Cardiac Medication Review

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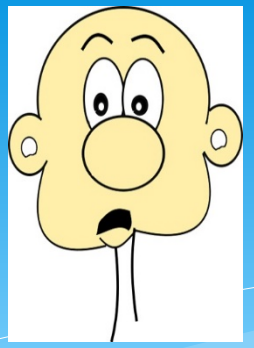
Who is this guy?



* Education: Bachelor of Science degrees in Criminal Justice, Psychology and Nursing. Finishing Master of Science in Finance in December
* Professional: 11 years as a nurse in Cardiac Telemetry, Cardiac ICU, Adult Cardiothoracic ICU, Trauma Surgical ICU, ECMO and Pediatric Cardiothoracic ICU

Hemodynamic review: Cardiac Output

* Represents the amount of blood pumped by the heart in one minute
* Measured as SV X HR
* Measured in L/min with “normal range” of 4-8
* Cardiac Index: Adjust for patient size by dividing cardiac output by BSA. Normal Range is 2-4 L/min

Hemodynamic Review: SVR

* Systemic Vascular resistance is a measure of afterload resistance
* Calculated as (MAP-CVP)/ CO
* Normal range is 700-1500
* Indirectly effects stroke volume of the heart

Fluid, Fluid and more Fluid

* The first line treatment of hypertension and hypotension is fluid management. Use of medications without treating hypo or hypervolemia will be ineffective and potentially dangerous.

Assessing Fluid Needs

* SVR
* CVP
* Heart Rate
* Blood Pressure
* How does the patient look?

What fluids to Use

* Colloids vs. Crystalloids
* Colloids: Blood Products and Albumin
* Colloids have higher tonicity allowing them to stay in the vasculature
* Crystalloids consist of fluids like D5W, NS or LR
* have lower tonicity causing more of the volume to “third space”.
* Some controversy surrounding Albumin

Cell Receptor Review

* Alpha 1 Receptor Cells- Work on smooth muscle. Causes vasoconstriction on the blood vessels supplying the skin, GI tract, kidneys and brain.
* Alpha 2 Receptor Cells- Undifferentiated smooth muscle relaxation
* Beta 1 Receptor Cells- Stimulation of Beta 1 receptor cells cause positive inotropy (cardiac output) and positive chronotropy (heart rate). Also stimulates the kidneys to secrete renin which activates the renin-angiotensin-aldosterone system causing systemic vasoconstriction to increase blood pressure.
* Beta 2 Receptor Cells- Smooth muscle relaxation more pronounced in bronchioles

Antagonist and Agonist

* An Agonist agent stimulates the effect of the receptor cell. For example, and Beta agonist increases heart rate, cardiac output and blood pressure.
* An Antagonist agent inhibits the effect of the receptor cell. For example, a Beta antagonist decreases heart rate, cardiac output and blood pressure. AKA beta blocker.

Catecholamines

* This group of medications are made up of drugs that are both Alpha 1 and Beta 1 agonists
* These medications have differing amounts of stimulation provided to each receptor cell. Some have more Alpha stimulation and others have more Beta stimulation.
* Medications that more strongly affect Alpha cells are often called pressors.
* Medications that more strongly affect Beta cells are often called inotropes.
* Most institutions require these medications to be given via central line.
* Use of these drugs is typically restricted to the ICU setting.

Catecholamine Chart

Medscape® www.medscape.com

	Activity at Receptors				
Agent	**α_1**	**α_2**	**β_1**	**β_2**	**Dopaminergic**
Dobutamine	+	+	++++	++	0
Dopamine	++/+++	?	++++	++	++++
Epinephrine	++++	++++	++++	+++	0
Norepinephrine	+++	+++	+++	+/++	0
Phenylephrine	++/+++	+	?	0	0

α, α adrenergic receptors; β, β adrenergic receptors, DA, dopamine receptors.
Activity ranges from no activity (0) to maximal activity (++++) or ? when activity is not known.
Reproduced with permission from Rudis et al. Is it time to reposition vasopressors and ionotropes in sepsis? Crit Care Med 1996;24:525–537.

Source: Semin Respir Crit Care Med © 2004 Thieme Medical Publishers

Medication to increase blood pressure: Phenylephrine (Neosynephrine)

* An alpha agonist causing blood pressure to rise through peripheral vasoconstriction
* Lacks Beta component so it has minimal effect on heart rate or contractility
* Normally used in patients with mild or early shock or hypotension cause by sedation
* Typically dosed from 20-200 mcg/min. Not typically weight based dosed. Titrated in 10-20 mcg/ min increments
* Due to lack of cardiac implications can be used as an IVP bolus to quickly raise blood pressure in the severely acute hypotension
* Safe to use through a peripheral IV site.

Pressor Catecholamine-Norepinephrine (Levophed)

* Has moderate to strong Alpha and Beta stimulation.
* Increases blood pressure through peripheral vasoconstriction through alpha stimulation
* Provides some improvement of cardiac output but is mild due to higher SVR caused by vasoconstriction. Mild heart rate increases seen as well
* Most often seen with patient experience septic shock
* Dosing: Normally dosed by weight starting at .02 mcg/kg/min. Non weight based usually start at 2 mcg/min. Maximum doses by institution and unit.
* Titration usually starts in .02mcg/kg/min intervals based on patient effect.

Mixed effect Catecholamines: Epinephrine

* Strong Alpha and Beta response.
* Increases heart rate, vasoconstriction and contractility.
* Used primarily in cardiac settings with severe cardiogenic shock.
* Typically a last line drug in adults due to increased myocardial oxygen consumption that results from its affects (heart is beating faster and stronger against more resistance)
* Not typically used in other shock syndromes due to stronger constriction of GI blood flow.
* Tends to be used less cautiously in pediatric patients who normally have healthier hearts that can tolerate the increased myocardial oxygen demand.
* Dosing: 0.01 mcg/kg/min to 0.2 mcg/kg/min or 2-10 mcg/min for non weight based dosing
* Also part of the ACLS algorithm for asystole, VT, Vfib and PEA. 1 mg for adults and 0.1 mg/kg for peds

Mixed Effect Catecholamines: Dopamine

* A versatile drug that changes properties depending on dosing.
* 1-2 mcg/kg/min stimulates dopaminergic receptors causing vasodilation that increases renal and mesenteric blood flow. This dose is frequently referred to as renal dose dopamine
* 2-5 mcg/kg/min stimulates beta cells which causes increases in cardiac output and heart rate
* 5-10 mcg/kg/min stimulates alpha cells causing increases in blood pressure
* Dosing: 1-20 mcg/kg/min. Dosing dependent on goal effect of Dopamine
* Can cause profound tachycardia particularly at higher doses. Rarely see doses higher than 10 mcg/kg/min. Additional medications usually added at this point.

Inotrope Catecholamine: Dobutamine

* Strong Beta cell agonist.
* Most pronounced effect is inotropic support. Can cause dysrhythmias and tachycardia due to strong Beta stimulation
* Most commonly used in CICU and cardiac stepdown floors for adults with CHF.
* Dosing: 2.5 -7.5 mcg/kg/min
* Titration usually occurs in 2.5 mcg/kg/min steps and is titrated to cardiac index.

Non Andrenergic Inotrope: Milrinone

* Milrinone is a phosphodiasterase inhibitor which inhibits the breakdown of cyclic AMP which ultimately causes calcium channels in the myocardium and arterial vasculature to allow more calcium to move in to intracellular level
* Increases myocardial contractility (inotrope)
* Causes vasodilation of arterial vasculature especially in the pulmonary artery which aids in right sided heart failure
* Used an IV drip mostly in ICU's for the treatment of CHF exacerbation.
* Blood pressure decrease is low to moderate as inotropic and vasodilation effect cancel one another
* Dosing: 0.125 mcg/kg/min to 0.75 mcg/kg/min

Medications to increase blood pressure: Vasopressin

* Naturally occurring hormone secreted by the pituitary gland that helps regulate fluid status.
* Stimulates receptor cells in the kidneys causing an increase in systemic vasoconstriction.
* Early in the shock cycle Vasopressin secretion is increased. This supply is quickly depleted though. This is where the concept of physiologic dose Vasopressin comes from.
* Minimal effect on heart rate or cardiac output
* Should be used cautiously in patients with renal in sufficiency or failure.
* In adults it is generally dosed in units/ hr or units/min. Physiologic dosing is 2.4 units/hr (.04 units/min).
* Pediatric dosing: .0003-.001 units/kg/min
* Titration occurs in one unit/hr increments or .003 units/kg/min for pediatrics

Drugs to treat hypertension/Cardiac Dysrhythmias

* Hypertension or cardiac dysrhythmias are usually treated with one and/or a combination of different drug classes
* Diuretics
* Vasodilators/Nitrates
* Calcium Channel Blockers
* ACE Inhibitors/ARBS
* Beta Blockers
* Anti-Arrhythmics

Diuretics

* Decrease hypertension by decreased circulating volume in the blood which decreases preload and afterload
* Decrease of preload is useful in treating patient with congestive heart failure and afterload reduction is useful in treating patients with HTN
* Multiple dosing strategies depending on type of diuretic, clinical setting and severity of fluid overload.

Diuretics

* Thiazides
  * First line drugs for the treatment of hypertension
  * Work by inhibiting sodium reabsorption in the distal renal tubules.
  * Chlorothiazide most commonly used in the acute care setting.
  * Commonly dosed as PO in step down setting and intermittent IVP in ICU settings
* Loop Diuretics
  * Inhibits sodium reabsorption in the Loop of Henle
  * Can be dosed as PO or IVP in step down settings or as continuous infusion in ICU setting.
  * Most commonly used Loop drugs are Furosemide (Lasix) and Bumetadine (Bumex)
* Most common and dangerous side effect for both versions is hypokalemia

Vasodilators: Nipride

* Extremely potent and fast acting vasodilator. Causes vasodilation of arteries and veins but with stronger effect on arteries. Half life is 2 minutes.
* Nipride goes through a complex chain of interactions to produce NO, cyanide and methaemoglobin.
* Requires close monitoring of cyanide levels to avoid cyanide toxixcity. Newer mixes have an additive that binds to cyanide to protect against cyanide toxicity.
* Use is restricted to the ICU setting and is only used as a continuous drip
* Used most commonly in patients with HTN crisis situations and/or patients with aneurysms.
* Dosing 0.1 mcg/kg/min to 10 mcg/kg/min though higher doses are rare due to fear of cyanide toxicity.
* Titration is usually done in .1 mcg/kg/min increments.

Nitroglycerin

* Vasodilator used mostly in the treatment of angina
* Centrally acting vasodilator that increases blood flow to the heart relieving angina symptoms. Most vasodilation occurs in the venous vasculature causing a decrease in cardiac work load.
* Most common setting for inpatient use is step down unit and CICU.
* Infrequently used as a treatment for hypertension
* Comes in a variety of forms: IV, Sublingual tablets, paste and oral tablet.
* Headache is a common side effect

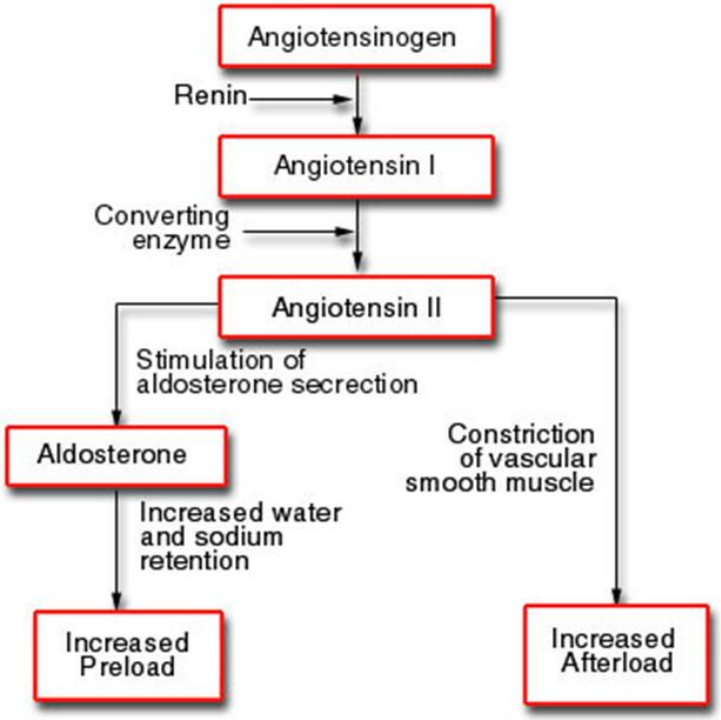
Clonidine

* Alpha 2 agonist that cause central venous and arterial vasodilation
* Tends to be used in chronic HTN rather than acute HTN
* PO only with dosing generally in the 0.1 to 0.3 mg range

Anti-hypertensives: Calcium Channel Blockers

* Works by preventing calcium from passing through calcium channels in myocardial cells and arterial smooth muscle.
* Myocardial blockage leads to decreased heart rate and contractility
* Vascular blockage leads to vasodilation arterial vasculature (no effect on venous vasculature) to decrease afterload.
* Typically have a “pine” ending to generic name
* Used in variety of inpatient settings for treatment of HTN and atrial dysrhythmias and tachycardia.
* Commonly used drugs include Amlodipine, Nicardipine, Nifedipine, Diltiazem and Verapamil
* Can be administered PO, IVP or continuous IV infusion.

Renin-Angiotensin-Aldosterone System



ACE Inhibitors

* Prevent the conversion of angiotensin I into angiotensin II to help treat HTN
* Interruption of the Renin-Angiotension-Aldosterone system cause vasodilation, decreased cardiac output and decreased circulation volume
* Used in all inpatient settings as PO medication. Most common usage is for adult patient with CHF
* Most ACE inhibitors have “pril”
* Most commonly used are Captopril, Lisinopril, Enaloporil
* Can be used in a variety of clinical settings (ICU, step down, general care)
* Usage is avoided in patient with renal insufficiency
* Most common side effect is a dry hacking cough

Angiotensin II receptor blockers (ARBs)

* Work very similarly to ACE inhibitors
* Mainly used in patients that cannot tolerate the effects of ACE inhibitors.
* Has all the same attributes as ACE inhibitors
* Most ARBs have “sartan” in their name

Anti-hypertensives: Beta Blockers

* Beta receptor cell antagonist causing decreased cardiac contractility and slowing of the heart rate.
* Reduces amount Renin produced thereby indirectly decreasing afterload.
* Slowing of the heart rate and decreased afterload resistance neutralizes decreased contractility making Beta blockers safe for patients with CHF
* Seen in all phases of inpatient care as PO, intermittent IVP and Continuous IV drip
* Most beta blockers have “olol” ending to their pharmaceutical names
* Common Beta Blockers include Metoprolol, Carvedilol, Esmolol, Atenolol, Labetalol
* Important ICU application is the treatment of aortic aneurysms
* Contraindicated for the treatment hypertension caused by cocaine overdose.

Amiodarone

* Anti-Arrhythmic useful in the treatment of atrial and ventricular arrhythmias
* Treats ventricular arrhythmias through decreased blockage of potassium channels
* Treats atrial arrhythmias through the blockage of calcium channels near the SA and AV nodes. Slows rate and can convert patient out of A-fib. Only used in acute cases of Afib
* Part of the ACLS algorithm for VT and V-Fib as a 150 mg IVP/ 5 mg/kg for pediatric patients
* Non emergent loading dose of 150 mg over 10 minutes
* 1 mg/minute drip rate x 6 hours followed by 0.5 mg/min x 18 hours and then transitioned to PO

Digoxin

* Increases contractility of the heart through the potentiation of calcium
* Decreases heart rate through stimulation of the vagal nerve. Makes it useful in treating A-fib
* Can be administered PO or IVP in step down and ICU settings
* Not used frequently due to difficulty in dosing.
* Requires semi regular blood draws.

Questions