SPMC JHCS

SELF-LEARNING MODULE

Administration of common cardiovascular drugs

Marie Francine C Basco,[1] Charlotte G Maligang,[1] Chillie M Ducante[1]

[1]Heart Institute, Southern Philippines Medical Center, JP Laurel Ave, Davao City, Philippines

Correspondence
Marie Francine C Basco,
mariefrancinebasco@gmail.com

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INTRODUCTION

In a hospital setting, handling and utilization of drugs and medicines may pose certain risks to patients. The World Health Organization (WHO) emphasized the importance of 'Medication Without Harm' in their slogan during the World Patient Day in 2022. The WHO aims to promote global awareness on medication-related harms and to engage stakeholders in taking action to reduce these harms.[1 2]

The United States Food and Drug Administration receives more than 100,000 suspected medication errors each year.[3] In 2021, the US National Center for Biotechnology Information reported that 7,000 to 9,000 Americans died due to a medication error.[4] In England's National Health Service, an estimated 712 preventable deaths from adverse drug reactions and an estimated 237 million medication errors occur per year.[5 6] The leading factors that increase the risk for errors are workload, interruptions or distractions in the workplace, and high patient-to-nurse ratio.[7]

Medications are important in therapeutics. Nurses are constantly challenged to ensure patient safety in medication administration, while facing daily obstacles like inadequate knowledge in safety protocols, excessive workloads, fatigue, illegible provider handwriting, and problems with the labeling of drugs.[8] Nurses can improve safety in medication preparation and administration by assessing their workplace, simplifying the medication reporting process, facilitating staff support when human errors occur, and staying updated with current practices of medication administration.[9]

For this self-learning module, we intend to focus on cardiovascular drugs. Ischemic heart disease has been the leading cause of death in the Philippines for the last 15 years.[10] Consequently, cardiovascular drugs are in the top ten most prescribed drugs in the clinical setting.[11-14]

LEARNING OBJECTIVES

This self-learning module brings together several important principles that can contribute to safe practices in the administration of common cardiovascular drugs. At the end of this module, you are expected to:

1. Enumerate the principles for safe medication administration.
2. Explain the indications, mechanisms of action, routes of administration, adverse effects, contraindications, and nursing considerations and monitoring of common cardiovascular drugs.
3. Apply drug dose calculations in clinical practice.

TARGET LEARNERS

Nurses who administer cardiovascular drugs in any clinical setting will find this self-learning module useful. To fully take advantage of the contents of this module, you should have basic knowledge in both pharmacology and fundamentals in nursing.

COURSE CONTENTS

This self-learning module has three parts.

1. Safe medication administration
2. Cardiovascular drugs commonly used in the clinical setting
3. Dose calculations

A 10-item self-assessment test with an answer key at the end of the module will help you evaluate your knowledge after going through the module.

Part 1. Safe medication

To a great extent, medication administration safety relies on several principles that underlie nursing practice. Nurses should apply the following principles when preparing for or performing medication administration to patients. Several sources refer to the following as the "rights of medication administration."[8 15-19] Each "right" enumerated below refers to either "right (i.e., correct) patient information, drug information, or procedures" or "patient's human right (i.e., in a similar sense as freedom and entitlement)."

When administering any drug, medicating nurses should obtain correct patient information, have the correct drug information, do the correct procedures, and respect the patient's human rights.

Obtain correct patient information

1. Nurses should ensure that the drug is given to the "right patient." They must read

the patient information in the medication administration record (MAR), check the patient's identification wristband, and request the patient to clearly state his/her complete name and date of birth (if conscious) for verification.

Have the correct drug information

2. Nurses should have the "right drug." They should read all essential parts of a drug order,[18] including: the patient's complete name, date and time when prescription was written, legible name of the prescribed drug, drug dosage, route of administration, frequency of administration, and the prescriber's signature. In addition, nurses should compare the MAR with the medication label for accuracy.
3. Nurses should know the "right reason" for medicating. They should assess if the patient fully understands the indication of the prescribed medication. Any concern or misconception prior to medication administration must be properly addressed by the nurse.
4. Nurses should verify the "right dose" of the drug. They should check the doctor's orders and the MAR for accuracy of transcribed dosage before preparing the medication. If the dosage seems inaccurate, they must consult with the prescribing physician.

Do the correct procedures

5. Nurses should have the "right history and assessment." They should check the patient's chart and interview the patient for drug allergies, or previous experiences of specific untoward reactions to any drugs.
6. Nurses should administer the drug at the "right time." They should check the MAR if the prescribed medication has already been given. The prescribed intervals according to hospital policy must be followed.
7. Nurses should administer the drug through the "right route." They should check the doctor's order, MAR, and the patient's status to ensure that the drug can be administered through the prescribed route. If they are unfamiliar with drug preparation and administration through the prescribed route, nurses should seek supervision from their head nurse or team leader.
8. Nurses should provide the "right documentation" of drug administration. They should follow the general guidelines for recording[18] in order to maintain patient confidentiality and meet legal standards. In recording medications, nurses must note down the five W's,[8] namely: (1) "when" for time; (2) "why" for the assessment, symptoms, and complaints; (3) "what" for medication, dosage, and route; (4) "where" for the application/injection site; and (5) "was" for adverse effects.
9. Nurses should give the "right education and information" to the patient. They should educate the patient about expected therapeutic effects, possible side effects, and potential drug-food interactions/incompatibilities related to the prescribed medication. The patient (and the patient's family, if applicable) should be informed on probable drug adverse effects to watch out for, and on when and how to report accordingly.

Respect the patient's human rights

10. Nurses should acknowledge the patient's "right to refuse." They must inform the patient about the importance of the prescribed medication in therapy. If the patient refuses to take the medication after thorough explanation, nurses must document the refusal in detail and notify the prescribing physician.

Part 2. Cardiovascular drugs commonly used in the clinical setting

It is important for nurses to have very good knowledge of all the medications that will be administered to their patients in order to help avoid medication errors. The common cardiovascular drugs used in the clinical setting are described below in terms of indications, mechanisms of action, administration routes, adverse effects, contraindications, and nursing considerations and monitoring.

Beta blockers

INDICATIONS. Beta-blockers are a class of drugs that are primarily used to treat cardiovascular diseases. These drugs are generally indicated for the treatment of tachycardia, hypertension, cardiac arrhythmias, myocardial infarction (MI), congestive heart failure, coronary artery disease, hyperthyroidism, glaucoma, migraine, benign essential tremors, and other conditions.[20 21]

MECHANISM OF ACTION. Beta-blockers bind to beta-adrenoceptors, where they block the binding of norepinephrine and epinephrine to these receptors, causing the inhibition of sympathetic activation.[22 23] Beta-blockers are classified as either non-selective (inhibit all beta-adrenergic receptors) or cardioselective (primarily blocks beta-1 receptors). Cardioselective beta-blockers—like atenolol, nebivolol, bisoprolol, metoprolol, betaxolol, and esmolol—cause cardiac effects, such as reduced heart rate and cardiac contractility, and decreased blood pressure (BP).[22 20] Non-selective beta-blockers—such as carvedilol, labetalol, propranolol, sotalol, and timolol—may cause bronchoconstriction, peripheral vasoconstriction, and metabolic imbalances,[22] as well as cardiac effects.[20 24]

ADMINISTRATION. Beta-blockers are available in three primary forms: oral, intravenous (IV), and ophthalmic.[20]

ADVERSE EFFECTS. Bradycardia and hypotension are the most common side effects. Fatigue, lightheadedness, cold clammy fingers and toes are also common adverse effects[20]

CONTRAINDICATIONS. Non-selective beta-blockers are contraindicated in patients with asthma or chronic obstructive pulmonary disease.[20 23] They should also be used with caution in patients with diabetes mellitus (DM) and Raynaud's phenomenon.[20 23 25]

NURSING CONSIDERATIONS AND MONITORING. When giving beta-blockers intravenously, nurses should monitor the patient's BP and pulse rate regularly during dose administration and adjustment, and periodically during therapy. The patient's heart rate must not be less than 60 beats per minute.[25] Patients on IV sotalol and propranolol should be on continuous ECG monitoring to check for the occurrence of cardiac arrhythmias during and after drug administration.[26 27]

Ace inhibitors

INDICATIONS. Angiotensin-converting enzyme (ACE) inhibitors belong to a class of drugs used in the treatment and management of hypertension, congestive heart failure, MI, stroke, hypertension with DM, chronic kidney disease (CKD), and other conditions.[28-30]

MECHANISM OF ACTION. ACE inhibitors block the enzyme involved in the renin-angiotensin-aldosterone system. This enzyme converts the inactive angiotensin I to the potent angiotensin II, which has vasoconstrictive and salt-retentive properties. The inhibition mechanism results in decreased formation of angiotensin II, causing vasodilation and decreased aldosterone secretion, and subsequently, lowering of BP.[28 29 31] ACE inhibitors also prevent the degradation of bradykinin–which contains vasodilatory and natriuretic properties–further enhancing the vasodilatory effects of these drugs.[28 32]

ADMINISTRATION. All ACE inhibitors (e.g., captopril, perindopril, fosinopril, lisinopril, ramipril) are given orally, except for enalapril, which may also be given intravenously.[28 29]

ADVERSE EFFECTS. ACE inhibitors are generally well-tolerated. Its most common side effect is dry cough, which appears in 5% to 20% of patients. Other adverse effects include dizziness, hypotension, syncope, hyperkalemia, dizziness, headache, urticaria, and rarely, angioedema.[29 30-32]

CONTRAINDICATIONS. ACE inhibitors are contraindicated in patients with a history of hypersensitivity reaction or angioedema after taking any ACE inhibitor or angiotensin-receptor blocker, or a history of idiopathic or hereditary angioedema. Other contraindications include pregnancy, renal artery stenosis, aortic valve stenosis, or hypovolemia.[29 30 32]

NURSING CONSIDERATIONS AND MONITORING. Patients should take the drug on an empty stomach one hour before or two hours after a meal. Nurses should monitor the patient's BP often, and check the patient's weight and fluid status regularly.[33 34] Nurses should also advise the patient to rise and change positions slowly to avoid orthostatic hypotension.[25 35 36]

Angiotension II receptor blockers

INDICATIONS. Several angiotensin II receptor blockers (ARBs)—e.g., irbesartan, losartan, valsartan, candesartan—that are in clinical use are beneficial to patients after MI, or those with hypertension, heart failure, or CKD, including diabetic nephropathy.[31 37]

MECHANISM OF ACTION. ARBs prevent the binding of angiotensin II to its receptor, thus inhibiting the effects of angiotensin II, including vasoconstriction and aldosterone release, which increase BP. These drugs work similarly as ACE inhibitors, except that they are not involved in the degradation of bradykinin.[31 37 38]

ADMINISTRATION. ARBs are available only in oral form. They are usually administered once daily for the treatment of hypertension, although some patients may benefit from twice-daily dosing of losartan if the BP

remains uncontrolled. Patients who cannot tolerate ACE inhibitors may be given ARBs as alternatives.[37 39]
ADVERSE EFFECTS. Patients taking ARBs may show similar adverse effects as patients on ACE inhibitors, except that the incidences of cough and angioedema are much less common in these patients.[31 37 40]
CONTRAINDICATIONS. ARBs are contraindicated in pregnancy, and in patients with bilateral renal artery stenosis. They are also contraindicated in patients who are taking agents that may increase serum potassium levels, such as those on ACE inhibitors, potassium supplements, or potassium-sparing diuretics.[31 36 40]
NURSING CONSIDERATIONS AND MONITORING. Nurses should instruct patients to avoid salt substitutes and foods with high levels of potassium. Since ARBs may also cause orthostatic hypotension, nurses should instruct patients to change positions more slowly.[25]

Calcium channel blockers

INDICATIONS. Cardiovascular indications for the use of calcium channel blockers (CCBs) are hypertension, angina, arrhythmia, pulmonary hypertension, and hypertrophic cardiomyopathy. Other indications include Raynaud's phenomenon, migraine headaches, and subarachnoid hemorrhage.[41 42]
MECHANISM OF ACTION. CCBs inhibit the influx of calcium into cells found on cardiac and vascular smooth muscles, cardiac nodal tissue, and the pancreas.[41 42] CCBs are classified into dihydropyridines (e.g., amlodipine, felodipine, nicardipine, nifedipine, nimodipine) and non-dihydropyridines, such as phenylalkylamine (verapamil), and benzothiazepine (diltiazem).[41-43] Dihydropyridines act as peripheral vasodilators.
ADMINISTRATION. CCBs can be given intravenously or orally.[41]
ADVERSE EFFECTS. CCBs are usually well-tolerated. Dihydropyridines can cause flushing, headaches, light-headedness, peripheral edema, excessive hypotension, and reflex tachycardia. Non-dihydropyridines may cause constipation, excessive bradycardia, and worsening cardiac output.[31 41 42]
CONTRAINDICATIONS. Non-dihydropyridines are contraindicated in patients with preexisting bradycardia, heart failure with reduced ejection fraction, or conduction defects, since these drugs may cause further worsening of bradycardia and further reduction of cardiac output. CCBs, especially non-dihydropyridines, should not also be given to patients on beta-blockers, since CCBs may augment the effects of beta blockade. Other contraindications include known hypersensitivity to the drug, acute MI, or pulmonary congestion.[31 41 42]
NURSING CONSIDERATIONS AND MONITORING. The BP, heart rate, and output of patients on CCBs—especially those with heart failure and those on nitrates—should be carefully monitored.[44] Nurses should advise patients who develop gingival sensitivity after long-term use of CCBs to maintain good oral hygiene. Patients who show signs of peripheral edema due to adverse effects of CCBs should also be instructed to elevate their legs.[45 46]

Antihyperlipidemic drugs

INDICATIONS. =190 mg/dL, those who are 40 to 75 years old with DM and LDL cholesterol levels >=70 mg/dL, or those who are 40 to 75 years old with a high risk of developing heart disease or stroke and LDL cholesterol levels >=70 mg/dL.[47] Lipid-lowering drugs can be used for primary or secondary prevention of cardiovascular events (unstable angina, nonfatal MI or stroke, coronary revascularization, or cardiovascular death).[48]
MECHANISM OF ACTION. The main classes of drugs that are used to treat dyslipidemia include statins, ezetimibe, fibrates, nicotinic acid, bile acid sequestrants (BAS), and proprotein convertase subtilisin/kexin type 9 (PCSK9) inhibitors.[48] Statins (e.g., simvastatin, atorvastatin, rosuvastatin, pravastatin) inhibit the enzyme, hydroxymethylglutaryl (HMG) CoA reductase, from binding to its active site during cholesterol biosynthesis in the liver. Ezetimibe inhibits the absorption of dietary and biliary cholesterol at the brush border of the small intestine. Fibrates (e.g., gemfibrozil, fenofibrate) are weak agonists of peroxisome proliferator-activated receptor α, which is present in many tissues, including adipose. Activation of this receptor by fibrates results in an enhanced catabolism of triglyceride-rich particles and very low-density lipoproteins. Nicotinic acid, or niacin, inhibits a hormone-sensitive lipase in adipose tissues, preventing the breakdown of triglycerides into free fatty acids and reducing the transport of free fatty acids to the liver. BAS (e.g., cholestyramine) bind bile acids in the intestine, thus preventing the reabsorption of bile acids, which in turn results in a reduced amount of cholesterol in the hepatic pool.[31 48-50]
ADMINISTRATION. All classes of antihyperlipidemic drugs are given orally except for PCSK9 inhibitors, which are administered by subcutaneous injections. Lipid-lowering therapy drugs are administered at bedtime in order to maximize their effectiveness, since most cholesterol synthesis occurs at night.[48]
ADVERSE EFFECTS. The most common adverse effects of statins are muscle pain and weakness, as well as new-onset DM and elevated liver transaminases. Other adverse effects include mild gastrointestinal symptoms (ezetimibe, fibrates), flushing/ urticaria (nicotinic acid), or constipation/flatulence (BAS).[31 48]

CONTRAINDICATIONS. A history of anaphylaxis or angioedema is an absolute contraindication for the use of lipid-lowering drugs. Statins are contraindicated in pregnancy and children. Ezetimibe, which is used as an adjunct to statin for resistant hyperlipidemia, is contraindicated in patients with active liver disease who are also on statin therapy. Fibrates are contraindicated in patients with alcoholism or renal/liver impairment. Nicotinic acid is contraindicated in patients with active liver disease, as well as those with active peptic ulcers and arterial hemorrhage. BAS are contraindicated in patients with complete biliary obstruction and severe hypertriglyceridemia.[31 48]

NURSING CONSIDERATIONS AND MONITORING. Nurses must instruct patients not to chew, crush, or cut the tablets. For patients taking BAS, nurses should administer other drugs 1 hour before or 4 to 6 hours after taking the BAS. Nurses should assess patients who are chronically taking statins for signs of muscle weakness or pain. They should instruct the patients to immediately report these symptoms to their physicians, who can determine whether the drug needs to be discontinued or not. The patients' hepatic function should also be checked regularly.[51- 53]

Diuretics

INDICATIONS. Diuretics are a class of drugs used for a variety of edematous (pulmonary edema resulting from heart failure, ascites due to liver cirrhosis, renal insufficiency due to nephrotic syndrome or Liddle syndrome, raised intracranial pressure after traumatic brain injury and cerebral edema, raised intraocular pressure due to glaucoma) and non-edematous (essential hypertension, nephrolithiasis or hypercalciuria, poisoning resulting from salicylate, phenobarbital, or lithium toxicity) conditions.[54]

MECHANISM OF ACTION. Diuretics are drugs that increase the production and volume of urine. This drug class consists of five different groups—thiazide diuretics, loop diuretics, osmotic diuretics, potassium-sparing diuretics (PSDs), and carbonic anhydrase inhibitors (CAIs)—classified based on their mechanism and site of action along the nephron. Thiazide diuretics (e.g., hydrochlorothiazide, indapamide), the most commonly used diuretic, block the sodium-chloride channels in the proximal segment of the distal convoluted tubule. Loop diuretics (e.g., furosemide, bumetanide), the most potent among all the diuretics, inhibit the sodium-potassium-chloride cotransporter in the thick ascending limb, thus preventing the largest amount of sodium reabsorption (25%). Osmotic diuretics (e.g., mannitol), raise the osmolarity of tubular fluids in the proximal tubule and the thick ascending limb of the loop of Henle. PSDs (e.g., spironolactone) antagonize the action of aldosterone at the distal segment of the distal tubule. CAIs (e.g., acetazolamide) block carbonic anhydrase on the luminal membrane and inside proximal tubule cells to decrease sodium reabsorption at these sites.[54-56]

ADMINISTRATION. Administration of diuretics is usually via the oral route, but in hospital settings, especially for cases of advanced heart failure, IV administration—continuous infusion is preferable to bolus injection—may be necessary in order to achieve maximum potency.[54]

ADVERSE EFFECTS. The most common adverse effect found in all diuretics is mild hypovolemia, which may lead to severe hypovolemia, if patients were overtreated with the drug. All diuretics—with the exception of PSDs—can cause hypokalemia. Other generalized side effects include headache, restlessness, weakness, and lethargy. Metabolic and acid-base disturbances are also common adverse effects.[54 55]

CONTRAINDICATIONS. Hypersensitivity to any of the drugs is a contraindication. Patients with sulfa allergies are also advised not to take sulfonamide-derivatives such as loop diuretics, thiazide diuretics, and CAIs. Diuretics are also contraindicated in patients with anuria and severe dehydration. Loop diuretics are contraindicated in patients with hypokalemia or hypotension, or in cases wherein volume depletion is expected, such as during major surgery.[54]

NURSING CONSIDERATIONS AND MONITORING. In patients admitted in the intensive care unit, strict monitoring and updating of urine output and arterial blood gases, as well as measuring daily body weight, are necessary in order to ensure patient safety. For patients with edema, it is important to assess the extent of edema by regularly auscultating lung sounds and measuring the abdominal girth. Nurses should also check for signs of dehydration, and signs/symptoms of hyperkalemia or hypokalemia.[54 57]

Anticoagulants

INDICATIONS. Anticoagulants are indicated mainly for atrial fibrillation, venous thromboembolism (deep venous thrombosis and pulmonary embolism), and post-prosthetic heart valve replacement, and for the prevention of ischemic stroke. Other indications include acute MI, left ventricular thrombus, left ventricular aneurysm, and heparin-induced thrombocytopenia.[58 59] These drugs are also indicated in pregnant patients with valvular heart disease, or with other pregnancy-related complications such as antiphospholipid antibody syndrome, antithrombin deficiency, or other thrombophilias.[60]

MECHANISM OF ACTION. The different types of anticoagulants are grouped according to the part of the coagulation cascade they affect. These include unfractionated heparin (UFH) drugs, vitamin K dependent

antagonists (VKA), low molecular weight heparin (LMWH) drugs, direct thrombin inhibitors (DTI), and direct factor Xa inhibitors. UFH drugs (e.g., heparin) bind to and increase the activity of antithrombin III, and inactivate various clotting factors. VKA (e.g., warfarin) inhibit vitamin K epoxide reductase, thus preventing the formation of the active form of the vitamin K dependent-factors. LMWH drugs (e.g., enoxaparin), are derivatives of UFH drugs. LMWH drugs have a similar mechanism of action to UFH drugs, but LMWH drugs have fewer side effects, and have a more predictable anticoagulation without the need for close monitoring. DTI (e.g., dabigatran) act by reversibly binding to thrombin, thus inhibiting the conversion of fibrinogen to fibrin. Factor Xa inhibitors (e.g., apixaban) bind selectively and reversibly to factor Xa, thereby preventing the conversion of prothrombin to thrombin.[58 61 62]

ADMINISTRATION. Anticoagulants are given either orally or parenterally. Most parenteral anticoagulants are administered in the hospital. UFH drugs are administered parenterally, either subcutaneously for prophylaxis or as slow IV infusion for treatment.[62 63]

ADVERSE EFFECTS. Hemorrhage is the most significant adverse effect of anticoagulant therapy. Bleeding episodes are associated with anticoagulant intensity and route of administration, as well as with the concomitant use of antithrombotic or fibrinolytic drugs. Other adverse effects include dyspepsia, abdominal pain, headache, dizziness, and dyspnea. Rarely, warfarin may also cause skin necrosis and limb gangrene, usually on the first 3 to 6 days after beginning therapy.[64]

CONTRAINDICATIONS. Absolute contraindications to the use of anticoagulants include active bleeding, coagulopathy, recent major surgeries, major intracranial pathology (prior intracranial hemorrhage and/or intracranial masses), and major trauma. Relative contraindications include gastrointestinal bleed, aortic dissection or aneurysm, and low-risk surgeries.[58 65] Anticoagulants should be used with caution in the elderly and pregnant patients.[66]

NURSING CONSIDERATIONS AND MONITORING. The patient's baseline status for complete blood count and clotting studies should be obtained. Nurses should assess and monitor for signs of blood loss to promote prompt intervention. In order to protect the patient from injury that may precipitate bleeding, nurses should set up safety precautions (e.g., raising handrails to minimize fall) while the patient is admitted. Hospitalized patients should be instructed to ambulate regularly to reduce the risk of thromboembolism. Unnecessary IV catheter insertion and venipuncture should also be avoided.[58 67]

Antiplatelet drugs

INDICATIONS. The indications for antiplatelet therapy are acute coronary syndrome, acute ischemic stroke, transient ischemic attack (TIA), and peripheral arterial disease. They are also used for the primary prevention of coronary artery disease and venous thromboembolism. Other indications include essential thrombocytosis, Kawasaki disease, rheumatic heart disease, acute pericarditis, and atrial fibrillation with a high risk of stroke.[68 69]

MECHANISM OF ACTION. Antiplatelet drugs inhibit platelet aggregation. They are categorized into different groups based on their mechanism of action, namely: cyclooxygenase (COX) inhibitors (e.g., aspirin), adenosine diphosphate (ADP) receptor blockers (e.g., clopidogrel), phosphodiesterase (PDE) inhibitors (e.g., dipyridamole, cilostazol), glycoprotein IIb/IIIa (GpIIb-IIIa) inhibitors (e.g., tirofiban), and thrombin receptor antagonists (e.g., vorapaxar). Aspirin irreversibly inhibits platelet thromboxane A2 synthesis, thus reducing arterial thrombus formation. ADP receptor blockers or thienopyridines inhibit ADP-induced platelet activation and aggregation. Cilostazol predominantly inhibits PDE3, while dipyridamole inhibits PDE5, and both have antiplatelet and vasodilatory properties. GpIIb-IIIa inhibitors block the final common pathway for platelet aggregation.[69 70]

ADMINISTRATION. Antiplatelets are available as oral, rectal, and IV preparations. Oral antiplatelet drugs include aspirin, clopidogrel, cilostazol, and dipyridamole. Aspirin, as a rectal suppository, is available to patients who cannot take this drug orally. Glycoprotein IIb/IIa inhibitors are administered intravenously, and only for a short period.[69]

ADVERSE EFFECTS. The most common adverse effects associated with antiplatelet drug use are aspirin-induced asthma, signs of bleeding (e.g., ecchymosis, hematuria, epistaxis, hemorrhage, upper gastrointestinal (GI) bleeding, menometrorrhagia), nasal polyps, and thrombocytopenia. Less common side effects include fever and chills, sore throat, arthritis, arrhythmia, and jaundice.[24 69]

CONTRAINDICATIONS. Contraindications to the use antiplatelet drugs include hypersensitivity to the drug, upper GI bleeding (active peptic ulcer), previous intracerebral hemorrhage, active pathological bleeding, severe hepatic dysfunction, large esophageal varices, coagulopathies or other bleeding disorders, and major surgery within 72 hours.[69 71]

NURSING CONSIDERATIONS AND MONITORING. Nurses should monitor any acute adverse symptoms, especially among patients receiving dual antiplatelet therapy. Patients on antiplatelet therapy, as well as those on anticoagulants, should also have baseline blood count and bleeding parameters. Patients must be educated on ways to promote safety and to avoid bleeding, especially on daily activities like brushing teeth and shaving. These drugs should also be administered with meals to prevent GI upset.[67 69]

Part 3. Dose calculations

Medication administration does not only involve what and when to give the drug, but also how much drug should be administered to the patient during a certain period of time. In this section, two computations—one to calculate the drug quantity desired and another to calculate the drip rate—that nurses commonly use before medication administration are presented.

Desired-over-have or formula method

The desired-over-have or formula method is an equation used to compute the drug quantity desired (x) for patient administration to fulfill a doctor's order (dose desired), given the fixed dose (dose on hand) per fixed quantity (quantity on hand) of the stock drug.[72] Among pediatric patients, drug doses vary according to body weight or body surface area.[18 73] However, calculating a drug dose based on the recommended dosage (mg/kg/day) and the child's body weight is usually not required for nurses.

The quantity desired in milliliters (mL) is calculated as follows.

Let x be equal to the quantity desired

$$x = \frac{D}{H}(Q)$$

where: D = dose desired
H = dose on hand
Q = quantity on hand

Example 1 A physician ordered 250 mcg digoxin elixir for a patient with heart failure. The available supply of digoxin elixir is 50 mcg/mL. What is the quantity of digoxin elixir to be administered for this dose?

Given:
D = 250 mcg
H = 50 mcg
Q = 1 mL
x = ?

Solution:

$$x = \frac{D}{H}(Q)$$

$$x = \frac{250\ \cancel{mcg}}{50\ \cancel{mcg}}(1\ mL)$$

$$x = 5\ (1\ mL)$$

$$\boxed{x = 5\ mL}$$

Therefore, the quantity of digoxin elixir 50 mcg/mL to be administered for this dose is 5 mL.

Drip rate computation

Drugs administered through IV infusions are usually initiated, monitored, and maintained by nurses as prescribed by the physician. Before starting any infusion, the nurse must determine the flow rate of the infusion. The doctor's order usually includes (1) the type and amount of diluent (e.g., 500 mL of 5% dextrose in water), (2) the dose on hand of any drug to be added to the infusion (e.g., 800 mg of dopamine), and (3) the hourly infusion rate (e.g., 10 mL/hr).[18] Once the nurse has identified these, the nurse then computes for the drip rate (e.g., 10 gtt/min), which is based on the infusion flow rate and the drop factor (e.g., 20 gtt/mL) of the infusion set.

The drip rate in gtt/min is calculated as follows.

Let x be equal to the drip rate

$$x = \frac{I}{60}(F)$$

where: I = hourly infusion rate
60 = number of minutes per hour
F = drop factor

Example 2 A physician ordered 50 mg of nitroglycerin in 250 mL of 5% dextrose in water for a patient, to run at 3 mL/hr using a microset with a drop factor of 60 µgtt/mL. What should be the drip rate in µgtt/min for this infusion?

Given:
I = 3 mL/hr
60 = 60 min/hr
F = 60 µgtt/mL
x = ?

Solution:

$$x = \frac{I}{60}(F)$$

$$x = \frac{3\ \cancel{mL/hr}}{60\ min/\cancel{hr}}(60\ \mu gtt/\cancel{mL})$$

$$x = 0.05\ \cancel{mL}/min\ (60\ \mu gtt/\cancel{mL})$$

$$\boxed{x = 3\ \mu gtt/min}$$

Therefore, the drip rate for this infusion should be 3 µgtt/min.

SUMMARY

In this self-learning module, you have read about the ten principles of safe medication administration. You have also read about the indications, mechanisms of action, routes of administration, adverse effects, contraindications, and nursing considerations and monitoring of eight classes of cardiovascular drugs. Finally, you have read about two common drug dose calculations, with their respective examples. Hopefully, this module has helped you improve your knowledge on administration of common cardiovascular drugs.

SELF ASSESSMENT

1. Which charting entry is the best example of proper documentation?
    a. Notified Dr. Agos of BP 90/40, 1 hour after initial dose of chlorothiazide.
    b. Client fell from bed after drinking the last dose of potassium chloride.
    c. Client drunk on admission, refused to take all medications.
    d. Large hematoma noted on IV site.

2. The pharmacist has restocked atorvastatin 10 mg tablets for your patient who was prescribed with atorvastatin 20 mg per orem at bedtime. How many tablets will you administer?
    a. 1 tablet
    b. 2 tablets
    c. 3 tablets
    d. 4 tablets

3. The nurse should determine the following parts of the doctor's order before starting any IV infusion, EXCEPT:
    a. drop factor
    b. hourly infusion rate
    c. type of diluent
    d. amount of diluent

4. A patient tells the nurse, "The color of the capsule seems different compared to the one I usually take." Which is the best response?
    a. "The doctor ordered a different brand."
    b. "Don't mind it and just take your medicine."
    c. "I'll leave the medicine here while I check with the doctor."
    d. "Let me recheck your medication orders."

5. The following antihyperlipidemic drugs are given orally EXCEPT one, which is:
    a. simvastatin
    b. cholestyramine
    c. evolocumab
    d. ezetimibe

6. Presume that the full name of the client, the date and time that the order was written, and the physician's signature are all present on the doctor's order sheet. The following medications are listed on the medication administration record. Which would you question?
    a. Furosemide 40 mg, per orem now
    b. Ampicillin 500 mg, every 6 hours, IV per bolus
    c. Human insulin (Humulin L) 36 units, subcutaneous, every morning before breakfast
    d. Codeine every 4-6 hours, per orem, as needed for pain

7. Which nursing consideration should be the priority when giving beta blockers to a patient?
    a. The patient should be fully awake and oriented to place and time
    b. Vital signs must not indicate bradycardia
    c. Capillary blood glucose test must not exceed 180 mg/dL
    d. Time of last meal or food consumption should be (at least) 2 hours ago

8. The following are contraindications for giving ARBs, EXCEPT:
    a. fever
    b. pregnancy
    c. hyperkalemia
    d. concomitant use of potassium supplements

9. Determine the drip rate using a microset with a drop factor of 60 µgtt/mL according to this doctor's order: start IV infusion of furosemide 250 mg in 250 mL of 5% dextrose in water to run at 30 mL/hr until consumed.

10. Which nursing consideration should be the priority when giving ACE inhibitors to a patient?
    a. The patient should be fully awake and oriented to place and time
    b. Vital signs must not indicate bradycardia
    c. Capillary blood glucose test must not exceed 180 mg/dL
    d. Time of last meal or food consumption should be (at least) 2 hours ago

FURTHER READINGS

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ANSWER KEY

1. A is the best answer, but this report could still be improved. To document events around medication administration properly, nurses should record the 5 W's: when (time), why (assessment, symptoms, complaints), what (medication, dosage, and route), where (for the application/injection site), and was (side effects and adverse effects).

2. The correct answer is letter B, which can be computed using the formula method as shown below.

Solution:

$$x = \frac{D}{H}(Q)$$

$$x = \frac{20\ \cancel{mg}}{10\ \cancel{mg}}(1\ \text{tablet})$$

$$x = 2\ (1\ \text{tablet})$$

$$\boxed{x = 2\ \text{tablets}}$$

3. The correct answer is letter A because this is usually not included in the doctor's order. The doctor's order for IV infusions usually includes the type and amount of diluent, the dose on hand of drug to be added, and the hourly infusion rate.

4. D is the best response for the safety of the client. When there is any doubt about a prescribed drug, the nurse should find out more information before proceeding with drug administration. It is necessary to review the patient's chart and refer any discrepancies to the prescriber accordingly.

5. C is the correct answer because antihyperlipidemic drugs that are proprotein convertase subtilisin/kexin type 9 inhibitors, like evolocumab, are given via subcutaneous injections.

6. The order in D should be questioned because no dosage is given. A prescription should include the medication, dosage, route of delivery, and frequency.

7. B is the best answer because the patient's heart rate must not be less than 60 beats per minute prior to giving beta blockers.

8. A is the correct answer because changes in body temperature is not a contraindication to giving ARBs. ARBs are contraindicated in pregnancy, patients with bilateral renal artery stenosis, and patients who are taking agents that may increase serum potassium levels (such as those on ACE inhibitors, potassium supplements, or potassium-sparing diuretics).

9. The answer for this item is computed as follows.

Given:

$I = 30\ \text{mL/hr}$
$60 = 60\ \text{min/hr}$
$F = 60\ \mu\text{gtt/mL}$
$x = ?$

Solution:

$$x = \frac{I}{60}(F)$$

$$x = \frac{30\ \text{mL}/\cancel{\text{hr}}}{60\ \text{min}/\cancel{\text{hr}}}(60\ \mu\text{gtt/mL})$$

$$x = (0.5\ \cancel{\text{mL}}/\text{min})(60\ \mu\text{gtt}/\cancel{\text{mL}})$$

$$\boxed{x = 30\ \mu\text{gtt/min}}$$

Therefore, the drip rate for this infusion is 30 µgtt/min.

10. D is the best answer because nurses should administer ACE inhibitors to patients on an empty stomach, one hour before or two hours after a meal.

Contributors
MFCB, CGM and CMD contributed to the conceptualization of this article. All authors wrote the original draft and subsequent revisions, and reviewed, edited, and approved the final version of the manuscript. All authors agreed to be accountable for all aspects of the work.

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