Flip a coin?

Titrating Vasoactive Medications

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What’s Important?

• Everything!

What’s Important?

• Autonomic Nervous System
  • Sympathetic
  • Parasympathetic

Sympathetic

• Fight or Flight
• Thoracic spinal cord
  • Epi & Norepi
  • RAAS

Sympathetic

• Speeds things up

Parasympathetic

• Feed and Breed
  • Brain stem and medulla
Parasympathetic
- Slows things down
- Balances Sympathetic
- Vagus Nerve
- Acetylcholine

The Receptors
- Beta One Cells
  - 1 Heart
  - Increase
    - heart rate
    - contractility
    - automaticity
    - conduction velocity

The Receptors
- Beta One Cells
  - When blocked?
    - Bradycardia
    - Decreased
      - Contractility
      - Automaticity
      - Conduction Velocity

The Receptors
- Beta Two Cells
  - 2 Kidneys
  - 2 Lungs

The Receptors
- Beta Two Cells
  - Peripheral arterioles
    - Vasodilation
    - Bronchodilation

The Receptors
- Beta Two Cells
  - When Blocked?
    - Bronchoconstriction
    - Vasoconstriction
The Receptors

• Alpha Receptors
  • Peripheral arterioles
    • Vasoconstriction
      • “Clamped down”

• Dopaminergic
  • Mesenteric
    • Vasodilation
  • Renal
    • Vasodilation

• Baroreceptors
  • Sensitive to stretch
    • Detect changes:
      • Aortic arch
      • Carotid sinus

• Problems with Trendelenburg
  • Baroreceptors are confused
  • Trendelenburg Useful for Cervical Line Placement, Some Spinal Anesthesia Techniques
  • Trendelenburg for Hypotension?
    • Question if Should Use at All
    • AJCC September 2005 Vol. 14 #5, 364-368

The Receptors

• Alpha receptors
  • When blocked?
    • Vasodilation
The Receptors

- Chemoreceptors
- Aortic Arch

- “Samplers” Detect
  - Decreased PaO2 and Increased PaCO2 and H+ ions
  - Stimulate Fight or Flight

RAS

- Hypotension
- Renin Release (Kidneys)
- Angiotensinogen (Lungs)
- Angiotensin I

Atrial Natriuretic Peptide

- Hormone secreted
  - Increased atrial pressure
  - Vasodilator
  - Excretes sodium and water
  - Salt Wasting – Triple H Therapy

Brain Natriuretic Peptide

- BNP Hormone secreted from ventricles
- Blocks RAAS
  - Vasodilator
  - Increases Excretion of sodium and water
  - Decreases secretion of Aldosterone and Renin

BNP Treatment for CHF

- Nesiritide aka NATRECOR
  - BNP
  - Increased Hypotension with ACE – I

- Dose: 2 mcg/kg bolus followed by 0.01 mcg/kg/min
Glucocorticoids
- Released
  - Gluconeogenesis – Formation of glucose from fats and proteins
  - Glycogenolysis – Formation of glucose from glycogen stores

ADH
- Anti-Diuretic Hormone
- Secreted by Pituitary Due To SNS Stimulation

Factors That Affect CO
- Cardiac Output
- Preload
- Heart Rate
- Contractility
- Afterload

Medication Effects
Preload = Volume
- Increase
  - Volume
  - Crystalloids
  - NS, LR
  - Colloids
    - PRBC, Albumin 5% & 25%, Hetastarch
  - Vasoconstriction
    - Dopamine, Epi, Norepi, Neo, Vasopressin
- Decrease
  - Diuretics
  - Natriuresis
  - Nesiritide (BNP)
  - Vasodilation
    - Nitroglycerin
    - Nitroprusside
    - Dobutrex
    - PDE Inhibitors
      - Dopamine < 3
      - Alpha Blockers
      - ACE Inhibitors
      - A II Blockers
    - Phenolamine
  - PEEP

Afterload = Resistance
- Increase
  - Vasocostringtion
    - α Stimulators
      - Epi, Norepinephrine, Neo-Syneprine
      - Dopamine > 10 mcg/kg/minute
      - Vasopressin

Afterload = Resistance
- Decrease Afterload
- Vasodilation
  - Beta 2 stimulators
    - Dobutamine
    - Isoproterenol
  - PDE inhibitors
  - Milrinone, Amrinone
  - ACE Inhibitors – “Pril”
  - Angiotensin Blockers
- NTG & NIPRIDE
  - Calcium Channel Blockers
    - Nicardipine
    - Cardizem®
  - Diuretics
  - IABP
  - Natrecor® (BNP)
  - Alpha blockers
    - Coreg®, Labetalol

Contractility = Inotropic
- Positive
  - Dopamine
    - 3 - 10 mcg/kg/min
  - Dobutamine
  - Epinephrine
  - Norepinephrine
  - PDE inhibitors
- Negative
  - Beta blockers
  - Mixed
    - Beta/Alpha Blockers
  - Coreg®
  - Calcium Channel Blockers
  - Hypoxemia
  - Acidosis

FROM Assessing THESE:
- Cardiac Output
- Preload
- Contractility
- Afterload

TO Intervening with:
- DRIP TITRATION
Titration

Choosing a method
- Assess your patient
  - All systems affect and will be affected by drip titration
- Evidenced Based Guidelines
  - Surviving Sepsis
  - Titrating Algorithms
- What to look for and why

Titration

Cardiac Function
- Preload
- Afterload
- Contractility
- Heart Rate
- Blood Pressure

BP 70/50 HR 148 -- Acute MI
- Lungs - Crackles, Peripheral edema, diminished pulses, mottled skin
- On Dopamine at 18 mcg/kg/min
- Nitroglycerin at 30 mcg/min

What are your thoughts regarding preload and afterload?
- Assessment
- Dopamine and Nitroglycerin

Volume or diuretics?
- Diuretics
  - Natriuresis NOT Indicated in Cardiogenic Shock
- Wean the dopamine?
  - Definitely – Reduce the Afterload
- Add new drips?
  - Vasodilation with a Positive Inotropic
    - Dobutamine or PDE Inhibitor

BP 70/50 HR 148 -- Acute MI
- Lungs - Crackles, Peripheral edema, diminished pulses, mottled skin
- PIP 50 cm H20, PEEP 8 cm H20
- SaO2 .91, Mode SIMV

What thoughts regarding ventilator assessment?
**Titration**

- Ventilator Adjustment?
  - Mode?
    - Change to Pressure Regulated Mode
      - PRVC, APRV, Bi-Level
  - PEEP?
    - Decreases Preload, Increases PVR
    - Need for Oxygenation
  - Ongoing assessment

- Cerebral perfusion
  - MAP
  - LOC
  - GCS

- PEEP?
  - Decreases Preload, Increases PVR
  - Need for Oxygenation

- Ongoing assessment

**Titration**

- Renal Function
  - BUN, Cr
  - BUN/Cr ratio
  - Na, K+
  - Urine output

- BUN – 35
- Cr – 1.5
- BUN/Cr – 23:1
  - Pre-renal
  - Na: 134
  - K: 3.6
  - UOP: 25 cc/h
  - Drip titration?

**Titration**

- Balancing
  - Use Your ASSESSMENT
  - ONE Drip at a TIME
    - Variable Creating Most Instability
      - Titrate against and MONITOR
      - Go SLOW
    - Know the Medication Half Life
    - How Often to adjust

**Weaning**

- Balancing
  - Use Your Assessment
  - ONE Drip at a TIME
    - Pick Most STABLE Variable
      - Go SLOW
    - Follow TRENDS – Do Complete Assessments
    - Stop Weaning if assess Instability
    - Know the Medication Half Life
      - How Often to adjust
      - How Long to Expect Result
**Titration Tidbits…**

- Norepi – Afterload
- Epi – HR & Contractility
- Levophed and Leav’em Dead
- Dopamine – Afterload > 10
  - Renal Function NOT Improved < 3
- Fluids
- Nitroglycerin - Preload
- Nipride - Afterload
- Fenoldopam
- Dual Action drugs
- Labetalol – Avoid in Brady or Blocks

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**Types of Shock**

- Hypovolemic Causes:
  - Internal
    - GI Bleed, Ascites, Sepsis
  - Internal Hemorrhage
- External
  - Hemorrhage, Vomiting Diarrhea

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<th>TYPES</th>
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**Case Study**

- 42 yo F admitted for GI bleed
  - HR 142, BP 86/46, CVP: 2, SVV: 18%
  - UOP: < 30cc/h
  - Skin: cool, clammy,
  - Pulses: weak & thready
  - Vitals Indicate 30 – 40% Blood Loss
  - What type of shock?
  - What interventions?
Case Study

- Interventions?

Volume, Volume, Volume

- Crystalloids, RBC, Colloids
- Hypertonic Resuscitation Research
  - Decreased Gut Perfusion
  - Increased Renal Failure and Death

Types of Shock

- Cardiogenic Causes:
  - Massive MI
  - Severe mitral or aortic disease
  - Cardiomyopathy
  - Pulmonary Embolism

Types of Shock

- Cardiogenic Assessment
  - General Appearance
    - Skin cool, clammy, Decreased capillary refill

Types of Shock

- Neurogenic Causes
  - Disruption of the SNS
    - Spinal cord injury above T-6
  - Spinal anesthesia
  - CNS dysfunction
  - Drugs, Emotional Stress, Pain

Types of Shock

- Neurogenic Assessment
  - General Appearance
    - Skin cool, clammy, Pink or Paled, Decreased capillary refill

Types of Shock

- 52 yo F admitted for Ant/Lat MI

  HR: 129, BP: 98/72, CVP: 16
  PAOP: 25, CI: 1.9, SVR: 1992,
  PVR: 225, UOP: 25 cc/h

C/O SOB, Crackles & Distant BS
Skin: Cold, clammy, LE Mottled
SpO2: 91% on NRB mask
Case Study
- 84 yo M, C-3 fracture, placed in halo traction, methylprednisolone drip
  - Room Air Sat: 95%
  - HR: 72, BP: 100/52, RR: 12 & Shallow,
  - UOP: 5 -10 ml/h, Skin: cool, No Response to 2 Liters NS & 500 ml Hetastarch
  - Skin Cool and Dry
  - LOC: Arouses to Slight Shaking, Garbled Speech, Disoriented to Time

Case Study
- Over 6 Hours
  - Intubated, PA & Art lines, FAST & DPL
  - 0200 Hemodynamics
    - T: 94, HR: 58, BP: 68/24, UOP: 0, RR: Vent
    - CI: 0.7, SVR: 120
    - Type of Shock?
    - Interventions – Epi & Norepi
    - Why NOT Neo?

“SIRS”
- Systemic Inflammatory Response Syndrome
  - Can occur due to non-infectious reasons
  - 2 or MORE signs as an ACUTE change
    - Temp. ≥ 100.4°F (38°C) or ≤ 96.8°F (36°C)
    - HR ≥ 90
    - RR ≥ 20 or PaCO₂ ≤ 32 mm Hg
    - WBC ≥ 12,000 cells/mm³ or ≤ 4,000 cells/mm³
      or ≥ 10% Bands (immature neutrophils)

Sepsis Definition
- SIRS + Infection = Sepsis

Severe Sepsis Definition
- Sepsis + Organ Dysfunction = Severe Sepsis

Types of Shock
- Septic “Hyperdynamic” Causes
  - Gram negative bacteria
    - Releases endotoxin
  - Gram positive bacteria
    - Releases exotoxin
  - SIRS – Similar appearance
Types of Shock

- SIRS/ Sepsis hyperdynamic Assessment
  - General Appearance
    - Skin warm
    - Pale to pink
    - UOP may be normal
  - Pulse: Increased
  - BP: May be Normal
  - CVP/PAOP: Decreased
  - CO/CI: Increased
  - SVR/PVR: Decreased

Case Study

- 63 yo M admitted – History of COPD, & alcoholism, Ventilator Dependent - Trach
- Dx. Pneumonia - Cultures Pending
- Assessment
  - LOC – Restless, Arousable & oriented x 2
  - HR 113, RR 24, (PRVC – 10)
  - BP 108/48, SpO₂ 92% - No ABG at this time
  - Skin flushed, diaphoretic,
  - UOP – 60 ml/hour
  - Temp: 102.9
  - CVP: 4, PAOP: 12, CO: 12.3, CI: 5.2
  - SVR: 416, PVR: 52
- SIRS Criteria MET?

Case Study – Sepsis?

- 63 yo M admitted – History of COPD, & alcoholism, Ventilator Dependent - Trach
- Positive Cultures for Klebsiella Pneumoniae
- PA Cath Placed & Intubated
  - HR: 113, BP: 90/48, UOP: 30 ml/h
  - CVP: 4, PAOP: 12, CO: 12.3, CI: 5.2
  - SVR: 416, PVR: 52
- Sepsis?
  - Interventions – Fluid Resuscitation
- SIRS Criteria ARE MET
- He MET the Criteria For SEPSIS
- SIRS + Infection = Sepsis
- Does He MEET Criteria for SEVERE SEPSIS?
  - Acute hypoperfusion or organ dysfunction
    - Pulmonary Failure – Intubated
- Interventions?
  - Fluids -Target MAP 60 – 65, CVP 8 – 12
  - Vasopressors if fluids fail
  - Early Antibiotics

What About Xigris?

- For Drotrecogin Alpha Activated
  - Do NOT Make Decision Solely Based on APACHE II
- Rh APC Recommended
  - APACHE II ≥ 25 AND/OR
  - High Risk of Death
    - Severe Sepsis – High Risk of Death
    - Sepsis Induced MODS
    - Sepsis Induced ARDS
    - Septic Shock

Surviving Sepsis

www.survivingsepsis.org
Types of Shock

- Septic Shock
  Hypodynamic Assessment
  - General Appearance
    - Skin cool, clammy, Decreased capillary refill
  - Pulse: Increased
  - BP: Decreased
  - CVP/PAOP: Increased
  - CO/CI: Decreased
  - SVR/PVR: Increased
  - UOP: Decreased

Case Study

- 63 yo M Vent dependent 36 hours later:
  (PRVC – 10)
  - HR: 115, BP: 88/68, RR: 20 T: 101
  - CVP: 11, PAOP: 18, CO: 3.8, CI: 2.0, SVR: 1340, PVR, 188
  - UOP: 20 ml/hour
  - Septic Shock?
  - Interventions
    - Optimize Hemodynamics
      - Consider adding Epinephrine or Dobutamine
      - Vasopressin if others fail to restore stability
    - PRBC administration if Hgb < 10
    - Optimize Pulmonary Functions

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Conclusion

- What questions do you have?