The Anesthesia Work-up:  
A Step-by-Step Approach to Formulate an Individualized Anesthetic Protocol  
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Ames, IA  

Patient evaluation and preparation – success begins here  
Pre-operative evaluation includes assessing the signalment and physical status, including co-morbidities of the patient, selecting the appropriate drugs for the patient and procedure and knowledge of concurrent medications and possible interactions. It is important that the anesthetist have a working knowledge of anesthetic and analgesic drugs including the advantages/disadvantages and potential side effects. The anesthetist should also be aware of the anticipated or potential complications based on the patient’s status, underlying disease, the procedure and drug selection and have a plan of action should they occur.  

Minimum patient database: signalment, history, physical exam, laboratory and diagnostic tests  
A thorough history is critical to give an accurate evaluation and timeline of the underlying disease process and identification of other abnormalities or co-morbidities that may affect anesthetic or surgical outcome. The history should include:  
1. Signalment: species (cat, dog, other?), breed (breed specific anesthetic concerns), age (age related anesthetic concerns; pediatric, geriatric), sex and neuter status, body weight and body condition score.  
2. Client complaint – duration and severity of illness  
3. Concurrent symptoms of disease – diarrhea, vomiting, seizures  
4. Diet – normal diet, recent appetite, fasted for anesthesia?  
5. Exercise – activity level, exercise intolerance  
6. Environment – indoor vs outdoor  
7. Past medical problems  
8. Current medications: Anti-inflammatories, anti-microbials, diuretics, cardiac medications  
9. Past anesthesia => any complications, reactions, recovery  
10. Any known drug reactions/interactions  
The patient should be systematically examined during the physical examination and all body systems should be evaluated.  
1. General body condition – obesity, cachexia, pregnancy, hydration status, body temperature, temperament (calm, nervous, aggressive, stressed)  
2. Cardiovascular – capillary refill time, mucous membrane color, heart rate and rhythm, auscultation, arterial blood pressure, pulse pressure and synchronicity with auscultation.  
3. Pulmonary – respiratory rate, depth, effort, mucous membrane color (pallor, cyanosis), auscultation (breath sounds, wheezes, crackles), upper airway obstruction  
4. Hepatic – abdominal palpation, jaundice, vomiting/diarrhea, lethargy, seizures, coma  
5. Renal – polydipsia/polyuria, vomiting, oliguria/anuria  
6. Gastrointestinal – vomiting, diarrhea, abdominal distension, auscultation of gut sounds  
7. Nervous System & special senses – mentation, behavior change, cranial nerve deficits, seizures, blindness/deafness, coma  
8. Metabolic/endocrine – body temperature, hair loss, diabetes, hyper/hypothyroidism, hyper/hypoadrenocortism  
9. Integument – hydration, hair coat, neoplasia, hair loss, burns, trauma/wounds, subcutaneous emphysema  
10. Musculoskeletal – muscle mass/atrophy/cachexia, weakness, lameness, ambulatory/non-ambulatory, fractures  
The anesthesia PE concentrates on the cardiovascular, respiratory and central nervous systems BUT only after a full evaluation of all body systems is performed.  

Laboratory data  
The patient’s signalment, physical status, co-morbidities and procedure to be performed will dictate the extensiveness of the laboratory work-up.  
Young, healthy patients, < 5years old, Physical Status classification I or II, undergoing elective procedure such as OHE, castration, or patellar ligament repair: packed cell volume (PCV), total protein (TP), blood glucose (BG) and Azostix  
Older patients > 5-7 years, even if Physical Status I or II should have a complete blood count (CBC), serum biochemistry and urinalysis – a recent study indicated that 30% of geriatric dogs has undiagnosed subclinical disease.
The necessity for additional laboratory data is dictated by the animal’s presenting signs and underlying disease. Examples: liver disease => clotting profile, colloid oncotic pressure, bile acids
Heart murmur => thoracic radiographs, ECG, echocardiogram
Trauma patient => thoracic and abdominal radiographs

Although economic considerations are important, thorough pre-operative evaluation is cost-effective since it can often predict or prevent complications and allow for pre-operative preparation and planning.

Patient Physical Status is directly related to the risk of peri-anesthetic death. In a recent study, the peri-anesthetic death rate in dogs and cats for Class I and II was 0.12% whereas it increased to 4.8% for patients Class III – V (a 40 fold increase).

example:

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<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Example</th>
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<tbody>
<tr>
<td>I</td>
<td>Healthy, normal patient, no disease</td>
<td>spay, neuter</td>
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<td>II</td>
<td>Healthy, localized or mild systemic disease</td>
<td>patellar luxation, cranial cruciate rupture</td>
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<td>III</td>
<td>Moderate systemic disease that limits</td>
<td>heart murmur, anemia, dehydration</td>
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<tr>
<td>IV</td>
<td>Severe systemic disease, life threatening</td>
<td>heart, liver or renal failure</td>
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<tr>
<td>V</td>
<td>Moribund, not expected to live &gt;24hrs</td>
<td>endotoxic shock, multi-organ failure, severe trauma</td>
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Anesthetic protocol

Preanesthetic

Pre-anesthetic Maropitant (Cerenia) anti-emetic/anti-nausea, adjunct analgesic – 1.0mg/kg SC one hour prior to opioid administration prevents opioid associated nausea and vomiting. Patients also have a faster return to feeding post-operatively.

Choice of sedative

Based on patient’s temperament, physical status, length of procedure, anticipated complications:

1. Benzodiazepines – Diazepam or Midazolam (0.2 – 0.4 mg/kg) – muscle relaxation, minimal cardiovascular effects, calming effects in very young (<4months of age), geriatric or sick/depressed animals, amnesia(?) – normal, healthy young-middle age adults may experience paradoxical excitement, midazolam is better absorbed IM, diazepam is painful when administered IM due to propylene glycol vehicle, reversible with flumazenil.
2. Acepromazine – phenothiazine (0.005 – 0.05mg/kg), alpha-1 adrenergic blockade can cause vasodilation and hypotension, anti-emetic effects, inhibits platelet aggregation, lasts 4-8 hours, onset 20-30 minutes, no analgesia, no reversal.
3. Dexmedetomidine – (1.0 – 10 ug/kg), alpha-2 agonist, high normal BP/reflex bradycardia, decreased cardiac output, more profound sedation than Ace but patient is arousable, excited/stressed animals can over-ride sedative effects (giving additional dose rarely effective), use lower doses when paired with opioid, provides analgesia in addition to sedation, quick onset, short duration, reversible, causes mild-moderate hypoxemia, especially when mixed with opioid; therefore oxygen supplementation is necessary, along with monitoring of SpO2, even for sedation alone.

Choice of opioid analgesic

This is based on a pre-emptive pain scoring system:
The Pre-emptive Scoring System uses a Simple Descriptive Scale. It involves simply assigning a degree of pain based on the procedure performed and the amount of tissue trauma involved.

- No Pain
- Mild pain
- Moderate pain
- Severe pain

This allows preemptive/intra-op/post-operative analgesia planning. The limitations are that it is not tailored to the individual and is not useful in assessing response to therapy. Therefore, monitoring and regular assessment are needed to evaluate the effectiveness of the original analgesic plan and to allow modification according to the individual patient’s needs.

- Butorphanol – (0.2 – 0.4mg/kg) mu antagonist/kappa agonist, short duration of action 30-90 minutes, mild analgesia, better sedation than buprenorphine, does not cause vomiting.
- Buprenorphine – 0.01 – 0.02 mg/kg), partial mu agonist, moderate analgesia/minimal sedation, has a ceiling effect for analgesia, long onset of action (30-45minutes), long duration of action (4-10 hours in dogs, 6-12 hours in cats), does not cause vomiting.
- Hydromorphone – mu agonist – 0.05 – 0.2 mg/kg, for moderate – severe pain, onset after IM administration is 10-20 minutes, duration of action 2-4 hours, causes vomiting in 50 – 75% of patients, no histamine release with IV administration.
- Morphine – 0.5 – 1.0mg/kg, similar to Hydromorphone, slightly longer duration of action (4-6 hours), can cause histamine release (hypotension/tachycardia) if given too quickly IV.
- Fentanyl – 2.0 – 10 ug/kg IV – mu agonist, short duration of action (<20minutes) so needs to be followed with a constant rate infusion, highly lipid soluble so rarely causes vomiting, mild cardiovascular effects but will cause bradycardia that may require treatment with anti-cholinergic, causes respiratory depression – recommend monitoring of EtCO2 and availability for intermittent positive pressure ventilation (IPPV). Monitor for hypoventilation (EtCO2 and SpO2) at recovery and transition from 100% oxygen to room air.

**Anti-cholinergics**
The decision to include an anti-cholinergic with anesthetic premedication is based on the patient’s signalment, the co-administration of vagotonic drugs (such as acepromazine, opioids and the use of propofol for induction), availability of the drugs and the anesthetist’s personal preference. Young patients (< 1 year of age) have immature cardiovascular and autonomic systems and are more likely to experience hypotension associated with bradycardia. Brachycephalic breeds may have high vagal tone due to upper airway obstruction, which can be exacerbated by premedication drugs. Geriatric patients may have subclinical cardiac disease and decreased cardiac reserve. Therefore, judicious use of anti-cholinergic treatment may be warranted to avoid sinus tachycardia. The advantage of IM administration of anti-cholinergics is that it is easier to prevent vagal induced arrhythmias (sinus bradycardia, atrio-ventricular blockade) than to treat them when they occur. However, not all patients exhibiting sinus bradycardia require treatment, some can compensate by increasing stroke volume to maintain mean arterial pressure. Intravenous anti-cholinergic administration is associated with an increased likelihood of arrhythmias such as second degree AV block and sinus tachycardia.

- Atropine – 0.02mg/kg
- Glycopyrrolate – 0.005 – 0.01mg/kg

**Induction adjunct**
Administration of induction adjuncts may decrease the dose of induction drug(s) and/or provide a loading dose for intra-operative constant rate infusions (CRI).

- Benzodiazepines – 0.2mg/kg IV may decrease propofol induction dose
- Lidocaine – 2.0mg/kg slowly IV over 2 minutes prior to induction, provides loading dose for intra-operative CRI.
- Ketamine 0.5mg/kg IV prior to propofol induction provides loading dose for intra-op CRI.

**Induction**
- Propofol – 4.0 – 6.0 mg/kg, dose and rate dependent hypotension and respiratory depression.
- Ketamine + Diazepam/midazolam – 4.0mg/kg + 0.2mg/kg mixed together IV. Better cardiovascular profile, ketamine provides analgesia and can serve as a loading dose for intra-op CRI.
- Fentanyl/Midazolam – 5.0 – 10 ug/kg slowly over 1- 2 minutes then 0.2mg/kg midazolam IV – opioid induction for critical patients – minimal cardiovascular depression

**Maintenance: inhalant choice**
Isoflurane vs Sevoflurane, Nitrous oxide can decrease inhalant requirements by ~25%, good waste gas scavenging is required.

**Intra-operative analgesic plan**
The intra-operative analgesic plan should be based on the patient’s signalment, underlying disease and physical status, the pre-emptive pain score and types of pain involved and use of a multi-modal approach.

When devising a pre-emptive/intra-operative analgesia protocol, the anesthetist should consider the classification or types of pain such as somatic, visceral, neuropathic and if there is an inflammatory or chronic pain component:

- Somatic – Originates from damage to bones, joints, muscle or skin; described as localized, constant, sharp
- Visceral – Arises from stretching, distention or inflammation of viscera; described as deep, aching, without good localization
- Neuropathic – Originates from injury or involvement of the PNS or CNS; described as burning or shooting and may or may not be associated with neurological deficits
- Chronic pain is often defined as any pain lasting more than 12 weeks

Defining the sources of pain and the underlying pathophysiology of the disease can also help take advantage of adjunct benefits of certain drugs such as prevention/treatment of central nervous system wind-up and sensitization, neuroprotection, anti-inflammatory or gastrointestinal prokinetic properties.

Multi-modal pain management uses multiple analgesic drugs in order to affect multiple levels of the pain pathway. Therefore, it is also helpful to recall the steps of the pain pathway and where each analgesic drug exerts its effect.

- Transduction: local anesthetics, NSAIDs, intra-articular opioids
- Transmission: local anesthetics, (alpha-2 agonists, opioids)
- Modulation: opioids, NSAIDs, alpha-2 agonists, local anesthetics, NMDA receptors antagonists, tricyclic antidepressants, anti-convulsants
- Perception: opioids, alpha-2 agonists, inhalants, sedatives/tranquilizers (acepromazine, benzodiazepines), general anesthetics.
Local/regional anesthesia/analgesia: Use of local anesthesia/analgesia including nerve blocks and epidurals is dependent on the anatomic area, underlying problem and procedure. The techniques (epidural vs local blocks) as well as the choice of drugs used (opioids vs local anesthetics vs alpha-2 agonists) have advantages and disadvantages.

Post-operative analgesia plan: The premedication and intra-operative analgesic plan may take into account the post-operative plan, but the transition at recovery is the most important with regard to drug choice (level of pain, onset and duration of analgesic drugs etc.)

Choice of IV fluids: Lactated Ringers solution, Plasmalyte or Normosol, colloids, plasma, blood products.

Historically, an IV fluid administration rate of 5-10ml/kg/hr has been recommended to counter anesthesia induced vasodilation and cardiovascular depression and help maintain adequate blood pressure. A recent study evaluated urine output, fluid retention, body weight gain and changes in PCV/TP in anesthetized dogs. Results indicated that urine output was only 0.46ml/kg/hr (instead of expected 1-2ml/kg/hr) and PCV dropped from an average of 47-49 to 29-33 and TP decreased from 6.6-7.0 to 4.5-5.1. Dogs gained an average of 1.1kg in body weight and retained close to 40ml/kg after 4 hours of anesthesia. This study confirmed our clinical impression that normal, healthy dogs with normal fluid balance preoperatively, anesthetized for long periods without an open body cavity retain large volumes of fluid. We have adjusted our intra-operative fluid rates to 5ml/kg/hr for the first hour and then 2.5mg/kg/hr thereafter. Intra-operative fluid therapy is more goal oriented in that crystalloid fluid boluses of 5 – 10ml/kg are administered in response to hypotension and blood loss.

Special equipment/procedures: The patient’s physical status, underlying condition and procedures performed should be considered with respect to the need for special equipment or procedures. Arterial catheter for direct blood pressure monitoring and blood gas analysis and placement of a jugular catheter for additional IV access are advantageous in critical patients. Blood glucose monitoring is indicated for diabetic patients, patients with liver dysfunction with altered glucose homeostasis and pediatric patients undergoing major surgical or long anesthetic procedures. Positive pressure ventilation required for thoracotomy procedures, patients in which neuromuscular blockade is needed, and may be indicated in obese patients and those receiving Fentanyl CRI.

Breathing circuit and therefore oxygen flow rate is dependent on the patient’s size:
circle – pediatric (< 15kg), adult (>15kg) – bag size dependent on weight ( 15 – 50kg = 3L, > 50kg = 5L) oxygen flow rate is 10 – 50mls/kg/min, start with 50ml/kg/min for first 15 minutes then lower to 20-30mls/kg/min
non-rebreathing system – patients < 7.0 kg, 150 – 300mls /kg/min

Anticipated or potential complications and action plan
- Hemorrhage – calculate patient’s total blood volume and 10%, 20% and 30% blood loss, quantitate intra-operative blood loss, treatment: 10% = replace with 3–4 times blood lost, 20% = crystalloid + colloid boluses of 2 – 10ml/kg up to 20 – 50mls/kg/24 hours depending on type of hetastarch, 30% = blood products => packed red blood cells (PRBC) + plasma (smaller patients where plasma transfusion is economically feasible) OR PRBC + hetastarch for colloid support OR whole blood (replaces oxygen carrying capacity + plasma/colloid support)
- Hypotension – pre-operative patient preparation, inhalant sparing anesthetic techniques, IV fluid support, management of hemorrhage, vasopressors and positive inotropes
- Cardiac arrhythmias – pre-operative patient preparation, ECG monitoring, awareness and identification of common arrhythmias during general anesthesia and their treatment,
- Hypothermia
- Hypoglycemia – see above intra-op special monitoring
- Pain – see above analgesic plan

Emergency drug calculations for each individual patient allows the anesthetist to be prepared for anesthetic accidents or patient deterioration resulting in cardiac arrest.

References

IOWA STATE UNIVERSITY
Dr. W. Eugene and Linda Lloyd
Veterinary Medical Center
College of Veterinary Medicine
**ANESTHESIA SOAP**

**Patient Sticker**

**Date of Procedure:** ________________________

<table>
<thead>
<tr>
<th>Student</th>
<th>Patient Location</th>
<th>Procedures</th>
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**Weight (kgs):** ___________  **Resuscitation Status:**

- SOAP completed? [ ] YES [ ] NO
- CCR [ ] OCR [ ] DNR
- IV Catheter? [ ] YES [ ] NO

**Temperature:** ________________________

**HISTORY:**

**PHYSICAL:**  T ___________ P ___________ R ___________ MM: Color: ___________ CRT ___________ Heart/Respiratory Auscultation ___________

**LABORATORY RESULTS:** Big 4 by anesthesia

- Hct ___________ Protein ___________ Albumin ___________ BUN ___________ U.Sp.G. ___________ Creatinine ___________ Glucose ___________
- Alk. Phos. ___________ SALT ___________ TCO₂ ___________ NA⁺ ___________ K⁺ ___________ Cl⁻ ___________ Ca⁺⁺ ___________ P ___________

**Radiographs, Cardiac consult, ECG?**

**Current Medications:**

*Prior Anesthesia:*

**PHYSICAL STATUS:** I ___________ II ___________ III ___________ IV ___________ V ___________

**Approved Anesthesia Protocol:** **Inhalant:** [ ] ISO [ ] SEVO [ ] N₂O

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<tr>
<th>Drug</th>
<th>Dose (mg/kg)</th>
<th>Wt (kg)</th>
<th>mg req</th>
<th>Drug conc (mg/mL)</th>
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**Special Equipment/Procedures:**

- [ ] Arterial BP
- [ ] Jugular Catheter
- [ ] Sterile IV Catheter Placement
- [ ] IPPV
- [ ] Neuromuscular Block Monitoring
- [ ] Other (Blood gas, Glucose)

**Breathing circuit:**

- [ ] Adult
- [ ] Pediatric

**Bag size:** ________________________

**Oxygen flow rate (mls/kg/min=>liters/min):** 1st 15 minutes: ________________________

**Maintenance:** ________________________

**Non-rebreathing circuit:**

**Oxygen flow rate (mls/kg/min=>liters/min):** ________________________

**Approved by:** ________________________

**Dose Checked by:** ________________________
Fluid Therapy (consider hydration, acid-base balance, electrolytes, osmolality, blood/fluid loss)
Fluid Type: ___________________________
Admin Technique: ☐ Venoset ☐ Buretrol ☐ Syringe Pump ☐ Fluid Pump

Possible anticipated complications (include pre-, intra- and post-operative) and your management plan:
(consider: age, body weight, breed, blood loss, procedure, co-morbidities, hemorrhage, airway, hypotension, positioning, etc.)

**EMERGENCY DRUGS**

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<th>Drug (IV Route)</th>
<th>Dose (mg/kg)</th>
<th>x</th>
<th>Wt (kg)</th>
<th>= mg req</th>
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<th>Drug conc (mg/mL)</th>
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**WORKING PROTOCOL**

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**CALCULATIONS**