April 10th 2026

Partners in Progress
Jen Segura BS, RVT

Beyond the Vaporizer Dial and the “Random Number Generator”

Gaining Confidence with Anesthesia Monitoring and Common Interventions

GOALS

- To develop skills as anesthetists and familiarize ourselves with how to judge the accuracy of our readings
- Gain confidence with critical thinking and interventions for common complications seen in patients under anesthesia (ASA I, some ASA II)

OUTLINE

1. Equipment Overview/Troubleshooting (Brief)
2. Common Anesthetic Drugs and Effects
   (Details included for reference)
3. Common Anesthetic Complications and Interventions
4. Recovery Management Strategies (Brief)

- Not all interventions outlined in this presentation are appropriate for every patient/situation. Each patient is an individual, and should be evaluated by you and your doctor on a case by case basis.
    - These interventions I would consider reasonably safe in ASA I and some ASA II patients.
- All interventions concerning administration of drugs/fluids should be appropriately communicated with your doctor prior to enacting

I’m about to present an insane amount of information in a very short amount of time. While I will be impressed if you are able to take detailed notes, no extra credit will be awarded for your efforts. If you write down anything, write down your questions, and I will do my best to answer them at the end of the presentation. I suggest you sit back and enjoy the show, a copy of the presentation will be provided to you for reference - there are slide/notes from an “unabridged” portion of the talk at the end! :)

Monitoring Equipment Nuggets

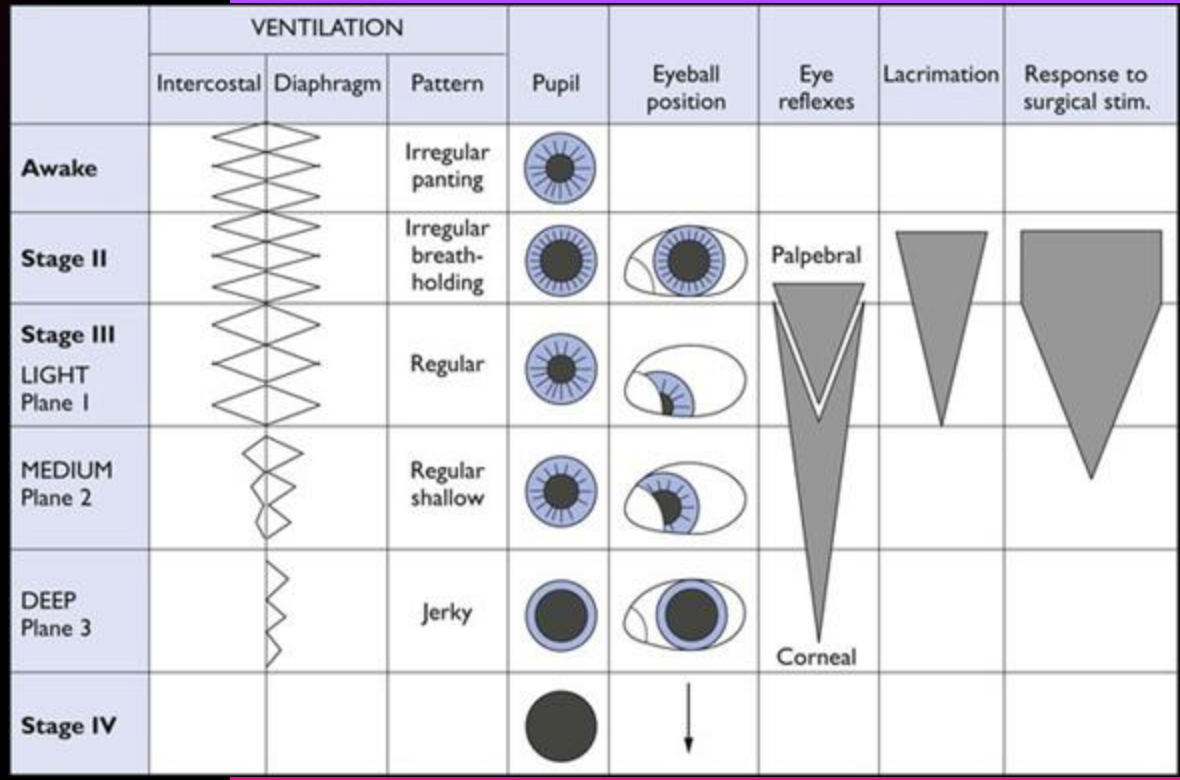
- Starts with good maintenance - know the manufacturer's recommendations
- Know what affects the accuracy of your monitors, rule out or mitigate these factors to determine accuracy
- SpO2 - match palpated pulse rate with strong pulse wave
  - Move probe, warm area
  - Can shave and use rectal probe on any palpable pulse
- ECG - avoid movement/electrical interference
  - Your leads just have to make a triangle through the body
  - Lead II primary lead
- EtCO2 - if questioning readings, zero and replace parts
  - Can use your own breath (with corrugated tubing for sidestream) to check accuracy
  - Give PPV for most accurate number (esp sidestream)
- BP - movement, cuff size/placement, at level of R atrium, osc - less accurate w low/high BP
  - NIBP flawed in terms of accuracy
  - Evaluate based on trends and multiple readings
  - If uncertain, corroborate with combinations of Osc, doppler, differences in pulse quality
  - Presence of pulse DOES NOT indicate MAP >60

THE "RANDOM NUMBER GENERATOR"

Monitoring Patient Depth

Stage III Anesthesia

- Consists of 3-4 planes depending who you ask
- Light plane - eyes more central/slightly ventral-medial, palpebral present, regular breathing, tighter muscle tone, response to surgical stimulation
- Surgical Plane - this is where it gets split into 2 planes: Eyes ventromedial, palpebral very slight or usually absent, minimal to absent response to surgical stimulation, minimal to loose muscle tone, transition to higher reliance on diaphragm for breathing
- Deep Plane - Eyes central, Pupil dilated, severely reduced to absent PLR, shallow or jerky diaphragmatic breathing to apnea, corneal reflex weak to absent - Dangerous



Hot Tip: Intercostal breathing causes expansion of chest, Diaphragmatic breathing seen in the abdomen as intercostal involvement decreases (even tracheal tug in extreme cases) - DON'T MISTAKE FOR BEING LIGHT

DRUGS

Premedications

- Overall goal is to get patient sedate in order to bring them closer to anesthesia, so they can be smoothly induced
- Pain control usually part of the premed protocol
- Reduce anxiety/fear to prevent cortisol/catecholamine release
    - Oral sedation at home is SO important for high FAS patients
        - Trazodone 5-7 mg/kg, but can go up to 10 mg/kg
        - Gabapentin 20-40 mg/kg
        - Night before (10 hours prior) and 2 hours prior to appt
        - Can add other drugs to supplement if needed for very aggressive dogs
        - Not just for outwardly anxious - MAC REDUCTION!
- May choose different protocols/routes of administration depending on hospital workflow, patient and procedure
    - Timing of surgery, duration of prep, staffing, patient handleability/anxiety, duration of procedure, expected pain

The faces of “chill protocol” deficiency

DRUGS

Premedicatic

- Overall go … closer to anesthesia
- Pain contr
- Reduce ar … ase
  - Oral … atients
    - …
    - …
    - … appt
    - … very aggressive dogs
    - Not just for outwardly anxious - MAC REDUCTION!
- May choose different protocols/routes of administration depending on hospital workflow, patient and procedure
  - Timing of surgery, duration of prep, staffing, patient handleability/anxiety, duration of procedure, expected pain

The faces of "chill protocol" deficiency

Common Premedication Drugs: Opioids

- Provide Analgesia and sedation
- Side Effects (Varying degrees depending on opioid given)
  - Respiratory depression and bradycardia
  - Increase of the threshold at which CO2 accumulation stimulates the reflex to breathe
  - GI: Vomiting, constipation/delayed GI passage/ileus, reduced appetite
  - Dogs: miosis and sedation
  - Cats: Mydriasis and euphoria and/or sedation

On same drug, but at different parties

Information	Butorphanol	Buprenorphine	Methadone	Hydromorphone	Morphine	Fentanyl
Receptor	Kappa Ag/Part. Mu Ant	Partial Mu Ag	Mu Ag/NMDA Ant	Mu Agonist	Mu Agonist	Mu Agonist
Sedation	++	0/+	+	++	++	+ - +++ DD
Analgesia	0/+ v.mild/brief/visceral	++ - +++ (++++?) DD	++++	++++	++++	++++(+) DD
Duration	Analgesia (30-40m)	DD - 6-10 hr (avg)	4-8 hr (P/DD)	2-6 hr	2-6 hr	30-40 mins avg
GI Side Effects	0	+ (minimal)	++ (Dec GI motility)	+++ (inc V - esp IM, decr. motility)	++ (Inc V, Dec GI motility)	+++ (Dec GI motility)
CV/Resp Depression	+ (sedation dependant)	+ - ++ (ceiling effect)	++ - +++	++ - +++	++ - +++	+++(+)
Routes	IV, IM, SQ	IV, IM, SQ*, TM(cat)	IV, IM, SQ, OTM	IV, IM, SQ	IV, IM, SQ	IV, TD patch
Other uses	Procedural sedation	Local, oral med - cat	Oral med	Local, epidural, CRI	Local, epidural, CRI	CRI
Notes	Partial reversal of mu opioids, avoid MDR1	- Peak analgesia slow (30 mins IV) - High affinity for receptor, difficult to reverse -Partial reversal of mu opioids	Low incidence of panting (rapid IV increased)	Panting common	-Rapid IV adm associated w histamine release (Dec BP and/or anaphylaxis possible) - Preferred for liver dysfunction canines	

Not So Fun Fact…

Cats receive little MAC sparing effect from opioids.
Management takeaway: you should rely on intermittent bolusing/CRI of alternative drugs (ie ketamine, dexmedetomidine), rather than adjustment in opioid CRI or repeat bolus of opioid if P is light, but has adequate analgesia.

Acepromazine - Alpha 1 Antagonist

- Great Sedation, no analgesia
  - Potentiates Opioid analgesia
- Duration: 6-8 hrs, peak @ 30-60mins (IV)
- Effects
  - Vasodilation (hypotension)
  - Sometimes injected MM
  - Mild Bradypnea
  - Bradycardia (poss reflex tachycardia w hypotension)
  - Possible Antidysrhythmic effects
  - CV collapse possible
- Patients:
  - Contraindications - significant cardiac disease, debilitation - hypovolemia, hypotension, shock
  - Avoid - Very young <12 weeks, MDR1
  - Caution - mild cardiac diseases, hepatic dysfunction

Dexmedetomidine - Alpha 2 Agonist

- Great sedation, mild analgesia
  - As an adjunct
- Duration: 1-2hrs, Peak @ 10*-30 mins (*IV)
  - Reversible with Atipamezole
- Effects
  - Transient Vasoconstriction (transient hypertension)
  - Pale MM
  - Hypoventilation
  - Reflex Bradycardia
  - Arrhythmias fairly common
  - CV collapse possible with reversal under gas anesthesia
- Patients:
  - Contraindications - heart disease, significant liver/kidney dz, debilitation - hypovolemia, hypotension, shock
  - Avoid - <12 weeks, cats w resp dz
  - Caution - mild kidney/liver dz

Acepromazine - Alpha 1 Antagonist

- Great Sedation, no analgesia
  - Potentiates Opioid analgesia
- Duration: 4-8 hrs, peak @ 30-60mins (IV)
- Effects
  - Vasodilation (hypotension)
  - Poss. injected MM
  - Mild Bradypnea
  - Bradycardia (poss reflex tachycardia w hypotension)
  - Possible Anti
  - CV Possible
- Patients:
  - Contraindica disease, deb
  - , hypotensio
  - Avoid - Very
  - Caution - mil dysfunction

Dexmedetomidine - Alpha 2 Agonist

- Great sedation, mild analgesia
  - As an adjunct
- Duration: 1*-2hrs, Peak @ 10*-30 mins (*IV)
  - Reversible with Atipamezole
- Effects
  - Transient Vasoconstriction (transient hypertension)
  - Pale MM

dia
ly common
ssible with reversal under

ns - heart disease, significant
, debilitation - hypovolemia,
ock
eks, cats w resp dz
idney/liver dz

Acepromazine - Alpha 1 Antagonist

- Management Considerations
  - Not an ideal agent for anesthetic use d/t vasodilation
  - Use for post-op dysphoria/hyperexcitability
    - More sedate P - monitor BP esp 30-60 mins after administration
  - Lower doses slowly to effect IV recommended

Dexmedetomidine - Alpha 2 Agonist

Management Considerations

- Bradycardia, AV Blocks/Bradyarrhythmias
  - Not a concern if normotensive
- Treat hypotension with anticholinergic (if bradycardic/has arrhythmia)
  - Glycopyrrolate (0.005-0.02 mg/kg) is preferred, as it has a less intense effect.
  - Atropine for emergencies but can use (0.01-0.04 mg/kg).
  - Glyco - low dose, wait 2-5 mins for it to kick in, titrate up if no/too little effect
  - If an AV Block is present it will temporarily worsen - IT'S OK - it will fix it
- It is actually risky to reverse dexmed under GA - can cause CV collapse

That was just the premeds....

Induction Agents

- Purpose is to smoothly produce an anesthetic state, defined as medications that can produce an unconscious state
    - Eliminate swallow reflex for intubation - coughing or huffing during intubation - not enough induction given
- Use of co-induction agents can help limit adverse effects due to administering higher amounts of any one drug
- These agents can also be used in TIVA - advanced technique

Benzodiazepines:
Midazolam and Diazepam

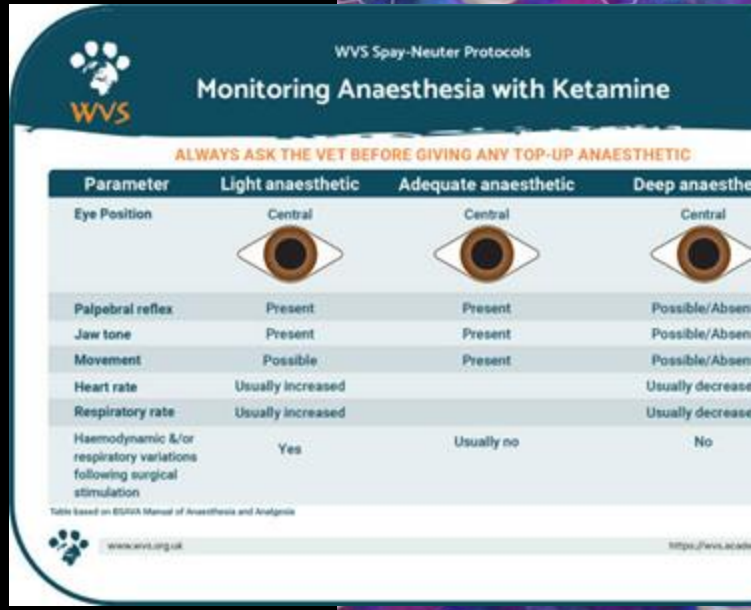
- Use in multimodal protocols for reduction of other drugs/MAC, no analgesia (in sedation protocols too)
  - Generally not effective sole agents
  - ESP - young/energetic and cats
- Effects
  - Muscle relaxation/Anxiolytic
  - Hyperexcitability (in young/healthy animals)
  - Poss respiratory depression
- Great for sick and compromised patients
- DOSE: 0.1- 0.5mg/kg (0.1-0.3 for multimodal)
- ONSET: Rapid IV (Peak IM 7-10 mins)
- DURATION: ~ 1-3 (up to 6 hrs) - dose and route dependant
- Management Considerations
  - Use in multimodal protocols to reduce induction agent/MAC sparing

Induction Agents: Ketamine - NMDA Antagonist

- Great for both sedation and analgesia adjunct (Dissociative)
- Possible Effects (Many are dose dependant)
  - Increased Muscle tonicity
  - Increased ICP/IOP - research considered less conclusive these days
  - Apneustic breathing patterns
  - CV - increased CO, HR, BP -> may increase myocardial O2 demand
  - Delayed or dysphoric recovery (@ higher doses)
  - Epileptogenic potential (typically as sole agent)
- Patients
  - Caution with reduced renal function, cardiac dz (reduced doses)
  - Extreme caution/avoid use in significant hepatic/renal insufficiency, previous seizure hx, heart failure, head trauma, HCM
- ONSET: Rapid IV (Peak IM ~10mins)
- DURATION: 1-3 hrs (significantly decreased for CRI and microbolus doses)

Induction Agents: Ketamine - NMDA Antagonist

- Management Considerations - REFLEXES
  - Ketamine can mess with them quite a bit
    - More evident following boluses
    - Preserves palpebral
    - Generally central position
    - Dilated eyes
    - Increased muscle tonicity - increased jaw tone
    - These all can happen, none of them can happen, or just some of them (and these effects can be temporary)
  - Evaluate WHOLE PICTURE before interventions
    - Absent blink can then mean excessive AP
      - Check RR change as indicators
    - Check PLR before and after bolus- reduced/absent PLR indicative of excessive depth



Induction Agents: CNS Depressants: Propofol and Alfaxolone

- Induction Agents (Alfaxalone in IM Sedation protocols)
- Alfaxalone - Neuroactive steroid, GABA modulation
- Propofol - Hypnotic Agent
- Effects/Comparison
  - Both: resp depression, apnea if rapid
  - Both: CV depression - Decreased CO and Hypotension (Alfax - less so? Research is not definitive, may be more transient)
  - Both: Opisthotonus, Myoclonus, Twitching
  - Alfax - can cause tachycardia after IV
  - Propofol - can cause histamine release
    - Hives, flushed skin - histamine release
    - Self limiting typically - but can adm IM diphenhydramine (doesn't always help)
    - May result in BP drop and tachycardia - indicator of possible/impending anaphylactic shock (very rare, but possible)
    - If true anaphylaxis rxn suspected - Give epinephrine IV
- DOSING:
  - Propofol 2-6 mg/kg IV - usually much less than 5mg/kg needed with good premedications
    - If moderate/heavy sedation, start with 1-2 mg/kg slowly over 30 seconds and reevaluate, titrate to loss of swallow
  - Alfax: 1-4 mg/kg IM/IV (low end dosing with multimodal protocol for induction IV
    - Start by giving 0.5mg/kg slow over 30 seconds, and titrate

Anesthetic Drugs: Management Considerations/Summary

- Know the effects and possible complications associated with the drugs you use
  - Gives you insight on how to correct them/mitigate their effect
- Be aware of the contraindications for each (and know your patients)
- Take careful note of the time administered/duration of effect
  - Will be significant for when the drug will reach peak effect and when drug wears off
  - May affect timing/dose of intra-op boluses
  - Consider when pain control may wear off - start oral meds or continue injectable support?
- The more types of drugs you use, the more you will be able to reduce their doses - generally reducing the incidence of side effects associated with any one drug

Common Anesthetic Complications

Hypothermia

- ⟶ CAN CAUSE
- ⟶ Decreased BP
- ⟶ Decreased CO
- ⟶ Decreased Perfusion
- ⟶ Decreased resistance to infection
- ⟶ Increased pain
- ⟶ Increased depth/increased recovery times
- ⟶ Shivering P may become O2 dependant in recovery
- ⟶ Bloodwork changes

Cardiovascular

- ⟶Bradycardia
- ⟶Tachycardia
- ⟶Hypotension
- ⟶Hypertension
- ⟶Arrhythmias

Respiratory

- ⟶Apnea
- ⟶Hypoventilation
- ⟶Hyperventilation
- ⟶Hypercapnia
- ⟶Hypoxemia

PUBLIC ENEMY #1: Reduced Perfusion

- ⟶ Not common in healthy patients - we aim to prevent this

⟶CAN BE CAUSED BY

⟶Reduction in O2 delivery

⟶Reduction in CV parameters (CO, SVR, BP, HR)

⟶Disease processes

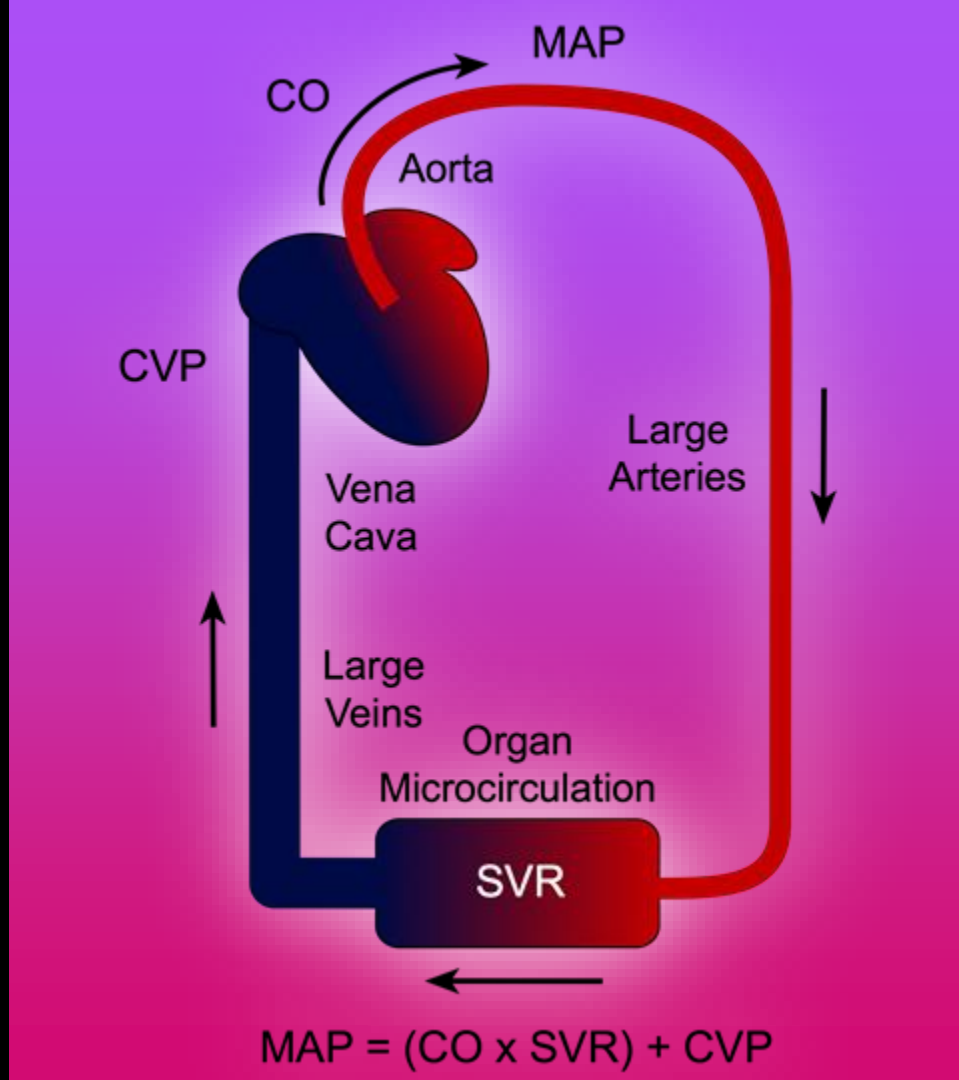
Hypothermia

- Hypothermia can be one of the most undermanaged vital signs
  - Affects multiple important patient parameters (see prev)
  - Severe hypothermia <96 degrees - can have severe side effects
- Best managed by preventing, rather than trying to re-warm patient
  - If doing mild sedation for P (or if already lower temp) waiting in kennel - mild active warming or passive warming
  - As soon as you start sedation/anesthesia start with passive warming and mild active warming (just passive if temp >102)
  - Forced air units are one of the most effective methods
    - Caution with aggressive heating with smaller patients - can overcorrect quickly (stop forced air >100.5)
    - Wait until area draped out to start - can increase infection risk
  - Can mitigate cooling by warming things that contribute to heat loss (ie fluids, ax circuit, lavage fluids), generally less effective
- Hypothermia can increase anesthetic depth - be aware of this
  - Progressive cooling - may need to adjust to lighten them
  - Progressive warming from hypothermia - may need more drugs
- Active core warming
  - Lavage open abdomen with progressively warmer fluids then suction. Let sit in cavity 2-4 mins each time (start with 104 degrees up to 114 degrees).
- Recovery - shivering P can become O2 dependant VERY QUICKLY
  - Give O2 supplementation to shivering patients

Cardiovascular Complications

$$MAP = (SV \hat{} \times HR) \times SVR$$

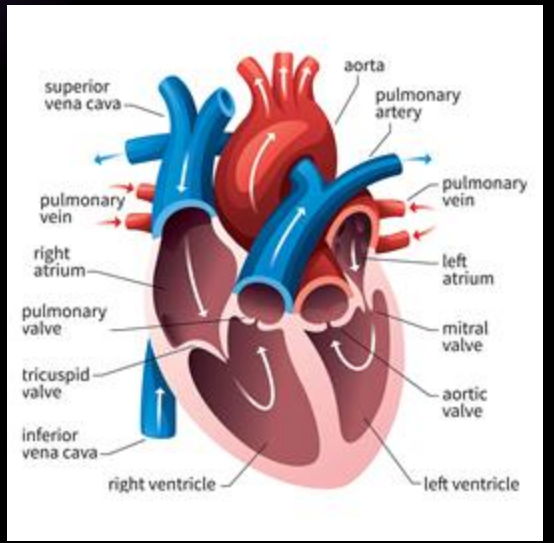
$$\hat{} \quad CO$$



Cardiovascular Complications

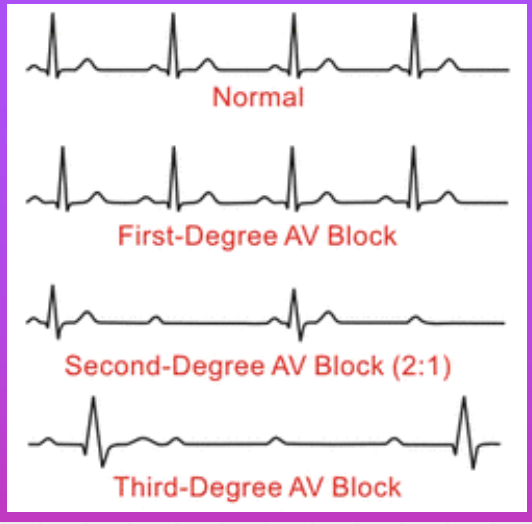
Bradycardia

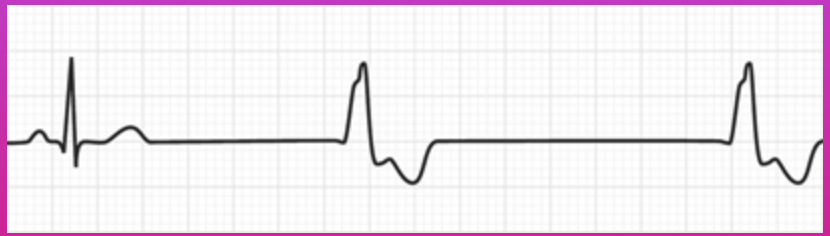
- Can be due to drugs, high vagal tone, deep anesthetic plane, significant hypothermia
- Deep anesthetic plane and hypothermia should be corrected
- If we know bradycardia is likely due to drugs, it is of no concern as long as normotensive
  - Monitor BP closely and administer anticholinergic if hypotension develops
- If sudden drop without drug administration/change in depth -concern for vagal reflex, hypertension causing reflex, anaphylaxis, impending arrest, decompensated shock (Later would be odd in otherwise healthy P with no comorbidities or prior indications of compensated shock)
  - What's happening in the procedure/patient?
    - Severe hypercapnia can cause arrest
    - Severe bleeding (typically compensated shock seen first)
    - Some nerve stimulation can cause
    - Reflex bradycardia d/t hypertension - often from drugs
  - Vagal response
    - Pressure on globe/throat manipulation/eye and throat procedures
    - Exhalation against closed airway
    - Brachys have higher vagal tone and more prone
    - Intense pain can cause
    - Carotid sinus stimulation - Usually must be purposeful but take Care when moving P
    - Increased gas use affected survivability negatively in one study

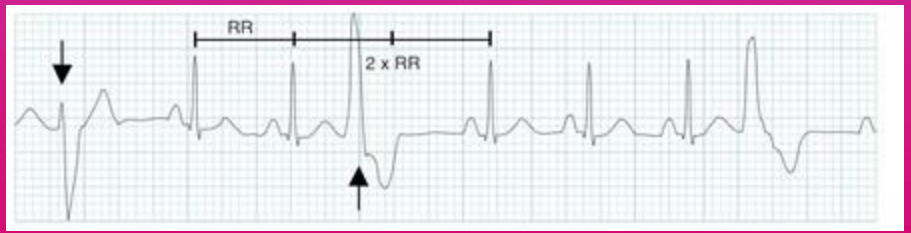


Arrhythmias

- Remember primary job of the heart is to maintain BP, any arrhythmia should be evaluated on that aspect as well as their likelihood to progress to a more dangerous arrhythmia
- Oxygenation and ventilation become all the more important if your P is experiencing an arrythmia
- Causes: Drugs, bradycardia, heart condition, electrolyte abnormalities, other comorbidities
- Bradyarrhythmias are fairly common
  - Not a concern unless BP suffers
  - AV Blocks
  - Escape Beat Complexes (VPCs don't typically occur with bradycardia)
  - Treat with anticholinergic if BP suffers
- VPCs
  - Fairly common as well often d/t higher vagal tone
  - Often well tolerated in healthy patients - again monitor effect on BP
  - Monitor for increasing frequency and/or runs
  - Can give lidocaine, but not all will respond well unless it's V-Tach
  - Can see AIVR with dexmed, inhalants - can be scary looking, but generally self-limiting







Hypotension

- Most Critical to manage as this has most direct relationship with perfusion
  - MAP #1
  - SBP #2
  - DBP #3
- Have to critically think about the suspected cause of the hypotension
  - Hydration status? Pre-Op PCV/TP
  - Too Deep?
  - Know the effects of the drugs in your protocol
  - Vasodilation?
    - Can ISO come down?
  - Bradycardia?
  - Arrhythmias?
  - Hypothermia?
- Fluid Bolus - will only help if P was hypovolemic/dehydrated/had significant blood loss
  - Can also briefly help in cases of vasodilation
  - Crystalloids don't stay in the vascular space long
  - Fluids are not benign

ASK YOURSELF ALL OF THESE QUESTIONS

P MAP <65 and/or SBP <85 (should be trying to intervene early)

- Is P too deep?
  - Yes - Turn ISO down
  - NO - consider turning down ISO anyway
- Will P wake up if you turn down ISO?
  - NO - turn down iso, monitor closely and be ready with induction agent or micro bolus of IV drug
  - YES - Consider micro bolus of IV drug and/or CRI for MAC reduction
- Did P have Increased Pre-op PCV/TP, have concern for significant blood loss or hypovolemia?
  - Yes - 5-10 mL/kg fluid bolus over 10-15 mins (if it helps can repeat if needed - if fluid deficit is significant)
  - NO
- What CV effects do your drugs?
- Does P have Bradycardia? (HR<60, small dog <70, cat <120)
  - Yes - Glyco/Atropine low dose
  - NO
- Is P hypothermic?
  - YES - Increase active warming efforts, if severe, anticholinergic may not help as much w/ bradycardia
  - NO

Intra-op Bolusing

- In general, start low and titrate up
- If they are already light you may have to give more, if they are not and your aim is to just reduce ISO, you may reduce ISO first and start titrating bolus as they get light

Ketamine

- Use for MAC reduction/multimodal analgesia
- Temporary apnea may occur - be prepared to manually ventilate
- 0.5 mg/kg standard (Start with 0.25 mg/kg in more debilitated or sensitive P, can titrate up to 1 mg/kg based on P response
- Repeat boluses in smallest increments possible to titrate to P response or follow with CRI (2-20 mcg/kg/min)
    - Post-op: 2-10 mcg/kg/min

Dexmedetomidine

- MAC reduction, multimodal analgesia, poss vasoconstriction
- Low doses (0.5-1 mcg/kg) supplement sedation so ISO can be reduced
- At higher doses (1-2mcg/kg) may reinstate vasoconstrictive phase
    - Consider 1st: P initial response &
    - time to extubation
- CRI (0.5-1 mcg/kg/hr) can be used to produce a more steady state

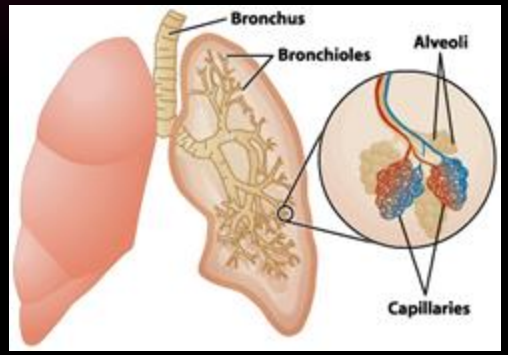
Opioids

- If P being light is suspect secondary to pain, this would be a first line option
- Can use dynamic CRIs for steady states and adaptive analgesia
- Generally use ½ low end dose
- Apnea possible

Respiratory Complications

Hypoventilation/Bradypnea (Decreased RR)

- Understanding the difference - ventilation is reduction in GAS exchange, bradypnea is RR
  - Depth of breaths, amount of functioning lung tissue, airway obstruction also affects ventilation
  - Decreased RR contributes to hypoventilation over time, so often used interchangeably
- Causes - excessive anesthetic depth, drugs, pain can cause breath holding sometimes



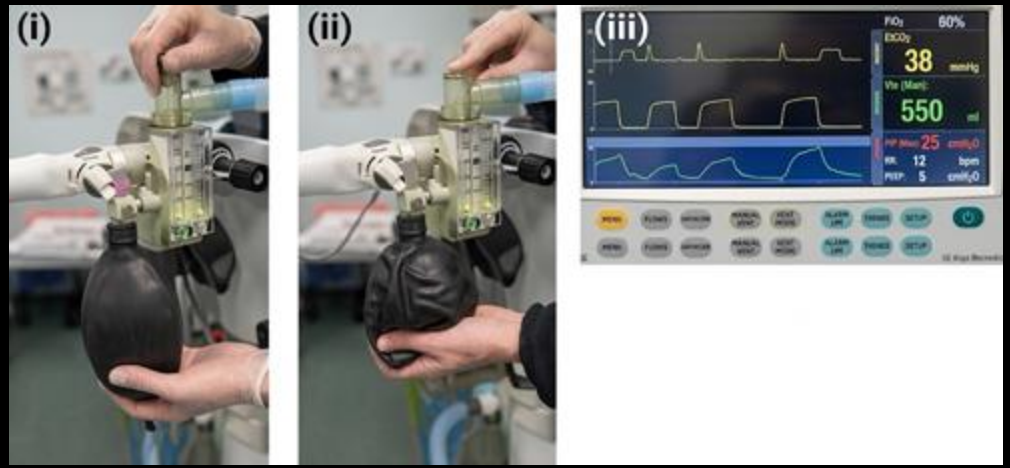
Hypercapnia (Increased ETCO2)

- Caused most typically by a failure to remove CO2 (inadequate ventilation) and/or rebreathing CO2
  - Can be caused by increased production, but that is more typical with a hyperthermic state or increased metabolic rate (generally rare under anesthesia)
- Things that may <u>contribute</u> to hypercapnia
  - Rebreathing CO2 - too much dead space - excessive length of ET tube/other additions, exhausted soda lyme, stuck flutter valve
  - Poor ventilation - decreased RR/apnea, atelectasis, dead space breathing (huffing/shallow breaths), lung dz

Respiratory Complications - Management Takeaways

For Decreased RR (<8bpm)

- Give manual intermittent PPV while correcting depth
- Keep in mind regular PPV may increase depth d/t increased gas exchange from previous (Monitor depth)
- Regular PPV can decrease venous return d/t increased ITP - monitor BP
- Too much PPV may depress respiratory drive
    - With apnea/hypoventilation typically 1-2 PPV/min, monitoring ETCO2 and SpO2 closely
    - More if hypercapnia or decreased SPO2 occur



Respiratory Complications - Management Takeaways

For Decreased Ventilation

- Prevent Atelectasis - PEEP valve (generally 2-5 cmH20 good starting point) - esp in overweight, large, deep-chested patients, lung dz
    - Contraindications are primarily in some specific emergency situations (pneumothorax) and small amounts will not harm a healthy P - cheap too!
    - Keep in mind some anesthetic machines have built in PEEP of 1-2 cm H2O already (can use safe sign for NRB off of ET tube to evaluate)
        - If P feels your PEEP is too high - can see decreased respiratory drive - decrease PEEP (but check depth first)
    - If no PEEP - manual PPV q5mins - some research shows no significant difference
- Prevent Dead Space - cut down ET tube, ensure correct adapter is used for capnography in smaller P/ET tubes,
- Prevent Rebreathing - very small P (>3-7 kgs may require NRB circuit - but also may not!), regular soda lyme changes (q8hr use/q2 weeks), clean/ air dry flutter valves regularly - monitor for warping

If RR/depth not responding to decrease in depth or ventilation parameters are not easily managed - consider putting on ventilator

Recovery - Tips and Nuggets

Most anesthetic deaths occur in this period

Continue to monitor all parameters as long as P will allow while waking up

- At minimum - 5 minutes of O2 after flushing the circuit
- If after 5 mins all signs stable, remove O2
    - Monitor SpO2 and EtCO2 over 5 mins after that
    - It can take ~ 5 mins for oxygen supplementation to "wear off"
    - Continue supplementation of O2 if Sp02 drops below 95
        - Keep in mind brachys and resp compromised
            - get SpO2 w P on intake (lower can be normal for them)
    - Manual ventilation PRN for severe hypercapnia on O2, but don't delay extubation
        - Often secondary to the sedation/drugs, waking up preferred

Monitor at regular intervals for 1 hour post-extubation (q15m is common)

- P may need longer monitoring if they are not stable yet

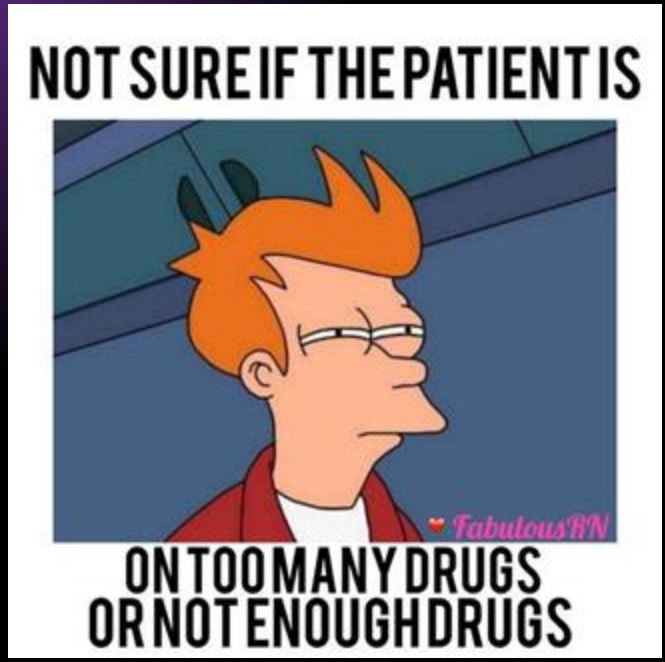
Extended Recovery

- Correct hypothermia!!
- Reverse drugs that do not contribute to analgesia first, then adjuncts
    - Example: Reverse Midazolam first, dexmed second, and opioids as a last resort
    - Some P can be sensitive to CV effects of mu opioids - have back up with pain control (local block, multimodal)
    - Consider "partial" reversal with regular dose of buprenorphine, replaces pain control, has ceiling effect for resp depression - can take a while to overcome/fully kick in
    - More emergent reversal without "fully" reversing analgesia with low dose butorphanol titrated to effect - 0.1-0.2 mg/kg and dilute with saline - GIVE VERY SLOWLY
    - Have more back ups to catch up P pain control (NSAID inj, local, ketamine/lidocaine CRI until oral meds)

Recovery - Tips and Nuggets

Dysphoria, Pain, or Hyperexcitability

- High FAS and high drug needs patients at highest risk for dysphoria
- Know the difference
  - Dysphoric patients don't respond to their environment/name
  - Painful patients will become more reactive with palpation of the surgery area/moving
  - Hyperexcitability can be associated with certain drugs (Midazolam)
    - May or may not respond to external stimuli, but non-painful
  - Treat dysphoria with patience first, then sedation
    - Many patients can come out if it on their own in a few minutes
    - Sedate if prolonged or if P a danger to themselves
    - "Reset" method - if still intubated can be prepared with low dose of propofol for a tumultuous wake up - titrate slowly to relaxation - watch for apnea - monitor oxygenation
      - Usually takes about 5-10 mins for them to come back out of it, second time is slower and wake up better
    - Low dose dexmedetomidine (start with 1mcg/kg)
      - Excessive sedation - will need more aggressive warming/may need additional monitoring
    - Low dose acepromazine (start with 0.005-0.02)
      - May need higher end for hyperexcitability/High FAS
  - Rescue dose for pain - repeat chosen opioid at a reduced dose to supplement, add NSAID (can take up to 60 mins to kick in), other CRIs could be used




Thank you
Thank you very much

Resources

Grubb, T., Sager, J., Gaynor, J. S., Montgomery, E., Parker, J. A., Shafford, H., & Tearney, C. (2020). 2020 AAHA anesthesia and monitoring guidelines for dogs and cats. Journal of the American Animal Hospital Association, 56(2), 59–82. https://doi.org/10.5326/JAAHA-MS-7055

American Animal Hospital Association. (2020, February 13). Troubleshooting anesthetic complications. https://www.aaha.org/resources/2020-aaha-anesthesia-and-monitoring-guidelines-for-dogs-and-cats/troubleshooting-anesthetic-complications/

American Animal Hospital Association. (2020, February 13). Hypothermia. https://www.aaha.org/resources/2020-aaha-anesthesia-and-monitoring-guidelines-for-dogs-and-cats/troubleshooting-anesthetic-complications/hypothermia/

American Animal Hospital Association. (2020, February 17). Hypoxemia. https://www.aaha.org/resources/2020-aaha-anesthesia-and-monitoring-guidelines-for-dogs-and-cats/troubleshooting-anesthetic-complications/hypoxemia/

American Animal Hospital Association. (2024, June 10). Section 4: Fluid therapy and anesthesia. https://www.aaha.org/resources/2024-aaha-fluid-therapy-guidelines-for-dogs-and-cats/section-4-fluid-therapy-and-anesthesia/

Burkitt Creedon, J. M. (2012, May). Indirect blood pressure measurement. Clinician's Brief. https://www.cliniciansbrief.com/article/indirect-blood-pressure-measurement

Quinn, R. L. (2017, September). Measuring blood pressure in cats. Clinician's Brief. https://www.cliniciansbrief.com/article/measuring-blood-pressure-cats

Clinician's Brief. (2010, August). Noninvasive blood pressure monitoring: A review. https://www.cliniciansbrief.com/article/noninvasive-blood-pressure-monitoring-review

Resources

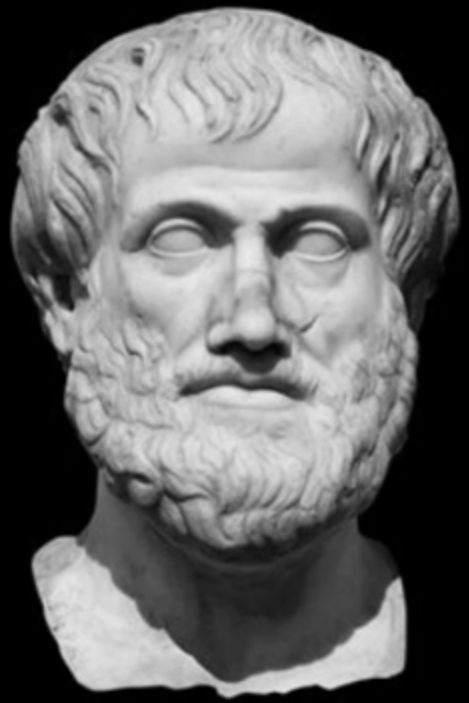
Clinician's Brief. (2016, July). Peripheral pulse palpation & systolic blood pressure. https://www.cliniciansbrief.com/article/peripheral-pulse-palpation-systolic-blood-pressure
Estrada, A. H., & Jones, A. (2014, January). Top 5 arrhythmias in dogs & cats. Clinician's Brief. https://www.cliniciansbrief.com/article/top-5-arrhythmias-dogs-cats

Burns, S. (2012, May 1). Anesthetic monitoring savvy. dvm360. https://www.dvm360.com/view/anesthetic-monitoring-savvy
Bryant, S. (2009, August 1). Respiratory monitoring under anesthesia (Proceedings). dvm360. https://www.dvm360.com/view/respiratory-monitoring-under-anesthesia-proceedings
Campbell, V. L. (2011, August 1). Approach to hypotensive patients (Proceedings). dvm360. https://www.dvm360.com/view/approach-hypotensive-patients-proceedings
Schroeder, N. A. (n.d.). Accelerated idioventricular rhythm. LeadER Vet. https://leadervet.com/articles-papers/accelerated-idioventricular-rhythm/
Merck Veterinary Manual. (n.d.). Opioids used in emergency practice [Table]. https://www.merckvetmanual.com/multimedia/table/opioids-used-in-emergency-practice
Love, L. (2019, December 14). Should I be using alfaxalone? MyNAVAS. https://www.mynavas.org/post/should-i-be-using-alfaxalone
Quandt, J. (2018, April 13). Hypothermia in the operating room. Today's Veterinary Practice. https://todaysveterinarypractice.com/anesthesiology/hypothermia-in-the-veterinary-operating-room/
Shippy, S. (2024, June 14). Capnography: Assessing ventilation during anesthesia.

Resources

Today's Veterinary Practice.
https://todaysveterinarypractice.com/anesthesiology/capnography-assessing-ventilation-during-anesthesia/
Lyons, J. L., & Scherk, J. R. (2017, June 9). Anaphylactic shock: How to effectively diagnose and treat. Today's Veterinary Practice.
https://todaysveterinarypractice.com/emergency-medicine-critical-care/anaphylactic-shock-effectively-diagnose-treat/
Stein, B. (2005, September). Perioperative pain management – Part I. VASG.
https://www.vasg.org/perioperative_pain_management_part_i.htm
Stein, B. (2005, October). Perioperative pain management – Part II. VASG.
https://www.vasg.org/perioperative_pain_management_part_ii.htm
Stein, B. (2006, March). Perioperative pain management – Part III. VASG.
https://www.vasg.org/perioperative_pain_management_part_iii.htm
Lee, J. (n.d.). How to measure blood pressure in a cat with Doppler [Video]. VETgirl.
https://vetgirlontherun.com/veterinary-continuing-educationdoppler-blood-pressure-vetgirl-video/
Parkin, A. (2022, January 27). Intermittent positive pressure ventilation (IPPV) for the surgery patient. Veterinary Specialist Services.
https://www.vss.net.au/blog/intermittent-positive-pressure-ventilation--ippv--for-the-surgery-patient
Pace, C. (2013, June 1). Common arrhythmias: The importance of ECG interpretation. The Veterinary Nurse.
https://www.theveterinarynurse.com/content/clinical/common-arrhythmias-the-importance-of-ecg-interpretation

In: Plumb DC, ed. Plumb's Veterinary Drug Handbook. 9th ed. Stockholm, WI: John Wiley & Sons; 2018:1119-1121.



"The more you know, the more you know you don't know."

— Aristotle

Monitoring Equipment Notes

THE “RANDOM NUMBER GENERATOR”

Taming the Random Number Generator

Starts with equipment maintenance - look at manufacturer info

ECG

- Factors affecting accuracy - lead placement, conduction agent drying out, movement, cautery use
- Rule out these factors if arrhythmia is suspected but unclear
- Generally, arrhythmias are more consistent and/or intermittently present
- FEAR NOT - If you think you see something, get BP and watch - most common arrhythmias are bradyarrhythmias, which do not necessarily need treatment if BP is stable

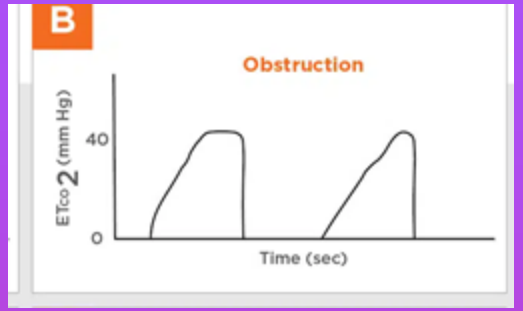
SpO2

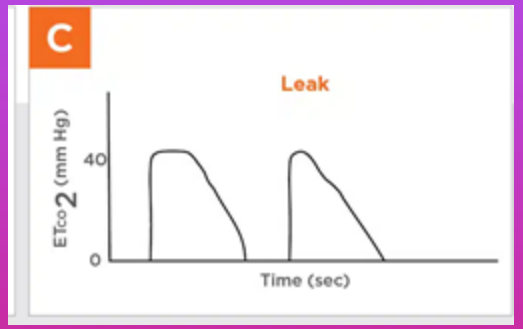
- Factors affecting accuracy - pigment, ambient light, cold, compression of vessels, vasoconstriction, weak pulses
- Different locations - tongue, rectum, prepuce, clear nail, toes. Can shave hair and use rectal probe wherever a pulse can be felt- femoral, dorsal/ventral pedal, palmar pulse
- Make sure pulse from machine matches HR/palpated pulse (dropped pulses are possible)
- Sometimes the number can take up to a minute or two to climb - be patient if reading starts low and/or signal is weak

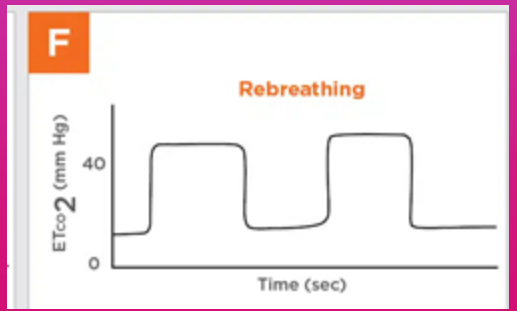
Taming the Random Number Generator

ETCO2

- Dead space breathing and huffing can cause falsely low readings (with sidestream unit) - not truly ventilating, give PPV to see true value
- Replace parts - sampling line, moisture traps, filters etc.
- Detach and recalibrate or zero if readings don't make sense with for the patient
    - Ex - low readings with manual ventilation with no recent/current hyperventilation
    - Sudden extremely high readings with no abnormal ventilation or hyperthermia
- Look at waveform - examples of common "us problems" on right
    - Suspected obstruction/mucus plug in ET tube- suction ET tube
    - Suspected leak - check cuff inflation and leak test - give PPV
    - Rebreathing CO2 - excessive dead space - cut down ET Tube, or stuck flutter valve, expired soda lyme







NIBP - Dogma or Myth?

1. If I can feel a pulse, then MAP is at least 60
2. Do not tape the blood pressure cuff
3. Systolic can be measured once the needle starts ticking
4. Do not put cuff proximal to hock
5. Doppler measures MAP in cats

1. INCORRECT BUT the absence of a distal peripheral pulse is more likely to predict that SBP is likely less than 80.
2. UNDECIDED - if you don't have to don't, if you do - just do it
3. INCORRECT - it is the WHOOSH, no other method of interpreting the doppler has been proven with research
4. INCORRECT - BUT and argument could be made in certain situations, if you can measure at a better spot, do it
5. IMO UNDECIDED - stronger evidence for MAP in ANESTHETIZED cats, but no conclusive studies in awake animals. What is more harmful to assume?

IN GENERAL:

-NIBP should be interpreted in the context of trends - not single readings.

-Both methods of NIBP are flawed accuracy-wise, and if you are questioning a reading, you should get another BP and/or use the other (doppler or Oscillometric) to corroborate the readings

-Presence of pulse and/or differences in pulse strength/quality can be used as an additional data point to aid your confidence in readings, but should not be used to make any assumptions about the quantification of the BP

Blood Pressure (NIBP)

- Doppler - Measures SBP (dogs), MAP? (cats)
  - Factors that affect - electrical impulses (cautery, and sometimes ECG), pulse strength, air (hair and poor gel conduction), bradycardia (with regards to sweep speed), location and size of cuff
  - If I suspect conduction issue, I rub in first gel layer at site, then gel my probe
  - If sound is fuzzy, try unplugging ECG temporarily.
  - If pulse strength is poor and/or sound is faint, I will use my stethoscope on the speaker
  - Slow sweep speed with significant bradycardia
  - Only inflate cuff to 20mmHg past when whoosh stops
- Oscillometric
  - Factors that affect accuracy - movement, cuff size and placement, HIGH/LOW blood pressures can reduce accuracy of readings (MAP <65 or >165 - tends to overestimate lower, underestimate higher), age of the machine
  - Look at cuff size, placement and relative positioning to right atrium
  - If your surgeon is causing movement at the cuff location, switch up location or find a way to mitigate.

NIBP Acquisition Technique

- Measurement of cuff and placement are going to be 2 most important factors to set yourself up for success
- Selecting correct cuff
  - Generally, 40% of the limb circumference, rounding up. Some sources say 30% for cats.
  - Measurement is the width in cm of cuff, NOT THE SIZE #
  - Quick and dirty method - short side of cuff should take 2-3 times to wrap around limb
    - Closer to 2-2.5x around with dogs, closer to 2.5-3x times with cats
    - If between sizes - air on larger.
- Consider the cuff should be at the level of the right atrium (generally considered @40% the depth of the chest (ventral to dorsal) at the level of the caudal edge of scapula OR at the level of the sternum if lateral
  - Forearm and tail preferred, then rear leg. If P has a fluffy tail, may benefit from shaving the ventral tail

Medication Notes

Common Premedication Drugs: Opioids

- Butorphanol - partial mu antagonist, kappa agonist
  - Kappa provides sedation and mild pain relief
  - Window of pain relief is narrow - 30-45 mins
    - Mild visceral pain relief, not somatic
  - Not a great choice for surgical procedures, better for procedural sedation and respiratory distress
  - 0.2-0.4 mg/kg IV, IM, SQ
  - Partial Reversal of Mu opioid technique: 0.1-0.2 mg/kg Butorphanol Diluted with saline 1:3, adm VERY slowly IV until desired effect reached.
    - Provides mild analgesia at Kappa receptor, but should have other plan for multimodal analgesia in place
    - In cases with more severe pain or where multimodal analgesia has not been established, buprenorphine preferred

On same drug, but at different parties

Premedication Drugs: Opioids

Buprenorphine - partial mu agonist

- Mild-Moderate (and severe?) pain relief
  - Recent research suggests pain relief could be comparable to pure mu opioids at higher doses than are currently being recommended (0.04- 0.06 mg/kg)
- Very little sedation - can make it a less attractive option for surgery, but can make up for sedation elsewhere
- Lower incidence and severity GI effects when compared to pure mus
- HIGH affinity for the mu receptor - can be difficult to reverse and wins the battle for the receptor against other opioids - can use to "partially reverse"
- Longer onset for peak analgesia (take ~30 mins even after IV adm and >45 mins IM)
- Cats: TM route effective (under tongue or in cheek pouch) same dose as IV
- Dose dependant duration: 0.005-0.02 mg/kg (up to 0.03 mg/kg in cats)
  - Studies indicate doses of 0.005-0.01 mg/kg - last as little as 3-6 hrs
  - 0.02 - 0.03 mg/kg - avg of 8 hours duration (6-10hrs)
  - Newer studies indicate higher doses of 0.04-0.06 mg/kg may produce 10-12 hours of analgesia
- Use in local blocks @ 0.003 mg/kg mixed with bupivacaine

Management Takeaways:
-With long onset to peak analgesia, may change how/when you decide to dose in your premed protocol. Won't be a very effective choice for intra-op boluses.
- Keep in mind dosing when considering level and duration of analgesia

Premedications: Opioids - pure mu agonists

- Methadone - Pure mu agonist and NMDA antagonist
  - Mild-moderate sedation - Poorer sedation when compared to other pure mus
  - Lower incidence of GI side effects (vomiting) and panting
    - Anecdotally, increased incidence of panting with rapid IV administration
  - Lasts 4-8 hours
  - 0.1-0.5 mg/kg IV, IM, SQ
- Hydromorphone - Pure mu agonist
  - Moderate sedation
  - Higher incidence of vomiting (especially IM), panting common - consider impacts on P comfortability and imaging (THX and US)
  - Comparatively reduced cardiac effects
  - Lasts 2-4 hours - relatively shorter duration - redosing may be needed intraop or earlier than anticipated post-op
  - DOGS: 0.05-0.2 mg/kg, CATS: 0.05-0.1 mg/kg
    - CRI: 0.015-0.05 mg/kg/hr
  - Local Block Use/potentiation: 0.015 mg/kg with bupivacaine
  - Epidural: 0.04-0.1 mg/kg diluted with saline (or given with PF bupivacaine 0.5 mg/kg) total volume of 0.1-0.2 mL/kg

FUN (or not so fun) FACT: Cats receive little MAC sparing effect from opioids.
Management takeaway: you should rely on intermittent bolusing/CRI of alternative drugs (ie ketamine, dexmedetomidine), rather than adjustment in opioid CRI or repeat bolus of opioid if P is light, but has adequate analgesia.

Premedications: Opioids - pure mu agonists

- Fentanyl - pure mu agonist
  - Dose dependant sedation (mild-moderate)
  - VERY SHORT DURATION: 30-60 minutes - only practical for intra-op intermittent bolus and/or CRI use
  - Considered have a more significant impact on respiratory depression/bradycardia
  - DOGS: Bolus/loading dose - 2-5 (up to 10) mcg/kg, CRI - 2-20 mcg/kg/hr IV
    CATS: Bolus/loading dose - 2-5 mcg/kg, CRI - 2-5 mcg/kg/hr IV
    - Dosing range is situational - For pain management of conscious animal: Bolus @2-3 mcg/kg, CRI typically @2-5 mcg/kg/hr
- Morphine - Pure mu agonist
  - Moderate sedation
  - Associated with histamine release if given too rapidly IV (can cause hives and transiently decrease BP), relatively higher incidence of vomiting
  - Opioid of choice for clinically significant canine liver dysfunction
    - Protein bound to a lesser extent, allowing for a more predictable dose to effect relationship
    - Method of metabolism for this drug is well preserved in compromised livers
  - Duration: 2-4 hours (up to 6 hrs in dogs)
  - DOGS: 0.5-1 mg/kg IV, IM, SQ,. CRI - 0.1-1.0 mg/kg/hr IV
    CATS: 0.1-0.5 mg/kg IV, IM, SQ, CRI - 0.1-0.4 mg/kg/hr IV
  - Local Block: 0.075 mg/kg with bupivicaine
    Epidural: PF Morphine @ 0.1-0.2mg/kg (lower dose with 0.5mg/kg PF bupivacaine OR Higher dose diluted with saline to volume limit of 0.1-0.2 mL/kg)

Keep in mind duration of effect for your chosen opioid: will give you an idea on management (intermittent redosing vs micro-boluses vs CRI) and how pain will be managed post-op: when is the earliest time the analgesia will wear off?

Premedications: Dexmedetomidine - Alpha 2 Agonist

- Phenomenal Sedation and Mild Analgesia
  - Reversible with Atipamezole
- Side Effects
  - Vasoconstriction (transient hypertension) -> Reflex bradycardia
    - Vasoconstrictive phase is temporary
  - Bradycardia can lead to hypotension
  - Pale MM (vasoconstriction)
  - Can produce arrhythmias
    - Bradyarrhythmias (AV blocks or ventricular escape beats)
    - Less commonly VPCs
  - Muscle tremors
  - Hypoventilation
  - Hypothermia
  - Emesis

- Patients
  - Generally contraindicated with cardiac dz d/t its CV effects
  - Use with extreme caution/contraindicated in compromised patients and in the event of clinically significant kidney/liver/respiratory dz
    - Higher ASAs or unstable patients I will avoid if possible
    - Age is NOT a disease that will contraindicate dexmed, but may cause me to reduce dose

Premedications: Dexmedetomidine - Alpha 2 Agonist

- PEAK EFFECT: 10-30 mins, DURATION: 1-2 hrs (IV on low end for both)
- DOSE: highly variable depending on the situation and intended use
  - Sedation: 5-10mcg/kg (can go as high as 15mcg/kg, but I prefer multimodal sedation)
  - Anesthetic premed: 3-5mcg/kg (higher doses may be required for high FAS P, but prefer other methods in anticipation of this)
  - Intermittent peri/intra-operative bolus: 0.5-1 mcg/kg (up to 2 mcg/kg)
    - START LOW TITRATE UP
    - Intraop bolus utilization for healthy/stable P only
  - CRI: 0.5-1 mcg/kg/hr (with or without loading dose of at 0.5-1 mcg/kg)
- Can be used in local blocks to extend duration of effects

Premedications: Dexmedetomidine - Alpha 2 Agonist Management Considerations

- Bradycardia is not a concern as long as BP is normal
- AV Blocks/Bradyarrhythmias can be common
  - Usually not a concern if BP remains normal
- If P becomes hypotensive, treat with anticholinergic
  - Glycopyrrolate (0.005-0.02 mg/kg) is preferred, as it has a less intense effect.
  - Atropine for emergencies but can use (0.01-0.04 mg/kg).
    - Glyco lasts longer, but when titrated at a low dose, it typically wears off w/in 30mins or so (in my experience).
    - Start with low dose, wait 2-5 mins for it to kick in, can redose/titrate up if no/too little effect
    - If an AV Block is present it will temporarily worsen - IT'S OK - it will fix it - JUST CLENCH YOUR BUTT CHEEKS
  - For intra-op bolus @ higher doses, may re-establish the vasoconstrictive phase (1-2mcg/kg) - can be used to your advantage, keep in mind P initial response
    - How long did initial vasoconstrictive phase last/at what dose
    - What point are you at in procedure? Can delay extubation if too high dose/given too late
  - It is actually risky to reverse dexmed under GA - can cause CV collapse

Premedications: Acepromazine (Alpha Antagonist/Tranquilizer)

- Excellent Sedative effects, no pain control
  - Best used in combination with an opioid to produce neuroleptanalgesia
- Patients
  - Generally well tolerated in healthy and/or anxious dogs
  - Contraindicated in hypovolemic, unstable or shocky P
  - Generally avoid use for <12 weeks, Caution/avoidance in geriatrics and significant liver dysfunction (Inc. Bili/Clotting times, Dec. TP/Albumin), and cardiac dz
  - Significant dose reduction or avoidance in MDR1 dogs
  - Known seizure hx - generally avoided, d/t possible reduction of seizure threshold (research is spotty)
- Effects
  - Hypotension - d/t vasodilation
    - MM may become injected
  - Bradycardia (sometimes reflex tachycardia with hypotension)
  - Cardiovascular
  - Anti-dysrhythmic effects
  - Decreased HCT - splenic sequestration of RBCs
  - ONSET: 15 mins when given IV (peak @30-60m), DURATION: 6-8 (up to 12) hrs

Premedications: Acepromazine (Alpha Antagonist/Tranquilizer)

- Dosing: HUGE DOSING RANGE
  - Typically less is needed than what is rec
  - Range for mild to moderate sedation: 0.01-0.03 mg/kg (up to >0.2mg/kg described not for me though)
- Management Considerations
  - IV injection should be slow, esp at higher doses
  - Low end of dosing range for post-op sedation - SLOWLY titrate up
    - If sedation is profound, monitor BP too (esp 30-60 mins post-adm)
  - Vasodilation can be difficult to counteract depending on what drugs you have available
    - May take 30-60 mins to appear (may be in recovery period already)
    - If no pressors available, generally avoid in anesthetic protocols if possible (my personal preference)
    - Better for post-op sedation/dysphoria or sedation in anxious patients
  - Sedation is usually less profound in cats - may need increased doses

Benzodiazepines:
Midazolam and Diazepam

- Use in multimodal protocols for reduction of other drugs/MAC, no analgesia (in sedation protocols too)
  - Generally not effective sole agents
  - ESP - young/energetic and cats
- Effects
  - Muscle relaxation/Anxiolytic
  - Hyperexcitability (in young/healthy animals)
  - Poss respiratory depression
- Great for sick/compromised patients
- ONSET: Rapid IV (Peak IM 7-10 mins)
- DURATION: ~ 1-3 (up to 6 hrs) - dose and route dependant
- Management Considerations
  - Use in multimodal protocols to reduce induction agent/MAC sparing
  - May be better option for intraop boluses with debilitated/cardiac patients

Induction Agents: Ketamine - NMDA Antagonist

- Great for both sedation and analgesia adjunct (Dissociative)
  - In general, lower doses better for analgesia, higher doses will produce more significant sedation/anesthesia (with ceiling effect)
    - Be prepared to intubate when using high dose sedation protocols
- Possible Effects (Many are dose dependant)
  - Increased Muscle tonicity/muscular tremors
  - Increased ICP/IOP - research considered less conclusive these days
  - Apneustic breathing patterns - rapid breaths > breath holding OR backwards respiratory cycle (Inspiratory, hold, expiratory)
  - CV - increased CO, HR, BP -> may increase myocardial O2 demand
  - Delayed or dysphoric recovery
  - Epileptogenic potential (typically as sole agent)
- Patients
  - Caution with reduced renal function, cardiac dz (reduced doses)
  - Extreme caution/avoid use in significant hepatic/renal insufficiency, previous seizure hx, heart failure, head trauma, HCM
- ONSET: Rapid IV (Peak IM ~10mins)
- DURATION: 1-3 hrs (significantly decreased for CRI and microbolus doses)

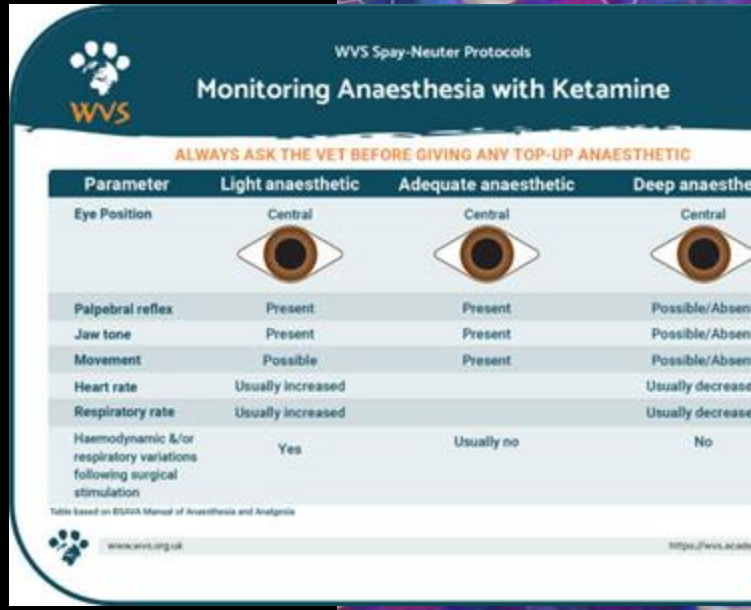
In the “K-Hole”

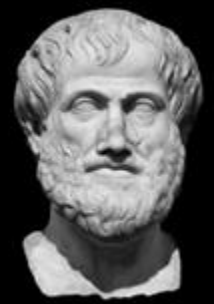
Induction Agents: Ketamine - NMDA Antagonist

- DOSING:
  - IM use up to 10mg/kg in cats described
  - I prefer its use at sub-anesthetic doses to take best advantage of analgesia
    - LOADING DOSE for CRI: 0.5-1 mg/kg IV slow
    - CRI: 10-20 mcg/kg/min (intraop), 2-10 mcg/kg/min (post-op)
    - Co-induction: 0.5-1 mg/kg IV
    - Intra-op Microbolusing: 0.25-0.5mg/kg (can always start lower and titrate response)
- Management Considerations
  - Micro Bolus Dosing considerations
    - Typically lower for any concurrent dz, 0.5mg/kg is a nice starting point for a young and/or healthy patient (typically will only go up to 1 mg/kg for these patients)
    - I typically will draw up between 1-2 mg/kg
      - Use 0.5-1 mg/kg with induction, and 0.25-1 mg/kg intraop
    - When under GA, microbollusing can cause temporary apnea - be prepared to manually ventilate - give low dose SLOW then titrate
  - Great for BP management for MAC reduction (nice alternative for cats)

Induction Agents: Ketamine - NMDA Antagonist

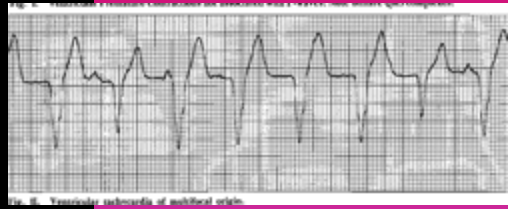
- Managment Considerations - REFLEXES
  - Ketamine can mess with them quite a bit
    - More evident following boluses
    - Preserves palpebral
    - Generally central position
    - Dilated eyes
    - Increased muscle tonicity - increased jaw tone
    - These all can happen, none of them can happen, or just some of them (and these effects are often temporary)
  - Evaluate WHOLE PICTURE before interventions
    - Absent blink can then mean excessive AP
      - Check HR/RR change as indicators
    - Check PLR before and after bolus- reduced/absent PLR indicative of excessive depth
  - Unless P is already reactive/light, will preemptively reduce ISO 2-5 mins prior to bolus

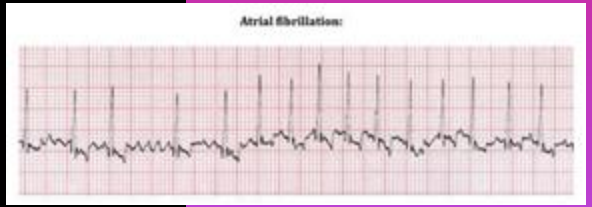


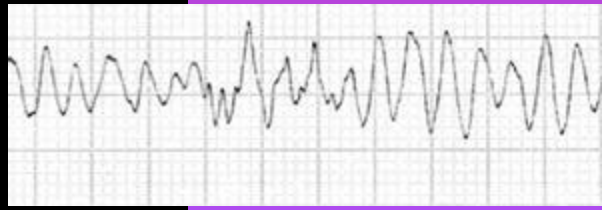


Arrhythmias - the Baddies

- Ventricular Tachycardia
  - Runs of VPCs with HR >180 dogs, >200 cats
  - If HR lower, could be AIVR - which is a not so baddie
    - If AIVR - tx underlying cause, which can be drugs (ie dexmed)
    - If reversal of dex occurs and GA continued - lighten ISO as much as possible with IM reversal and administer slow push of drug to keep induced once they begin to get light (Midaz rec d/t being CV sparing)
  - Treat V-Tach with IV Lidocaine 1-2 mg/kg dogs, 0.5 mg/kg cats
- Atrial Fibrillation
  - Rapid HR coupled with "fluttering" baseline, QRSs randomly spaced, no P waves
  - Watch out you don't mistake NSR with motion artifacts
- Ventricular Fibrillation
  - No QRS, discoordinated, looks like a "seismograph"
- PEA - ECG tracing and QRS complexes despite having no pulse
  - P has already coded - significance is that ECG can look normal with P already in arrest.
  - Rapid decrease in EtCo2 and complete loss of SpO2 first indications of arrest
  - Listen and feel P regularly







The Anesthetic Process - Tips and Nuggets

Patient Prep/Intake

- Know your patient as much as possible - review their chronic conditions, medications
  - Some chronic conditions may increase anesthetic risk/contraindicate the use of some medications
  - Some medications can interact/contraindicate use of certain medications
- Intake TPR - will help you evaluate what is considered relatively normal for that P
  - Helps gauge - level of anxiety, evaluation of P's pain after procedure

Premedication

- What are the goals? Do procedures need completed prior to anesthetizing?
  - Can help you decide the level of sedation desired and possible routes
- Consider pain control - what is appropriate for the procedure, how long will it last
- Oxygenate P when they become sedate

Induction

- Pre-oxygenate @ least 5 mins - apnea common
- Double O2 flow rate following induction (for RB circuits) - will help circuit reach steady state of gas faster- 80-90 ml/kg/min
- Regular manual ventilation while P apneic/hypoventilating - they will wake up if they don't breathe the gas
- Best to start gas low and monitor reflexes as they become lighter (1.5% generally a good target)

Procedure

- Know the procedure well - what are the painful parts? What complications may be common?
- Goal should be to keep ISO as low as possible while maintaining anesthesia/analgesia (Rarely do I have to go over 2% with locals)
  - Intermittent bolus/CRIs can help bridge the gap - if getting toward end of procedure - use lowest dose possible
  - May need to rely more heavily on fast acting agents/gas toward end of procedure - closing is often more stimulating
    - However, a well timed bolus prior to that point can help immensely
- Intra-op NSAID? 30 mins prior to procedure end/possibly delay a little more if MAP <60
- Double O2 flow rate again as tapering ISO at very end and during recovery