Seminar on Nursing and Pharmacology

Or, stuff you have to know for boards
Or, stuff the nurses do that is good to know about
Or, why we do some of the stuff we do
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Nurse Practitioner, Interventional Radiology
University of Virginia
Charlottesville
The fun stuff
But there’s more to this picture!

• How do we get the patient safely TO the procedure?
• How do we keep the patient safe IN the procedure?
• What drugs help us during and post procedure, and how do we use them?
• What about AFTER the procedure?
Objectives

• Discuss basic pre-, intra-, and post- procedure assessment concerns
• Discuss basic drugs used, their class, action, and dosing
• Identify lab values of importance
• Demonstrate various devices that assist with monitoring, and how they are used.
A Patient comes into the department

What needs to be done / evaluated before the patient can go into procedure?
“69 year old with history of CHF, A-Fib (not on anticoagulation), DM, HTN, COPD, presenting with two weeks of bilateral leg swelling L>R, now with 1 day of left sided leg pain. No history of leg pain (including when walking). Questionable history of stroke in 2009 (main symptom was vertigo), but the patient claims the MRI was negative. Last surgery was in 2010 (splenectomy). Transferred from OSH after found to have pulseless left foot. Started on heparin and sent to UVA. “
CTA runoff:

“Short segment occlusion of the distal left popliteal artery, the left tibioperoneal trunk, the proximal first 3 cm of the left anterior tibial, and the origin of the left peroneal artery....Findings are favored to be due to acute thromboembolic event, particularly in the absence of collaterals.”
Basics - Patient assessment

- Can they lie flat / prone?
- How is their breathing?
- What is their baseline ____ (pulses, liver function, renal function, etc)
- Cardiac status
- Meds
- Allergies
- Airway
Things that need to be done

- LIP assessment with sedation plan
- Informed Consent
- Patient education
- Nursing assessment prior to sedation
- Verification of meds and allergies
REGULATIONS

JCAHO (Joint Commission...)
ACR (American College of Radiologists)
AACN (American Association of Critical Care Nurses)
CMS (Center for Medicare and Medicaid Services)
ARIN (Association of Radiologic / Imaging Nursing)
ASA (American Society of Anesthesiologists)
JHACO 2015 Patient Safety Goals

- Patient Identification—two identifiers
- Communication—especially of results
- Medication safety—labelling, medication verification, awareness of anticoagulation
- Use alarms safely—must be on, must be audible
- Prevent infection
- Prevent surgical mistakes—site marking, correct consent, time out before procedure begins
So, What First?

- Vitals
- Exam
- Med Reconciliation
- Education
- Consent
Vitals

Temperature, Respirations, Heart Rate, Blood Pressure, O² Sat

**Temperature**
- Normal: 37°C or 98.6°F
- High: Hyperthermia
- Low: Hypothermia

**Checking Temperature**
- NPO 10 minutes prior
- Oral, axillary, auricular, rectal

**Respirations**
- Normal: 10-20 breaths per minute
  - Tachypnea
  - Bradypnea
  - Apnea

**Checking Respiration**
- Count chest rise and fall
- 15 sec and multiply if regular, full minute if irreg.
Vitals

Temperature, Respirations, Heart Rate, Blood Pressure, O² Sat

**Heart Rate**

NORMAL VARIES

40 – 100

< 40 Bradycardia

>100 Tachycardia

Quality and regularity also important

**Checking Heart Rate**

Radial, Brachial, Apical, Carotid, Femoral, pedal

If regular, count for 15, multiply by 4.

If not regular count for a full minute.

If using stethoscope, listen for extra sounds.

Thready, regular, bounding
# Vitals

Temperature, Respirations, Heart Rate, Blood Pressure, O² Sat

## Blood Pressure

- **Systolic** = heartbeat = top number
- **Diastolic** = relaxation = bottom number
- Varies with changes in posture, exercise, stress or sleep

<table>
<thead>
<tr>
<th>Normal</th>
<th>Prehypertension</th>
<th>Hypotension</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 120/80 mmHg</td>
<td>120-139/80-89</td>
<td>Low</td>
</tr>
</tbody>
</table>

## Checking Blood Pressure

- Upper arm preferred
- Very large or odd shaped, may use forearm
- Avoid fistulas, sites of mastectomies, vascular malformations
- Stethoscope position over brachial artery
- Listen for sounds to START, and STOP. These are two numbers
Oxygen occurs freely in blood, as well as bound to red blood cells. Reason for bright red arterial blood.

Free oxygen used first, followed by bound oxygen.

Low saturation is very late sign of hypoxia.

Exceptions: COPD, Carbon Monoxide poisoning

**Vitals**

Temperature, Respirations, Heart Rate, Blood Pressure, O² Sat

**Oxygen Saturation**

Number = percent saturated hemoglobin

Normal = 95 – 100%

Dangerously low < 85%

Low Oxygen is called Hypoxia

Shine through nail, no polish

Difficulty with Renaud's or poor UE circulation.

Oxygen occurs freely in blood, as well as bound to red blood cells. Reason for bright red arterial blood.

Free oxygen used first, followed by bound oxygen.

Low saturation is very late sign of hypoxia.

Exceptions: COPD, Carbon Monoxide poisoning
Special points

- If someone is very short of breath, axillary temp may be more accurate than oral.
- If patient complains of pain or coolness in an upper extremity, check blood pressure on both arms.
- If having trouble getting automatic BP, GO MANUAL.
- COUNT RESPIRATIONS.
Patient’s Vital Signs

- Temp: 97.7°F
- Pulse: 80
- BP: 137/67
- O2 Sat: 95%
Exam

- Can they understand what we are doing?
- Are they breathing well? Can they lie flat or prone.
- What are their baseline pulses?
- Abdominal distension? Ascites?
- Leg swelling?
- Easy bruising?
ASA classification

ASA I: normal healthy patient with no major comorbidities
ASA II: Managed or minor systemic disease with no limitation in activity
ASA III: Moderate to severe systemic disease
ASA IV: Severe systemic disease that is a constant threat to life
ASA V: Moribund patient at high risk of death
Mallampati Classification

Class I

Class II

Class III

Class IV

Refers to size of airway, ability to open mouth, dental issues, tongue size
Patients should bring actual bottles in with them if possible
Make sure what we have is what they are actually taking
Diabetic medications, Antihypertensives, Anticoagulants all important to know about
Education includes not only the procedure, but what patient can expect
Consent

- LIP must obtain consent
- Must be informed: risks, benefits, alternatives, and anything that might happen in that room needs to be explained
- Patient must be competent to consent
- Virginia - competency and surrogate decision making.
Lab Values

**Creatinine** – Normal 0.5 – 1.0 mg / dl
- Higher creatinine indicates renal dysfunction
- May change type of contrast used or how procedure is performed

**Sodium** – Normal 135 – 145 mg / dl
- Hyponatremia = below 135, common in late liver disease
- Hypernatremia = above 145, happens with some neurologic disorders
- Sodium conducts impulses across nerve endings

**BUN** – Normal 6 – 20 mg / dl
- Very low may indicate too much fluid administration
- High BUN can be because of dehydration or kidney disease, correlate with Creatinine
Lab Values

Potassium – Normal 3.5 – 5.0 mg / dl

- Hypokalemia – below 3.5, happens in adrenal disease
- Hyperkalemia – above 5.0, common in dialysis patients
- Potassium assists with the electrical pulses that cause heart muscle to contract.
- Hyperkalemia – longer time from impulse to contraction, longer recovery, eventual heart block
- Hypokalemia- heart becomes irritable and is prone to all kinds of arrhythmias

NEED NOT STOP A CASE, but MUST BE TREATED
Lab values

**Glucose**—normal 70 – 110

Below 70 = **Hypoglycemia**
- Hypoglycemia is associated with mental status changes, coma, death
- Early signs: irritability, shakiness, anxiety
- Treat with sugar oral or IV

Above 110 = **Hyperglycemia**
- Blood sugar over 400 greatly increases infection risk, and may be sign of infection
- Can lead to diabetic coma
- Hyperglycemia over time leads to many complications
- Treat with insulin in procedure setting
Lab values associated with clotting

**INR** – Normal < 1.0   Therapeutic 2 – 3 mg/dl
**Platelets** – Normal 150 – 300 mg/dl
**Fibrinogen** – Normal 200 – 400 mg/dl
**PTT** (Partial Thromboplastin time) –
  Normal 25 – 35 mg/dl
  Therapeutic 60 – 90 mg/dl
<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Test</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>13.4</td>
<td>Fibrinogen</td>
<td>729</td>
</tr>
<tr>
<td>RBC</td>
<td>5.45</td>
<td>PT</td>
<td>11.1</td>
</tr>
<tr>
<td>HGB</td>
<td>16.2</td>
<td>INR</td>
<td>1.0</td>
</tr>
<tr>
<td>HCT</td>
<td>49.4</td>
<td>PTT</td>
<td>41</td>
</tr>
<tr>
<td>PLT</td>
<td>282</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GLU</td>
<td>108</td>
<td>What labs are we concerned about?</td>
<td></td>
</tr>
<tr>
<td>NA</td>
<td>140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K+</td>
<td>4.0</td>
<td>Do we need to change anything?</td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUN</td>
<td>19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example

- 64 year old lady Cryptogenic cirrhosis
- Admitted with severe variceal bleeding
- Ultrasound shows retrograde flow in portal vein
- Team has requested TIPS procedure

What Labs for TIPS?
What about if they want embolization?
<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC</td>
<td>12.36 (H)</td>
<td></td>
</tr>
<tr>
<td>RBC</td>
<td>0.91 (L)</td>
<td></td>
</tr>
<tr>
<td>Hemoglobin</td>
<td>4.0 (LL)</td>
<td></td>
</tr>
<tr>
<td>Hematocrit</td>
<td>12.2 (LL)</td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td>85 (L)</td>
<td></td>
</tr>
<tr>
<td>Glucose</td>
<td>141 (H)</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>136</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>2.9 (L)</td>
<td></td>
</tr>
<tr>
<td>Chloride</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>BUN</td>
<td>31 (H)</td>
<td></td>
</tr>
<tr>
<td>Creatinine</td>
<td>1.6 (H)</td>
<td></td>
</tr>
<tr>
<td>Calcium</td>
<td>8.8</td>
<td></td>
</tr>
<tr>
<td>Total Protein</td>
<td>5.8</td>
<td></td>
</tr>
<tr>
<td>Albumin</td>
<td>2.7 (L)</td>
<td></td>
</tr>
<tr>
<td>Protime</td>
<td>24.2 (H)</td>
<td></td>
</tr>
<tr>
<td>Protime INR</td>
<td>2.1 (H)</td>
<td></td>
</tr>
<tr>
<td>PTT</td>
<td>42.4 (H)</td>
<td></td>
</tr>
</tbody>
</table>

**MELD Score** = (0.957 * ln(Serum Cr) + 0.378 * ln(Serum Bilirubin) + 1.120 * ln(INR) + 0.643) * 10 (if hemodialysis, value for Creatinine is automatically set to 4.0)
Meds to know about pre procedure

- Diabetic medications – regulate blood sugar
- Antihypertensives – regulate blood pressure
- Anticoagulants – prevent normal blood clotting
MATH PROBLEM.
John has 32 candy bars. He eats 28. What does he have now?

Diabetes.
Diabetic Medications

Oral

- Tend to end in: -ide, -azone, -ose, -inually
- Metformin is most common
- Should be stopped day prior to contrast and held for 48 hours post contrast, can cause lactic acidosis, and worsen renal function

Table 1 - Non-insulin agents available for treatment of diabetes in the United States

<table>
<thead>
<tr>
<th>Drug class</th>
<th>Route of administration</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biguanides (metformin)</td>
<td>Oral</td>
<td>Effectively lowers HbA1c, low cost, does not cause weight gain</td>
<td>GI complaints, minimal risk of lactic acidosis (contraindicated in patients older than 80 y and in those with elevated creatinine levels)</td>
</tr>
<tr>
<td>Sulfonylureas (tolbutamide, glyburide, glipizide, glimepiride)</td>
<td>Oral</td>
<td>Available as generics (low cost)</td>
<td>Can cause weight gain</td>
</tr>
<tr>
<td>Dipeptidyl peptidase 4 (sitagliptin)</td>
<td>Oral</td>
<td>May preserve beta cells from ongoing destruction</td>
<td>Cause fluid retention (sometimes leading to heart failure); stimulate accumulation of adipose tissue</td>
</tr>
<tr>
<td>Meglitinites (reposeglinide, nateglinide)</td>
<td>Oral</td>
<td>Rapid disappearance time results in lower risk of hypoglycemia than with sulfonylurines</td>
<td>Much shorter duration of action than sulfonylurines; thus, these agents must be taken before meals; moderately high cost</td>
</tr>
<tr>
<td>GLP analogs (exenatide)</td>
<td>Parenteral</td>
<td>May result in progressive weight loss in some patients</td>
<td>Nausea (often severe); must be injected twice daily; high cost</td>
</tr>
<tr>
<td>Amylin analogs (pramlintide)</td>
<td>Parenteral</td>
<td>Weight loss can occur</td>
<td>Nausea; unpredictable hypoglycemia; high cost</td>
</tr>
<tr>
<td>DPP-IV inhibitors (sitagliptin)</td>
<td>Oral</td>
<td>No prominent side effects, low risk of hypoglycemia</td>
<td>Does not lead to weight loss; high cost</td>
</tr>
</tbody>
</table>

HbA1c, glycated hemoglobin; GLP, glucagon-like peptide; DPP-IV, dipeptidyl peptidase IV
Diabetic medications

Insulin

• Short and long acting
• Can be injected subcu or IV
• Some diabetics use a pump to control insulin injection rate
• Important to know what kind and how much patient takes and WHEN taken
Anti-Hypertensives

- Medications designed to lower blood pressure
- Some medications can cause “rebound hypertension” when skipped – blood pressure gets higher.
- Look for meds that end in –pril, or –lol, or –pine
- Some are used intra-procedure (more about that in a bit), so good to know what pt was on to start with.
Lisinopril
Captopril
Ramipril
Metoprolol (lopressor)
Propranolol
Amlodipine (Norvasc)
Clonidine
Cardiazem
Nebivolol (Bystolic)
Valsartan (Diovan)
Candesartan (Cozaar)
Irbesartan

__________lol = Beta Blockers
__________pril = ACE inhibitors
__________sartan = ARBS
__________pine = calcium channel blockers

Common antihypertensive names
Anticoagulants

Heparin — Don’t need to stop

Low molecular weight heparins: -parin
  • Fraxiparin, enoxaparin, dalteparin, ardeparin, tinzaparin, reviparin, (lovenox, fragmin, arixtra, Innohep) – Hold between 12 and 36 hours

Coumadin / Warfarin – Hold 3-5 days, may need to bridge with LMWH

Argatroban – Hold for 4 hrs. No labs to draw
Platelet Inhibitors

Clopidogrel (Plavix)
Aspirin
Abciximab (ReoPro)
Eptifibatide (Integrilin)
Tirofiban (Aggrastat)
Other things pre procedure

IV placement
Other things pre procedure

Foley placement
Other things pre procedure

ECG leads
Other things pre procedure

Oxygen placement
NOW, we can go in the room!
Intra Procedure

Sedatives, anticoagulants, contrast, and other drugs
Sedation Terms

- Analgesia
- Minimal sedation
- Moderate sedation and analgesia
- Deep sedation and analgesia
- General anesthesia
- Dissociative sedation
Analgesia

Definition: The loss of ability to feel pain while conscious. The absence of pain without loss of consciousness.
Let’s face it, pain and anxiety often go together.....
Anxiolysis

Definition: The treatment of anxiety by pharmacologic or other means with a goal of producing a calm, relaxed state.
Minimal Sedation

- Response to verbal stimulation is normal
- Cognitive function and coordination may be impaired
- Ventilatory and cardiovascular functions are unaffected
- Frankly, this is what we often provide

Minimal sedation MAY = Anxiolysis
Moderate Sedation and Analgesia

- Depression of consciousness is drug-induced.
- Patient responds purposefully to verbal commands.
- Airway is patent, and spontaneous ventilation is adequate.
- Cardiovascular function is usually unaffected.
Deep Sedation and Analgesia

- Depression of consciousness is drug-induced.
- Patient is not easily aroused but responds purposefully following repeated or painful stimulation.
- Independent maintenance of ventilatory function may be impaired.
- Patient may require assistance in maintaining a patent airway.
- Spontaneous ventilation may be inadequate.
- Cardiovascular function is usually maintained.
DRUGS

NARCOTICS

ANXIOLYTICS

LOCAL ANESTHETICS
Benzodiazepines

- Cause depression of the CNS
- Effectiveness is Dose Dependent
- Midazolam (Versed) specifically causes amnesia up to 60 minutes following administration.
- Can cause Respiratory depression
- Cause loss of muscle tone which can result in inability to protect airway
- Cause hypotension, Bradycardia
- Flumazenil is reversal agent
Analgesics

- Can be Narcotic or Non-narcotic
- When Narcotic given within 5 minutes of benzodiazepine, small dose can increase overall sedative effect.
- Act on the CNS as opioid agonists
- Decrease respiratory rate and sufficiency
- Can cause bradycardia
- Can cause hypotension OR hypertension
- Narcan is reversal agent
<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Onset</th>
<th>Peak</th>
<th>Duration</th>
<th>Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midazolam (Versed)</td>
<td>0.5 mg/kg 1-3 mg every 2-3 min avg total dose 5 mg</td>
<td>1-3 minutes</td>
<td>5-7 minutes</td>
<td>20-30 minutes</td>
<td>Respiratory and cardiac depression</td>
</tr>
<tr>
<td>Lorazepam (Ativan)</td>
<td>0.02-0.05mg/kg 1-2 mg every 3-5 min up to 4 mg</td>
<td>3-7 minutes</td>
<td>10 – 20 Minutes</td>
<td>6-8 hours</td>
<td>Above plus ataxia, euphoria</td>
</tr>
<tr>
<td>Diazepam (Valium)</td>
<td>2.5 mg every 5 mg up to 10 mg</td>
<td>1-5 min</td>
<td>1-8 hours</td>
<td>Very damaging to veins</td>
<td></td>
</tr>
<tr>
<td>DRUG</td>
<td>Onset (MIN)</td>
<td>Peak (MIN)</td>
<td>Duration (HRS)</td>
<td>Half-Life (HRS)</td>
<td></td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------</td>
<td>------------</td>
<td>----------------</td>
<td>-----------------</td>
<td></td>
</tr>
<tr>
<td>Fenatnyl IV</td>
<td>1-2, Slow</td>
<td>10-15</td>
<td>0.5-1</td>
<td>1-4</td>
<td></td>
</tr>
<tr>
<td>Fentanyl TD</td>
<td>2-3, 15-30</td>
<td>18-24hrs</td>
<td>48-72</td>
<td>Variable</td>
<td></td>
</tr>
<tr>
<td>Morphine IV</td>
<td>2-5</td>
<td>10-20</td>
<td>2-4</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Morphine PO-IR</td>
<td>15-30</td>
<td>30-60</td>
<td>3-6</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>30-60</td>
<td>30-60</td>
<td>4-5</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>Hydromorphone PO</td>
<td>60-120</td>
<td>6-8</td>
<td>1,5-2</td>
<td>1-5-2</td>
<td></td>
</tr>
<tr>
<td>Methadone</td>
<td>10-15</td>
<td>30-60</td>
<td>6-8</td>
<td>2-3</td>
<td></td>
</tr>
<tr>
<td>Oxycodone</td>
<td>10-20</td>
<td>30-60</td>
<td>4-5</td>
<td>3-4</td>
<td></td>
</tr>
<tr>
<td>Hydrocodone</td>
<td></td>
<td></td>
<td></td>
<td>3-4</td>
<td></td>
</tr>
</tbody>
</table>

NOTE PEAK TIMES AND DURATION AS RELATED TO HALF LIFE!!! THIS IS WHERE PATIENTS DEVELOP OVERSEDATION POST PROCEDURE!
Propofol

- It is an alkylphenol derivative. Is derived from egg lecithin. **DO NOT GIVE TO PATIENTS WITH EGG ALLERGY**
- Adult dose 0.5-1 mg/kg IV loading dose; may repeat by 0.5-mg increments q3-5min.
- Onset of action <1 min, and duration 3-10 min.
- Provides rapid onset and recovery phase, and brief duration of action.
- No analgesia.
- Has anticonvulsant properties.
- Can rapidly cause deep sedation.
- Causes cardiovascular depression and hypotension.
Ketamine

- Dissociative general anesthetic
- Given IV to adults, which enables immediate onset, can be IM.
- The duration of effect is 10 to 20 minutes.
- For adults, a dose of 1 to 2 mg/kg/IV/1-2min.
- Give quickly when procedure starts.
- Doses of 0.25 to 0.5 mg/kg may be repeated every five to ten minutes.
Ketamine

- Side effects include tachycardia, hypertension, hypersalivation, laryngospasm, nausea and vomiting, increased intracranial and intraocular pressure.
- Emergence reaction (disorientation, dream-like experiences, or hallucinations that may be frightening) the most reported side effect. It can be prevented by midazolam.
- It can lead to hypersalivation, which can be reduced by atropine.
Nitrous oxide

- N2O is an ultra-short acting agent used for PSA that is inhaled as a 30 to 50 percent mixture, with 30 percent O2.
- It has an immediate onset of action and provides analgesia, anxiolysis, and sedation.
- It must be administered in a well-ventilated room with a scavenging system to prevent clinician exposure.
- Increasing body of literature on safety in adults.
- There has been some discussion about its use in pediatric line placement.
GENERALLY......

- Persons to be sedated MUST be evaluated pre and post procedure by an LIP, and by the person providing sedation.
- Sedation must be provided by a PA, NP, or RN, and ordered by an LIP.
- Documentation must occur of all assessment, and of vitals every 5 minutes during sedation.
- The “monitor” should have no other duties besides watching the patient.
Specific things

- Intravenous access must be achieved and maintained during sedation.
- Supplemental oxygen must be immediately available
- Emergency (Code) cart with defibrillator must be available
- Reversal drugs must be at hand (ie: narcan and flumazenil)
Complications of Sedation

- Over or under sedation
- Dysrhythmias
- Respiratory Insufficiency
- Cardiac Arrest
- Airway obstruction
- Pain
- Aspiration
- Nausea and vomiting
- Hemodynamic instability
- Paradoxical reactions
Managing Oversedation

• DON’T PANIC
• Stay close to your patient. DON’T RELY ON THE MONITOR
• Stimulate your patient from time to time – Use touch, move head or arms if accessible
• Remove Pillow
• Head Tilt Chin Thrust
• Increase fluids
Two easy maneuvers to stimulate respiration

Glabellar Tap

Mastoid Process Massage
MIDAZOLAM wears off faster than FENTANYL

- The above maneuvers will generally improve respiratory status in the short term until medication wears off.
- Have Flumazenil and Narcan on hand
- Be prepared to protect airway (oral airways and nasal trumpets must be on hand at start of case)
- Beware High flow Oxygen in COPD patient
Oral Airway
Nasal Trumpet
Naloxone

- Reverses opioid agonists.
- Adults dose 0.1-0.2 mg/kg IV; may repeat q2-3min prn, in overdose: 0.4-2 mg IV; may repeat q2-3min prn.
- Onset of action for IV is 1-3 min, 10-15 min for IM.
- Rebound sedation may occur.
- If used in patient with chronic opioid use, will precipitate acute withdrawal.
Flumazenil

- Reverses benzodiazepines.
- For sedation reversal: 0.1-0.2 mg IV infused over 15 sec, may repeat after 45 sec and then every min; not to exceed 1 mg.
- For overdose: 0.2 mg IV infused over 30 sec, may repeat with additional doses of 0.5 mg over 30 sec at 1-min intervals; not to exceed 3 mg.
- Rebound sedation may occur.
- If used in patient with chronic BZP use, will precipitate acute withdrawal.
- May precipitate seizures unresponsive to BZPs.
Contrast is a Drug!

- Dosing changes with age, renal function
- Anaphylactic reaction is possible
- Osmolarity and viscosity must be considered
- Adverse effects can range from benign to life threatening
ALL INTRAVASCULAR RADIOPAQUE CONTRAST MEDIA CONTAIN IODINE
Ionic monomer contrast medium
Iotrolan
ratio 6.0

Iodixanol
ratio 6.0
<table>
<thead>
<tr>
<th>Brand Names</th>
<th>Generic Name</th>
<th>Structure</th>
<th>Iodine Ratio</th>
<th>Osmolarity</th>
<th>Viscosity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conray</td>
<td>Iothalamate</td>
<td>IONIC MONOMER</td>
<td>3.2 = 1.5</td>
<td>1500 - 1600</td>
<td>5-9</td>
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<tr>
<td>Isopaque</td>
<td>Metrizoate</td>
<td></td>
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<tr>
<td>Vasoray</td>
<td>Amidotrizoate</td>
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<tr>
<td>Urografin</td>
<td>Ioxithalamate</td>
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<tr>
<td>Angiografin</td>
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<tr>
<td>Gastrografin</td>
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<td>Telebrix</td>
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<tr>
<td>hexabrix</td>
<td>Ioxaglate</td>
<td>IONIC DIMER</td>
<td>6.2 = 3</td>
<td>600</td>
<td>12</td>
</tr>
<tr>
<td>Omnicaque</td>
<td></td>
<td>NON IONIC MONOMER</td>
<td>3.1 = 3</td>
<td>500 - 700</td>
<td>11</td>
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<tr>
<td>Iopamiro</td>
<td>Iohexol</td>
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<td></td>
<td>6</td>
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<tr>
<td>Ultravist</td>
<td>Lopamidol</td>
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<td></td>
</tr>
<tr>
<td>Optiray</td>
<td>Lopromide</td>
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<tr>
<td></td>
<td>Ioversol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visipaque</td>
<td>Iotrolan</td>
<td>NON IONIC DIMER</td>
<td>6.1 = 6</td>
<td>300</td>
<td>25</td>
</tr>
<tr>
<td>Iovist</td>
<td>Iodoxanol</td>
<td></td>
<td></td>
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<td>10</td>
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</tbody>
</table>
CONTRAST MUST BE WARMED TO $37^{\circ}C$ PRIOR TO ADMINISTRATION

Central devices specify that their ratings are for WARMED contrast.
Complications of Contrast administration

- Contrast reaction
- Extravasation / Catheter Malposition
- Contrast Induced Nephropathy
- Nephrogenic Systemic Fibrosis
Contrast Reaction Epidemiology

- Occur in 2 – 3% of patients
- Historically thought to be pseudoallergic (anaphylactoid)
- Now believed that there are instances of both IgE and pseudoallergic reactions
- Not associated with shellfish allergy
- Level of iodine not a factor
- Topical Iodine allergy doesn’t count either
Risk factors for Adverse Reaction

- History of allergies
- Asthma
- Renal Insufficiency
- Cardiac status
- Anxiety
- Beta Blocker use
Oral Regimen

- Prednisone 50 mg at 13, 7 & 1 hr prior to contrast administration, WITH Benadryl 50 mg 1 hr prior
- Methylprednisilone (Medrol) 32 mg at 12 & 2 hrs prior to contrast WITH Benadryl 50 mg 1 hr prior
- Benadryl can be PO or IV

IV or Emergent Regimen

- Methylprednisolone (solumedrol) 40 mg or Hydrocortisone 200mg every 4 hrs until contrast WITH benadryl 50 mg
- Dexamethasone 7.5 mg or betamethasone 6.0 mg IV every 4 hrs until contrast WITH benadryl
- Benadryl 50 mg IV alone

Premedicating to prevent reaction
"IV steroids have not been shown to be effective when administered less than 4 – 6 hours prior to contrast injection"
Symptoms of Adverse Reaction

• Rash, may be immediate or delayed
• Warmth and / or flushing (should be in combination with other symptoms to be considered a true adverse reaction)
• Transient Hypotension
• Severe Hypertension
• Ventricular tachycardia
Symptoms of Adverse Reaction

- Vasovagal reaction
- Laryngeal edema
- Hives
- Difficulty breathing
- Anaphylaxis
Treatment of adverse reactions

- High flow O₂
- Epinephrine
- Albuterol
- Benadryl
- Famotidine
- Fluids
- Atropine for brady arrhythmia
- PROTECT AIRWAY
- OBSERVE
Drugs on the table during procedures

- Anesthetic agents
- Anticoagulants
- Thrombolytics
- Antiplatelet
- Vasoconstrictors
- Vasodilators
- Sclerosants
Anesthetic Agents

Esters
- Benzocaine
- Chlorprocaine
- Cocaine
- Procaine / Novacaine
- Tetracaine

Amides
- Bupivacaine
- Lidocaine
- Prilocaine

- Usually topical or injectable
- Topical includes creams and jellies, as well as spray on anesthetics
- Injectable anesthetics divided into two classes:
  - Esters
  - Amides
- While there may be some cross reactivity, if reaction to one class, usually ok to use one from other class
Anticoagulant - Warfarin (Coumadin)

Function
• Inhibits blood's ability to clot or coagulate
• Effectiveness is measured with either PT or INR
• Dose: 2-10mg per day

Uses
• Atrial Fibrillation
• Prevent worsening of blood clots

Route
• Oral

Complications
• Bleeding

Reverse with vitamin K
Anticoagulant - Heparin

Indications
- Inhibits blood's ability to clot or coagulate
- Effectiveness is measured with PTT

Dose
- Loading Dose: 3,000u-5,000u
- Maintenance Dose: 800u/h-1200u/h

Uses
- Treatment of clots
- Prevention of clots in at risk people

Route
- IV or Subcutaneous

Complications
- HITT, Bleeding

Reverse by holding or giving FFP
Anticoagulant - Argatroban

Indications
• Inhibits formation of thrombus material

Dose:
• 2mcg/kg/minute

Route
• IV Infusion

Uses
• Heparin induced thrombocytopenia

Complications/Concern
• No blood test to measure effectiveness
• Must be off 4 hours before invasive procedure
• IV only route currently

NO Reversal, just hold for 4 hours
Anticoagulant - Low molecular weight Heparins

**Route**
- Subcutaneous

**Complications**
- Prolonged half life
- No reversal agent
- No lab value to measure effectiveness
- Bleeding

**Indications**
- Inhibits bloods ability to clot or coagulate

Reverse with vit. K or FFP, holding usually sufficient

- Enoxaparin, Fragmin, Arixtra
Antiplatelet - Plavix

**Indications**
- CAD and PVD

**Contraindications**
- Bleeding ulcer, Allergy, Hemorrhagic stroke

**Dose**
- Loading Dose: 300mg
- Daily: 75mg

**Route**
- Oral

**Complications**
- Bleeding
- Discontinue use 3-5 days prior to surgery
Antiplatelet - Aspirin

Indications
- Anti-inflammatory, Analgesic, Prevent recurrence of MI, Ischemic stroke, TIA, and Angina

Contraindications
- GI bleed
- Thrombocytopenia
- Bleeding disorders
- Allergy

Route
- Oral, Rectal

Complications
- Bleeding
Antiplatelet - Integrilin, ReoPro, Aggrastat

Indications
• Prevents platelet aggregation

Contraindications
• Major surgery within past 6 weeks, ESRD, History of stroke within 30 days, Hypertension

Dose:
• Loading 180mcg/kg bolus x 2 (10 min apart)
• Infusion at 2mcg/kg/min

Route
• IV

Complications
• Bleeding
Thrombolytic - Alteplase, Urokinase, Streptokinase

Indications
• Used to dissolve existing clot

Contraindications
• Recent surgery, GI bleeding, Traumatic injury, Intracranial hemorrhage, Atrial fibrillation

Patient Preparation
• Check Coags and fibrinogen
• Two IV’s
• Available blood products

Complications
• Bleeding
Vasoconstrictor

Indication

- Increases systemic vascular resistance thereby increasing blood pressure and heart rate
- Increases blood flow to vital organs
- Increases contractile force and bronchodilation
Vasoconstrictor

**Epinephrine** (Adrenaline)

**Dose**
- 1mg IV/IO (1:10,000)
- Repeat every 3-5 min

**Route**
- Intracardiac, ET, infusion

**Vasopressin**

**Indications**
- Asystole, PEA, Pulseless VT, VF

**Dose**
- 40 units IV only once
- Always follow with 20ml saline

**Route**
- IO, ET
**Drugs to increase HR and BP**

<table>
<thead>
<tr>
<th><strong>Atropine</strong></th>
<th><strong>Dopamine</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Comes from nightshade plant</td>
<td>• Neurotransmitter affecting catecholamine response</td>
</tr>
<tr>
<td>• Neurotransmitter affecting catecholamine response</td>
<td>• Precursor of epinephrine</td>
</tr>
<tr>
<td><strong>Indications</strong></td>
<td><strong>Indications</strong></td>
</tr>
<tr>
<td>• Asystole, Bradycardia</td>
<td>• Low dose helps renal perfusion</td>
</tr>
<tr>
<td></td>
<td>• High dose increases blood pressure</td>
</tr>
<tr>
<td><strong>Dose</strong></td>
<td><strong>Dose</strong></td>
</tr>
<tr>
<td>• 0.5mg IV for symptomatic bradycardia</td>
<td>• 2-20mcg/kg/min IV infusion</td>
</tr>
<tr>
<td>• 1mg IV for asystole; total 3mg</td>
<td><strong>Route</strong></td>
</tr>
<tr>
<td><strong>Route</strong></td>
<td><strong>Route</strong></td>
</tr>
<tr>
<td>• IO, IV</td>
<td>• IV</td>
</tr>
</tbody>
</table>
Vasodilator

- Relax the smooth muscle in blood vessels
- Vasodilators are used to treat hypertension, heart failure and angina
- Increase O₂ demand
Vasodilator

Hydralazine (Apresoline)

Indications
• Hypertension, Heart failure, Angina

Risks
• Can cause angina attacks and ECG changes due to myocardial ischemia

Dose:
• 5-20mg IV

Route
• IV

Nitroglycerine

Indications
• Hypertension, Heart failure, Angina

Risks
• Dizziness, headache

Dose:
• Start with 5 mcg/min and titrate up to desired effect

Route
• IV, ointment, Sublingual Patch, Spray
When and Where would these drugs be used?

- Heparin
- Nitroglycerine
- Epinephrine
- Hydralazine
- TPA (tissue plasminogen activator)
Thrombolytics

- Break up the Fibrin bonds that hold clot together
- Tissue Plasminogen Activator, Urokinase, Streptokinase, Retaplace are all versions of the same, with slightly different actions and side effects.
What is going on?
Spasm of artery after angioplasty

What drug would we use?
Nitro injection to dilate vessel and reduce spasm
Post procedure

- Vitals and level of consciousness must return to pre procedure baseline before discharge.
- Frequent checks of pulses and groin for arterial cases
- Risk of bacteremia in biliary, cholecystostomy, nephrostomy tubes
Post Procedure Concerns

- Bleeding
- Hematoma
- Bacteremia
- Distal Embolization
- Oversedation
- Late onset of other complications
- Reinforce education with family and patient