

**SNS COLLEGE OF ALLIED HEALTH SCIENCES** SNS Kalvi Nagar, Coimbatore - 35 Affiliated to Dr MGR Medical University, Chennai

## **DEPARTMENT OF CARDIO PULMONARY PERFUSION CARE TECHNOLOGY**

**COURSE NAME : Pharmacology Pathology and Clinical Microbiology** II nd YEAR **TOPIC : INOTROPES** 

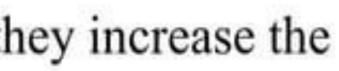




### INTRODUCTION

- An inotrope is an agent, which increases or decreases the force or energy of muscular contractions. & By enhancing myocardial contractility, cardiac output, the amount of blood ejected by the heart with each beat, will also increase.
- All inotropes are successful because they increase the myocardial contractility of the heart.
- As science advanced, other inotropes were developed which were more potent and have different chemical properties and physiological effects.used for CCF.









- The result of these direct and indirect effects are: -An increase in force and velocity of myocardial contractility (positive inotrope effect).
- Slowing of heart rate (negative chronographic effect).
- Decreased conduction velocity through the AV node.

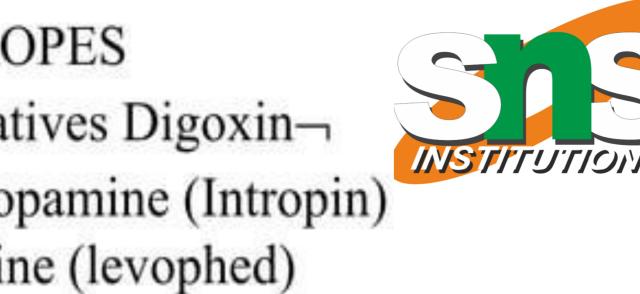






- CLINICALLY APPROVED INOTROPES
- Cardiac Glycosides: -Digitalis Derivatives Digoxin-
- Sympathomimetics: Epinephrine Dopamine (Intropin) Dobutamine (dobutrex) Norepinephrine (levophed) Isoproenol (isuprel)
- Phosphodiesterase Inhibitors: Amrinone (Inocor) Milirinone (Primacor)







### CARDIAC GLYCOSIDES

- An indirect effect on the cardiovascular system regulated by the autonomic nervous system which is responsible for the effect on the sino-atrial (SA) and atrioventricular (AV) nodes.
- A direct effect on cardiac muscle and the conduction system.
- Digitalis Glycosides have
- The first line of inotropes include all digitalis derivatives







DIGOXIN LOADING DOSE

Loading doses of Digoxin range from 10 – 15mg/kg Digoxin can be given orally, but with a slower onset of action and peak effect.

DIGOXIN MAINTENANCE DOSE :- Initial therapy of Digoxin is usually started at 0.125 to 0.375mg/day. NOTE: DRAW A SERUM DIGOXIN LEVEL AT LEAST SIX HOURS AFTER THE LAST DOSE!



١.





- SIDE EFFECTS ASSOCIATED WITH TOXICITY
- GASTROINTESTINAL: Anorexia, nausea, vomiting, diarrhea Rare: abdominal pain, hemorrhagic necrosis of the intestines
- CNS: visual disturbances, (blurred or yellow vision), headache, weakness, dizziness, apathy and psychosis.
- OTHER: Skin rash, gynecomastia







SYMPATHOMIMETICS (ADRENERGIC) Sympathomemetic drugs exert potent inotropic effects by stimulating beta (B1 & B2), alpha(A1 & A2) and dopaminergic receptors in the myocardium, blood vessels, and sympathetic nervous system.







DOPAMINE (INTROPIN) (200MG/5ML AMPULE). INTERMEDIATE DOSE2 to 10 mcg/kg/minute LOW DOSE 0.5- 2mcg/kg/minute







- Indication:-
- Occlusive vascular disease.
- Tachyarrhythmias.
- Phaeochromocytoma. •
- Pregnancy. Increases mesenteric flow in mesenteric ischaemia.
- Contraindication:
- Hypotention/haemodynamic compromise due to MI, trauma, sepsis, CCF. – Renal protection. –







### ADVERSE EFFECTS

- Hypotension when used concomitantly with dilantin
- Increased myocardial oxygen demand.
- Headache.
- Vomiting
- Nausea
- Pulmonary congestion
- Ventricular arrhythmias
- Supraventricular tachycardia
- Tachycardia





### ntly with dilantin nd.



- Nursing implication
- Monitor cardiac output, pulmonary artery pressure ECG
- Monitor for hypertension, tachycardia, chest pain, and premature ventricular contractions







- DOBUTAMINE (DOBUTREX) (250MG IN 20ML) AMPULE)
- Usual dose: 2.5 to 10 mcg/kg/minute.' Initial dose: 2 to 3 mcg/kg/minute.'
- 2 Dobutamine administration concentrations: Infusion pump: 500 mg per 250 cc normal saline Syringe pump: 250 mg (20cc) in total 50 cc normal saline (5 mg per cc)
- Maximum dose: 20 mcg/kg/minute.







## Indication

- Patient with aterial fibrillation should be digitalized before giving this drug to prevent ventricular tachycardia.
- Correct hypovolemia before treating with this drug.' Contraindication:-
- Idiopathic hypertrophic subaortic stenosis. Contraindication: - Idiopathic hypertrophic subaortic stenosis







- Adverse effects
- Hypokalemia
- Tremors
- Nausea
- Headache
- Myocardial ischemia
- Blood pressure fluctuation •
- Arrhythmias
- Tachycardia







- Nursing implication
- Monitor cardiac output, pulmonary artery pressure ECG
- Monitor for hypertension, tachycardia, chest pain, and premature ventricular contractions.







### Adrenalin

Mechanism of action

- The action of adrenalin may vary by the type of tissue it act,
- It causes smooth muscle relaxation in the airway
- It causes smooth muscle contraction in the arterioles
- In cardiac muscles increase contractability







INDICATION:
Anaphylaxis reaction
Hypotension
Bronchospasm
Cardiac arrest
Asystole







### DOSE: •

For Infusion : 0.05 – 0.1 microgram/kg/minute maximum dose: 1 - 1.5 microgram/kg/minute For In arrest: 1 ml every 2 minutes







### Dilution

- 1 ampule = 1 ml/1 mg
- Prepration : 4ml of adrenalin + 46 ml NS = 50 ml
- Drug concentration = 4mg/50ml =0.8mg
- 0.8 mg x 1000 = 80 mcg/ml
- Rate of infusion : desired dose x 60 =ml/hr 80 mcg

### Example : $2 \mod x 60 \min = 1.5$ 80







### Drug interaction

Interacts with β-blocking agents, digitalis glycosides, antidepressants,







- ADVERSE EFFECTS:
- Hypertension
- tachycardia
- Extravasations
- Anxiety, dysrhythmias
- dizziness
- pallor
- tremor,
- insomnia
- Headache, nausea
- palpitations







### Nursing consideration:

- Inotropes must be adminstered in central line
- Do not cease infusion abruptly,
- Should be used with caution in patients with atherosclerosis, mesentric and peripheral vascular thrombosis or other occlusive vascular diseases, metabolic acidosis, hypoxia or hyperthyroidism.
- It should be avoided in patients who are hypersensitive to the drug.
- discard diluted solutions after 24 hours Protect ampoules from light during storage and discard if discoloured







- Follow ten rights
- Monitor for adverse effect
- Continuous BP using invasive arterial BP monitor
- connect the patient with cardiac monitor and monitor ECG rythym
- Inotropes must be administered using infusion or syringe
- Should follow standard dilution
- The lable on loaded drug should contain drug concentration and dilution
- Monitor urine output







### Nor adrenalin

- Mechanism of action
- The action of Inotropes may vary by the type of tissue it act,
- It causes smooth muscle relaxation in the airway It causes smooth muscle contraction in the arterioles
- In cardiac muscles increase contractability







### INDICATION:

- Anaphylaxis reaction
- Hypotension
- Bronchospasm
- Cardiac arrest
- Asystole







Formula for rate of infusion of inotropes

Rate of infusion : desired dose x weight x60 =ml/hr

drug concentration









- Dilution for adrenalin/nor-adrenalin
- 1 ampoule adrenalin =1ml/1mg
- 1 ampoule nor-adrenalin =2ml/2mg
- Preparation : 4ml of adrenalin + 46 ml NS = 50 ml
- Drug concentration = 4mg/50ml =0.8mg
- 0.8 mg x 1000 = 80 mcg/ml
- Rate of infusion : desired dose x 60 =ml/hr

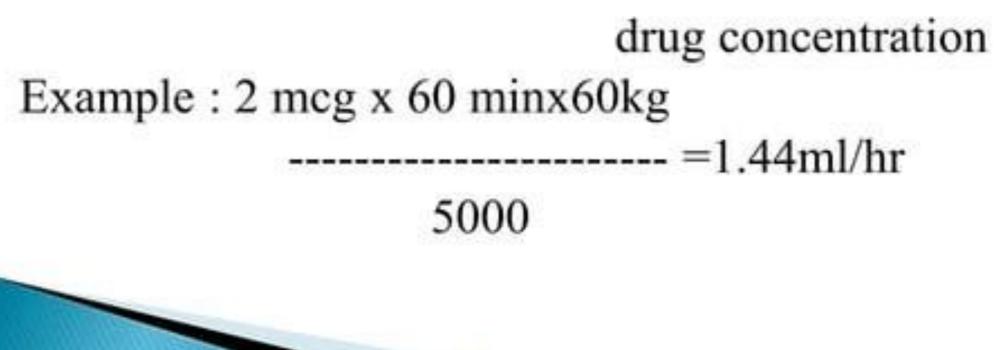
drug concentration

Example : 2 mcg x 60 min -----= 1.5 80 mcg





- Dilution for dopamine an
- In this we have calculate the patient weight
- ▶ 1 ampule dopa=250 mg,
- Each ml dopa-50 mg,
- Prepration : 5+45 ml NS =50 ml
- Drug concentration = 250/50ml =5
- $5 \times 1000 = 5000 \text{ mcg/ml}$
- Rate of infusion: desired dose x weight x60 =ml/hr









- Dilution for dobutamine
- In this we have calculate the patient weight
- 1 ampule dopa=200 mg ,
- Each ml dopa-40 mg,
- Prepration : 5+45 ml NS = 50 ml
- Drug concentration = 200/50ml =4
- 4x 1000 = 4000 mcg/ml
- Rate of infusion: desired dose x weight x60 =ml/hr

drug concentration Example : 2 mcg x 60 minx60kg -----===1.8ml/hr 4000







- Dilution for NTG
- 1 ampule = 5 ml/25 mg
- Prepration : 5ml of NTG + 45 ml NS = 50 ml
- Drug concentration = 25mg/50ml =0.5mg
- 0.5 mg x 500 = 250 mcg/ml
- Rate of infusion : desired dose x 60 =ml/hr
- Example : 2.5 mcg x 60 min = 0.6 250 mcg





# drug concentration



### Drug interaction

Interacts with β-blocking agents, digitalis glycosides, tricyclic antidepressants, mono-amine oxidase inhibitors, cocaine.







ADVERSE EFFECTS:

- Hypertension
- bradycardia
- Extravasations
- Anxiety, dysrhythmias
- dizziness
- pallor
- tremor
- insomnia
- Headache, nausea
  - palpitations





Nursing consideration:

- Inotropes must be adminstered in central line Do not cease infusion abruptly,
- Should be used with caution in patients with atherosclerosis, mesentric and peripheral vascular thrombosis or other occlusive vascular diseases, metabolic acidosis, hypoxia or hyperthyroidism.
- It should be avoided in patients who are hypersensitive to sodium metabisulfite (which is the preservative in the solution).
- discard diluted solutions after 24 hours Protect ampoules from light during storage and discard if discoloured





- Follow ten rights
- Monitor for adverse effect
- Continuous BP using invasive arterial BP monitor
- connect the patient with cardiac monitor and monitor ECG rythym
- Inotropes must be administered using infusion or syringe
- Should follow standard dilution
- The lable on loaded drug should contain drug concentration and dilution
- Monitor urine output







### ISOPROTERENOL (ISUPREL)

- Has nearly pure beta-adrenergic receptor activity.
- Increase heart rate and contractility and cause peripheral vasodilation.
- Used for temporary control of symptomatic bradycardia.
- Initial drug of choice for heart transplant.
- Increases myocardial oxygen requirements and the possibility of inducing or exacerbating myocardial ischemia is present.
- > The risk of arrhythmias is also increased.
- > It is not the first treatment of choice for bradycardias.
- Atropine, epinephrine or pacing should be initiated first.



- activity. ause peripheral
- tic bradycardia.

. oradycardias. oe initiated first



DOSE: - □ Initial dose of 2 mcg/minute □ Titrate dose to a maximum of 10 mcg/min. or heart rate is 60 or greater. □ Decrease the rate if blood pressure is >120/60 □ Decrease rate if PVC's or Ventricular tachycardia is noted.Isoporterenol administration concentration: - □ 1 mg in 250 cc crystalloid (4 mcg/cc).







- Adverse effects: -
- Arrhythmias.
- Ventricular tachycardia.
- Ventricular fibrillation.Warning:-•
- May exacerbate tachyarrhythmias due to digitalis toxicity.
- May precipitate hypokalemia.







- PHOSPHODIESTERASE INHIBITORS Powerful positive inotropic agents. The action is not fully understood.
  - Inhibits phosphodiesterase, an enzyme that degrades (CAMP)
- Cyclic Adenosine Monophosphate.
- There is no effect on alpha or beta-receptors.
- Increase contractile force and velocity of relaxation of cardiac muscle.
- Increasing cardiac output without increasing myocardial
- oxygen consumption.
- They cause vasodilation and a decrease in SVR (systemic
- vascular resistance) and PVR (Pulmonary vascular
- resistance & in afterload (resistance to ventricular ejection)





- AMRINONE (INOCOR)
- Has a hemodynamic effect similar to Dobutamine.
- Increase cardiac output and decrease pulmonary vascular resistance.
- It should be used with caution in patients with ischemic heart disease because it can exacerbate ischemia.
- It should be considered for use in patients with severe congestive heart disease, which is no longer responsive to other inotropes, diuretics, and vasodilators.
- It is also used after aorto-coronary bypass surgery. It is recommended that the lowest dose that produce the desired hemodynamic effect to be used.





- LOADING DOSE:
- 0.5 TO 0.75 mg/kg given over 2-3 min.
- IV DO NOT EXCEED 1 mg/kg.
- Maintenance dose: 5 to 10 mcg/kg/min Maximum dose: 10mg/kg/24hours.
- Doses higher than 15 mcg/kg/minute can produce tachycardia
- NEVER DILUTE WITH DEXTROSE!
- (Chemical reaction occurs)Syringe pump: Use Straight Solution Concentration 5 mg/ccAdverse reaction: - Thrombocytopenia occurs in 10% of all patients seen 48 -72 hours after infusion and resolves when drug is discontinued. 
  Gastrointestinal upset 
  Myalgia 
  Fever □ Hepatic dysfunction □ Ventricular irritability





- Nursing implication: -
- Monitor for arrhythmias, hypotension, thrombocytopenia & hepatotoxicity.
- Monitor cardiac output, pulmonary artery pressure and heart rate.
- Effects last for 2 hours after drip is discontinued.
- The loading dose may be given over 2 to 5 minutes, but to prevent Hypotension it is recommended the loading dose be given over 10 to 15 minutes.
- MILRINONE (Primacor)
- Milrinone is about 10 fold more potent than Amrinone.
- A positive inotropic agent that increases cardiac output and decreases systemic vascular resistance.
- Because of its vasodilating effect, Milrinone is not generally associated with an increase in myocardial oxygen demand.
  - Milrinone can be diluted in dextrose or saline solution.





- LOADING DOSE:- 50 mcg/kg given IV over 10 minutes MAINTENANCE DOSE:- 0.375 to 0.75
  - mcg/kg/minuteWarning; -
- DOSES TO HIGH CAN CAUSE HYPOTENSION AND TACHYCARDIA.
- MILRINONE IS INCOMPATIBLE WITH L ASIX! ADVERSE EFFECTS:
- Supraventricular tachycardia
- Ventricular arrhythmias
- Ventricular ectopy
- Increased ventricular rate in atrial fibrillation/flutter
- Headache
- Hypokalemia
- Tremors
- Thrombocytopenia





- EASY FORMULAS FOR DRUG CALCULATIONS FOR INFUSION PUMPSTO DETERMINE DESIRED RATE:- (Remember 1 mg = 1000 mcg) (Desired mcg) X kg. X  $60 \div mcg/cc$  (in solution)
- Example:- Give Dopamine 5 mcg/kg/min to a patient who weights 65 kg. 5 X 65 X 60 ÷ (800 mg in 500 cc) (5 mcg) X (65 kg) X 60  $\div$  (800 mg  $\div$  500 cc = 1.6 mg. X 1000) = 1600 mcg 19500  $\div$  1600 = 12.18 cc
- Example: Give Dopamine 2.5 mcg/kg/min to a patient who weight 55 KG. 2.5 X 55 X 60 ÷ 1600 (2.5 mcg) X (55 kg) X  $60 \div 1600 = 5.15$  cc







- TO DETERMINE MCG/KG/CC INFUSING:
- Example: You have a patient that weighs 85 kg who has a dopamine drip infusion at 8cc per hour and you want to determine how many mcg/kg/min the patient is receiving.
- The dopamine is mixed at 1600 mcg per cc. MCG/CC X RATE  $\div$  60  $\div$  KG 1600 X 8  $\div$  60  $\div$  85 = 2.5 mcg/kg/minute
- Example: You have a patient that weighs 102 kg who has a Dobutamine drip infusing at 12 cc per hour and you want to determine how many mcg/kg/min the patient is receiving.
- ▶ The Dobutamine is mixed at 500 mg in 250 cc = 2000 mcg per cc. (500 mg  $\div$  250 = 2 X 1000 = 2000) 2000 X 12  $\div$  60  $\div 102 = 3.92 \text{ mcg/kg/min.}$





### CONCLUSION

- Inotropes are very effective drugs when administered properly.
- Patients receiving inotropes should be monitored closely including blood pressure, cardiac monitoring, intake and output, and laboratory tests that have been ordered by the physician.
- Knowledge of desired effects and side effects is critical to the administration of inotropes.
- CONCLUSION CONT...
- A thorough grasp of the pharmacology of inotropes is crucial to understand the rationale for drug therapy of heart failure.
- Inotropes continue to improve through scientific research.
- Oral forms of inotropes are now being investigated to manage congestive heart failure at home.





### THANK YOU

