or the common cold. They may also be used to treat motion sickness, anxiety, or as a sleep aid (for insomnia). (©Medicine Net, 2013).

Mode of action

When the body is exposed to allergens, it releases histamines. Histamines attach to the cells in the body and cause them to swell and leak fluid. H1 receptor antagonists then inhibit smooth muscle constriction in blood vessels, respiratory and GI tracts. They also decrease capillary permeability and salivation and tear formation. Antihistamines are used for a variety of allergic disorders to prevent or reverse target organ inflammation. This can cause itching, sneezing, runny nose and watery eyes. Antihistamines prevent histamines from attaching to the cells and causing symptoms.

Side effects

The drugs may cause drowsiness, dizziness, and headache, loss of appetite, stomach upset, vision changes, irritability, dry mouth and nose. These effects should subside as your body adjusts to the medication. If they persist or become bothersome, inform your doctor. As a nurse you have to notify the doctor if the patient complains of breathing difficulties, pounding or irregular heartbeat, ringing in the ears and difficulties in urinating. (© Medicine Net, 2013).

Typical antihistamines include: generic names (the first part of the scientific name):

- Cetirizine
- Levocetirizine,
- Loratadine
- Desloratadine
- Fexofenadine
- Diphenhydramine
- Chlorpheniramine (common drug in Zambia)
- Azelastine,
- Brompheniramine.

Nursing implications for antihistamines

i. Review patient's history for evidence of glaucoma, prostatic hyperplasia or asthma. If one of these is present, consult the health care provider before initiating therapy.

ii. Assess the patient's work environment and consider whether drowsiness will affect safety and work performance.
iii. As a nurse ensure that you individualise patient assessment with the underlying pathologic condition.

Examples of antihistamines

Chlorpheniramine Maleate (Piriton)

Presentation: 4 mg tablet, 2mg/ml Elixir & expectorant

Indications: Allergies, motion sickness

Dose: Adult; 4mg 3-4 times daily

Children: 1-2yrs: 1 mg twice daily

Children: 2-12yrs: 1- 2 mg q4-6h, Max:12 mg daily

Side Effects: Sedation, Drowsiness, Dry mouth, blurred vision, GI disturbances, Headache

Contra-Indications: Hepatic Disease

Promethazine Hydrochloride (Phenergan)

Presentation: 10mg, 25mg to 50 mg tablets, 5mg/5ml Elixir

Indications: Allergies, pre-operative medication, motion sickness and sedative

Dose: Adult; 25 mg at night; 25 mg twice daily if needed.

Children: 2-10yrs: 5-25 mg daily in 1 to 2 divided dose

Side Effects: Sedation, Drowsiness, Dry mouth, blurred vision, GI disturbances, Headache

Contra-Indications: Hepatic disease

Azatadine (Optimine)

Presentation: 1 mg tablet

Dose: Adult 1 mg twice daily

Children: 1-12 years: 0.25-1 mg twice daily.

Side Effects: Sedation, Drowsiness, Dry mouth, blurred vision, GI disturbances, Headache.

Contraindications: hypersensitivity, glaucoma

Cetirizine (Zyrtec)

Presentation: tablet containing 10mg or oral solution containing 5mg/5mls

Dose: Adult; 10 mg daily

Children: 5 mg daily / 2.5 mg twice daily (2-6 years)

Side effects: Drowsiness, headache, psychomotor impairment.

Contraindications: In children with epilepsy

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Histamine is produced by mast cells ….

2. Patients taking antihistamines are not advised to operate heavy machinery …..

ANSWERS:

1.T

2. T

7.4 Bronchodilators

A bronchodilator is a substance that dilates the bronchi and bronchioles, decreasing resistance in the respiratory airway and increasing airflow to the lungs. Bronchodilators may be endogenous (originating naturally within the body), or they may be medications administered for the treatment of breathing difficulties. They are most useful in obstructive lung diseases, of which asthma and chronic obstructive pulmonary disease are the most common conditions. The three types of prescription of bronchodilator drugs are:

- Adrenoceptor agonists which are selective β2-agonists & other adrenoceptor agonists (short- and long-acting),
- Antimuscarinic bronchodilators
- Xanthine derivatives

Bronchodilators are divided into two categories that is sort-acting and long-acting.

Short-acting medications provide quick or ‘rescue’ relief from acute bronchoconstriction such as in asthma. Long-acting bronchodilators help to control and prevent symptoms by keeping the airways open for 12 hours; this helps prevent asthmatic attacks.

Beta 2-Agonists (Short Acting)

They are called ‘reliever’ or ‘rescue’ medicines because they stop asthma symptoms very quickly by opening the airways. Selective beta 2 agonists stimulate beta2 receptors in smooth muscle of the lung, promoting bronchodilation, and thereby relieving bronchospasms

These are the best medications for treating sudden and severe or new asthma symptoms. They work within 20 minutes and last four to six hours. They are also taken 15 to 20 minutes ahead of time, to prevent asthma symptoms triggered by exercise or exposure to cold air. Some short-acting β-agonists (for example salbutamol) are specific to the lungs; they are called β2-agonists and can relieve bronchospasms without unwanted cardiac (β1) side effects of nonspecific β-agonists (for example, ephedrine or epinephrine). Inform the doctor if your patient uses short-acting beta 2-agonists more than twice per week because it is a sign of unstable asthma. There is need to change the dose to long-term control medicines.

Examples of Beta2 agonits

Salbutamol

Presentation: Oral tablet containing 2mg or 4mg, syrup 2mg/5mls, aerosol 100mcg/metered inhalation, nebulizer solution 1mg/ml and 2mg/ml.

Dose Adult: 8 mg twice daily

Children: 4 mg twice daily

Salbutamol Inhaler (MDI), 100-200mcg up to three to four times daily

Side effects: Fine tremos, nervous tension, headache, peripheral dilatation and palpitations.

Contraindications: Hypersensitivity, severe cardiac disease and heart block.

Nursing implications

i. Assess respiratory function, vital capacity, forced expiration volume, lung sounds, heart rate for baseline data.
ii. Determine that patient has not received theophyliine.
iii. Monitor for evidence of allergic reactions, paradoxic bronchospasm and withhold the dose and inform prescriber.

Beta 2-Agonists Long Acting

These are long-term medications taken routinely in order to control and prevent bronchoconstriction. They are not intended for fast relief. These medications may take longer to begin working, but relieve airway constriction for up to 12 hours. Commonly taken twice a day with an anti-inflammatory medication (corticosteroid), they maintain open airways and prevent asthma symptoms, particularly at night.

Examples include

Formoterol

Presentation: Inhaler 4.5mcg / dose (Turbuhaer); Inhaler 9mcg / dose (Turbuhaer)

Dose adult: Inhaler 4.5mcg / dose (Turbuhaer), Children same as adult

Side effects: As above (salbutamol)

Contraindication: As above.

Nursing implications: As above.

Salmeterol

Presentation: Inhaler 25mcg / dose (MDI);50 mcg / dose (Accuhaler.

Dose adult: 50-100 mcg twice daily 50 mcg twice. **Children:** Same as adult

Side effects: As above

Contraindications and nursing implications: As above.

Corticosteroids

These have anti-inflammatory properties, they therefore help to relieve inflammation in the respiratory tree.

Examples include

Beclomethasone Dipropionate (Becotide)

Presentation: Aerosol, 50 micrograms/metered dose

Indications: Chronic airways obstruction, especially in Asthma not controlled by Bronchodilators

Dose: 1 to 2 puffs three to four times a day **.**

Side effects: Headache, dry mouth, dyspepsia, facial oedema, cough

Contraindications: Hypersensitivity, status asthmaticus, bacterial infection and viral infections.

Nursing implications

1. Conduct blood studies and discontinue drug if neutrophile count is less than 1000/mm^3.
2. Assess respiratory status, rest, rythym characteristics and listen to lung sounds
3. Assess for presence of fungal infections in mucous membranes.

Other corticosteroids include prednisolone, dexamethasone and hydrocortisone.,

Anticholinergic Drugs

There are two anticholinergic bronchodilators currently available. Examples of these drugs include;

Ipratropium bromide (Atrovent® HFA), available as a metered dose inhaler and nebulizer solution and It is used 4 times per day. It exerts maximum effect within 30-60 minutes and has a duration of action of 3-6 hours.

Presentation: Inhaler 20 mcg / dose (MDI)

Action; inhibits interaction of acetylcholine at receptor sites on the bronchial smooth muscle, resulting in decreased cyclic guanoosine monophosphate and bronchodilatation

Dose: Adult 20-80 mcg three to four times a day

Children: 20-40 mcg three to four times a day (≥6yrs)

Side effects: dry mouth, nausea, throat irritation, cough, headache, dizziness, constipation, laryngospasms.

Nursing implications

i. Monitor respiratory function and if patient has severe bronchospasm, a more rapid medication is required.
ii. Assess if patient is allergic to belladonna agengts (atropine) as allergy may occur with drug.

Tiotropium bromide (Spiriva®), dry powder inhaler.

It is used only once per day because of its long action property which can last for 24 hours. It is also used in the management of chronic obstructive pulmonary disease (COPD).

Presentation: Inhaler 18 mcg /dose

Dose: 8 mcg daily

Side effects: contraindication and nursing implications as above.

Take Note 7.1

Tiotropium bromide is not recommended in children and adolescents

Xanthine Derivatives

These are long-acting broncho-dilators that prevents asthma episodes by relaxing smooth muscle of the bronchi. It is used for reversible airway obstruction.

Examples of these drugs include

Theophylline

Presentation: tablet containing 175mg and capsule containing 60mg

Indications: Severe cases of asthma or those that are difficult to control.

Dose: Adult: Tablet 200 – 300 mg twice daily / Capsule 7-12 mg/ kg / day in two divided doses

Children: Tablet 10 mg / kg ((≥2yrs) twice daily

Side effects: nausea, vomiting, gastric irritation, diarrhoea, palpitations, tachycardia, insomnia, convulsions.

Contraindications: hypersensitivity and tachydysarrythymias.

Nursing implications

1. Monitor theophylline serum levels as toxicity may occur with small increase above 15mcg/ml.
2. Monitor intake and output as diuresis occurs with the drug.
3. Assess for signs of toxicity such as irritability, insomnia, restlessness, tremorand nausea.

Aminophylline

Presentation: Injection 25 mg / ml 10 ml

Dose: adult: 500 mcg / kg / hour IV infusion, adjust when necessary

Dose; children: 1 mg / kg /hour (6 months – 9 years) 800 mcg / kg /hour (10 – 16 years) IV infusion, adjust when necessary

Side effects:

- Nausea and/or vomiting
- Diarrhea
- Stomach ache
- Headache
- Rapid or irregular heartbeat
- Muscle cramps
- Jittery or nervous feeling
- Hyperactivity

Contraindications: hypersensitivity and tachydysrhythymias.

Nursing implications

i. Monitor theophylline serum levels as toxicity may occur with small increase above 20mcg/ml.
ii. Monitor intake and output as diuresis occurs with the drug.
iii. Give the drug slowly IV over 20 minutes to prevent sudden drop in blood pressure.

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Beta-2 adrenergic antagonists should be used with caution in patients with heart failure ….

2. Salbutamol is a commonly used bronchodilator …..

ANSWERS:

1. T

2. T

7.5 Expectorants and Anti-tussives

Expectorants are also known as bronchomucotropic agents. These drugs are used to assist in the removal of secretions or exudate from the trachea, bronchi, or lungs. They act by liquefying viscid mucus or mucopurulent exudates, that is , they are decongestants. They are used in the treatment of coughs to help expel these exudates and secretions.
Examples of such drugs include

Guaifenesin

Indication: It may be useful in the symptomatic relief of dry, nonproductive coughs and in the presence of mucous in the respiratory tract.

Dose: 100-400 mg qid P.O (5 to 20 ml every 4 to 6 hours.)

Ammonia & Ipecacuaha Mixture

Dose: 10-20 ml three to four times daily P.O

Mucolytics

These are drugs that react directly with mucus to make it more watery. They help make the cough more productive

Acetylcysteine

Dose: 100 mg two to four times daily

200 mg two to three times daily

600 mg once daily

Bromhexine

Dose; 8-16 mg three times daily po

Carbocisteine

Dose: 750 mg three times daily, then 1.5 g daily in divided doses.

Antitussives

Antitussives are drugs that suppress coughing, possibly by reducing the activity of the cough centre in the brain. Antitussive agents are used to relieve dry cough by specifically inhibiting or suppressing the act of coughing.

Adverse effects:

- Drowsiness
- Respiratory depression (for opioid antitussives)
- Constipation (for opioid antitussives)

Take Note 7.2

Preparations containing codeine or similar analgesics are not generally recommended in children & should be avoided altogether in those under 1 year of age

Nursing implications

You must observe for excessive suppression of the cough reflex (inability to cough effectively when secretions are present). This is a potentially serious adverse effect because retained secretions may lead to lungs collapse, pneumonia, hypoxia, hypercarbia, and respiratory failure

Examples of antitussive drugs

Codeine phosphate

Presentation: syrup containing 25mg/5ml

Indication: Dry, hacking, nonproductive cough that interfere with rest & sleep

Dose: 15-30 mg three to four times daily

Dextromethorphan

Mechanism of action and use: This is a synthetic non-narcotic derivative of codeine that acts as an antitussive. It is used to control nonproductive coughs by soothing minor throat and bronchial irritations.

Usual dose: 5 to 15 ml (10 to 30 mg) every 6 to 8 hours.

Pholcodine

Presentation: 5mg/5ml ELIXIR

Dose: 5-10 mg three to four times daily.

Diphenhydramine

Presentation: 10mg/ 5ml

Dose: 25 mg q4h, Max: 150 mg daily

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Some expectorants act by liquefying mucus ….

2. Antitusives are contraindicated in children below 2 years …..

ANSWERS:

1. T

2. T

7.6 Decongestants

Decongestants are drugs that help to shrink the blood vessels in the nasal membranes and allow the air passages to open up. Decongestants are chemically related to adrenaline, the natural decongestant, which is also a type of stimulant. Therefore, the effect of decongestants taken as a pill or liquid cause difficulty in going to sleep and elevating blood pressure and pulse rate. Sympathomimetics are used to reduce nasal congestion by stimulating alpha1-adrenergic receptors on nasal blood vessels, which causes vasoconstriction and hence shrinkage of swollen membranes.

Adverse effects: Rebound congestion develops with topical agents when used for more than a few days.

CNS stimulation (such as restlessness, irritability, anxiety and insomnia) occurs with oral sympathomimetics

Sympathomimetics can cause vasoconstriction by stimulating α-1 adrenergic receptors. More common with oral agents sympathomimetics cause CNS stimulation and can produce effects similar to amphetamine. Hence, these drugs are subject to abuse .The use of topical agents is limited to no more than 3 to 5 days

Nursing implications

i. Overuse of topical nasal decongestants can cause rebound congestion, meaning that the congestion can be worse with the use of drug. To minimise this, drug therapy should be discontinued gradually.
ii. The patient's blood pressure and pulse should be assessed before a decongestant is administered
iii. Inform the patient that nasal burning and stinging may occur with topical decongestants

Examples of nasal decongestants

Ephedrine Hydrochloride

Presentation: Ephedrine nasal drops, 0.5%

Indication: Nasa**l** decongestant not recommended for infants

Administration: Instil 1-2 drops into each nostril when required

Side-effects:Local irritation, after excessive use tolerance with diminished effect, rebound congestion

Oxymetazoline

Indication: Nasal decongestant not recommended for infants

Presentation: Nasal Drops 0.025% 20 ml, nasal spray 0.05% in 15mls

Dose: Children: 2-3 sprays BD; Adult: 2-3 sprays BD

Dose: Children: 2-3 sprays BD

Phenylephrine

Presentation: Nasal Drops 0.5% 10 ml

Dose: Adult: Several drops

Xylometazoline

Presentation: Nasal Drops 0.05% / 0.1%

Dose: Adult: 2-3 drops q8-10h (0.1%); Children**:** 2-3 drops q8-10h (2-12 years) (0.05%)

Self-Assessment Test: TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Decongestants are sympatholytic in action ….

2. Epinepherine is an example of a nasal necongestant ….

ANSWERS:

1. F

2. T

7.7 Oxygen

It is a gas prescribed for hypoxemic patients to increase alveolar oxygen tension in order to maintain the necessary arterial oxygen tension. It may also be prescribed for people with breathlessness, in the setting of end-stage cardiac or respiratory failure, advanced cancer or neurodegenerative disease, despite having relatively normal blood oxygen levels. Oxygen therapy provides the patient with extra oxygen, a gas that the body needs to work well.

Oxygen is widely used in emergency medicine, both in hospital and by emergency medical services or advanced first aiders.

A common use of supplementary oxygen is in patients with chronic obstructive pulmonary disease (COPD), the occurrence of chronic bronchitis or emphysema and asthma.

Oxygen is supplied in metallic cylinder painted black and whiter. It flows through a tube and is delivered to the patient's lungs in one of the following ways:

- Through a nasal cannula, this consists of two small plastic tubes, or prongs, that are placed in both nostrils.
- Through a face mask, which fits over the patient's nose and mouth?
- Through a small tube inserted into the patient's windpipe through the front of the neck. Oxygen delivered this way is called transtracheal oxygen therapy.

Hyperbaric oxygen therapy involves breathing pure oxygen in a pressurized room. Hyperbaric oxygen therapy is a well-established treatment for decompression sickness, a hazard of scuba diving. Other conditions treated with hyperbaric oxygen therapy include serious infections, bubbles of air in your blood vessels, and wounds that won't heal as a result of diabetes or radiation injury.

In a hyperbaric oxygen therapy room, the air pressure is raised up to three times higher than normal air pressure. Under these conditions, the lungs can gather up to three times more oxygen than would be possible breathing pure oxygen at normal air pressure.

Your blood carries this oxygen throughout your body, stimulating the release of substances called growth factors and stem cells, which promote healing.

Figure 9: A patient on oxygen therapy

Adopted from cleverland clinic web site

Types of oxygen sources

The main types of sources for oxygen therapy are:

1. Liquid storage

Liquid oxygen is stored in chilled tanks until required, and then allowed to boil (at a temperature of −182.96 °C)) to release oxygen as a gas. This is widely used in hospitals due to their high usage requirements, but can also be used in other settings.

2. Compressed gas storage

The oxygen gas is compressed in a gas cylinder, which provides a convenient storage, without the requirement for refrigeration found with liquid storage. Large oxygen cylinders hold 6,500 litres and can last about two days at a flow rate of 2 litres per minute. A small portable cylinder holds 170 litres and can last 4–6 hours.

Figure 10: A picture of oxygen cylinders

3. Instant usage

The use of an electrically powered oxygen concentrator or a chemical reaction based unit can create sufficient oxygen for a patient to use immediately.

These units are widely used in home and hospitals where oxygen therapy and portable personal oxygen, has the advantage of continuous supply without the need for additional deliveries of bulky cylinders.

Figure 11: Oxygen concentrator machine

7.8 Summary

You have come to the end of the topic lesson and I hope you found it interesting. Let us review what you have learnt.

In this unit you have learnt about drugs that act on the respiratory system; antihistamines, bronchodilators, expectorants and anti-tussives, decongestants as well oxygen administration therapy. They are as well categorized for effective selection of the drugs with regard to specific conditions, respectively. I hope this session has prepared you to handle any patient with respiratory tract problems and those who need emergency resuscitation to serve lives.

In the next unit you are going to learn about the cytotoxic drugs. These are special drugs used to treat mostly cancer conditions. But before then, test your understanding of this unit by doing the following self-test.

7.9 Self-Assessment Test

TRUE OR FALSE

State whether true (T) or false (F) against the following statements in the spaces provided

1. Smoking around the patient on oxygen therapy is prohibited ….

2. Retrolenta fibroplasia is a known side effect of oxygen therapy ….

ANSWERS:

1. T

2. T

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UNIT 8: CYTOTOXIC DRUGS

8.1 Introduction

Welcome to another interesting topic on cytotoxic drugs. In the previous unit you learnt about drugs that act on the respiratory system and their categories for effective treatment of respiratory tract problems. In this unit you will acquire knowledge on cytotoxic drugs. Cytotoxic drugs are therapeutic agents intended for, but not limited to, the treatment of cancer. Cancer is a disease characterized by a shift in the control mechanisms that govern cell survival, proliferation, and differentiation. Cells that have undergone neoplastic transformation may exhibit qualitative or quantitative chromosomal abnormalities, including various translocations and the appearance of amplified gene sequences. Such cells proliferate excessively and form local tumors that can compress or invade adjacent normal structures.

Hence there is need to use cytotoxic drugs to controll abnormal cell proliferation.These drugs are known to be highly toxic to cells, mainly through their action on cell reproduction. Cytotoxic drugs are increasingly being used in a variety of healthcare settings, laboratories and veterinary clinics for the treatment of cancer and other medical conditions such as rheumatoid arthritis, multiple sclerosis and auto-immune disorders. *(Basic & Clinical Pharmacology, 2006)*

8.2 Objectives

By the end of this unit you should be able to:

1. Describe the classification of cytotoxic drugs
2. Explain antidots to cytotoxic drugs
3. Outline the management of a patient on cytotoxic drugs

Activity 8.1

What is cancer?

Name any types of cancer that you know.

Write your suggested answers in your note book.

Good! Now proceed to learn about the classification of cytotoxic drugs

8.3 Classification of Cytotoxic Drugs

Cancer is a broad group of diseases involving unregulated cell growth. In cancer, cells divide and grow uncontrollably, forming malignant tumours, and invade nearby parts of

the body. Cancer may spread to more distant parts of the body through the lymphatic system or bloodstream. However, not all tumours are cancerous. For example, benign tumours do not invade neighbouring tissues and do not spread throughout the body. There are over 200 different known cancers that trouble humans.

It is against this background that cytotoxic drugs have increased in a number to use in the management of malignant disease. The use of anti-neoplastic drugs forms only one aspect of cancer therapy. Though there are other aspects and they include analgesia administration, nursing care and palliative surgery. Unless indicated, you must not administer cytotoxic drugs to pregnant women to prevent teratogenic effects.

Treatment of cancer is often palliative and is directed towards controlling the disease and distressing symptoms. Cytotoxic drugs must always be prescribed under the supervision of a cancer specialist. The cancer specialists make use of clinical management guidelines and treatment protocols, containing details of treatment regimens, side effects, dose adjustments and supportive care.

Haematologic effects

Cytotoxic chemotherapy is known to be potentially carcinogenic, mutagenic and is hazardous as defined by the Control of Substances Hazardous to Health (COSHH) regulations (2002). There is evidence to indicate that health care professionals involved in the preparations and administration of chemotherapy drugs can, if not using adequate safe handling measures, absorb potentially harmful quantities of these compounds therefore endangering their own lives. Under COSHH regulations all staff working with chemotherapy agents must be made and kept aware of risks and the circumstances under which they may be exposed to carcinogen and all the necessary measures should be adopted to protect staff from occupational exposure.

Non-malignant disease

Cytotoxic drugs are also used for their immunosuppressive or anti–proliferative effects in the treatment of auto–immune conditions, rheumatoid arthritis, psoriasis, or prevention of transplant rejection. This guidance should be referred to whenever chemotherapy agents and identified hazardous drugs are being used in any care setting. All staff must be aware of the risks of handling these drugs and the precautions that need to be taken to safeguard themselves and others.

Systemic Anti-Cancer Therapy (SACT) drugs are prescribed by specialist only and are not suitable for general use in primary care. Please note that as a nurse, you are not mandated to prescribe cytotoxic drugs unless you do oncology nursing. This is because of the effects the drugs have on the body cells. That is why only SACT drugs may be prescribed occasionally by general practitioners.

SACT drugs are:

a) Cyclophosphamide
b) Azathioprine
c) Methotrexate

d) Mercaptopurine
e) Hydroxyurea.

Types of treatment for Cancer

There are three methods used to treat cancer. And these include:

i. Chemotherapy
ii. Radiation therapy
iii. Surgery

The choice of these interventions depends on the disease pattern and either one or more interventions may or may not be used. However, treatment of cancer almost always is started with chemotherapy. There are several drugs used in the treatment of cancer and they are divided into the following categories:

a) Cell cycle non-specific drugs (these are the drugs which kill the cell whether actively dividing or at rest).

b) Cell cycle specific drugs (these drugs only kills the cell that are actively dividing). Their site of action is confined to one phase of cell division cycle. Drugs in this group kill dividing cells and are therefore toxic not only to cancer cells but also to health dividing cells in the body. (**Trounce's Clinical Pharmacology for Nurses 2013).**

The following are the groups used to treat cancer.

Alkylating drugs

Mechanism of action: These act by damaging DNA, thus interfering with cell replication or they cause cross linking of DNA strands, abnormal base pairing, or DNA strands breaks, thus preventing the cell from dividing. These drugs are most effective against cells in G_o phase of the cell cycle; however they destroy cells at any level of cell division.

Example: Cyclophosphamide (Cytoxan)

Indications: Hodgkin's disease, breast, lung ovarian cancers etc.
Dose: 1-5mg/kg over 2-5 days. Maintenance dose 1-5mg/kg/day. IV 40-50mg/kg in divided doses over 2-5 days with maintenance dose of 10-15mg/kg every 7-10 days.
Adverse effects: Haemorrhagic cystitis, neoplasm, leukopenia, thrombocytopenia, cardiotoxicity and hepatotoxicity.
Interaction: The effect of the drug is decreased by chloramphenical; it also decreases the levels of digoxin.
Contraindications: Hypersensitivity and severe bone marrow depression.

The following are other Alkylating drugs:

i. Bendamustine

ii. Busulfan
iii. Carmustine
iv. Chlorambucil
v. Estramustine
vi. Ifosfamide
vii. Lomustine
viii. Melphalan
ix. Thiotepa
x. Treosulfan

Anthracyclines and other cytotoxic antibiotics

The drugs are widely used and they act as radio mimetics and simultaneous use of the drugs should be avoided as it may result in markedly enhanced toxicity.

Mechanism of action

They act through interference with the DNA and RNA synthesis and thus they work by preventing cell division either through direct action on DNA itself or blocking the enzymes involved in replication.

Example: Doxorubicin (Adriamycin)

Indications: Cancer of the breast, bladder, ovary and lungs, leukaemia etc.
Dose: 60-75mg/m^2 as a single dose every 21 days or 30mg/m^2 IV for 3 days every 4 weeks.
Adverse effects: Oesophagitis, anaemia, hyperpigmentation of nails and tongue, anaphylaxis CHF etc.
Interaction: The drug increase cyclophosphamide induced cardiotoxicity and increased haemorrhagic cystitis, and increases radiation induced bone marrow depression.
Contraindications: Pregnancy, severe cardiac disease.

Other examples of drugs in this group includes:

i. Bleomycin,
ii. Dactinomycin,
iii. Epirubicin,
iv. Idarubicin,
v. Mitomycin,
vi. Mitoxantrone.

Antimetabolites

These agents resemble substances used by the cell for these metabolic processes.

They therefore become incorporated in the cell and can be metabolized hence causing death of the cell. Malignant cells often have the rapid a rapid metabolic turnover and therefore incorporate antimetabolites more rapidly than normal cells.

This makes it possible to kill majority of malignant cell without interfering too drastically with normal cells. Many agents resemble purines and pyrimidine which are building blocks for DNA. These drugs then block the building up of DNA by completing with the purines and pyrimidines hence causing cell death.

Examples of these drugs are:

Methotrexate- This drug specifically inhibit dihydrofolate reductase enzyme essential for the synthesis of purines and pyrimidines.
Indications: Maintenance therapy in childhood acute lymphoblastic leukaemia, choriocarcinoma, non-hodgkin lymphomas and other solid tumours.
Dose: 15mg/m^2 weekly in child with leukaemia
Adverse effects: Myelosuppression, mucositis and rarely pneumonia
Interaction: The drugs increases toxicity of alcohol, phenylbutazone and decreases the effects of digoxin
Contraindications: Renal failure as the drug is excreted by kidneys, hepatic failure, pleural effusion and ascites as the drug accumulates in these fluids.

Other drugs in the group include

i. Azacitidine
ii. Capecitabine
iii. Cladribine
iv. Clofarabine
v. Cytarabine
vi. Fludarabine
vii. Fluorouracil
viii. Gemcitabine
ix. Mercaptopurine
x. Pemetrexed
xi. Raltitrexed
xii. Tioguanine (thioguanine).

Vinca Alkaloids and Etoposide (Mitotic Inhibitors)

These are extracted from plants and are known as spindle poisons. These drugs act by interfering with DNA replication by binding to DNA. They inhibit microtubule assembly and cause cell cycle arrest in mitosis.

Examples of these drugs are:

Vincristine (Oncovin)

Indications: Cancer of the breast, lungs, and cervix, multiple myelomas, sarcomas etc.
Dose: Adult 1-2mgmg/m^2 IV and in children 1.5-2mg/m^2
Adverse effects: Leukopenia, neurotoxicity, ptosis and motor instability.
Interactions: The drug causes decreased digoxin levels, increases the action of methotrexate and increases radiation toxicity also increases the action of anticoagulants.
Contraindications: Pregnancy, hypersensitivity, infants and radiation therapy.

Other drugs in the group include

i. Vincritine (Oncovin)
ii. Vinblastine (Velbad)
iii. Vindesine
iv. Etoposide,
v. Vinorelbine

Steroids/ Hormones

These drugs act by altering the DNA transcription process. Examples include; Predinisolone and Hydrocortisone.

Regimens Commonly Used

Systemic chemotherapy aims to eradicate leukemia cells and induce remission. It is used when fewer than 5% of blast cells in the marrow and peripheral blood are normal. The specific chemotherapeutic treatment and radiation varies with the diagnosis.

Chemotherapy is given to destroy the malignant cells of the bone marrow and includes three phases: induction phase, consolidation phase and maintenance phase.

1. Induction phase

The client receives an intensive course of chemotherapy designed to induce complete remission are blast cells less than 5% of bone marrow cells and normal peripheral blood counts. Both conditions must be sustained for at least 1 month.

Once remission is achieved, the consolidation phase begins.

2. Consolidation phase

Modified courses of intensive chemotherapy are given to eradicate any remaining disease. Usually a higher dose of one or more chemotherapeutic agents are administered.

Maintenance Phase

Small doses of different combinations of chemotherapeutic agents are given every 3 to 4 weeks. This phase may continue for a year of longer and is structured to allow the client to live as normal life as possible.

Radiation Therapy

It may be administered as an adjuvent to chemotherapy when leukemic cells infiltrate the CNS, skin, rectum, and testes or when a large mediastinal mass is noted at diagnosis.

Targeted Therapy

This type of treatment only affects the tumour cells and spare normal cells, hence decreasing the associated toxicities.

Treat or Prevent Tumour Lysis Syndrome

This is a group of metabolic complication associated with rapid destruction of a large number of white blood cells. If WBC is high when chemotherapy is initiated, rapid cell lysis can lead to increased serum uric acid, phosphate, and potassium levels, decreased serum calcium levels

Common side-effects of cytotoxic drugs include:

Fatigue, reversible alopecia, nausea and vomiting, oral ulceration, diarrhoea, skin rashes, bone marrow suppression and effects on fertility

You must always discuss the possible effects on fertility and gonadal function must be discussed before treatment begins.

Activity 8.2: Case study

A patient diagnosed with breast cancer is commerced on anti-cancer drug therapy. Two weeks following treatment, she develops urethral toxicity, constipation, nausesa and vomiting. She is brought to the health facility for adivise and possible management.

Write down the possible advice/management that you would give to this patient in order to control these presenting problems.

8.4 Selected Antidotes to Some Specific Cytotoxic Drugs

Drugs used to counteract methotrexate induced mucositis and myelosuppression:

Calcium Folinate- Active ingredient is folinic acid and issued to counteract the folate-antagonist action of methotrexate and thus speed recovery from methotrexate induced mucositis or myelosuppression. Given 24hrs after methotrexate administration. Other drugs include calcium levofolinate and disodium folinate.

Drugs used to counteract urothelial toxicity:

Mesna- This drug is used to counter the effects of acrolein a metabolite of Cyclophosphamide, ifosfamide which causes urothelial toxicity which presents haemorrhagic cystitis.

8.5 Management of a patient on cytotoxic drugs

Patients on cytotoxic drugs present with syndromes of side effects. This is due to the toxicity of the drugs they are on. As a nurse you must explain to the patient the

expected side effects before they start treatment to enable the patient make an informed choice of their treatment.

Symptom control

Nausea and vomiting

Before the patient is given cytotoxic drugs, you must give pre-medication drugs such as antihistamines to prevent drug reactions and antiemetics to prevent vomiting. (Refer to drugs acting on the gastrointestinal tract)

Psychological Care

Educate the patient on how cancer comes about. Inform the patients that there is no cure to cancer and that treatment may be for life. You must involve other members of the family in caring of the patient for him/her to feel loved.

You must always assess the condition of the patient and explain nature of the disease to him/her. Before the patient is started on treatment, inform him/her about the potential side effects as a result of treatment. Reassure him/her that some side effects can go away while others are permanent. The patient may also experience skin changes and loss of hair (alopecia), but reassure him/her that the hair may recover 2 -6 months after treatment. Encourage the use of scarves, hats, or wigs as desired. Alopecia may be permanent with the whole brain radiation. Let the patient ventilate his /her fears and anxiety and make him feel comfortable in hospital.

Explain effects of drugs

Inform client that sexual libido may be altered during and after the acute phase of the illness because of other side effects of the therapy. Provide the client with emotional support and references to support groups. Provide manuals for alternative sexual positions and techniques.

Give support to patient and relatives and explain all procedures done on the patient to gain cooperation.

Pain control

Administer prescribed analgesics to relieve pain due to diseases progression. Minimize interruptions and reduce on visitors when patient is resting. Provide diversional therapy as well by providing reading materials, radio for listening to current affairs and music of their choice and television for watching movies.

Fluids and food

Give enough fluids to maintain hydration and prevent constipation and also to help excrete drug toxicity. Administer prescribed Blood transfusion if patient is anaemic. You must advise the patient to eat mixed diet containing proteins to repair worn out tissues, vegetables to promote the immunity of the body and energy giving foods for energy of the body cells.

Health education

You must educate the patient to avoid injuries because healing is a problem for them. Encourage them to take enough fluids and well balanced diet to booster his immunity. Emphasize on compliance to treatment and they should observe the review dates. Finally tell them on the importance on frequent blood test to detect early any side effect of the drugs they are on.

Precautions for Health Care Providers

Cytotoxic drugs are primarily eliminated from the patient by renal and hepatic excretion. All body substances might be contaminated with either the unchanged drug or active drug metabolites. As such, you as a health care provider must take the following precautions:

Wear protective gown (where there is a risk of splash), closed footwear, protective gloves and protective eyewear (where there is a risk of splash to the eye) when:-

i. Handling vomitus, blood, excreta and fluid drained from body cavities
ii. Handling bedpans, urinals, emptying urinary catheter bags, colostomy/urostomy bags and vomitus bowls
iii. Handling bed linen or clothing soiled with patient waste, or potentially contaminated with unchanged drug or active metabolites cleaning spills.

Personal contamination

Exposure to cytotoxic agents may occur through skin contact, skin absorption, inhalation of aerosols and agent particles, ingestion and needle stick injuries. Personal contamination may result from the following activities; agent preparation, agent administration, handling patient waste, transport and waste disposal or spills.

In the event personal contamination occurs:-

i. Immediately remove gloves or gown and any contaminated clothing and dispose of in purple cytotoxic waste container
ii. Package and launder clothing that is not overtly contaminated

You have come to the end of the unit.

8.6 Summary

In this unit you have learnt about cytotoxic drugs and how they slow the cell progression of malignant cells. You have also looked at the classes of cytotoxic drugs used to treat various cancers and some antidots used to counteract the effects of these drugs. In the next and last part of Pharmacology I, you will learn about drugs used to treat tuberculosis. But before then, complete the following self-test.

8.7 Self-assessment test

State TRUE or FALSE for the following statements :

Which of the following drugs are Alkylates?

A…….Vinblastine (Velbad)

B……Bendamustine,

C……..Busulfan,

D……Vincritine (Oncovin)

E……Etoposide,

F……Vinorelbine

G……Carmustine,

H……..Vindesine

I……..Chlorambucil,

J……..Cyclophosphamide,

Answers to the Self-Assessment Test

A……F……Vinblastine (Velbad)

B……T……Bendamustine,

C……T…….Busulfan,

D……F……Vincritine (Oncovin)

E……F…….Etoposide,

F……F……Vinorelbine

G……T……Carmustine,

H……F……..Vindesine

I……T……..Chlorambucil,

J……F……..Cyclophosphamide

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UNIT 9: DRUGS USED IN THE TREATMENT OF TUBERCULOSIS

9.1 Introduction

Welcome to the last unit in pharmacology part I where you will learn about drugs used in the treatment of tuberculosis. In the previous topic you learnt about cytotoxic drugs. You discovered that these drugs are used to treat cancer conditions. In this unit, you will learn about drugs used to treat tuberculosis. These drugs have been in use for a long period of time. At one time tuberculosis (TB) was perceived to have been eradicated. But since the advent of HIV, cases of TB have once again increased and the TB drugs have been transformed from single pills to combined doses. The majority of cases appear in young adult populations groups aged 15-45 years, the age group affected by HIV/AIDS.

9.2 Objective

At the end of this unit you should be able to:

1. Explain the drugs used in the treatment of tuberculosis
2. Outline special considerations in tuberculosis management

9.3 Drugs used in the treatment of tuberculosis

In Zambia, TB patients are treated under different categories. There are two categories for adults and two categories for children. Treatment for tuberculosis consists of two different phases of taking special combinations of drugs.

If anti-TB drugs are taken incorrectly or irregularly, the patient will not be cured and drug resistance is likely develop. The disease will be prolonged and will be more difficult to treat in the future. It is very important for you to advise TB patients to take all their medications correctly to be cured with a minimum risk of relapse.

The first treatment phase is known as the **initial or intensive** phase which lasts for 2 months and the other phase is known as the **continuation phase** which lasts for 4 months.

The only effective treatment of TB is taking adequate chemotherapy, which involves:-

- An appropriate combination of anti-TB drugs.
- Giving the correct dosages.
- Taken daily by the patient under supervision.
- For the stipulated duration of treatment.

As a nurse, you must ensure that you observe a patient directly as he/she swallows the TB drugs or train a community TB treatment supporter to watch each patient swallow the drugs. This is called directly observed treatment (also known as fully supervised

treatment). Directly observed treatment can take place at a hospital, a health centre or health post, the patient's workplace, or at the home of the patient.

Acitivity 9.1

Write four drugs used in the treatment of tuberculosis, indicating their dosages, side effects and nursing implications.

Write down the answers in your note book.

Excellent work! Let us now look at the examples of anti-TB drugs.

Five first-line anti-TB drugs

Isoniazid (H)

Mechanism of action: This is an important and specific drug in the treatment of TB. It inhibits the production of long-chain mycolic acids which are unique to the cell wall of mycobacterium species. It is bactericidal against dividing organisms but also has bacteriostatic effects on resting organisms. The drug kills more than 90% of the total population of TB bacilli during the first few days of treatment.

Dose: It is given according to the weight of patient.

Side effects

- Nausea and vomiting
- Peripheral neuropathy prevented by giving pyridoxine.
- Hepatoxicity which require regular LFT monitoring
- Systemic lupus erythematous like syndrome

Contraindication: In patients with liver disease

Nursing implications

i. Obtain culture and sensitivity, including sputum tests before treatment is commenced.
ii. Monitor liver function tests as these indices turn increase.
iii. Assess mental status often and affect, mood, behavioural changes; psychosis may occur with hallucinations and confusion.

Rifampicin (R)

Mechanism of action

This acts by inhibition of DNA-dependent RNA polymerase and has broad spectrum activity against mycobacterium laprae, brucellosis etc. The drug in Zambia the drug is reserved for TB and leprosy. It is bacteriocidal in action with high potency; it is the most effective sterilizing anti-TB drug and makes short-course chemotherapy possible.

Dose: given according to weight of patient.

Side effects

- Nausea and vomiting
- Pseudomembranous colitis
- Hepatoxicity
- Orange colouration of urine
- Induction of drug-metabolizing enzymes in the liver thus reducing the effect of drugs such contraceptives pills and other drugs such as phenytoin
- Various toxicity syndromes occur commonly with intermittent use- renal failure, shock like syndrome and acute haemolytic anaemia.

Contraindication: In patients with liver disease, patients taking neverapine.

Nursing implications

i. Monitor liver studies every month to ascertain ALT, AST and bilirubin levels.
ii. Culture and sensitivity tests must be done and sputum examination before treatment is commenced.
iii. Assess mental status often; affect, mood, behavioural changes, psychosis may occur with hallucinations and confusion.

Take note 9.1

The Isoniazid and rifampicin have the ability to prevent drug resistance.

Pyrazinamide (Z)

Mechanism of action: The drug acts through metabolites formed by the enzyme pyrazinamidase which is found in mycobacterium tuberculosis. The product pyrazinoic acid produces an acid intracellular pH to destroy the cell. In essence the drug is bactericidal to semi-dormant cells. Its sterilizing action is achieved in 2-3 months.

Dose: given per Kg body weight

Side effects

- Hepatoxicity with cessation of treatment when there is raise in plasma bilirubin
- Nausea vomiting
- Gout can occur through inhibition of uric acid excretion by the kidney.
- Arthralgia

Contraindications: Hypersensitivity, severe hepatic damage and acute gout.

Nursing implications

i. Monitor serum uric acid which may be elevated and cause gout symptoms.
ii. Monitor liver studies weekly ALT, AST, bilirubin, hepatic status, decreased appetite, jaundice, dark urine and fatigue
iii. Assess mental status often; affect, mood, behavioural changes, psychosis may occur with hallucinations and confusion.

Ethambutol (E)

Mechanism of action: It is uncertain how the drug acts, but it probably impairs synthesis of the cell wall of the mycobacteria. It is primarily bacteriostatic with low potency and particularly active against *Mycobacterium tubercle* and *Mycobacterium avium* which causes lung infections.

Dose: It is given per Kg body weight

Side effects

- Headache
- Dizziness
- Optic neuritis which initial red/green colour blindness, then reduced visual acuity.
- Peripheral neuritis

Caution: Warn patients to report visual changes

Contra-indications: Renal impairment, children under 6 years, elderly patients, optic neuritis, poor vision

Nursing implications

i. Assess patient for visual disturbances that may indicate optic neuritis, blurred vision, and change in colour perception which may lead to blindness.
ii. Monitor liver studies weekly ALT, AST, bilirubin, hepatic status, decreased appetite, jaundice, dark urine and fatigue
iii. Assess mental status often and affect, mood, behavioural changes, psychosis may occur with hallucinations and confusion.

Streptomycin (S)

This drug is bactericidal with low potency.

Presentation: Powder in containing 1g.

Mechanism of action: Anti-tuberculars act by inhibiting RNA or DNA, or interfering with lipid and protein synthesis, thereby decreasing tubercle bacilli replication

Indications: Second line treatment in tuberculosis

Dose: It is given/ kg body weight; 60 injections in TB treatment o.d

Side effects: Skin rashes, vertigo, tinnitus and deafness which is more common in the elderly, dermatitis and allergic oedema in staff handling the drug, seizures, confusion, hypotension, myocarditis, ototoxicity, nephrotoxicity

Contraindications: Pregnancy and young children, hypersensitivity, renal disease.

Nursing implications

i. Assess patient for previous sensitivity reaction to the drug or other aminoglycosides.
ii. Monitor for bleeding, ecchymosis, bleeding gums and haematuria.
iii. Obtain weight before treatment as dosage is weight dependent.

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Take Note 9.2

All drugs given in TB are weight related and TB national guidelines must be followed.

Zambia is now using the FIXED DOSE COMBINATIONS (FDC) that is 3FDC AND 4 FDC

Fixed dose combinations (FDCs) are tablets that contain 2, 3, or 4 different anti TB drugs in the appropriate strengths.

The following are the FDCs currently being used in Zambia:

1 for initial phase given for 2 months is called 3FDC and comprises of:-

- 60mgs Rifampicin
- 30mgs Isoniazid
- 150mgs Pyrazinamide

1 for continuation phase given for 4 months is called 2FDC and comprises:

- 60mgs Rifampicin
- 30mgs Isoniazid

Adult category 1 for initial phase is called 4FDC given for 2 months and comprise of:-

- 150mgs Rifampicin
- 75mgs Isoniazid
- 400mgs Pyrazinamide
- 275mgs Ethambutol

Adult category 1 for continuation phase given for 4 months is called 2 FDC:

- 150mgs Rifampicin
- 75mgs Isoniazid

Paediatric category 2 for initial phase is called 3FDC + streptomycin given for 3 months and comprise of:

- 60mgs Rifampicin
- 30mgs Isoniazid
- 150mgs Pyrazinamide
- Plus Streptomycin for 2 months

Paediatric category 2 for continuation phase given for 10 months is called 3FDC and comprises of:

- 60mgs Rifampicin
- 30mgs Isoniazid

Adult category 2 for initial phase given for 3 months is called 4FDC plus stremptomycin and comprise of:-

- 150mgs Rifampicin
- 75mgs Isoniazid
- 400mgs Pyrazinamide
- 275mgs Ethambutol
- 0.1g Streptomycin (streptomycin is given for 2 months)

Adult category 2 for continuation phase given for 6 months is called 2 FDC

- 150mgs Rifampicin
- 75mgs Isoniazid

Patients need to be followed up while on treatment in order to determine whether their condition is improving or not.

Patients with smear positive pulmonary TB should be monitored at 2, 5 and 8 months to review treatment progress.

Patients with smear negative sputum smears are done at 2 and 6 months.

Activity 9.2: Case study

Mr. M.N, weighing 40kg comes to your clinic complaining of chest pains, fever, productive cough and night sweats for the past two weeks now. During history taking, you discover that Mr. M.N was previously treated for sputum smear positive tuberculosis which he only took for 2 months and later could not afford to collect the drugs due to financial problems he encountered. Describe the management category that you are going to give to Mr. M.N and state reasons for your answer.

Write down the answers in your note book.

This is good! We can now look at the table showing how you can select a particular treatment for a T.B patient.

Table 6: Selecting a treatment category

ADULTS		***PAEDIATRICS***	
Category I	**Category II**	**Category I**	**Category II**
• All new patients (Smear positive, negative and extra pulmonary)	• All previous treated patients including smear positive retreatment, smear negative retreatment , extra pulmonary retreatment and treatment failures, treatment after default and relapse cases	• All new patients (Smear positive, negative and extra pulmonary)	• All previous treated patients including smear positive retreatment smear negative retreatment, extra pulmonary retreatment and treatment failures, treatment after default and relapse cases. • Serious forms of TB

Recommended treatment regimens by body weight using fixed-Dose combination drugs (Ministry of Health, 2008)

You determine the number of tablets to be given to the patient for the initial phase with the weight of the patient.

Table 7: Adult category I

Intensive Phase **2 months** **RHZE**		**Continuation Phase** **4 months** **RH**	
Weight	**No. Tabs**	**Weight**	**No. Tabs**
30 - 37kgs	2	2 7 – 37kgs	2
38 - 54kgs	3	38 – 55kgs	3
55 – 70kgs	4	56 – 75kgs	4
> 71kgs	5	> 75	5

Table 8: Adult Category II

Weight in Kg	**Intensive Phase**		**Continuation Phase**
Weight in Kg	**Intensive Phase 3 months**		**Continuation Phase 5 months**
	2 months	1 month	5 months
	RHZE + S	**RHZE**	**RHE**
30 – 37	2 0.50 g	2	2
38 – 54	3 0.75 g	3	3
55 – 70	4 1 g	4	4
>71	5 1 g	5	5

Table 9: Paediatric category I (New uncomplicated)

Weight in Kg	Intensive Phase 2 months RHZ (60/30/150)	Continuation Phase 4 months RH (60/30)
5 – 9	1	1
10 - 14	2	2
15 - 19	3	3
20 - 25	4	4
>25	Use Adult	Use Adult RH

Table 10: Paediatric category II (Retreatment and severe, complicated)

Weight in Kg	Intensive Phase 3 months		Continuation Phase 10 months
	2months		
	RHZ (60/30/150)	S	RH (60/30)
5 – 9	1	0.1g	**1**
10 - 14	2	0.2g	**2**
15 – 19	3	0.5g	**3**
20 – 25	4	0.5g	4
>25	**Use Adult**	0.5g	**Use Adult RH**

(Ministry of Health, 2008)

9.4 Special Considerations in Tuberculosis Management

Pregnancy

Ask women patients whether they are or may be pregnant. Most anti-TB drugs are safe for use in pregnancy with the exception of streptomycin. **Do not give streptomycin to a pregnant woman** as it can cause permanent deafness in the baby. Pregnant women who have TB must be treated, but their drug regimen must not include streptomycin. Refer pregnant TB patients to a clinician who can prescribe an anti-TB drug regimen.

Oral contraception

Rifampicin interacts with oral contraceptive medications with a risk of decreased protection against pregnancy. A woman who takes the oral contraceptive pill may choose between the following two options while receiving treatment with rifampicin: following consultation with a clinician, she could take an oral contraceptive pill containing a higher dose of estrogen (50mg). Alternatively, she could use another form of contraception.

Breastfeeding

A breastfeeding woman who has TB can be treated with the regimen appropriate for her disease classification and previous treatment. The mother and baby should stay together and the baby should continue to breastfeed in the normal way. Give the infant a course of preventive therapy (isoniazid for 6 months). When preventive therapy is completed, give the infant BCG if not yet immunized. (See section 2)

Children

Ethambutol is contra-indicated in children because it can lead to visual impairment and blindness.

HIV patients on antiretrovirals

TB patients with HIV infection or HIV/AIDS may experience a temporary worsening of symptoms and signs after beginning TB treatment. This is what is known as Immune Reconstitution Syndrome (IRIS). In TB patients infected with HIV, treatment with antiretrovirals may interact with treatment of TB, reducing the efficacy of antiretrovirals and of anti-TB drugs and increasing the risk of drug toxicity. In patients with HIV-related TB, the priority is to treat TB. Options are to defer antiretroviral treatment until TB treatment is completed; defer until completing the initial phase and use HE in the continuation phase; or use antiretrovirals that are less likely to interact with anti-TB drugs (Refer to National TB/HIV guidelines for further instructions).

Preventive therapy with Isoniazid for TB contacts aged less than 5 Years

1. Give preventive therapy with isoniazid ONLY to children who do not have TB or possible TB.
2. Children aged less than 5 years are at high risk. If a child aged less than 5 years has cough, fever or weight loss, refer to clinician for assessment of TB and HIV. If child does not have TB, give isoniazid (H) daily for 6 months to prevent TB.
3. Give 5 mg/kg isoniazid daily for 6 months up to a maximum of 300mg.
4. Review the child monthly and give 1 month’s supply at each visit.

Activity 9.3: Scenario

A patient has been receiving anti-TB drugs in the intensive phase for one week now. He comes to your health centre/clinic complaining of anorexia, nausea and vomiting and passing orange/red urine. How would you manage this patient?

Table 11: Side-effects and their management

Minor side-effects	**Management**
Anorexia, nausea, abdominal pain	Take drugs with food or gruel
Joint pains	Aspirin
Burning sensation in feet	Pyridoxine 100 mg daily
Orange/red urine	Reassure patient that this is expected (with rifampicin)

Major side-effects	**Management**
Itching of skin, skin rash	
Deafness *(confirm that this is not due to ear wax)*	
Dizziness, lack of balance	
Jaundice (yellow skin or eyes)	Stop anti-TB drugs.
Vomiting repeatedly a	
Difficulty with vision	Refer the patient urgently to a clinician.

You have come to the end of the topic and indeed of pharmacology I.

9.5 Summary

Wonderful! I. You have looked at drug used in the treatment of tuberculosis, you also looked at how tuberculosis is spread and special consideration in managing special groups of people diagnosed with different types of tuberculosis. It was interesting to go through all the topics in pharmacology.

Next time, we will be learning pharmacology II and we will start by looking at drugs acting on the endocrine system.

Until then, goodbye for now but start brainstorming on the drugs acting on the endocrine system after the self-test examination below.

9.6 Self- assessment test

1. Which drug cannot be administered to a child with tuberculosis
    A. Ethambutol
    B. Isoniasid
    C. Pyrazinamide
    D. Rifampicin
2. A pregnant woman can receive all the TB drugs except
    A. Ethambutol
    B. Isoniasid
    C. Pyrazinamide
    D. Rifampicin
    E. Streptomycin
3. Which TB drug causes peripheral neuropathy?
    A. Ethambutol
    B. Isoniasid
    C. Pyrazinamide
    D. Rifampicin
    E. Streptomycin
4. The follow up sputum examination of a patient who was diagnosed with TB smear positive is done at….
    A. 2,3,and 12
    B. 2,3 and 8
    C. 2,5 and 8
    D. 2 and 5
    E. 2 and 8
5. Which TB drug colours urine and body secretions?
    A. Ethambutol
    B. Isoniasid
    C. Pyrazinamide
    D. Rifampicin
    E. Streptomycin
6. For how long is a TB relapse adult patient treated

A. 2 months
B. 4 months
C. 6 months
D. 8 months
E. 12 months

7. Which drug is given to children under 5 years who were in contact of a TB patient?
A. Ethambutol
B. Isoniasid
C. Pyrazinamide
D. Rifampicin
E. Streptomycin

8. A Child with complicated TB is treated for…… months
A. 4
B. 6
C. 8
D. 10
E. 12

9.An adult with TB relapse is treated for…….months
A. 4
B. 6
C. 8
D. 10
E. 12

10. TB is spread through…….
A. Inhalation of TB droplets
B. Sex
C. Using same eating utensils
D. Exchanging clothes

Answers to the self-assessment test

1	2	3	4	5	6	7	8	9	10
A	E	B	B	D	D	E	E	C	A

9.7 References

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