SMALL ANIMAL ANESTHESIA GUIDE

Dr. Bob Stein

s) Pain Management
t) Rabbit Anesthesia
u) Renal Disease
v) Sight Hounds
w) Thoracotomy

3) INFORMATION BY SPECIFIC DRUG

a) Alphabetically

4) DOSING CHARTS

a) Alphabetically by generic name

FORWARD

The transition to higher quality anesthetic management requires a commitment to a new way of looking at our patients. It is not a matter of collecting a broader inventory of agents or adding monitoring equipment. First, and foremost, we must begin to look at each patient as a distinct individual. Is the patient young or old, calm or excitable, small or large, healthy or diseased. By thinking of our patients as individuals, we can adjust a given protocol to achieve the best possible balance of safety, comfort, and cost effectiveness. It should not be difficult to establish a familiarity with several protocols that provide flexibility when approaching routine healthy patients and high-risk protocols that allow for a confident approach to the difficult patient. The declining cost of anesthetic monitoring equipment and many of the better anesthetic agents has clearly favored the advancement of veterinary anesthesia. By applying the advances at hand, we can provide a much more valuable service to our clients and, what should be, a much more significant profit center in our business. We need to bury the concept that anesthesia is simple mathematics, giving so many mg per lb., with the only question being the weight of the animal. This guide can provide a framework for viewing anesthetic management as the critical cornerstone of quality veterinary medicine that it should be. Remembering that there are no safe anesthetics, I hope this guide can help us all to become safer anesthetists.

In many ways, we should look at this reference as we would a surgical reference. It may contain information about techniques that would not be appropriate for all veterinarians without receiving additional training. Epidural injections might be an example of an attractive procedure that would be better learned in a supervised setting. Unlike an advanced surgical technique, we can maintain familiarity with a variety of advanced, high-risk anesthetic techniques by periodically utilizing them on low risk patients. By doing so, we are much more comfortable when applying such protocols during a real crisis situation.

The changes we have made at our practice have been very rewarding for the entire staff. The moderation of patient stress, anxiety, and pain has led to a generation of patients that not only been handled more safely but they have also been handled much more humanely. These patients are much more enthusiastic about subsequent visits to our building because they were handled in a fashion that was so much more patient friendly than our past practice's approach to veterinary anesthesia. There are no more vocal supporters than the technicians who have transferred to our practice and realized how much more meaningful and rewarding veterinary anesthesia can be.

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ADMISSION

1) It is recommended that a veterinarian or licensed veterinary technician supervise the patient admissions.
    a) A properly trained nonprofessional can be quite capable of handling this process but we recommend that a licensed professional be available to assist this individual should questions or concerns arise.
2) The patient's medical record should be reviewed for completeness.
3) A pre-surgical review of the patient's history should be performed prior to admission. An admission checklist or questionnaire can be a valuable tool to insure a thorough assessment of the patient. An example questionnaire is included at the end of this reference.
    a) Food should be withheld for 12 hours prior to admission in normal cats and dogs over age 4 months.
        i) For cats and dogs less than 4 months of age, hypoglycemia is a significant concern.
            (1) Withholding food for only 4 hours prior to anesthesia helps to minimize this concern.
            (2) Offering food within 2 or 3 hours of recovery is also recommended.
    b) Any medications or supplements given in the prior 7 days should be recorded and reviewed with a doctor.
    c) Any **new** health concerns should be recorded and reviewed with a doctor.
    d) Any previous anesthetic "problems" should be reviewed with owner, recorded and reviewed with a doctor.
    e) Pets with histories of excessive stress when kenneled, chewing at stitches or bandages, difficulty restricting activity, or difficulty maintaining pet in clean, dry area during recovery should be noted.
    f) Water should **not** be withheld prior to admission.
4) Smaller growths should be marked for easy identification.
    a) The owner should show the admitting staff member where the growths are, and the staff member should mark them with the owner present.
        i) Hair can be clipped at the site or a marker used to identify the site.
5) An accurate Estimate and Surgical Release Form should be reviewed with, and signed by, the owner.
    a) Please be vigilant for owners who may not understand the form or, in fact, may not be able to read the form.
        i) A resistance to sign the form may be one indication of this.

PRE-ANESTHETIC ROUTINE

1) GENERAL

a) A **current** weight must be obtained and recorded on the patient's anesthetic record.

b) An Emergency Drug Reference Sheet should be immediately accessible for all patients at all times.

i) Some computer systems have an emergency drug component built into the software. If so, a customized reference should be produced for, and kept with, each patient. Alternatively, an emergency drug reference should be immediately available in the event it should be needed. The AAHA library has such a reference sheet if you do not have a current one.

c) An Anesthetic Record should be prepared for each patient. A copy of an example sheet is included at the end of this reference.

2) PHYSICAL EXAMINATION

a) A pre-anesthetic physical examination should be performed and the information entered into the patient record

i) This examination should be performed by a licensed technician or a staff veterinarian. Each practice should develop their own guidelines as to when the physical examination is to be performed by the doctor and when it can be performed by the technician. Generally speaking, this interval can be longer for younger pets exhibiting no health concerns and it should be shorter when dealing with geriatric and unhealthy patients.

(1) Some States may require this PE be performed by a DVM and may stipulate the timing of this PE. Be familiar with your State requirements. We cannot detail State to State variation in this reference.

b) A final categorization of the patient should be made based upon the following guidelines:

i) Excellent - animal with no organic disease or in whom the disease is localized and is causing no systemic disturbance.

(1) example - healthy 3 year old neuter.

ii) Good - animal with **mild** systemic disturbance which may or may not be associated with the planned procedure.

(1) example - mildly anemic patient, obese patient, geriatric patient.

iii) Fair - animal with moderate systemic disturbance which may or may not be associated with the planned procedure and which usually interferes with normal activity but is not incapacitating.

(1) example - mitral valve insufficiency, moderate anemia.

iv) Poor - animal with extreme systemic disturbances which are incapacitating and are a constant threat to life and seriously interferes with the animal's normal function.

(1) examples - uncompensated mitral valve insufficiency, severe pneumothorax.

v) Critical - animal presenting in a moribund condition, and is not expected to survive 24 hours with or without surgery. This implies that medical treatment cannot improve the animal's condition and that surgery is required immediately.

(1) Example – acute, severe intra-abdominal hemorrhage.

3) PRE-ANESTHETIC MEDICATIONS & FLUIDS

a) Pre-anesthetic medication decisions should be discussed with a staff veterinarian.

i) Patients should be provided with an experience that minimizes their stress and anxiety and minimizes their discomfort.

(1) This not only makes their stay more pleasant; reducing stress and anxiety is an important component in the analgesic process

ii) The selection of these medications should be based on the individual needs of the patient as discussed with one of the doctors.

(1) Species, size, age, attitude, and health status should be factored into this decision.

(2) The safety of our staff and the importance of the planned procedure are also important factors to be considered.

iii) The timing of the administration of the pre-anesthetic meditation is also an important consideration.

(1) In general, the pre-anesthetic medications should be administered:

(a) 30 to 45 minutes prior to the induction of anesthesia if given subcutaneously.

(b) 15 to 20 minutes prior to the induction of anesthesia if given intramuscularly

(c) It would be ideal to wait until the pre-anesthetic medications have taken effect before placing the patient's IV catheter.

b) All syringes must be labeled as to their contents.

i) Consider commercial stickers when available.

ii) Use tape and marker as needed.

c) It is preferable to have securely placed an intravenous catheter prior to anesthetic induction.

i) The catheter should normally remain in place until the animal is recovered to a point that no further need for IV medication or fluid support is anticipated.

ii) Due to the fractious nature of some patients, it may be necessary to place the catheter immediately after anesthetic induction and remove the catheter prior to full anesthetic recovery in order to protect the safety of the staff.

iii) In feline patients, the medial femoral vein, just above the tarsus, is an often overlooked site to place a peri-operative catheter.

(1) This site is not as attractive for day to day IV fluid management.

d) Pre-anesthetic fluids may be indicated for optimal patient support. The timing and the length of the fluid administration should involve input from a staff veterinarian.

i) For general peri-operative fluid support:

(1) 5 ml/lb/hr (10 ml/kg/hr) is the suggested starting point.

(2) 10 ml/lb/hr (20 ml/kg/hr) is the upper limit for general fluid support.

(3) the individual needs of the patient may dramatically alter this fluid rate.

(a) A 5 ml/lb (10 ml/kg) bolus can be useful when Bp drops and needs to be addressed more quickly. This may be repeated once.

ii) IV fluids should be administered through an infusion pump whenever available.

(1) This is especially important for small patients and cardiac patients for whom fluid overload is a much more likely complication.

(2) If an infusion pump is not available, a micro-dripset should be used when administering fluids to patients under 15 pounds or patients requiring more control over fluid rates.

iii) Fluid bag and drip set protocol.

(1) Date all fluid bags and drip sets when first put into service.

(2) Switch IV extension sets between patients.

(3) Always cover the drip set end with a new sterile needle.

(4) Discard fluid bags and drip sets over 1 week old.

(a) Immediately discard any fluid bags that contain cloudy fluid or those suspected to be contaminated.

(b) Immediately discard any drip sets suspected to be contaminated.

(5) A high visibility fluorescent orange label must be used to identify any medications added to a fluid bag.

4) PRE-ANESTHETIC TESTING

a) Pre-anesthetic testing is a consideration to allow detection of underlying disorders that may influence the management of the patient or influence the prognosis associated with any given disorder. The decision regarding when to perform preanesthetic tests and which tests to include is a decision that needs to be addressed individually by each practice.

b) There is considerable debate as to the extent and timing of such testing.

c) Blood samples should be drawn prior to premeds if it is not excessively stressful to the patient as premeds may influence the results of certain tests

i) Example – Acepromazine can decrease patient PCV up to 30%

d) If blood collection is not possible without premeds, or is too stressful, then administer premeds, wait 15 to 20 minutes, then collect samples

(1) Make sure the laboratory results are labeled so as to indicate that they were collected post-premeds if acepromazine has been used.

SPECIFIC PRE-ANESTHETIC PROTOCOLS

1) Acepromazine (only)

a) General information

i) A phenothiazine tranquilizer

(1) Acepromazine has no direct analgesic properties

ii) Acepromazine can be used alone, as a premedicant. However, it is more effective to use Acepromazine in combination with an opioid narcotic agent.

(1) The addition of an opioid reduces the acepromazine dose, and therefore, also reduces the likelihood of hypotension or sustained, excessive sedation that can occur.

b) Patient selection

i) Recommended use

(1) Use of acepromazine as a sole agent is not recommended

2) Acepromazine & Butorphanol

a) General information

i) Combination of a phenothiazine tranquilizer and an opioid

ii) Butorphanol adds a short acting analgesic effect

iii) The synergistic effect of these two agents allows for a substantial reduction in the acepromazine need, reducing the likelihood of hypotension or sustained, excessive sedation that can occur

b) Patient selection

i) Recommended use

(1) Healthy animals in the Good to Excellent category

(2) Larger, calmer, older patients require much lower acepromazine doses

(3) Smaller, stressed, younger patients may require higher acepromazine doses

ii) Cautionary information

(1) Avoid if:

(a) History of seizures

(i) Some anesthesiologists feel that seizures are of minimal concern at usual clinical doses

(b) Geriatric

(i) It is generally recommended to avoid acepromazine in geriatric patients. Substantially lower doses are adequate in patients 7 years of age or older

(c) Debilitated

(d) Liver dysfunction

(e) Anemic

(f) Hypotensive

(g) Hypovolemic

(h) Known patient sensitivity exists

(2) Butorphanol has an antagonistic effect when used with mu agonist opioids such as morphine, hydromorphone, fentanyl, or oxymorphone

c) Dosage

i) Diluting 10 mg/ml acepromazine to 1 or 2 mg/ml helps facilitate more accurate dosing, especially when managing smaller patients

(1) For 2 mg/ml concentration - inject 2 cc of 10 mg/ml acepromazine and 8 cc of sterile water into a sterile vial to produce 2 mg/ml acepromazine

(2) For 1 mg/ml concentration - inject 1 cc of 10 mg/ml acepromazine and 9 cc of sterile water into a sterile vial to produce 1 mg/ml acepromazine

(3) Alternatively, when using 10 mg/ml acepromazine, measure drug doses utilizing U-100 1/3 cc insulin syringes

ii) Dog

(1) Acepromazine 0.005 to 0.060 mg/kg (0.0025 to 0.03 mg/lb)

(a) 2.0 to 3.0 mg are frequently recommended maximum total dosages regardless of weight

(2) Butorphanol 0.1 to 0.4 mg/kg (0.05 to 0.2 mg/lb)

(a) 0.1 mg/lb is usually adequate for most patients

(b) Higher dosages do not result in better analgesia and excitation can occur.

iii) Cat

(1) Acepromazine 0.04 to 0.10 mg/kg (0.02 to 0.05 mg/lb)

(2) Butorphanol 0.10 to 0.40 mg/kg (0.05 to 0.2 mg/lb)

(a) 0.1 mg/lb is usually adequate for most patients

iv) Route of administration

(1) IV/IM/SC use

(a) IV has a more rapid and profound effect

(i) Use the lower end of the dose range for both agents when administering this combination IV

(b) IM has a moderately rapid, moderately profound effect but is painful

(c) SC is less painful though the effect is slower and less profound

d) General Cost Category

i) Moderate - acepromazine is inexpensive but butorphanol is of moderate expensive especially for larger dogs

3) Acepromazine & an Opioid (Hydromorphone, Oxymorphone, Morphine, Fentanyl)

a) General information

i) Combination of phenothiazine tranquilizer and a reversible opioid agonist

ii) Compared to acepromazine & butorphanol, this combination provides somewhat greater sedation in dogs and a stronger analgesic influence of longer duration in both dogs and cats

iii) Less sedative synergism exists between acepromazine and hydromorphone **in dogs** when compared to the sedative synergism that exists between acepromazine and morphine **in dogs** (see below)

iv) Medetomidine may produce more consistent sedation and relaxation than acepromazine when combined with the mu opioids in **cats**

b) Patient selection

i) Recommended use

(1) Generally for healthy animals in the Good to Excellent category

(2) Larger, calmer, older patients may require much lower acepromazine doses

(3) Smaller, stressed, younger patients may require higher acepromazine doses

ii) Cautionary Information

(1) All mu agonists can cause bradycardia and respiratory depression

(2) Morphine and hydromorphone commonly cause vomition regardless of route

(a) Oxymorphone is less likely to cause vomition regardless of route

(3) Histamine release: morphine can cause a histamine release which may cause a transient hypotensive effect

(a) This is more likely with IV use and is unlikely when morphine is given IM or SC

(4) Mu agonists may cause a mild, transient hyperthermia in cats

(5) Avoid acepromazine if:

(a) History of seizures

(i) Some anesthesiologists feel that seizures are of minimal concern at usual clinical acepromazine doses

(b) Geriatric

(i) It is generally recommended that acepromazine be avoided in geriatric patients. When used in older patients, substantially lower doses may be adequate

(c) Debilitated

(d) Liver dysfunction

(e) Anemic

(f) Hypotensive

(g) Hypovolemic

(h) Known patient sensitivity exists

c) Dosage

i) Dog

(1) Acepromazine 0.010 to 0.060 mg/kg (0.005 to 0.03 mg/lb)

(a) 2.0 to 3.0 mg are frequently recommended maximum total dosages regardless of weight

(2) One of the following opioids:

(a) Hydromorphone 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

(b) Oxymorphone 0.05 to 0.10 mg/kg (0.025 to 0.05 mg/lb)

(c) Morphine 0.50 to 1.0 mg/kg (0.25 to 0.50 mg/lb)

(d) Fentanyl 0.005 to 0.010 mg/kg (0.0025 to 0.005 mg/lb)

ii) Cat

(1) Acepromazine 0.04 to 0.10 mg/kg (0.02 to 0.05 mg/lb)

(a) Most common dose is 0.06 to 0.10 mg/kg (0.03 to 0.05 mg/lb) for cats

(b) Higher acepromazine dose may be needed for cats when combining acepromazine with a mu agonist as mu agonists have an excitatory influence on cats which contrasts with the mu agonists sedative affect on dogs

(2) One of the following opioids:

(a) Hydromorphone 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

(b) Oxymorphone 0.05 to 0.10 mg/kg (0.025 to 0.05 mg/lb)

(c) Morphine 0.50 to 1.0 mg/kg (0.25 to 0.50 mg/lb)

(d) Fentanyl 0.005 to 0.010 mg/kg (0.0025 to 0.005 mg/lb)

(i) The lower end of the opioid dose range is usually adequate for cats

iii) Routes of administration

(1) IV/IM/SC use

(2) IV has a very rapid and profound effect

(i) Use the lower end of the dose range for both agents when administering this combination IV

(3) IM has a moderately rapid, moderately profound effect but is painful

(4) SC somewhat less painful and somewhat slower, less profound effect

d) General Cost Category

i) Low

4) Buprenorphine (only)

a) General information

i) Mixed agonist/antagonist opioid of moderately long duration depending on dose

(1) Agonistic effect at mu opioid receptor

(2) Extremely high receptor affinity gives buprenorphine an antagonistic effect when mixed with pure mu opioids like hydromorphone, oxymorphone, morphine, or fentanyl which may be a strategic advantage

ii) Dose has significant influence on duration of effect but no influence on degree of analgesia

iii) Undesirable effects are rare

iv) Minimal sedation, limited reversibility, and moderate cost make this less attractive as a single agent premed

v) There is a significantly delayed time of onset

(1) 30 minutes when given IV

(2) 45 to 60 minutes when given IM

(3) SC use is not recommended

b) Patient selection

i) Recommended use

(1) Aging or debilitated patients where an analgesic effect is desired but sedation is not

(2) Routine surgeries and procedures that are not associated with severe pain

ii) Cautionary information

(1) Extremely high affinity makes this opioid difficult to reverse

c) Dosage

i) Dogs 0.010 to 0.040 mg/kg (0.005 – 0.020 mg/lb)

ii) Cats 0.010 to 0.040 mg/kg (0.005 – 0.020 mg/lb)

iii) The dose influences the duration of effect but not the degree of analgesia

(1) 0.010 mg/kg 4 to 6 hour duration

(2) 0.020 mg/kg 6 to 8 hour duration

(3) 0.030 to 0.040 mg/kg 10 to 12 hour duration

iv) Routes of administration

(1) IV or IM

(2) SC use is not recommended

d) General Cost Category

i) Moderate to high depending on dose

5) Butorphanol (only)

a) General Description

i) Mixed agonist/antagonist opioid with short duration and very mild sedative effects

(1) Agonistic effect at Kappa and sigma opioid receptors

(2) Antagonistic effect at the mu receptor which may be a strategic advantage

(3) Reversibility is a subject of debate

b) Patient selection

i) Recommended use

(1) In patients where:

(a) Acepromazine use is a concern

(b) Some analgesia and mild sedation is desired

(c) A mu agonist is not necessary or is of a concern

ii) Cautionary information

(1) The duration of analgesic effect is very short

(a) 45 to 60 minutes in the dog

(b) 60 to 90 minutes in the cat

(2) Will antagonize mu agonists if given concurrently

c) Dosage

i) Dog 0.10 to 0.40 mg/kg (0.05 to 0.2 mg/lb)

ii) Cat 0.10 to 0.40 mg/kg (0.05 to 0.2 mg/lb)

iii) Increased dosages are NOT associated with an increase in analgesia

(1) Doses exceeding 0.4 mg/kg (0.2 mg/lb) can cause undesirable excitatory effects

iv) Routes of administration

(1) IV, IM, or SC

d) General Cost Category

i) Moderate

6) Hydromorphone (only)

a) General information

i) Mu opioid agonist of moderate duration

ii) Same properties as oxymorphone although ½ the potency and it is much less costly

(1) Vomition occurs more commonly than with oxymorphone

(2) Noise sensitivity is not as likely with hydromorphone when compared to oxymorphone

b) Patient selection

i) Recommended use

(1) Higher risk patients

ii) Cautionary information

(1) See ace/opioid combinations above

(2) Histamine release is not expected with hydromorphone

(3) Cat usually experience excitatory effects when given mu agonists alone

c) Dosage

i) Dogs 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

ii) Cats not recommended as a sole agent

iii) Routes of administration

(1) IV, IM, or SC

d) General Cost Category

i) Low

7) Medetomidine

a) General Description

i) Alpha-2 agonist

ii) Medetomidine can be used alone, however it is often combined with an opioid for a synergistic effect.

(1) Addition of an opioid allows a reduction of the Medetomidine dose and reduces the likelihood of the more dramatic negative cardiovascular effects that alpha-2 agonists can cause

iii) Substantially reduces induction agent need

iv) Potent sedative and analgesic

v) Effects can be completely reversed using atipamazole

(1) The more complete the sedation reversal, the more complete the reversal of the analgesic effect

(2) Partially reversing the agent may allow you to retain some of the analgesic benefit of the drug

b) Patient selection

i) Recommended use

(1) Normal, young, healthy patients in the excellent category

ii) Cautionary information

(1) Use of medetomidine in older or more debilitated patients requires significant reductions in dosage and more vigilant attention the patient's cardiovascular status

(2) Stressed patients may not respond as well

(a) Isolate in quiet, dark room if possible to facilitate effect

(b) Additional medetomidine may be given after 20 minutes if further sedation is required

iii) Can cause bradycardia

(1) Anticholinergic use is controversial

c) Dosage

i) Dogs 0.002 to 0.040 mg/kg (0.001 to 0.020 mg/lb)

(a) Doses above 0.020 mg/kg (0.010 mg/lb) should be used with careful attention to patient selection

ii) Cats 0.002 to 0.040 mg/kg (0.001 to 0.020 mg/lb)

(a) Doses above 0.020 mg/kg (0.010 mg/lb) should be used with careful attention to patient selection

iii) Routes of administration

(1) IV/IM use

(a) IV has a much more rapid and profound effect

(i) Use lower doses - approximately 50% of the dose you would consider giving IM

(b) The epaxial muscles are the preferred site of injection for more predictable drug absorption

(i) Needles of appropriate length to penetrate through subcutaneous fat and into muscle must be selected. Larger dogs will commonly require a 1½" needle

d) General Cost Category

i) High – especially if reversal agent, atipamazole, is used

8) Medetomidine & Butorphanol

a) General Description

i) An alpha-2 agonist and opioid agent

(1) The synergistc effect of these two agents allows for a substantial reduction in the medetomidine dosage, thereby reducing the likelihood of the more dramatic negative cardiovascular effects that alpha-2 agonists can cause

ii) Substantially reduces induction agent need

iii) Potent sedative and analgesic effects

iv) Effects can be substantially reversed using atipamazole

(1) The more complete the sedation reversal, the more complete the reversal of the analgesic effects

(2) Partially reversing the medetomidine may allow you to retain some of the analgesic benefit of the drug

v) Provides good relaxation and analgesia when used in young, healthy cats

b) Patient selection

i) Recommended use:

(1) Normal, young, healthy patients in the excellent category

ii) Cautionary information

(1) Use of medetomidine in older or more debilitated patients requires significant reductions in dosage and more vigilant attention the patient's cardiovascular status

(2) Stressed patients may not respond as well

(a) Isolate in quiet, dark room if possible to facilitate effect

(b) Additional medetomidine may be given after 20 minutes if further sedation is required

iii) Can cause bradycardia

(1) Anticholinergic use is controversial

c) Dosage

i) Dogs

(1) Medetomidine 0.002 to 0.040 mg/kg (0.001 to 0.020 mg/lb)

(a) Doses above 0.020 mg/kg (0.010 mg/lb) should be used with careful attention to patient selection

(2) Butorphanol 0.10 to 0.40 mg/kg (0.05 to 0.2 mg/lb)

ii) Cats

(1) Same as the dogs

iii) Routes of administration

(1) IV/IM use

(a) IV has a much more rapid and profound effect

(i) Use lower doses - approximately 50% of the dose you would consider giving IM

(b) The epaxial muscles are the preferred site of injection for more predictable drug absorption

(i) Needles of appropriate length to penetrate through subcutaneous fat and into muscle must be selected. Larger dogs will commonly require a 1½" needle

d) General Cost Category

i) High – especially if reversal agent, atipamazole, is used

9) Medetomidine & an Opioid (Hydromorphone, Oxymorphone, Morphine, or Fentanyl)

a) General Description

i) An alpha-2 agonist and a mu opioid agonist

(1) The synergistc effect of these two agents allows for a substantial reduction in the medetomidine dosage thereby reducing the likelihood of the more dramatic negative cardiovascular effects that alpha-2 agonists can cause

ii) Substantially reduces induction agent need

iii) Potent sedative and analgesic effects

iv) Effects can be completely reversed using atipamazole and naloxone

(1) The more complete the sedation reversal, the more complete the reversal of the analgesic effects

(2) Partially reversing the agents may allow you to retain some of the analgesic benefit of the drugs

b) Patient selection

i) Recommended use:

(1) Normal, young, healthy patients in the excellent category

ii) Cautionary information

(1) Use of medetomidine in older or more debilitated patients requires significant reductions in dosage and more vigilant attention the patient's cardiovascular status

(2) Stressed patients may not respond as well

(a) Isolate in quiet, dark room if possible to facilitate effect

(b) Additional medetomidine may be given after 20 minutes if further sedation is required

iii) Can cause bradycardia

(1) Bradycardia may be more profound than with medetomidine alone

(2) While the use of anticholinergic is still controversial, the addition of the opioid often justifies the use of anticholinergics.

c) Dosage

i) Dogs

(1) Medetomidine 0.002 to 0.040 mg/kg (0.001 to 0.020 mg/lb)

(a) Doses above 0.020 mg/kg (0.010 mg/lb) should be used with careful attention to patient selection

(2) **One** of the following opioids:

(a) Hydromorphone 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

(b) Oxymorphone 0.05 to 0.10 mg/kg (0.025 to 0.05 mg/lb)

(c) Morphine 0.50 to 1.0 mg/kg (0.25 to 0.50 mg/lb)

(d) Fentanyl 0.005 to 0.010 mg/kg (0.0025 to 0.005 mg/lb)

ii) Cats

(a) Same as the dogs

(i) Use the lower end of the opioid dose range above

iii) Routes of administration

(1) IV/IM use

(a) IV has a much more rapid and profound effect

(i) Use lower doses - approximately 50% of the dose you would consider giving IM

(b) The epaxial muscles are the preferred site of injection for more predictable drug absorption

(i) Needles of appropriate length to penetrate through subcutaneous fat and into muscle must be selected. Larger dogs will commonly require a 1½" needle

d) General Cost Category

i) High – especially if reversal agent, atipamazole, is used

10) Midazolam (only)

a) General Description

i) Benzodiazepine (as is diazepam)

(1) Unlike diazepam, midazolam is quickly and predictably absorbed when given by the IM route.

ii) Of little use as a sole agent due to minimal sedation in normal healthy adult patients

(1) Generally combined with an opioid or ketamine

b) Patient selection

i) Recommended use

(1) Can reduce induction agent need in dogs

ii) Cautionary information

(1) When used alone may cause nervousness and excitement in cats

c) Dosage

i) Dogs 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

ii) Cats not recommended

(1) Used alone, can cause nervousness and excitement in cats

iii) Routes of administration

(1) IV or IM use

d) General Cost Category

i) Moderate

11) Midazolam & Butorphanol

a) General information

i) A benzodiazepine and an opioid agent

b) Patient selection

i) Recommended use

(1) Higher risk patients:

(a) Cardiac disease

(b) Debilitation

ii) Cautionary information

(1) Generally not suitable if heavy sedation is desired

c) Dosage

i) Dogs

(1) Midazolam 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

(2) Butorphanol 0.10 to 0.40 mg/kg (0.05 to 0.2 mg/lb)

ii) Cats

(1) Same as the dogs

iii) Routes of administration

(1) IV or IM use

d) General Cost Category

i) Moderate

12) Midazolam & an Opioid (Hydromorphone, Oxymorphone, Morphine, or Fentanyl)

a) General Description

i) A benzodiazepine and an mu opioid agonist

b) Patient selection

i) Recommended use

(1) Higher risk patients:

(a) Cardiac disease

(b) Debilitation

ii) Cautionary information

(1) Generally not suitable if heavy sedation is desired

(2) Can cause bradycardia and respiratory depression due to the opioid

(3) Use mu agonists with caution if vomition is considered a significant risk

c) Dosage

i) Dogs

(1) Midazolam 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

(2) **One** of the following opioids

(a) Hydromorphone 0.10 to 0.20 mg/kg (0.05 to 0.10 mg/lb)

(b) Oxymorphone 0.05 to 0.10 mg/kg (0.025 to 0.05 mg/lb)

(c) Morphine 0.50 to 1.0 mg/kg (0.25 to 0.50 mg/lb)

(d) Fentanyl 0.005 to 0.010 mg/kg (0.0025 to 0.005 mg/lb)

ii) Cats

(a) Same as the dogs

(i) Use the lower end of the opioid dose range above

iii) Routes of administration

(1) IV or IM use

d) General Cost Category

i) Moderate

13) Morphine (only)

a) General Description

i) A pure mu opioid agonist

b) Patient selection

i) Recommended use

(1) Suitable for healthy animals

(a) Most commonly used in combination with acepromazine, an alpha-2 agonist, or a benzodiazepine sedative/tranquilizer

(2) When greater sedation than can be achieved with hydromorphone or oxymorphone is desired

ii) Cautionary information

(1) Histamine release: morphine can cause a histamine release which may cause a transient hypotensive effect

(a) This is more likely with IV use and is unlikely when morphine is given IM or SC

(2) Often causes vomiting and defecation when given IM or SC

(3) Higher dosages can cause bradycardia and respiratory depression

(4) Should be used with caution in the cat if no sedative/tranquilizer is used

c) Dosage

i) Dog 0.5 to 1.0 mg/kg (0.25 to 0.5 mg/lb)

ii) Cat not recommended except as a low dose CRI

(1) Should be combined with acepromazine to avoid hypersensitivity

iii) Routes of administration

(1) IV/IM/SC use

(a) IV injections should be given slowly to minimize the potential for a histamine mediated hypotensive effect

d) General Cost Category

i) Low

14) Oxymorphone (only)

a) General Description

i) A pure Mu opioid agonist

b) Patient selection

i) Recommended use

(1) Similar to the other the other mu agonists

(2) Higher risk patient when the risk of vomiting needs to be minimized

(3) Hypotensive patients

ii) Cautionary information

(1) Similar to the other the other mu agonists

(a) Histamine release is not expected with oxymorphone

(2) Noise hypersensitivity may be a problem

c) Dosage

i) Dog 0.05 to 0.10 mg/kg (0.025 to 0.05 mg/lb)

ii) Cats 0.025 to 0.10 mg/kg (0.0125 to 0.05 mg/lb)

iii) Routes of administration

(1) IV/IM/SC use

d) General Cost Category

i) Moderate

ANESTHETIC INDUCTION

1) GENERAL

a) Induction and maintenance anesthetic plans should be reviewed by a staff veterinarian

b) Regardless of the apparent similarity between anesthetic candidates, anesthetic agents should not be selected automatically.

- i) Each patient should be considered a unique individual and the anesthetist must have considered the species, breed, size, age, attitude, health status, and planned procedure when selecting pre-anesthetic medications and anesthetic agents

c) Insure that adequate monitors are present at the site of the procedure

d) An anesthetic machine should be carefully examined and moved to the site of induction

- i) insure adequate anesthetic is present in the vaporizer
- ii) check for any system leaks
- iii) confirm adequate oxygen source
- iv) select circuit hoses
  - (1) the circuit hoses should always be significantly larger than endotracheal tube diameter to minimize system resistance
  - (2) pediatric tubes for patients under 20 lbs.
    - (a) Some prefer a nonrebreathing system for patients under 15 lbs.
  - (3) Standard hoses for patients over 20 lbs.
- v) Select a reservoir bag for circle systems
  - (1) Bag size should be 3 to 5 times tidal volume
    - (a) Tidal volume is 10 to 15 ml/kg

e) A reasonable selection of endotracheal tubes should be available at induction. Make sure all disinfectant residue has been rinsed from the tubes prior to use. Chlorhexidine will cause significant mucosal irritation if allowed to contact the airways.

- i) 3 tube sizes usually will suffice – the size you expect to use, one size smaller, and one size larger
  - (1) inflate the cuff prior to induction to insure no leaks are present
- ii) Keep in mind that brachycephalic breeds have disproportionately smaller tracheal diameters than their body size would indicate
  - (1) Select the size you expect to use and the next 2 smaller sizes
  - (2) this is particularly true for large brachycephalic dogs such as English Bulldogs

f) Confirm proper intubation by:

- i) direct visual confirmation if possible
- ii) palpation of **one** clearly defined, firm tube in the cervical region
- iii) auscultation of lung sounds bilaterally when bagging patient
- iv) if the animal is draped, manually follow the tube to the laryngeal opening to confirm proper intubation

g) 1 - 2 drops of lidocaine (0.2 ml max.) can be placed on the arytenoids to facilitate cat intubation

h) Because benzocaine(Cetacaine®) is capable of producing deleterious methemoglobinemia, its use cannot be recommended. Lidocaine is the preferred topical laryngeal anesthetic as it is readily available and very inexpensive.

i) Only inflate the endotracheal cuff to the point that a seal will allow bagging at 20 cm of water

  i) excessive cuff pressure can cause serious tracheal damage including tracheal rupture

    (1) Simply feeling the small reservoir bubble at the cuff valve can be misleading

  ii) to minimize risk of tracheal trauma, use a 3 cc syringe for cat and small dog cuff inflation and a 6 cc syringe for medium and larger dog cuff inflation

    (1) Inflate the cuff to low pressure, close the pop-off valve, and pressurize the system by squeezing the reservoir bag. Add or remove air from the cuff until you just hear gases leak around the cuff at 15 to 20 cm H_2O circuit pressure

j) An anticholinergic drug dose appropriate for the patient must be on hand at all times **even if already given as a pre-anesthetic component**

k) A syringe containing saline should be available at all times during the procedure to flush the catheter after administering medications, facilitating the medication's introduction into systemic circulation. It is common to use heparinized saline for this task but heparin may not be necessary if the catheter is connected to an active fluid line.

  i) heparinized saline is produced by mixing 1 ml of heparin (1000 units/ml) with 1 liter 0.9% Saline (or 0.5 ml of heparin in a 500 ml 0.9% saline bag)

    (1) A dated high visibility fluorescent orange label must be used to identify any medications added to a fluid bag

    (2) Discard heparinized saline bags over 1 week old

      (a) Immediately discard any fluid bags that contain cloudy fluid or those suspected to be contaminated

  ii) Another option is to coat the inside of the syringe with heparin, empty the syringe of all excess heparin, then fill the syringe with 0.9% sterile saline.

    (1) This method reduces the wastage of the method above but may lead to some variability in heparin content and increase the potential for contamination of the heparin vial.

l) The maintenance of a patient's body temperature is an important consideration paramount to a successful outcome

  i) The use of an insulating material during patient clipping/preparation should be considered to minimize body temperature loss that may occur from contact with a stainless steel surface.

    (1) This is especially critical for small, short haired animals

  ii) During the anesthetic event, the patient should be maintained on a warm water blanket and covered with a towel when possible

    (1) Warm water blankets are relatively inefficient heat sources

      (a) Placing the patient directly on the pad is recommended

  iii) Warm air patient warmers like the Bair Hugger are a particularly effective way to support patient body temperature

    (1) The surgical site should be fully draped before the Bair Hugger is turned on to minimize the contamination risks of the increased regional airflow

iv) IV fluids can be warmed at the time of administration by:
    (1) curling up the terminal portion of the IV line and placing it under the warm water blanket
    (2) utilizing a commercial IV fluid warmer
v) Bubble wrap is an efficient insulating material

m) Additional induction agent should be on hand at all times to accommodate:
i) Sudden patient arousal due to:
    (1) Surgical stimulation
    (2) Improper endotracheal tube placement or tube slippage during procedure
ii) Respiratory distress at extubation requiring patient re-intubation

SPECIFIC INDUCTION PROTOCOLS

1) Diazepam & An Opioid (Hydromorphone, Oxymorphone, Morphine, Fentanyl)

a) General Description

i) A benzodiazepine and an opioid

b) Patient selection

i) Recommended use

(1) Debilitated patients

(2) Geriatric patients

(3) Severe valvular insufficiency or cardiomyopathy

ii) Cautionary information

(1) Watch for bradycardia and respiratory depression due to the opioid

(a) Heart rate may decrease but blood pressures are usually adequate.

(2) Opioids, particularly oxymorphone, can create a hypersensitivity to loud noises

(3) This protocol is most effective when the patient is either depressed from their disease or very sedate from the premedications

c) Dosage

i) Routine induction

(1) Dogs

(a) Diazepam 0.4 mg/kg (0.2 mg/lb) IV followed by

(b) One of the following opioids:

(i) Hydromorphone 0.1 mg/kg (0.05 mg/lb) IV

(ii) Oxymorphone 0.05 mg/kg (0.025 mg/lb) IV

(iii) Fentanyl 0.005 mg/kg (0.0025 mg/lb) IV

(iv) Morphine 0.2 mg/kg (0.1 mg/lb) IV slowly

(c) Some patients will require a second dose of diazepam and some patients will require a second dose of the narcotic, given in that order, to complete the induction

(d) Rarely, patients will require a third dose of diazepam followed by a third dose of the narcotic, if needed, to complete the induction

(e) If, at any point, the **canine** patient is nearly, but not quite, able to be intubated, the addition of 2 mg/kg (1 mg/lb) lidocaine IV, may deepen the anesthetic effect and facilitate successful intubation

(i) This strategy is useful when minimizing the induction agent for more critical patients

(2) Cats –the doses are the same as for the dog, cats are often difficult to intubate with benzodiazepine/opioid combinations alone

(i) A small ketamine 2 to 10 mg/kg (1 to 5 mg/lb) or propofol 0.5 to 2.0 mg/kg (0.25 to 1.0 mg/lb) bolus may be necessary to complete induction and intubation.

(ii) Cats are more sensitive to the toxic effects of lidocaine (CNS stimulation, seizures). Lidocaine is not recommended for use in cats at this time.

ii) In dogs, surgical anesthesia can often be maintained using additional opioid with a benzodiazepine

(1) Hydromorphone 0.04 mg/kg (0.02 mg/lb) or oxymorphone 0.02 mg/kg (0.01 mg/lb) every 20 to 30 minutes and diazepam 0.1 mg/kg (0.05 mg/lb) every 40 to 60 minutes

(a) Maintenance of anesthesia by this method may be indicated if isoflurane or sevoflurane anesthesia is not well tolerated (i.e. adequate blood pressure is difficult to maintain)

(b) This technique is often not as successful in cats although it can significantly lower the inhalant concentration necessary to maintain surgical anesthesia

(2) CRIs of mu agonists, especially fentanyl, with midazolam can be used to accomplish this same strategy. See Maintenance Protocols for more information on this method

d) General Cost Category

i) Low to moderately high if oxymorphone is used)

2) Etomidate

a) General Description

i) An imidazole

b) Patient selection

i) Recommended use

(1) Patients with serious cardiac that include a decrease in contractility, such as cardiomyopathy patients.

ii) Cautionary information

(1) May cause myoclonus, retching, or excitement during induction or recovery

(a) Adequate preanesthetic sedation will minimize or eliminate this

(2) Suppresses adrenocortical function for up to 3 hours following administration

(a) This effect can be overcome by the administration of a short acting corticosteroid if there is an existing concern

(b) It has been reported that this lack of a "stress response" may actually reduce patient morbidity

(3) The Abbott etomidate product contains propylene glycol which may cause hemolysis

(a) Hemolysis may create a pigment load that can be significant for renal compromised patients

(i) Give slowly IV or give with IV fluids to minimize pain on injection and/or hemolysis

(b) Note: Diazepam is also in a propylene glycol solution

(4) The European Braun product, etomidate-lipuro, is the same concentration as the Abbott product but the vehicle is a hyperlipid emulsion like propofol. There is no risk of hemolysis with this product but once opened, the product should be handled appropriately and used within 8 hours.

c) Dosage

i) Routine induction

(1) Dogs

(a) 0.5 to 3.0 mg/kg (0.25 to 1.5 mg/lb) IV

(2) Cats

(a) 0.5 to 2.5 mg/kg (0.25 to 1.0 mg/lb) IV

(3) If the patient is not adequately sedate, precede the etomidate with diazepam 0.2 to 0.6 mg/kg (0.1 to 0.3 mg/lb) IV

ii) When utilizing the propylene glycol preparation, give slowly IV or give with IV fluids to minimize pain on injection and to minimize hemolysis (both due to the propylene glycol).

d) General Cost Category

i) Very high

3) Ketamine & Diazepam

a) General Description

i) 50/50 mixture of a benzodiazepine & a dissociative agent

b) Patient selection

i) Recommended use

(1) Animals of any age in generally good health

(2) An acceptable choice for animals with well compensated valvular heart disease

(3) Acceptable for sighthounds

ii) Cautionary information

(1) This protocol is most effective when the patient is either depressed from their disease or very sedate from the preanesthetic medications

(2) Avoid if:

(a) Intracranial disease is suspected (can raise ICP)

(b) An increase in intraoccular pressure is contraindicated (i.e. descmetocele)

(c) Severe renal insufficiency is present (renal clearance - cats)

(d) Serious cardiac disease (uncompensated mitral or tricuspid regurgitation or moderate to severe cardiomyopathies)

c) Dosage

i) Routine induction

(1) Dog & Cat

(a) 1 to 1.5ml of total mix per 10 kg (20 lbs)

(i) If unsedated, give 50 - 75 % as a bolus, then additional increments to effect

(ii) If sedate, give 25 % as a bolus, then additional increments to effect

(b) If, at any point, the **canine** patient is nearly, but not quite, able to be intubated, the addition of 2 mg/kg (1 mg/lb) lidocaine IV, may deepen the anesthetic effect and facilitate successful intubation

(i) This strategy is useful when minimizing the induction agent for more critical patients

(ii) Cats are more sensitive to the toxic effects of lidocaine (CNS stimulation, seizures). Lidocaine is not recommended for use in cats at this time

ii) Routes of administration

(1) IV

(2) IM/SC use, while not contraindicated, is not recommended as diazepam is not absorbed well

d) General Cost Category

i) Low – currently the least expensive of the induction agents

4) Ketamine & Midazolam

a) General Description

i) A combination of a dissociative & a benzodiazepine agent

ii) Similar to Ketamine & Diazepam

b) Patient selection

i) Recommended use

(1) Animals of any age in generally good health

(2) An acceptable choice for animals with well compensated valvular heart disease

(3) Acceptable for sighthounds

(4) Older difficult-to-handle cats where IM administration is required to gain control of the patient

(a) Follow with IV catheter and finish induction with IV agent(s)

(b) Midazolam's IM absorption is excellent

ii) Cautionary information

(1) This protocol is most effective when the patient is either depressed from their disease or very sedate from the preanesthetic medications

(2) Avoid if:

(a) Intracranial disease is suspected (raises ICP)

(b) An increase in intraoccular pressure is contraindicated (i.e. descmetocele)

(c) Severe renal insufficiency is present (renal clearance)

(d) Serious cardiac disease (uncompensated mitral or tricuspid regurgitation or moderate to severe cardiomyopathies)

(3) Etomidate should considered our first choice for serious cardiac disease, especially cardiomyopathies

c) Dosage

i) Routine induction

(1) Cats

(a) Ketamine – 4 to 10 mg/kg (2 to 5 mg/lb)

(i) For younger, fractious cats use 10 mg/kg (5 mg/lb)

(ii) For quiet, older cats reduce ketamine to 4 to 6 mg/kg (2 to 3 mg/lb)

(iii) Give an additional 2 to 10 mg/kg (1 to 5 mg/lb) IM or IV to effect if needed to complete induction

(b) Midazolam – 0.1 to 0.4 mg/kg (0.05 to 0.2 mg/lb)

(i) Give additional 0.1 to 0.2 mg/kg (0.05 to 0.10 mg/lb) IM or IV to effect if needed to complete induction

(2) Routes of administration

(3) IV (or IM if patient is too fractious to allow IV catheterization)

(a) These two drugs can be mixed together in same syringe

d) General Cost Category

i) Moderately high due to expense of midazolam

(1) Higher cost limits use in larger patients

5) Propofol

a) General Description

i) A phenol in a hyperlipid emulsion

b) Patient selection

i) Recommended use

(1) Animals of any age

(2) Cases in which rapid recovery is desired

(3) Diabetes Mellitus

(a) Propofol is capable of providing a smooth and rapid return to a comfortable state if premedications are appropriately utilized

(b) Appetite appears increased in many patients for a short period of time after recovery from propofol

(4) Outpatient procedures

(5) Sighthounds

(6) C sections

(7) Giant breed dogs when early ambulation is desired

ii) Cautionary information

(1) Predictable respiratory depression and hypotension if given rapidly

(a) Should not be a major concern if given slowly

(2) Hyperlipid emulsion and no preservative promote bacterial growth

(a) Once opened, contents should be used within 6 - 8 hours

c) Dosage

i) Routine induction

(1) Dogs

(a) 4 to 6 mg/kg (2 - 3 mg/lb) if not depressed or sedate

(i) Effective premeds or pre-existing CNS depression or debilitation can reduce the dose required for intubation to 1 to 4 mg/kg (0.5 to 2 mg/lb)

(2) Cats

(a) 6 to 8 mg/kg (3 - 4 mg/lb) if not depressed or sedate

(i) Effective premeds or pre-existing CNS depression or debilitation can reduce the dose required for intubation to 1 to 4 mg/kg (0.5 to 2 mg/lb) or less

ii) Plan on delivering the calculated dose over 90-120 seconds, stopping when the patient appears deep enough to intubate

(1) Rapid administration causes:

(a) Apnea of short duration

(b) Hypotension

(c) Reduction in myocardial contractility

iii) If, at any point, the **canine** patient is nearly, but not quite, able to be intubated, the addition of 2 mg/kg (1 mg/lb) lidocaine IV, may deepen the anesthetic effect and facilitate successful intubation

(1) This strategy is useful when minimizing the induction agent for more critical patients

(2) Cats are more sensitive to the toxic effects of lidocaine (CNS stimulation, seizures). Lidocaine is not recommended for use in cats at this time.

iv) Diazepam 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb) IV can decrease propofol need by 50%

v) Routes of administration

(1) IV

(2) Intraosseous

d) General Cost Category

i) Moderate

6) Sevoflurane/Isoflurane Mask Induction

a) General Description

i) Low solubility inhalant agents

b) Patient selection

i) Recommended use

(1) Mask inductions are not recommended for most patient groups

ii) Cautionary information

(a) Increased patient stress

(i) Increased arrhythmic risk

(b) Unnecessary staff exposure to anesthetic agents

(c) Time required for complete induction of anesthesia is longer than compared to IV agents.

(d) Prolonged period of unsecured airway with an increased risk of airway compromise or obstruction

(e) High concentrations of inhalant agents are required to achieve mask induction. Higher doses produce more cardiovascular and respiratory depression than seen with comparable doses of IV induction agents.

(i) During intubation removal of the mask results in cessation of drug administration of the drug and recovery from anesthesia begins as the drug is eliminated.

(ii) Once intubated higher concentrations of inhalant are required compared to use of IV induction drugs.

(f) Contraindicated in brachycephalic patients

c) Dosage

i) Isoflurane 1 to 5 %

(1) Mask Induction

(a) Start with 100% oxygen at 3 liters/min for 3 - 5 minutes if patient is tolerant of the face mask

(i) Do not cover patients eyes

(b) After 3 - 5 minutes of O2, start isoflurane @ 0.5 %

(c) Increase by 0.5 % every 30 - 60 seconds until 2 % is reached

(d) Then increase to 3.5 % - 5 % to complete induction

ii) Sevoflurane 2 to 7 %

(2) Mask Induction

(a) Start with 100% oxygen at 3 liters/min for 3 - 5 minutes if patient is tolerant of the face mask

(i) Do not cover patients eyes

(b) After 3 - 5 minutes of O2, start sevoflurane at 1 %

(c) Increase by 1 % every 30 - 60 seconds until 3 % is reached

(d) Then increase to 5 % - 7 % to complete induction

d) General Cost Category

i) Moderately high with sevoflurane

7) Thiopental

a) General Description

i) Ultra-short acting thiobarbiturate

b) Patient selection

i) General use

(1) Healthy animals in the Good to Excellent category

ii) Cautionary information

(1) Avoid if:

(a) Sighthound (lower volume of distribution and altered metabolism)

(b) Anemic

(i) Thiopental can cause splenic pooling of RBCs leading to a rapid decrease in PCV of up to 30%

(2) Extravascular thiopental may produce tissue necrosis

(a) Infiltrate area with saline, 0.5 to 1 mg of dexamethasone and 1 mg/kg (0.5 mg/lb) of lidocaine

(b) Additionally, a gauze soaked in DMSO can be wrapped over the site

c) Dosage

i) Routine induction

(1) Dog

(a) Begin with 12 mg/kg (6 mg/lb)

(i) Administer 4 to 6 mg/kg (2 - 3 mg/lb) rapid bolus initially followed by additional small boluses to effect

1. Excessively slow injection may precipitate unwanted excitement

(2) Cat

(a) Same as dog

(3) If at any point the **canine** patient is nearly, but not quite, able to be intubated, the addition of 2 mg/kg (1 mg/lb) lidocaine IV, may deepen the anesthetic effect and facilitate successful intubation

(a)) This strategy is useful when minimizing the induction agent for more critical patients

(b) **Cats** are more sensitive to the toxic effects of lidocaine (CNS stimulation, seizures). Lidocaine is not recommended for use in cats at this time.

(4) Route of administration

(a) IV only

d) General Cost Category

i) Moderate

8) Tiletamine & Zolazepam (Telazol)

a) General Description

i) 50/50 mixture of a benzodiazepine & a dissociative agent

ii) Tiletamine is capable of providing the loading dose for NMDA dorsal horn windup antagonism prior to ketamine CRI use

b) Patient selection

i) General use

(1) Healthy animals in the Good to Excellent category

(2) Can be used for induction or as the exclusive agent for short procedures in cats

(3) An acceptable induction agent for sighthounds

ii) Cautionary information

(1) See Ketamine & Diazepam

(2) Avoid is:

(a) Intracranial disease is suspected (can raise ICP)

(b) Renal insufficiency is present (renal clearance)

(3) Somewhat more stormy recoveries in dogs compared to Ketamine/Diazepam

(a) The ½ life of zolazepam is **shorter** than the ½ life of the tiletamine in dogs increasing the risk that the patients will be more agitated during the recovery

(i) This is less of an issue if a longer procedure over 1.5 hours

(a) The ½ life of zolazepam is much **longer** than the ½ life of the tiletamine in cats

c) Dosage

i) Routine induction

(1) Dog

(a) Unsedated – 2 mg/kg (1 mg/lb) IV bolus

(b) Sedated or pre-existing CNS depression or debilitation - draw up 2 mg/kg (1 mg/lb), give 25 - 50% as bolus then additional increments to effect

(2) Vicious, aggressive dogs

(a) 5 mg/kg (2.5 mg/lb) IM - usually reach lateral recumbancy within 10 minutes

(b) May be combined with acepromazine for more dramatic effect

(3) Cats

(a) Same as dog

ii) Routes of administration

(1) IV/IM/SC

(a) IV – allows for lower telazol doses

(b) IM – more rapid effect than SC but more painful

(c) SC - somewhat less painful and somewhat lower effect but SQ administration is still a rapidly acting route

d) General Cost Category

i) Moderately low

ANESTHETIC MAINTENANCE

1) Disconnect the endotracheal tube before moving or turning patient to minimize tracheal trauma
2) All anesthetized patients will be kept on a warm water blanket whenever possible.
    a) Utilize a warm air patient warmer like the Bair Hugger whenever possible.
    b) Microwaved water bottles or rice bags can cause serious burns. Their use is not recommended.
    c) Warm water can be of some use if the patient is wrapped in a light towel and the bottles are changed frequently.
        i) Cooled water bottles are a heat-sink that must be avoided.
        ii) Direct contact with very hot tap water can cause first degree burns.
3) All anesthetized patients will be monitored in the most complete fashion available to the practice.
    a) The most important monitor is a properly trained health professional dedicated to observing and managing the patient's anesthetic care.
    b) Technology enhances the anesthetist's ability to safely manage their patient. Blood pressure, ECG, End-tidal CO2 and Pulse Oximeter monitors are recommended for every patient.
        i) See the monitoring section below entitled "Monitoring" for more details on these monitors.
4) The anesthetic record should be maintained as consistently as possible during the event.
    a) All unusual developments should be noted on the record and all important points transferred to the Master Problem List in the patients medical record

SPECIFIC MAINTENANCE PROTOCOLS

1) HALOTHANE

a) General Description

i) A volatile halogenated liquid of moderately low solubility that undergoes significant metabolism by the liver

b) Patient selection

i) Recommended use

(1) This anesthetic agent is suitable for use with most veterinary patients

(2) It is an alternative for those patients that demonstrate a poor tolerance for isoflurane or sevoflurane

(3) The bronchodilatory effect of halothane may make it attractive for selected patients with respiratory disease

ii) Cautionary information

(1) As with any inhalant anesthetic, cardiac and respiratory depression result as anesthetic concentrations are increased

(2) Chronic exposure has been associated with anesthetic personnel developing liver concerns

(3) Avoid Halothane when intracranial disease is suspected

(a) Halothane can raise intracranial pressures

c) Dosage

i) Routine use

(1) Completing induction following injectable agent

(a) Initiate flow rates of 1.0 to 1.5 liter per minute at 2.5 % - 4.0 %

(i) Reduce percentage as indicated by patients response

(2) Maintenance

(a) Once stable, reduce oxygen flow to 500 ml to 1 liter per minute

(i) The reservoir bag must remain moderately full

1. If not, the flow rate must be increased and the machine must be examined for leaks at the earliest possible convenience

(b) Remember that prior to surgical stimulation, a patient may appear adequately anesthetized only to show a dramatic response to stimulation

(i) An experienced anesthetist should be able to anticipate and minimize this event

(ii) A 0.002 mg/kg (0.001 mg/lb) fentanyl bolus IV at initiation of surgery may help to stabilize a patient that is on the light side

(c) Effective analgesic & sedative premedicants will significantly reduce the level of inhalant agent necessary for maintenance of a surgical plane of anesthesia

d) General Cost Category

i) Low

2) DIAZEPAM & an OPIOID (Hydromorphone, Oxymorphone, Fentanyl)

i) General Description

(1) A benzodiazepine and an opioid

ii) Patient selection

(1) Recommended use

(a) Debilitated **canine** patients

(i) Primarily if inhalant agents are not well tolerated (especially if blood pressure is difficult to maintain on inhalant agents)

(2) Cautionary information

(a) This technique is not familiar to most veterinarians. Initial familiarization should involve the application of this method to healthy, routine cases under careful supervision.

(i) Routine patients must be very sedate from their preanesthetic medications in order to consider them eligible for this protocol

(b) Surgical anesthetic levels are not realistically achievable in feline patients

iii) Dosage

(1) Intermittent bolus technique

(a) Diazepam @ 0.05 mg/lb every 40 to 60 minutes

(b) Add one of the following opioids every 20 to 30 minutes

(i) Hydromorphone 0.04 mg/kg (0.02 mg/lb)

(ii) Oxymorphone 0.02 mg/kg (0.01 mg/lb)

(2) CRI (TIVA) technique

(a) TBC

iv) Cautionary Notes

(1) Watch for bradycardia and respiratory depression

v) General Cost Category

(1) Moderately low with hydromorphone

(2) Moderately high with oxymorphone

3) ISOFLURANE

a) General Description

i) A volatile liquid of low solubility that is minimally metabolized by the liver

b) Patient selection

i) Recommended use

(1) This anesthetic agent is suitable for use with most veterinary patients

ii) Cautionary information

(1) As with any inhalant anesthetic, cardiac and respiratory depression result as anesthetic concentrations are increased

(a) Not all patients under Isoflurane will be able to maintain adequate blood pressures

(b) Switching to an alternative maintenance agent may be necessary

(2) Although isoflurane is considered the safest agent as pertains to staff exposure, we should all strive to minimize our exposure to this or any other inhalant agent

c) Dosage

i) Routine use

(1) Completing induction following injectable agent

(a) Initiate flow rates of 1 to 1.5 liter per minute at 3.5 % - 5.0 %

(i) Reduce vaporizer setting as indicated by patients response

(2) Maintenance

(a) Once stable, reduce oxygen flow to 500 ml or 1 liter per minute

(i) The reservoir bag must remain full

1. If not, the flow rate must be increased and the machine must be examined for leaks at the earliest possible convenience

(b) Remember that prior to surgical stimulation, a patient may appear adequately anesthetized only to show a dramatic response to stimulation

(i) An experienced anesthetist should be able to anticipate and minimize this event

(ii) A 0.002 mg/kg (0.001 mg/lb) fentanyl bolus IV at initiation of surgery may help to stabilize a patient that is on the light side

(c) Effective analgesic & sedative premedicants will significantly reduce the level of inhalant agent necessary for maintenance of a surgical plane of anesthesia

d) General Cost Category

i) Moderately low

4) PROPOFOL

a) General Description

i) A phenol in a hyperlipid emulsion

b) Patient selection

i) Recommended use

(1) Canine cases when:

(a) Tracheal intubation is not possible

(i) Bronchoscopy

(b) An anesthetic machine cannot be used

(i) MRI studies as a constant rate infusion via a plastic drip set

(c) Isoflurane/Sevoflurane is not well tolerated

(2) Appropriate for sighthounds

(3) Appetite appears increased in many patients for a short period of time after recovery from propofol

(a) This would be an advantage when dealing with diabetic patients where an early return to their normal routine is desired

ii) Cautionary Notes

(1) Hyperlipid emulsion easily promotes bacterial growth

(a) Once opened, contents should be used within 6 - 8 hours

(2) Feline patients do not clear phenols well

(a) Subsequent boluses or ongoing CRI doses should be adjusted downward over time

(b) Recovery will be more prolonged than with dogs

c) Dosage

i) Routine maintenance

(1) Dogs

(a) Boluses of ¼ to 1/3 of the original induction dose as needed

(b) CRI at 0.2 to 0.4 mg/kg/minute (0.1 to 0.2 mg/lb/minute)

(i) If too light, give 0.5 to 1.0 mg/kg (0.25 to 0.5 mg/lb) IV then increase CRI rate by 25%

(ii) If too deep, stop propofol until suitable anesthetic level is reached, then reinitiate CRI at 25% lower rate

(2) Cats

(a) Boluses of ¼ to 1/3 of the original induction dose as needed

(b) CRI at 0.1 mg/lb/minute

(i) If too light, give 0.5 mg/kg (0.25 mg/lb) IV then increase CRI rate by 25%

(ii) If too deep, stop propofol until suitable anesthetic level is reached, then reinitiate CRI at 25% lower rate

(iii) Feline patients do not clear phenols well

(c) Subsequent boluses or ongoing CRI doses should be adjusted downward over time

(d) Recovery will be more prolonged than with dogs

d) General Cost Category

i) Moderately high - usually some wastage

5) SEVOFLURANE

i) General Description

(1) A volatile liquid of low solubility that is minimally metabolized by the liver

(a) Liver metabolism exceeds that of Isoflurane

(2) Its extremely low solubility provided for the quickest inductions, level adjustments, and recoveries of the currently used inhalant anesthetics

(3) MAC

(a) Dog – 2.1 to 2.4%

(b) Cats – 2.6%

ii) Patient selection

(1) Recommended use

(a) This anesthetic agent is suitable for use with most veterinary patients

(b) With the exception of patients experiencing extreme respiratory compromise sevoflurane is rarely of any advantage over isoflurane

(2) Cautionary information

(a) As with any inhalant anesthetic, cardiac and respiratory depression result as anesthetic concentrations are increased

(i) Not all patients under sevoflurane will be able to maintain adequate blood pressures

(ii) Switching to an alternative maintenance agent may be necessary

(b) Although sevoflurane is considered a relatively safe agent as pertains to staff exposure, we should all strive to minimize our exposure to this or any other inhalant agent

iii) Dosage

(1) Routine use

(a) Completing induction following injectable agent

(i) Initiate flow rates of 1.0 to 1.5 liter per minute at 5 % - 7.0 %

1. Reduce percentage as indicated by patients response

(b) Maintenance

(i) Once stable, reduce oxygen flow to 500 ml or 1 liter per minute

1. The reservoir bag must remain full
2. If not, the flow rate must be increased and the machine must be examined for leaks at the earliest possible convenience

(ii) Remember that prior to surgical stimulation, a patient may appear adequately anesthetized only to show a dramatic response to stimulation

1. An experienced anesthetist should be able to anticipate and minimize this event
2. A 0.002 mg/kg (0.001 mg/lb) fentanyl bolus IV at initiation of surgery may help to stabilize a patient that is on the light side
3. Effective analgesic & sedative premedicants will significantly reduce the level of inhalant agent necessary for maintenance of a surgical plane of anesthesia

iv) General Cost Category

(1) Moderately high

RECOVERY

1) An immediate post-op rectal temperature should be performed and used as a guide in determining the patients supplemental heat needs.
   a) rectal temperatures should be monitored every 15 to 30 minutes until the patient has demonstrated the ability to consistently maintain a stable core body temperature of at least 99.5^0 F but not greater than 103.0^0 F.
      i) Remain vigilant for hyperthermia, especially in patients with poor mobility and pets with compromised airway including brachycephalic breeds
      ii) Remain vigilant for animals that regain normal body temp initially but become hypothermic after the supplemental heat source is removed
2) Extubation should not be performed until the patient has demonstrated a clear ability to swallow
   a) Before extubating, insure that the upper airway is free of any gross materials that could be aspirated
      i) be especially vigilant for debris or gauze left in oral cavity after dental procedures
   b) Avoid overly aggressive stimulation that might trigger initial swallowing, only to be followed by a relapse into unconsciousness when stimulation is removed
      i) This is especially important when dealing with airway compromised patients including brachycephalic breeds
      ii) sternal recumbancy may be the best position for recovery of brachycephalic breeds
3) Continue to monitor the patient's respiratory function, perfusion, and mental status after extubation to insure that the recovery is progressing in a stable manner
4) Discuss agitated recovering patients with a doctor
   a) Dysphoria as well as pain can combine to produce agitation
      i) First attempt to directly comfort your patient
      ii) If necessary, consider repeating sedatives and/or analgesics as needed
      iii) Remember that analgesics are best given before your patient demonstrates need
         (1) Have a planned drug, dose, and administration interval in place prior to the recovery of the patient
5) Continue fluids post-operatively as directed by the supervising veterinarian
6) Patients who are not on long term IV fluids should retain their catheter until they have been clearly stable for a minimum of 1 hour.
7) Administer and record the dose and timing of all post-anesthetic medications as directed by a staff veterinarian
8) Postanesthetic recovery notes are an essential component to the anesthetic record. Please do not fail to record this valuable information.
9) For pediatric patients, offering food within 2 or 3 hours of recovery is recommended to help minimize hypoglycemic risk.
10) Home care following an anesthetic procedure is a final recovery consideration. Anesthetic events can make a patient somewhat nauseous.

a) Patients should be allowed to settle in at home for at least 1 hour before offering water.
    i) Initially water should be offer in limited amounts until it is clear that the patient will not vomit after drinking and that they are not interested in “guzzling” large amounts of water.
b) If the patient has been home for at least 2 hours, has not vomited at all, and is exhibiting some interest in food, they can be offered a small meal
    i) The meal should not exceed 25% of their normal meal size.
    ii) The patient can resume their normal meal routine the following day unless told to do otherwise by the attending doctor.
c) Post anesthesia, pets can be unsteady on their feet. The evening after anesthesia owners should be cautioned to be careful with them on stairs, and in situations that would not normally be considered dangerous (such as cats jumping down from high places).

ADDISON'S DISEASE

5-04

1) RECOMMENDATIONS

a) General Approach

i) Stabilize this disease before proceeding with anesthetic events

ii) Accommodate animals decreased ability to respond to stress

iii) Confirm serum electrolyte values prior to induction

b) Pre-anesthetic Medications

i) These patients should receive additional glucocorticoids the morning of the procedure

(1) Prednisolone acetate should be administered at 0.25 mg/lb IM at admission

ii) Follow routine pre-anesthetic medications guidelines based upon patient assessment and categorization

c) Induction

i) Follow routine induction guidelines based upon patient assessment and categorization

d) Maintenance

i) Follow routine maintenance guidelines based upon patient assessment and categorization

e) Support

i) 0.9% Saline would be indicated for fluid support

(1) Replacement fluids, such as lactated ringer's solution, are not ideal due to their potassium content

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Nothing specific

b) Induction

i) Nothing specific

c) Maintenance

i) Nothing specific

d) Support

i) Use potassium containing fluids with caution (both maintenance and replacement fluids contain potassium)

(1) Maintenance fluids contain higher potassium levels compared to replacement fluids

(2) 0.9% Saline would be indicated for fluid support

BLOOD PRESSURE MANAGEMENT

5-04

1) RECOMMENDATIONS

a) General Approach

i) All anesthetized patients should be consistently monitored using indirect oscillometric or doppler blood pressure monitors

(1) Main priority is to maintain systolic blood pressure (SAP) at or above 90 mm Hg

(a) 80 mmHg is often discussed as a minimum SAP

(2) Mean arterial pressure (MAP) should be maintain at or above 70 mm Hg (if you feel the MAP is being accurately measured)

(a) This value is less likely to be accurate compared to the systolic pressure as the diastolic blood pressure (DAP) is averaged into the MAP and the diastolic pressure can be the least reliable of all parameters

ii) Oscillometric Monitors

(1) Are less labor intensive than doppler monitors but tend to be less accurate for smaller patients

(2) Set to automatically cycle every 2 to 3 minutes

(a) 1 minute cycles tend to create an ischemic challenge to the extremity

(3) Cuff width should be 40 to 60% of limb diameter

(a) Excessively wide cuffs will lead to an under-estimation of blood pressure

(b) Excessively narrow cuffs will lead to an over-estimation of blood pressure

(4) Location of cuff is important

(a) Most consistent cuff location for small patients is the mid-foreleg

(i) Don’t hesitate to try all locations as needed

(b) Good locations for larger animals include metacarpus, metatarsus, and distal tibia just above tarsus

(c) The tail base may be an adequate site for some patients including cats

iii) Doppler

(1) More consistently effective when monitoring small patients

(2) Measures systolic pressure only

(a) In cats there is some evidence that you are measuring MAP rather than SAP

(3) Locations include ventral tail, caudal metacarpus, and caudal metatarsal area

(4) Hair is generally clipped at the probe site

(a) The depression in the probe must be filled with aquasonic coupling gel

(b) Once you hear the swishing sound, tape the probe in place

(i) Both excessive and inadequate pressure can create difficulties measuring pressures

(5) It is often possible to obtain readings by first wetting the site with alcohol, then applying coupling gel to the site and the probe without clipping any hair

(6) The cuff is placed just proximal to the probe

(a) Cuff width is as important with doppler BP measurement as with oscillometric BP measurement

(i) Cuff width should be 40 to 50 % of appendage diameter

(ii) Excessively wide cuffs will lead to an underestimation of blood pressure

(iii)Excessively narrow cuffs will lead to an overestimation of blood pressure

b) Pre-anesthetic Medications

i) An opioid alone or with a benzodiazepine usually provides the best maintenance of optimal blood pressures

ii) Effective premeds, with an emphasis on opioid analgesics, are an extremely important first step in handling a patient in a fashion that helps best preserve tissue perfusion

c) Induction

i) Induction agents for maintenance of the most optimal blood pressures

(1) Etomidate

(2) Hydromorphone or oxymorphone with diazepam (canines)

d) Maintenance

i) If blood pressures are too low:

(1) Decrease inhalant anesthetic level if possible

(a) If systolic pressures are at least 80 mm Hg, awaiting surgical stimulation is a reasonable short term option

(2) Increase fluid rate if possible

(a) Increase from 10 ml/kg/hr (5 ml/lb/hr) to 20 ml/kg/hr (10 ml/lb/hr)

(i) Consider a quick bolus of 10 ml/kg (5 ml/lb) over 5 minutes

(3) Relocate monitor site (mainly pertains to oscillometric monitors)

(a) Verify proper cuff selection

(4) Hetastarch

(a) Dogs

(i) 5 ml/kg (2.5 ml/lb) over 5 minutes

1. Can be repeated with caution until SAP reaches 80 mmHg or a total of 20 ml/kg/day (10 ml/lb/day) is reached

(b) Cats

(i) 2 ml/kg (1 ml/lb) over 5 minutes

1. Can be repeated with caution until SAP reaches 80 mmHg to a total of 20 ml/kg/day (10 ml/lb/day)

(5) Consider administering dobutamine

(a) Dog – 0.004 to 0.40 mg/kg/min (0.002 to 0.20 mg/lb/min)

(b) Cats - use low end of dog dose range

(c) Recipe for 0.008 mg/kg/min (0.004 mg/lb/min) dose

(i) 4 ml @ 12.5 mg/ml = 50 mg

(ii) Add to 250 ml 0.9% saline for 0.2 mg/ml

(iii)Give 0.2 ml/min per 5 kg (10 lb) body weight

1. Requires infusion pump or syringe pump for accurate delivery

(d) Discontinue dobutamine if significant increase in heart rate or if any arrhythmias develop

(6) For dogs, consider switching from isoflurane/sevoflurane to:

(a) Hydromorphone or oxymorphone as a periodic bolus with periodic boluses of diazepam (see Anesthetic Maintenance section for details on Hydromorphone and Oxymorphone maintenance guidelines)

(b) Fentanyl and midazolam CRI

(i) Ketamine and lidocaine may be added to the CRI unless there is a specific contraindication

(c) For cats these protocols may be used to reduce the inhalant need but it is unlikely to be a successful strategy without additional anesthetic agents

e) Support

i) See above

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Acepromazine can cause hypotension

(1) This is a dose dependent effect

b) Induction

i) Administering propofol too rapidly can cause myocardial depression and a transient decrease in blood pressure

c) Maintenance

i) Any inhalant agent is capable of causing significant hypotension at surgical anesthetic levels

(1) Switching inhalant agents may be beneficial

(2) Switching to injectable agents may be beneficial

d) Support

i) As needed base upon above discussion

BRACHYCEPHALIC BREEDS

5-04

1) RECOMMENDATIONS

a) General Approach

i) Manage airway compromise issues

(1) Often have:

(a) Hypoplastic trachea

(b) Elongated soft palate

(c) Decreased chest wall compliance and low tidal volumes

ii) Gain rapid control over airway

iii) Plan for smooth, rapid recovery

(1) Plan thorough patient monitoring during recovery phase

iv) Expect increased vagal tone in these patients

b) Pre-anesthetic Medications

i) Avoid heavy sedation

(1) Use reversible drugs

ii) Pre-oxygenate if not overly stressful

iii) Brachycephilcs may have generally higher vagal tone

(1) Many will premedicate with an anticholinergic especially if a mu opioid is used

c) Induction

i) Gain rapid control over airway

(1) Ket/val

(2) Etomidate

(3) Thiopental

(4) Propofol

ii) Consider Lidocaine bolus (1mg/lb Dog & Cat) post-induction agent to facilitate intubation, avoid vagal stimulation, and minimize induction agent requirement

d) Maintenance

i) Sevoflurane or Isoflurane for more rapid patient recovery

e) Support

i) Routine anesthetic support

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid heavy sedation

(1) Use reversible agents

ii) Pre-oxygenate if not overly stressful

b) Induction

i) Expect to use a much smaller endotracheal tube
   (1) Carefully select a wide variety of sizes
      (a) Have 2 tubes smaller than what you estimate to be the right size
ii) Gain rapid control of airway at induction

c) Maintenance

i) Be ready to assist ventilation

d) Support

i) As needed

e) Recovery

i) Maintain oxygen delivery prior to extubation to buy more time to re-establish the airway
ii) Have additional induction agent at recovery in the event that obstruction occurs and reintubation is needed
iii) Avoid overly aggressive stimulation that might trigger initial swallowing, only to be followed by a relapse into unconsciousness when stimulation is removed
   (1) Sternal recumbancy may be the best position for recovery of brachycephalic breeds

BRONCHOSCOPY

5-04

1) RECOMMENDATIONS

a) General Approach

i) Maintain adequate ventilation and effective anesthesia while allowing for airway study

b) Pre-anesthetic Medications

i) Consider an opioid with either benzodiazepine or acepromazine depending on patient status

ii) Atropine or glycopyrrolate should be given prior to bronchoscopy in order to prevent vagal-vagal bradycardic effect

(1) When the collection of airway secretions is considered a priority, anticholinergic medications should be postponed until diagnostic sample collection is complete

c) Induction

i) Propofol

d) Maintenance

i) Propofol - intermittent boluses

e) Support

i) Provide oxygen insufflation by passing a red rubber catheter down trachea

(1) Connect to oxygen source

(a) 1 to 2 liter flow

ii) Always have appropriate selection of endotracheal tubes in case of emergency

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Without anticholinergic medications, bronchoscopy can trigger potentially fatal vagal-vagal bradycardic event

(1) In the event of a bradycardic emergency, atropine is preferred over glycopyrrolate

b) Induction

i) Rapid propofol infusion can lead to apnea and hypotension

c) Maintenance

i) N/A

d) Support

i) Use red rubber catheter to provide tracheal oxygen insufflation during the procedure

ii) Carefully monitor heart rate, blood pressure, and oxygen saturation

C-SECTIONS

5-04

1) RECOMMENDATIONS

a) General Approach

i) Minimize anesthetics and surgical time

ii) Hydrate and pre-oxygenate (if possible)

iii) Do not over-ventilate

(1) $PaCO_2$ less than 35 will decrease uterine blood flow (UBF)

iv) MAC is significantly decreased

(1) Isoflurane MAC decreases 40%

(2) Halothane MAC decreases 25%

(3) Sevoflurane?

b) Pre-anesthetic Medications

i) Manage maternal stress response

(1) Acepromazine

(a) Avoid if hypotensive

(b) Stay at the low end of the dose range

(2) Mu agonist

(a) Hydromorphone, oxymorphone, morphine, fentanyl

(3) Butorphanol

ii) Anticholinergics

(1) ***If*** bitch is bradycardic, pups are probably too

(2) Select atropine if anticholinergic needed

(3) Glycopyrrolate dose not cross placenta

(a) Larger protein size block trans-placental transfer

iii) Epidurals

(1) Increased collateral blood flow distends epidural veins decreasing local anesthetic requirements

(a) Dose lidocaine @ 1 ml per 12-14 lb.

c) Induction

i) Propofol

(1) 0.5 to 3.0 mg/lb IV over 30 to 90 seconds followed by lidocaine 1 mg/lb IV, if needed, to deepen anesthetic plane and facilitate intubation

d) Maintenance

i) Isoflurane/Sevoflurane

(1) Remember MAC decreases significantly during pregnancy

e) Support

i) IV fluid support is a basic requirement

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid glycopyrrolate

ii) Avoid acepromazine **if** hypotensive

b) Induction

i) Minimize dose

c) Maintenance

i) MAC is lowered significantly during pregnancy

d) Support

i) Insure adequate hydration and oxygenation

ii) Bradycardia in the pups is a poor prognostic indicator

(1) Intubate and ventilate ASAP

(2) 1 drop of dopram can be placed sublingually to help stimulate respiration if intubation is not possible

(a) Remember, doxapram increase cerebral oxygen demand

(i) Ventilating the patient is preferred to doxapram use

(3) 1 drop naloxone can be placed sublingually to reverse narcotic bradycardic or respiratory depressive effects

CARDIAC DISEASE

5-04

1) RECOMMENDATIONS

a) General Approach

i) Minimize myocardial depression, myocardial oxygen demand/stress, and myocardial irritation

b) Pre-anesthetic Medications

i) Hydromorphone, fentanyl, or oxymorphone with midazolam IM

(1) Diazepam could be substituted for the midazolam but is less well absorbed when given IM

c) Induction

i) Etomidate – may be considered the first choice for inducing cardiac cases

(1) Certainly for patients with decreased myocardial contractility like dilated cardiomyopathy (DCM)

ii) Hydromorphone, fentanyl, or oxymorphone & a benzodiazepine IV

(1) Closely monitor heart rate - consider anticholinergics if bradycardic trend is noted **and** systolic blood pressure drops below 90 mm Hg

iii) Ketamine with diazepam or midazolam IV

(1) Reasonable choice if sympathetic release is not considered an inappropriate stress

(a) Increased heart rate will increase myocardial oxygen demand

(b) Avoid using if hypertrophic cardiomyopathy (HCM) patient

(2) Ketamine and midazolam are absorbed efficiently when given IM

(a) This is an advantage when trying to gain control of a fractious cat with cardiac disease

(i) Combine with butorphanol to increase the sedative effect

iv) Propofol

(1) May be a consideration for some cardiac patients

(a) More useful for HCM

(b) Avoid use if DCM or other patients with decreased myocardial contractility

(2) Precede with 0.2 to 0.4 mg/kg diazepam IV and consider 2 mg/kg lidocaine IV after initial propofol administration to reduce total propofol need

d) Maintenance

i) Isoflurane or Sevoflurane

(1) Generally preferred over halothane as they are generally less arrhythmogenic

(a) If a significant arrhythmia develops while on Isoflurane or Sevoflurane, however, a switch to halothane **may** resolve or reduce the severity of the arrhythmia

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Pre-oxygenate if not overly stressful

ii) Anticholinergics

(1) Routine use is not recommended

(a) Tachyarrhythmias can increase myocardial oxygen demand creating deleterious effects

b) Induction

i) Avoid Thiopental

(1) More myocardial irritation than other choices

(2) May cause a bigeminy that many consider a benign effect

c) Maintenance

i) Halothane

(1) May be more arrhythmogenic than isoflurane or sevoflurane

d) Support

i) Fluids

(1) You may need to run lower than standard fluid rates

(a) Overly aggressive IV fluids can create volume overload and pulmonary edema

CARDIOPULMONARY RESUSCITATION

5-04

1) RECOMMENDATIONS

a) General Approach

i) Cardiac arrest is characterized by an absence of auscultable heart beat, no palpable pulse, cyanotic or grey mucous membranes, dilated pupils, and an absence of spontaneous respiration

ii) Recovery from a true cardiac arrest is difficult

b) Compensatory Steps

i) **A** = **ESTABLISH AN AIRWAY VIA ENDOTRACHEAL INTUBATION**

ii) **B** = **BREATH/VENTILATE PATIENT AT 5 BREATHS PER MINUTE**

(1) Ventilate to 15 to 20 cm H_2O

(2) Tidal volume estimated @ 10 ml/kg (5 ml/lb)

(3) Hyperventilate if overdose of gas anesthetic is suspected

iii) **C** = **CARDIAC COMPRESSIONS AT 80 TO 100 PER MINUTE**

(1) External thoracic compression

(a) Thoracic Pump – square wave pattern compressions with slight hesitation at top and bottom

(2) If ineffective after 2 minutes, go to internal compression

(a) Some promote immediate internal compression of verified arrest

(b) Enter chest at 4^{th} –5^{th} rib space on left side

iv) **D** = **DRUG THERAPY - USE LARGE VOLUMES OF FLUSH IF USING PERIPHERAL VEIN**

(1) Epinephrine (1:1000) @ 1cc/10 kg (20 lb) IV

(2) Atropine @ 1cc/10 kg (20 lb) IV

(3) Fluids IV

(a) Dogs @ 20 ml/kg/hr (40 ml/lb/hr)

(b) Cats @ 10 ml/kg/hr (20 ml/lb/hr)

(4) Sodium bicarbonate

(a) Not acidotic for 10 – 12 minutes after arrest

(b) After 10 – 12 minutes post arrest, give 2 meq/kg (1 meq/lb) IV

(5) Defibrillation

(a) Potassium Chloride @ 3.5 to 7.5 meq/kg (7 to 15 meq/lb) followed by 10% Calcium Chloride @ 1 ml/10 kg (1 ml/20 lb)

c) Newer Thoughts

i) Recovery may be enhanced by:

(1) Moderate hypothermia to 93^0 to 94^0 F
    (a) Ice packs around head and neck
(2) Moderate hypertension – SAP of 200 mm Hg
    (a) Norepinephrine may be required
(3) Moderate hemodilution – Reduce PCV to 30%
    (a) Dextran-40 is one recommended option
        (i) 10% in isotonic saline
        (ii) Maximum of 20 ml/kg (10 ml/lb)
(4) Maintain ETCO2 at 30 mm Hg

CONSTANT RATE INFUSIONS

5-04

1) RECOMMENDATIONS

a) General Information

i) An easily controlled way of adding to any analgesic plan

ii) Lidocaine has been shown to improve the recovery from reperfusion injury and helps maintain motility after GI surgery

2) PRECAUTIONS

a) General Information

i) Avoid ketamine if history of seizures or recent head trauma

ii) Cats are more prone to dysphoria from morphine

(1) Use the low end of the dose range

iii) Cats are relatively sensitive to CNS stimulation effects of lidocaine

(1) If used in a combination CRI, use the low end dose and monitor closely for seizure activity

3) PROTOCOLS

a) Analgesics

i) Ketamine

(1) Ketamine alone, without an opioid on board, is not an effective analgesic

(a) Precede ketamine with buprenorphine, oxymorphone, morphine, fentanyl or hydromorphone

(2) Give 0.25 to 0.5 mg/kg (0.125 to 0.25 mg/lb) IV bolus if ketamine/diazepam or telazol is not used for induction

(a) Initiates NMDA receptor antagonism

(3) Recipe for general intra-op fluid rates

(a) Add 60 mg (0.6 ml) ketamine to 1 liter bag of fluids

(b) Affix high visibility sticker itemizing added medications

(c) Adjust fluid rate from 2 to 20 ml/kg/hr (1 to 10 ml/lb/hr) to administer ketamine at a rate of 2 to 20 ug/kg/minute (1 to 10 ug/lb/minute)

(d) Dose range is 2 to 20 ug/kg/minute (1 to 10 ug/lb/minute) or 0.12 to 1.2 mg/kg/hr (0.06 to 0.6 mg/lb/hr)

ii) Morphine Sulfate CRI recipe

(1) If no previous mu agonist has been given, administer an initial 0.25 mg/lb of Morphine IM or very slowly IV to provide an analgesic effect

(2) Recipe for general **INTRA-OP FLUID RATES**

(a) Add 15 mg Morphine (1.0 cc) to 1 liter fluid bag

(i) Affix high visibility sticker itemizing added medications

(b) Administer 10 ml/kg/hr (5 ml/lb/hr) to begin with

(i) Provides 0.0025 mg/kg/min (0.00125 mg/lb/min) or 0.15 mg/kg/hr (0.075 mg/lb/hr) of Morphine

(ii) Rate can be doubled to 20 ml/kg/hr (10 ml/lb/hr) if needed

(3) Recipe for **INDEPENDENT CRI USE**

(a) 500 ml 0.9% Saline

(b) 60 mg Morphine (4cc)

(c) Administer 1 ml/kg/hr to begin with (enter patient's weight (kg) in IV pump)

(i) Provides 0.1 mg/kg/hr of Morphine

(d) Increase as needed to 3 ml/kg/hr

(i) Provides 0.3 mg/kg/hr of Morphine

(4) Dose range is 0.002 to 0.006 mg/kg/minute (0.001 to 0.003 mg/lb/minute) or 0.12 to 0.36 mg/kg/hr (0.06 to 0.18 mg/lb/hr)

(a) Cats are more prone to dysphoria from mu agonists – use the low end of the dose range

(5) If on drip for over 24 hours, plan gradual reduction over 12 to 24 hours to avoid withdrawal symptoms

iii) Lidocaine

(1) Recipe for general intra-op fluid rates

(a) Give an initial bolus of 0.5 mg/kg (0.25 mg/lb) IV to cats and 1.0 mg/kg (0.5 mg/lb) IV to dogs prior to starting the lidocaine CRI

(b) Add 30 mg Lidocaine (1.5 cc) to 1 liter fluid bag

(i) Affix high visibility sticker itemizing added medications

(c) Administer 10 ml/kg/hr (5 ml/lb/hr) to begin with

(i) Provides 10 ug/kg/minute (5 ug/lb/minute) or 0.3 mg/kg/hr (0.15 mg/lb/hr)

(d) Rate can be doubled to 20 ml/kg/hr (10 ml/lb/hr) for dogs if needed

(e) Dose range is 10 to 25 ug/kg/minute (5 to 12 ug/lb/minute) for cats and 10 to 50 ug/kg/minute (5 to 25 ug/lb/minute) for dogs

(i) Use very cautiously in cats

DIABETES MELLITUS

5-04

1) RECOMMENDATIONS

a) General Approach

i) Patient should be given ½ of the usual morning insulin dose, at the normal time at home, prior to admission

ii) Maximize speed of recovery and early return to oral food intake

b) Pre-anesthetic Medications

i) Butorphanol, buprenorphine, or oxymorphone combined with midazolam or acepromazine at the lower end of the dose range

(1) Less nausea than hydromorphone or morphine

c) Induction

i) Propofol

(1) Propofol has some ability to stimulate appetite temporarily after its use

ii) Etomidate

(1) If significant cardiac concerns

(2) Can cause some retching at induction and recovery

(a) Effective premeds usually prevents this effect

(b) Precede etomidate with IV diazepam

d) Maintenance

i) Isoflurane or Sevoflurane

e) Support

i) Fluid support is highly recommended

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid heavy sedation with non-reversible agents

(1) Acepromazine

(a) Reserve for patients in good to excellent categories

(b) Is used, dose conservatively

ii) Hydromorphone

(1) Can cause transient nausea

iii) Morphine sulfate

(1) Can cause transient nausea

b) Induction

i) Etomidate may stimulate retching

(1) Effective premeds usually prevents this effect

c) Maintenance

i) Nothing specific

d) Support

i) Serial blood glucose testing can help identify hypoglycemic trends

(1) Dextrose IV can be used as indicated to stabilize hypoglycemia

ELECTIVE SURGERIES

5-04

(OHE, NEUTER, & DECLAWS IN YOUNG ANIMALS)

1) RECOMMENDATIONS

a) General Approach

i) Maximize patient comfort by minimizing stress and pain

b) Pre-anesthetic Medications

i) Dog

(1) Morphine – 0.5 to 1.0 mg/kg (0.25 to 0.5 mg/lb) combined with acepromazine – 0.010 to 0.04 mg/kg (0.005 to 0.02 mg/lb) **or** medetomidine 0.005 to 0.015 mg/kg (0.0025 to 0.0075 mg/lb)

(2) Hydromorphone – 0.1 to o.2 mg/kg (0.05 to 0.1 mg/lb) combined with Acepromazine – 0.02 to 0.06 mg/kg (0.01 to 0.03 mg/lb) **or** medetomidine 0.005 to 0.020 mg/kg (0.0025 to 0.010 mg/lb)

ii) Cat

(1) Butorphanol 0.2 mg/kg (0.1 mg/lb) combined with medetomidine 0.005 to 0.020 mg/kg (0.0025 to 0.010 mg/lb)

c) Induction

i) Many choices

(1) Ketamine & valium, propofol, thiopental, telazol

d) Maintenance

i) Halothane

ii) Isoflurane

iii) Sevoflurane

e) Support

i) IV fluids are recommended for any anesthetized patient

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid acepromazine or use low end doses if history of seizure activity

(1) See Acepromazine listing under individual drugs for more information

b) Induction

i) Avoid ketamine if history of seizure activity

c) Maintenance

i) Nothing specific

d) Support

i) Watch these patients closely – it is often the patient you least expect to be a problem that ends up being the surprise fatality

EPIDURALS

5-04

1) RECOMMENDATIONS

a) General

i) Total volume of 0.1 ml/kg for average case

(1) Maximum volume is 0.2 ml/kg

(2) Q.s. with lidocaine, bupivacaine, or 0.9% saline if needed

ii) 20 - 22 gauge spinal needles are used @ 1.5" to 3.0" length

b) Indications

i) Useful to reduce systemic anesthetic need in older or debilitated patients

ii) To provide substantial, long term analgesia without major systemic effect

c) Procedure

i) Remember spinal cord ends at L5-6 to L6-7 in dogs and L7-S1 in cats

ii) Place patient in sternal recumbancy with rear legs pulled forward

(1) Lateral recumbancy for certain fracture cases or if personal preference

iii) Clip and prep area as you would for surgery

iv) Use sterile gloves +/- sterile drape

(1) If a drape is not used, the prepped area must be larger

v) Draw up sterile saline in a "test" syringe

(1) Assistant handles fluid bag

(2) Volume should be different, smaller volume than medication syringe

(3) Leave an air bubble in syringe to help in judging proper placement at injection

vi) Draw up medication aseptically in second syringe

(1) Assistant handles vial

(2) If using glass ampoules, consider using a sterile filter straw to remove glass particle contaminants

(3) Make sure volume in syringe is clearly more than test syringe

(4) Leave an air bubble in syringe to help in judging proper placement at injection

(5) Some prefer to use different size syringes to decrease likelihood of switching the syringes in error

(6) Some prefer to use same size syringes to provide the exact same feel as the test syringe but test syringe volume must be significantly less than medication containing syringe

vii) Palpate the wings of the right and left ileum – the dorsal spinous process of L7 should be even with an imaginary line drawn across the dorsoiliac wings but can be just cranial or caudal to this line

(1) The needle should introduced just caudal to L7

viii) Place the needle through the skin first, then place saline in hub for "hanging drop" technique

ix) Needle should encounter three fascial layers with the ligamentum flavum being the final and most distinct pop

x) The saline in the needle hub should be pulled into the needle when the epidural space is entered

(1) If the drop does not move but the feel suggests proper placement, proceed to test injection

xi) Perform test injection with saline syringe

(1) Aspirate before injecting

(a) If blood is present withdraw needle, replace with new needle, reassess landmarks, and begin again

(b) If spinal fluid is present, plan to reduce the epidural medications volume by 50%

(2) Inject small amount of saline

(a) Bubble in syringe should not compress during injection

(b) There should be no significant resistance to the injection

xii) Connect medication syringe

(1) Reaspirate before injecting

(a) If blood is present withdraw needle, replace with new needle, reassess landmarks, and begin again

(b) If spinal fluid is present, plan to reduce the epidural medications by 50%

(2) There should be no resistance to the injection

xiii) Withdraw needle

d) Analgesic Agents

i) Buprenorphine

(1) General

(a) Similar to somewhat less effective when compared to morphine in its duration and analgesic effect

(i) Duration (14 - 18 hours)

(2) Dose

(a) 0.004 mg/kg

(b) Q.s. to 0.1 ml/kg to 0.2 ml/kg with saline

(i) If volumes over 6 cc are used (some will use 0.2 ml/kg without limit) give slowly over 1 to 2 minutes

ii) Hydromorphone

(1) General

(a) Slower onset (30 - 40 minutes) than Oxymorphone but longer duration (10 - 15 hours)

(i) Based on lower lipid solubility than Oxymorphone

(2) Dose

(a) 0.04 to 0.10 mg/kg

(b) q.s. to 0.1 ml/kg to 0.2 ml/kg with saline

(i) If volumes over 6 cc are used (some will use 0.2 ml/kg without limit) give slowly over 1 to 2 minutes

(3) Use a dedicated "Epidural" bottle
(a) Label as "Epidural Use Only" and date vial
(b) Decide how many uses and over what timeframe you will be using the vial

iii) Morphine
(1) General
(a) Slower onset (40 - 60 minutes) than oxymorphone but longer duration (12 - 18 hours)
(i) Based on lower lipid solubility than oxymorphone and hydromorphone
(2) Dose
(a) 0.1 mg/kg
(b) q.s. to 0.1 ml/kg to 0.2 ml/kg with saline
(i) If volumes over 6 cc are used (some will use 0.2 ml/kg without limit) give slowly over 1 to 2 minutes
(3) If preservative free Morphine is not available
(a) Use a dedicated "Epidural" bottle
(i) Label as "Epidural Use Only" and date vial
(ii) Decide how many uses and over what timeframe you will be using the vial
(b) Methylparaben is the preferred preservative
(c) Formaldehyde containing morphine is not recommended

iv) Oxymorphone
(1) General
(a) Faster onset (20 minutes) than morphine but shorter duration (8 to 12 hours)
(i) Based on higher lipid solubility than morphine and hydromorphone
(2) Dose
(a) 0.10 mg/kg
(b) q.s. to 0.1 ml/kg to 0.2 ml/kg with saline
(i) If volumes over 6 cc are used (some will use 0.2 ml/kg without limit) give slowly over 1 to 2 minutes

e) Local Anesthetic Agents

i) General
(1) Causes peripheral vasodilation via sympathetic blockade leading to some degree of hypotension
(2) May still have motor effects the next day

ii) Bupivacaine
(1) General
(a) 20 - 30 minute latent period before onset of surgical analgesia
(b) Provides 4 -6 hours of surgical analgesia
(2) Dose
(a) 1.0 ml of 0.5 % solution / 5 kg lb. to maximum of 20 ml total dose
(i) Can be added to 0.05 mg/kg morphine

(ii) Total volume should not exceed 0.2 ml/kg
1. Reduce bupivacaine dose accordingly
(b) Sympathetic blockade can create hypotension
(c) Great for perianal surgery

iii) Lidocaine
(1) General
(a) Almost immediate effect - 5 minutes
(b) Provides 60 - 90 minutes of surgical analgesia
(2) Dose
(a) 1.0 ml / 5 kg to maximum of 20 ml total dose
(i) Can be added to 0.05 mg/lb morphine
(ii) Total volume should not exceed 0.2 ml/kg
1. Reduce lidocaine dose accordingly
(b) Sympathetic blockade can create hypotension

f) General

i) Use luer slip syringes
ii) Cats have more angled dorsal spinus processes

2) PRECAUTIONS

a) Contraindications for Epidural

i) Sacral fractures
ii) Overlying skin disease
iii) Bleeding disorder
iv) Septicemia
v) Hypotensive/Hypovolemic Patients
(1) Avoid local anesthetics

b) Analgesics

i) Temporary urine retention can result
(1) Check bladder carefully
(2) Most likely with morphine
ii) Some respiratory depression can occur
iii) Some sedation can occur
iv) Bradycardias can develop
v) Pruritis can develop
vi) Delayed hair regrowth
vii) Neurologic deficits can be revealed the next day
(1) Vague weakness
(2) Usually resolves within 2 - 3 days

c) Anesthetic Agents

i) Cause peripheral vasodilation via sympathetic blockade
   (1) Avoid if hypotensive/hypovolemic
ii) Can still have motor effects the next day

d) Support

i) Watch bladder for urine retention

GENERAL DEBILITATION

5-04

1) RECOMMENDATIONS

a) General Approach

i) Minimize overall systemic effect

b) **Pre-anesthetic Medications**

i) Dogs

(1) Oxymorphone, hydromorphone, or fentanyl

(a) Doses

(i) Oxymorphone 0.05 mg/kg (0.025 mg/lb) IM

(ii) Hydromorphone 0.1 mg/kg (0.05 mg/lb) IM

(iii)Fentanyl 0.005 mg/kg (0.0025 mg/lb) IM

(2) May be combined with midazolam or diazepam

(a) Doses

(i) Midazolam 0.1 to 0.2 mg/kg (0.05 to 0.1 mg/lb) IM

(ii) Diazepam 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb) IV or IM

ii) Cats

(1) Pre-medicate with one of these combinations:

(a) Hydromorphone 0.1 mg/kg (0.05 mg/lb) combined with midazolam 0.2 mg/kg (0.1 mg/lb) IM

(b) Butorphanol 0.2 mg/kg (0.1 mg/lb) combined with midazolam 0.2 mg/kg (0.1 mg/lb) IM

(c) Ketamine 2 to 6 mg/kg (1 to 3 mg/lb) with butorphanol 0.2 mg/kg (0.1 mg/lb) and midazolam 0.2 mg/kg (0.1 mg/lb) IM

(i) Particularly useful for fractious debilitated cats

(ii) Avoid ketamine if intracranial disease is suspected or if myocardial stress is a concern

c) Induction

i) Preoxygenate whenever possible if not overly stressful to the patient

ii) Hydromorphone, oxymorphone, or fentanyl with diazepam IV

(a) More suitable for dogs than cats

(b) See induction section for details

iii) Propofol

(1) Dogs - use ultra-low-dose technique starting with 1.0 mg/kg (0.5 mg/lb) propofol slowly IV over 30 to 60 seconds followed by 2 mg/kg (1 mg/lb) lidocaine IV then 0.5 to 1.0 mg/kg (0.25 to 0.5 mg/lb) boluses of propofol given slowly IV to effect

(2) Cats - use ultra-low-dose technique starting with 1.0 mg/kg (0.5 mg/lb) propofol slowly IV over 30 to 60 seconds followed by 0.5 to 1.0 mg/kg (0.25 to 0.5 mg/lb) boluses of propofol given slowly IV to effect

iv) Ketamine & diazepam

(1) An alternative choice for debilitated cats that can tolerate the myocardial effects of ketamine

(2) Induction dose

(a) 1 cc/20 lb. of a 50/50 mix

(i) Start with 1/4 to 1/2 of calculated dose, then small boluses to effect

d) Maintenance

i) Isoflurane or sevoflurane

ii) Hydromorphone or oxymorphone & diazepam

(1) Repeat hydromorphone or oxymorphone every 20 to 30 minutes and diazepam every 40 to 60 minutes for maintenance

(2) This is primarily a canine appropriate protocol

(3) See details in Anesthetic Maintenance Section

e) Support

i) Fluids

(1) Maintenance of adequate hydration is very important

ii) Colloids followed by dobutamine – if needed - for blood pressure management

(1) See details in Blood Pressure Management section

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Morphine Sulfate

(1) Can cause nausea, transient hypotension

b) Induction

i) Avoid rapid propofol administration

(1) Can cause apnea, myocardial depression and hypotension

ii) Avoid ketamine if intracranial disease or if significant myocardial disease is suspected

c) Maintenance

i) If blood pressures are not stable under isoflurane or sevoflurane, consider intermittent hydromorphone or oxymorphone boluses with intermittent diazepam boluses

(1) See Anesthetic Maintenance Section for details

d) Support

i) Focus on:

(1) Blood pressure management

(2) Body temperature maintenance

(a) Coordinate warm water blanket with warm air patient warmer

(3) Adequate ventilation

INTRACRANIAL DISEASE

5-04

1) RECOMMENDATIONS

a) General Approach

i) Avoid any increase in intracranial pressure

b) Pre-anesthetic Medications

i) Benzodiazepines are generally well tolerated

ii) Opioids are generally well tolerated

(1) Can cause respiratory depression so watch $ETCO_2$

(2) Vomiting can increase ICP

(a) If this is a concern, consider butorphanol or oxymorphone as a premed then add mu agonist after induction

iii) Acepromazine

(1) If not in shock

(2) If not anemic

(3) If not seizuring

iv) Diuretics if not in hypovolemic shock

v) Prednisolone sodium succinate or dexamethasone IV

c) Induction

i) Thiopental

(1) If not in shock and not anemic

ii) Opioid and benzodiazepine

(1) Watch for hypoventilation – keep $ETCO_2$ under 30

iii) Propofol

(1) Watch for apnea – keep $ETCO_2$ under 30

d) Maintenance

i) Isoflurane or sevoflurane

(1) Watch respiratory depression and elevated CO_2

(2) Isoflurane and sevoflurane may both increase ICP at higher concentrations even if normocapnic

(a) Avoid concentrations above 1.5 MAC

ii) Propofol

(1) Appears capable of maintaining anesthesia with lower ICP compared to isoflurane or sevoflurane

e) Support

i) Ventilate as needed to maintain an ETCO2 of 25 to 30 mmHg

(1) $ETCO_2$ of 20 decreases cerebral blood flow

(2) As $ETCO_2$ increases above 30 mmHg vasodilation follows causing increased intracranial pressure

2) PRECAUTIONS

a) General

i) Avoid:

(1) Occluding jugular veins

(2) Coughing

(a) Lidocaine 1mg/lb can help suppress cough reflex

(3) Hypercapnea

(a) Keep $ETCO_2$ between 20 and 30

(i) As $ETCO_2$ increases, vasodilation follows causing increased intracranial pressure

(4) Vomiting

(5) Avoid hypertension

(a) Systolic blood pressure should not exceed 150 mm Hg

b) Pre-anesthetic Medications

i) Avoid acepromazine if hypotensive

ii) If vomiting is considered a significant concern avoid morphine and hydromorphone

(1) May also consider avoiding oxymorphone as it too can cause vomiting

(2) Xylazine also often causes vomiting

c) Induction

i) Avoid:

(1) Ketamine

(2) Telazol

d) Maintenance

i) Avoid halothane (causes undesirable vasodilation)

e) Support

i) Avoid hypoventilation

(1) Maintain $ETCO_2$ monitoring

(2) Ventilate as needed to keep $ETCO_2$ between 25 and 30

(a) As $ETCO_2$ increases, vasodilation follows causing increased intracranial pressure

ii) Avoid hypertension

(1) Systolic blood pressure should not exceed 150 mm Hg.

LIVER DISEASE

5-04

1) RECOMMENDATIONS

a) General Approach

i) Generally speaking, we are referring to symptomatic patients with a significant liver dysfunction

(1) Higher risk is associated with low albumin, elevated bilirubin, elevated coag tests

(2) A clinically normal patient with elevated ALT and/or ALP who has normal hepatic function does not necessarily require a unique perianesthetic approach

ii) Generally, use lower doses of everything

iii) Avoid agents that require extensive liver metabolism for clearance

iv) Regardless of agents used, expect a more prolonged anesthetic recovery

b) Pre-anesthetic Medications

i) Reversible agents are advantageous

ii) Benzodiazepines and opioids are generally good choices

(1) Use lower doses, titrating to effect

(2) Morphine may be the most attractive opioid as it is the least protein bound opioid

(a) Morphine's route of metabolism is the best preserved in liver failure (glucuronidation)

c) Induction

i) Propofol

ii) Etomidate is an attractive agent for severe liver disease cases but caution must be extended to the proplylene glycol containing preparations

(1) The lipuro version (similar to propofol) is preferred over the propylene glycol containing preparation

d) Maintenance

i) Isoflurane or Sevoflurane

e) Support

i) Epidural analgesia and regional analgesia help reduce systemic doses of opioids

ii) IV fluids highly recommended

iii) May need glucose support

(1) Monitor blood glucose

(2) Consider 5% dextrose containing fluids if needed to maintain blood glucose

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid acepromazine

ii) Avoid alpha-2 agonists (xylazine & medetomidine)

iii) Avoid high doses of opioids and benzodiazepines

b) Induction

(1) Avoid barbiturates, especially if hypoalbuminemic

c) Maintenance

i) Avoid halothane

ii) Avoid methoxyflurane

d) Support

i) Avoid hyperventilation and positive pressure ventilation

(1) Both can decrease hepatic blood flow

(2) Maintain PaCO2 at or slightly above 40 helps preserve hepatic blood flow

LOCAL ANESTHETICS

12-04

1) AGENTS

a) Lidocaine

i) General

(1) Local anesthetic with quick onset and short duration of action

(a) Onset = 5 to 10 minutes

(b) Duration = 1 to 2 hours

ii) Dose

(1) Dogs

(a) 1.0 to 5 mg/kg (0.5 to 2.5 mg/lb)

(2) Cats

(a) 1.0 to 2.5 mg/kg (0.5 to 1.0 mg/lb)

iii) Precautions

(1) Potential CNS toxicity

(a) Usually manifests as seizure activity

iv) Cost

(1) Low

b) Mepivacaine

i) General

(1) Local anesthetic with quick onset and moderate duration of action

(a) Onset = 5 to 10 minutes

(b) Duration = 2 to 3 hours

ii) Dose

(1) Dog

(a) 5 mg/kg (10 mg/lb) in dogs

(2) Cat

(a) 2.5 mg/kg (1.0 mg/lb)

iii) Precautions

(1) IV use is not currently recommended

iv) Cost

(1) Low

c) Bupivacaine

i) General

(1) Local anesthetic with slower onset and longer duration of action

(a) Onset = 20 to 30 minutes

(b) Duration = 3 to 5 hours

ii) Dose

(1) Dog and cat

(a) 1.0 to 2.0 mg/kg (0.5 to 1.0 mg/lb)

iii) Precautions

(1) Never give bupivacaine IV

(2) Potentially fatal cardiac toxicity

(a) Calculate doses carefully and aspirate carefully to guard against intravascular administration

iv) Cost

(1) Moderate

2) APPLICATIONS

a) Consider adding an opioid to the local anesthetic

i) Both 0.075 mg/kg (0.035 mg/lb) morphine and 0.003 mg/kg (0.0015 mg/lb) buprenorphine have been shown to effectively double the analgesic duration when combined with lidocaine and bupivacaine[1],[2]

b) Outpatient/awake patient use

i) Mix 0.9 cc Lidocaine, 0.1 cc sodium bicarbonate, and 2 cc of sterile water

(1) Reduced sting

(2) Volume is more important than concentration

c) Splash block

i) Drip on or in SubQ space at closure of skin wound

ii) The effectiveness of splash blocks is in question

d) Ring blocks

i) Mix 1.0 mg/kg (0.5 mg/lb) bupivacaine with 1.0 mg/kg (0.5 mg/lb) lidocaine and:

(1) Either 0.075 mg/kg (0.035 mg/lb) morphine or 0.003 mg/kg (0.0015 mg/lb) buprenorphine to effectively double the duration of analgesia[1,2]

(2) Sterile water q.s., if needed, to total 1 cc volume for cats less than 2.5 kg (5 lb).

(3) Sterile water q.s., if needed, to total 2 cc volume for cats 2.5 kg (5 lb) and over.

ii) Inject subcutaneously at the three sites demonstrated below:

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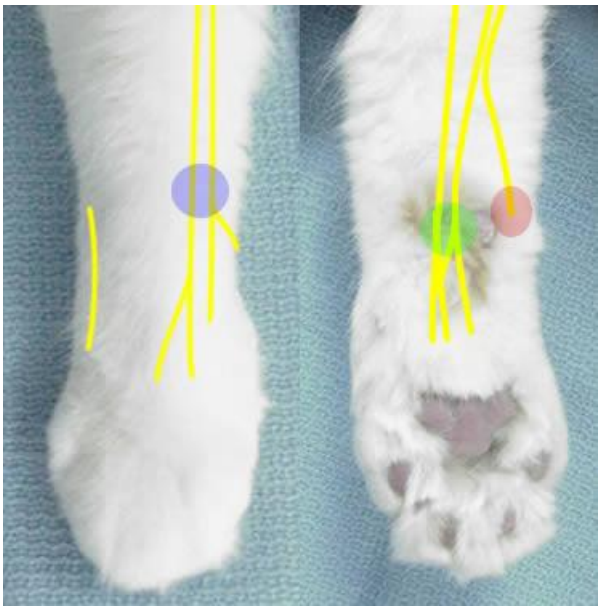
[1] Buprenorphine added to the local anesthetic for axillary brachial plexus block prolongs postoperative analgesia. Candido KD, Winnie AP, Ghaleb AH, Fattouh MW, Franco CD: Reg Anesth Pain Med. 2002 Mar-Apr;27(2):162-7

[2] The addition of opioids to local anaesthetics in brachial plexus block: the comparative effects of morphine, buprenorphine and sufentanil. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P: Anaesthesia. 1997 Sep;52(9):858-62



iii) You may drop the lidocaine if given prior to spay (gives bupivacaine time to take effect)

iv) Bupivacaine has significant potential to cause cardiac toxicity

(1) Calculate dose carefully

e) Intra-articular Injections

i) Lidocaine

(1) 2 mg/kg (1 mg/lb)

(a) With epinephrine prior to arthrotomy to help control hemorrhage

(b) Without epinephrine after joint closure

ii) Bupivacaine

(1) 1.0 mg/kg (0.5 mg/lb) after closure

iii) Generally, 4 - 6 ml fills a stifle

iv) Place in joint after closure or place lidocaine w/epinephrine in joint before arthrotomy, wait 5 minutes, then proceed with surgery

f) Mandibular Block

i) Palpate foramen digitally from oral cavity to guide needle

ii) Use 0.5 to 1.5 ml total volume

iii) Effective coverage includes:

(1) Lower teeth

(2) Skin and mucosa of lower lip

g) Maxillary Block

i) 1.5 cm caudal to medial canthus

ii) Just ventral to zygomatic arch and ahead of the ramus

iii) Use 1.0 to 1.5 ml total volume

iv) Effective coverage includes:

(1) Maxilla and upper teeth

(2) Nose and upper lip

h) Intercostal blocks

i) Block 2 spaces ahead and behind intercostals incision

ii) Place 0.25 to 1.0 ml per site along the caudal border of each rib near the level of the intervertebral foramen

(1) Do not exceed the dose guidelines above

MONITORING

5-04

1) RECOMMENDATIONS

a) General Approach

i) Thorough monitoring improves patient safety

ii) No single monitor can fully gauge patient stability

iii) Most anesthetic problems begin as small deviations from the norm

(1) A drop in Blood Pressure generally is the first sign of excess anesthetic depth, followed by increased $ETCO_2$, then decreased S_pO_2 (Pulse Oximeter). All of this should occur before most animals will cease spontaneous ventilation and before ECG abnormalities would typically arise.

(2) At times, a given monitor may fail to consistently provide accurate values. The anesthetist must keep a constant eye on the patient not simply watch the monitors. Palpebral response, eye position, jaw tension, and lingual pulse remain important reference points.

(3) The technology we employ enhances our awareness of patient status. Thorough monitoring requires multiple reference points factored in with direct visual information. In this way we will, more often than not, become aware of a negative trend before a serious problem becomes established.

iv) Ideal monitoring would include ECG, Pulse Oximeter, ETCO2, Blood Pressure, and core body temperature.

(1) The Doppler BP Monitors are more likely than oscillometric monitors to provide consistent, accurate reading for the smaller patients, especially cats.

b) Pre-anesthetic Phase

i) Consider pre-anesthetic ECG, Oximeter, and Blood Pressure readings for older or debilitated patients if they are not stressed by the presence of the monitors

c) Induction Phase

i) Monitors could be in place during induction for high risk patients if they are not stressed by the presence of the monitors

d) Maintenance

i) Some anesthetists prefer to have monitor alarms disabled. This reduces the likelihood of becoming overly dependent on the monitor alarms. Relying heavily on the alarms could generate an attitude that “if the alarms do not go off, the patient must be fine”. The monitors are simply tools that are able to generate information. The anesthetists must interpret this information along with the direct visual clues to properly assess the status of the patient. The monitors cannot do this job on their own.

e) Support

i) Please record as much data on the patient anesthetic record as possible during the anesthetic event.

2) PRECAUTIONS

a) General

i) Monitors cannot take the place of a dedicated trained anesthetist

NEONATAL/PEDIATRIC MANAGEMENT

5-04

1) RECOMMENDATIONS

a) General Approach

i) Patients under 12 weeks of age are consider at higher risk during anesthetic events

ii) They possess little cardiac reserve

(1) These patients are much more dependent on heart rate for cardiac output

iii) They have an increased oxygen requirement and very small airways making for an increased overall risk of hypoxia

iv) They are more prone to hypothermia

v) They generally require lower doses of sedatives, tranquilizers, and injectable anesthetics

(1) Renal and hepatic functions are not yet mature and will delay drug clearance

vi) They are prone to hypoglycemia

(1) Withholding food for only 4 hours prior to anesthesia helps to minimize this concern

(2) Offering food within 2 or 3 hours of recovery is also recommended

b) Pre-anesthetic Medications

i) Opioids combined with benzodiazepines are effective preanesthetic agents

(1) Dose reductions are in order especially if under 6 to 8 weeks of age

ii) Anticholinergics are recommended to help maintain adequate heart rate and cardiac output

(1) Glycopyrrolate would be preferred over atropine

iii) Acepromazine and alpha-2 agonists like medetomidine and xylazine should be avoided

c) Induction

i) Preoxygenate whenever possible

ii) Standard induction agents can be used if venous access is available

(1) Give carefully to effect

(a) Expect to need a lower total amount per kg

(2) Propofol is a good choice when given carefully to effect

iii) Masking may be necessary when there is no direct venous access

(1) Intubation is highly recommended whenever possible

d) Maintenance

i) Isoflurane or sevoflurane

ii) Nonrebreathing systems are recommended for neonatal patients

(1) Reduced work of breathing

(2) Lighter weight system is advantageous

e) Support

i) Fluid support is important

(1) Neonates are more sensitive to fluid overload

(a) Basic fluid rates from 5 to 10 ml/kg/hr are usually sufficient

(2) If a standard IV catheter is not an option, intraosseous fluids are an effective next choice

(a) Fluids contain 2.5 % or 5.0 % dextrose may be necessary for these patients

ii) Monitor body temperature – provide safe supplemental heat

6) PRECAUTIONS

a) Pre-anesthetic Medications

i) Acepromazine, xylazine, and medetomidine are **not** recommended

ii) Keep the doses of all agents on the low end of the dose range

b) Induction

i) Give carefully to effect

c) Maintenance

i) A circle system is not recommended

d) Support

i) Do not use microwaved rice bags – their use has been associated with major third degree patient burns

OPIOIDS

5-04

1) RECOMMENDATIONS

a) General Information

i) Opioids are excellent agents for a variety of perioperative purposes.
   (1) Their general reversibility makes them especially attractive in higher risk cases

ii) Opioid uses:
   (1) Pre-anesthetic sedative-analgesics
   (2) Induction agents
   (3) Anesthetic maintenance
   (4) Analgesics
      (a) Can be given as oral tablet, intermittent injection, constant rate infusion, transdermally, or epidurally
      (b) Can be combined with lidocaine and bupivacaine for extended duration local analgesia[3,4]

iii) Their expense varies.
   (1) Inexpensive – fentanyl injectable, hydromorphone, morphine
   (2) Moderately expensive – butorphanol and buprenorphine at lower dose range
   (3) Expensive – duragesic patches, oxymorphone, butorphanol and buprenorphine at higher dose range

iv) Their duration of effect varies.
   (1) Very short (30 minutes) - fentanyl injectable
   (2) Moderately short (1 to 3 hours) - butorphanol
   (3) Medium (4 to 6 hours) – oxymorphone, hydromorphone, morphine sulfate, buprenorphine at lower dose range
   (4) Moderately long (6 to 8 hours) – buprenorphine at moderately high dose
   (5) Long (10 to 12 hours) - buprenorphine at high end dose
   (6) Very long (12 to 18 hours) – epidural morphine, epidural buprenorphine, epidural oxymorphone, epidural hydromorphone
   (7) Many days (3 to 5 days) – fentanyl transdermal patch

v) Categorization
   (1) Pure mu agonists – fentanyl, hydromorphone, morphine sulfate, & oxymorphone
   (2) Partial mu agonist – buprenorphine

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[3] Buprenorphine added to the local anesthetic for axillary brachial plexus block prolongs postoperative analgesia. Candido KD, Winnie AP, Ghaleb AH, Fattouh MW, Franco CD: Reg Anesth Pain Med. 2002 Mar-Apr;27(2):162-7

[4] The addition of opioids to local anaesthetics in brachial plexus block: the comparative effects of morphine, buprenorphine and sufentanil. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P: Anaesthesia. 1997 Sep;52(9):858-62

(3) Mixed – butorphanol (controversial – mainly kappa agonist, may have partial mu agonistic activity at very low doses and has antagonist properties at higher doses)

b) Pre-anesthetic Medications

i) The following opioids are preanesthetic options:
   (1) Butorphanol
   (2) Buprenorphine
   (3) Fentanyl – injectable and duragesic patches
   (4) Hydromorphone
   (5) Morphine Sulfate
   (6) Oxymorphone

ii) Usually combined with other medications
   (1) Benzodiazepines (diazepam IV or midazolam IM)
      (a) Well suited to older or more debilitated patients
   (2) Acepromazine
      (a) Best suited to younger and middle age pets in good to excellent category

iii) Sedative effect
   (1) When used alone, only morphine has a consistent sedative effect
      (a) Hydromorphone and oxymorphone have less sedative influence
   (2) When used with Acepromazine:
      (a) Buprenorphine has the least sedative effect
      (b) Hydromorphone and oxymorphone have moderate sedative effect
      (c) Butorphanol and morphine have greater sedative synergism

c) Induction

i) Fentanyl, oxymorphone, or hydromorphone combined with diazepam or midazolam
ii) Most effective for dogs
iii) Usually requires some additional agent for inducing cats
   (1) Ketamine
   (2) Propofol
   (3) Etomidate
   (4) Isoflurane/sevoflurane mask

d) Maintenance

i) Oxymorphone or hydromorphone alternated with diazepam or midazolam
ii) Most effective for dogs

e) Support

i) Respiratory depression and bradycardia are the two most predictable negative consequences when utilizing opioids
   (1) ETCO2, Pulse Oximetry, and Blood Pressure monitoring help guide the anesthetist regarding anticholinergic use and ventilatory assistance

(2) Hydromorphone and oxymorphone are less likely to cause any significant respiratory depression or significant bradycardia
    (a) Even with lower heart rates, there is rarely a significant decrease in blood pressure.
(3) Morphine, especially when given IV, is more likely to cause a transient decrease in blood pressure.
    (a) This is caused by histamine release

2) PRECAUTIONS

a) General Information

i) Respiratory depression and bradycardia are the two most predictable negative consequences when utilizing any opioids

ii) Buprenorphine has an extremely high mu receptor affinity which makes it difficult to effectively reverse with opioid antagonists
    (1) Adverse effects are highly unlikely however

iii) Vomiting usually occurs with IM or SubQ use of morphine and hydromorphone
    (1) Vomiting is less frequent with oxymorphone but may still occur

iv) Morphine sulfate
    (1) Commonly causes defecation and vomiting
    (2) IV use associated with histamine release and transient drop in blood pressure
        (a) IM use minimizes this effect

v) Oxymorphone
    (1) May sensitize patients to loud noises

vi) Panting is commonly seen with hydromorphone and oxymorphone

b) Pre-anesthetic Medications

i) Morphine's strong synergism with acepromazine requires lower acepromazine doses

c) Induction

i) Opioid based induction techniques do not allow for rapid airway control

ii) This is of much more limited use for cats
    (1) Requires some additional agent (ketamine, propofol, etomidate, isoflurane or sevoflurane mask)

d) Maintenance

i) This is not a practical option for use with cats

e) Support

i) Monitor ventilation adequacy and insure proper blood pressure maintenance

ii) Heart rate values can be deceiving if interpreted alone. Use blood pressure values to help determine when anticholinergics are needed for cardiovascular support.

PAIN MANAGEMENT

5-04

1) RECOMMENDATIONS

a) General Approach

i) Pain management is an integral part of any thorough anesthetic program. Patient comfort improves and morbidity is reduced with effective pain relief.

ii) Key facts:

(1) Pre-emptive analgesic use is the most effective.

(a) Central and peripheral sensitization are most effectively managed preemptively

(2) Strategic analgesic use requires **anticipation** of patient need. We are not as effective when we wait for the symptoms of increasing pain before employing added analgesics.

(a) An understanding of currently held opinions regarding duration of analgesic effect is critical

(b) Developing a familiarity with techniques that provide sustained analgesia is critical

(3) Analgesics should not be reserved for severe pain. They should be employed during any procedure that is associated with stress and discomfort. By more effectively limiting patient anxiety and pain, we create a patient population that is much less fearful about future visits to our facilities. This can enhance the enjoyment for client, patient, and veterinary staff alike.

(a) We extend this concern over patient stress to include the collection of pre-anesthetic screening tests. If it is deemed appropriate by the anesthetist, an analgesic/sedative may be given to help facilitate patient comfort and reduce the struggle associated with sample collection.

(i) Few tests are directly influenced by analgesic/sedative medications but these influences can include:

1. Decreased PCV – Acepromazine can decrease the PCV by 30 %.
2. Blood pressure – Acepromazine can decrease systemic blood pressure.
3. Opioid agents can decrease heart rate and decrease ventilation.
4. Alpha-2 agonists can dramatically lower heart rate.
    a. Blood pressure may remain normal.

iii) Duration of effect

(1) 30 minutes

(a) Fentanyl injectable

(2) 30 to 60 minutes

(a) Butorphanol in dogs

(3) 1 to 3 hours

(a) Butorphanol in cats

(b) Buprenorphine at 0.006 mg/kg

(4) 4 to 6 hours

(a) Morphine, hydromorphone, oxymorphone
(b) Buprenorphine at 0.010 mg/kg
(c) Medetomidine

(5) 6 to 8 hours
(a) Buprenorphine at 0.020 mg/kg

(6) 8 to 10 hours
(a) Buprenorphine at 0.030 mg/kg

(7) 10 to 12 hours at high end of dose range
(a) Buprenorphine at 0.040 mg/kg
(b) Epidural oxymorphone

(8) 12 to 18 hours
(a) Epidural hydromorphone
(b) Epidural morphine
(c) Epidural buprenorphine
(d) Ketoprofen
(i) To avoid GI side-effects, limit to single dose use
(ii) F
(e) 3 to 5 days

(9) Indefinite duration
(a) Sustained effect during CRI administration
(b) No specific limitation
(c) Agents
(i) Ketamine
1. Should be preceded by an opioid agent
(ii) Fentanyl
(iii) Morphine
(iv) Lidocaine

b) Pre-anesthetic Medications

i) Medetomidine, acepromazine, opioids, and benzodiazepines are utilized based upon patient status and need.

ii) Remember that Fentanyl patches take 12 – 18 hours to develop adequate Fentanyl blood levels, possibly up to 24 hours in dogs

c) Induction

i) Effective pain management will lead to a reduction in induction anesthetic need

d) Maintenance

i) Effective pain management will lead to a reduction in maintenance anesthetic need

ii) Intraoperative fentanyl, hydromorphone, or oxymorphone boluses or increasing the CRI analgesic rate can help a patient through a particularly painful portion of a procedure and help avoid the need for higher levels of maintenance anesthetic

e) Post-op

i) Repeat analgesics as needed or continue CRI

(1) Anticipate patient need – do not wait for patient to act painful before redosing

f) Support

i) Constant rate infusion (CRI) – the following dose schedules are intended for use during the perioperative period with planned flow rates of 10 to 20 ml/kg/hr (5 to 10 ml/lb/hr) - See CRI specific heading for alternatives

(1) Ketamine

(a) Add 60 mg Ketamine (0.6 cc) to 1 liter fluid bag

(i) Affix high visibility sticker itemizing added medications

(b) Administer 10 ml/kg/hr (5 ml/lb/hr) to begin with

(i) Provides 0.6 mg/kg/hr (0.3 mg/lb/hr)

(ii) Rate can be doubled if needed

(c) Bolus 0.15 to 0.25 mg/lb IV at the start of the infusion if ketamine or telazol was not already given in the induction protocol

(d) Ketamine CRI should always be preceded by an opioid agent

(2) Morphine Sulfate CRI recipe

(a) Add 15 mg Morphine (1.0 cc) to 1 liter fluid bag

(i) Affix high visibility sticker itemizing added medications

(b) Administer 10 ml/kg/hr (5 ml/lb/hr) to begin with

(i) Provides 0.15 mg/kg/hr (0.075 mg/lb/hr)

(ii) Rate can be doubled if needed

(c) If on drip for over 24 hours, plan gradual reduction over 12 to 24 hours to avoid cold turkey withdrawal

(3) Lidocaine

(a) Add 30 mg Lidocaine (1.5 cc) to 1 liter fluid bag

(i) Affix high visibility sticker itemizing added medications

(b) Administer 10 ml/kg/hr (5 ml/lb/hr) to begin with

(i) Provides 0.3 mg/kg/hr (0.15 mg/lb/hr)

(ii) Rate can be doubled if needed

(iii)Use very cautiously in cats

2) PRECAUTIONS

a) General

i) Benzodiazepines are not analgesics

ii) Acepromazine is not an analgesic

iii) Ketoprofen should be limited to single use only - dose should not be repeated

(1) Potential for undesirable effects is extremely small if limited to single use only but potential for undesirable effects increases substantially when Ketoprofen is repeated

iv) Ketamine use is generally discouraged in seizure patients and head trauma patients

v) Remember that narcotic antagonists will reverse opioid analgesic effect as they reverse sedative effect.

(1) Most pure Mu opioid agonists have a longer duration than naloxone. If you are serious about reversing a narcotic effect, you should consider redosing naloxone as needed until you are confident the agonist effect has worn off.

RENAL DISEASE

5-04

1) RECOMMENDATIONS

a) General Approach

i) Focus on maintaining adequate hydration and normal blood pressures

ii) Avoid drugs that dependent on renal clearance for recovery

iii) More advanced renal patients usually benefit from IV fluid administration initiated the day prior to the planned anesthetic event.

b) Pre-anesthetic Medications

i) Good choices include mu agonists like morphine, hydromorphone, or oxymorphone alone or in combinations with Midazolam or Diazepam

c) Induction

i) Hydromorphone or oxymorphone and diazepam

(1) See Anesthetic Induction section

ii) Low dose propofol

(1) Precede propofol with 0.2 to 0.4 mg/kg diazepam

(2) Use lidocaine if needed to reduce propofol dose in dogs

iii) Etomidate is another option due to its ability to maintain optimal blood pressures

(1) With the standard US product, Amidate, the relatively high propylebe glycol content can cause hemolysis and subsequent renal pigment load which might adversely affect the kidneys

(a) This is more of a concern with cats

(2) The etomidate-lipuro product is prepared in a hyperlipid vehicle similar to propofol and is not associated with this concern

iv) If ketamine/diazepam is being considered for induction, precede the ket/val with 0.2 mg/kg diazepam IV to reduce the overall ketamine need

d) Maintenance

i) Isoflurane or sevoflurane unless blood pressure management is a problem

(1) Hydromorphone or oxymorphone alternated with diazepam is a consideration for maintenance in dogs that do not maintain adequate blood pressure on inhalant agents

(a) See Anesthetic Maintenance section for details

e) Support

i) IV fluids are a must but, by themselves, are no guarantee of adequate patient blood pressure and tissue perfusion

(1) Blood pressure monitoring is crucial to safe renal patient management

(a) Doppler monitors are preferred for smaller patients

ii) Appropriate supplemental heat is very important

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid acepromazine or use low-end doses

(1) May reduce blood pressures

ii) Avoid NSAIDs

b) Induction

i) Avoid ketamine or minimize doses especially in cats

(1) Requires renal clearance

(a) Although significant hepatic clearance occurs in dogs and people

c) Maintenance

i) Some patients do not have stable blood pressures when under isoflurane or sevoflurane

(1) Consider switching dogs to hydromorphone or oxymorphone and diazepam

(2) Morphine or fentanyl CRIs, with lidocaine for dogs, can help reduce inhalant agent needs

(3) Local blocks should be considered when appropriate to help reduce overall inhalant need

d) Support

i) Remember, some renal patients are hypertensive

(1) Blood pressure monitoring is a must

SIGHTHOUNDS

5-04

1) RECOMMENDATIONS

a) General Approach

i) Avoid agents that depend on redistribution to body fat for recovery

b) Pre-anesthetic Medications

i) Opioids combined with benzodiazepines are effective preanesthetic agents

ii) If acepromazine is used it should be limited to the low end of the dose range

c) Induction

i) Propofol is a very effective induction agent associated with smooth recoveries

ii) Ketamine/Valium is a good option

iii) Opioid/benzodiazepine induction is another option

(1) Recovery may be prolonged – reversal agents can be employed if needed to facilitate recovery

iv) Methohexital is the only recommended thiobarbiturate for sighthound induction

(1) It does not require redistribution for recovery

(2) Recovery is through agent metabolism which sighthounds handle adequately

(3) Thiopental can be used in sighthounds but its use is not recommended as the therapeutic index is uncomfortably narrow

d) Maintenance

i) Isoflurane or sevoflurane

e) Support

i) N/A

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Use acepromazine with caution

b) Induction

i) Avoid thiobarbiturates other than methohexital

c) Maintenance

i) N/A

d) Support

i) Monitor body temperature – sighthounds may be more prone to malignant hyperthermia than other dogs

THORACIC SURGERY

5-04

1) RECOMMENDATIONS

a) General Approach

i) Control ventilation

(1) Tidal volume = 10 to 15 ml/kg (5 to 7.5 ml/lb)

(a) Some quote as high as 20 ml/kg (10 ml/lb)

(2) Airway pressures

(a) 15 to 20 cm H_2O if closed chest

(b) 20 to 30 cm H_2O if open chest

(3) Ventilate at 6 to10 breaths per minute to control ventilation

(a) Reduce to 4 to 6 breaths per minute at end of procedure to increase CO_2 and subsequent respiratory drive

ii) Epidural analgesics are considered helpful in thoracotomies

iii) Intercostal nerve blocks with bupivacaine are of substantial benefit to these patients

b) Pre-anesthetic Medications

i) Hydromorphone, morphine, or oxymorphone

(1) Can combine with diazepam IV, midazolam IM, or very low acepromazine or medetomadine doses

c) Induction

i) Based upon specific health status of patient

d) Maintenance

i) Isoflurane or sevoflurane

e) Support

i) Patient should have ECG, Pulse Oximeter, Blood Pressure, and $ETCO_2$ monitors in place at all times during the procedure

2) PRECAUTIONS

a) Pre-anesthetic Medications

i) Avoid non-reversible agents

b) Induction

i) Based upon specific health status of patient

c) Maintenance

i) Based upon specific health status of patient

d) Support

i) Inadequate postoperative analgesic management may interfere with postoperative patient ventilation, increasing postoperative morbidity

A

1) ACEPROMAZINE

a) Classification

i) Phenothiazine tranquilizer

b) General Information

i) Very inexpensive, effective tranquilizer for healthy animals

ii) Clinically more effective in dogs than cats

iii) Duration of effect is 6 to 8 hours

(1) Some pets appear sedate for more than 12 hours

iv) Acepromazine can be used alone, as a premedicant. However, it is more effective to use Acepromazine in combination with an opioid narcotic agent

(1) The addition of an opioid reduces the acepromazine dose, and therefore also reduce the likelihood of hypotension or sustained, excessive sedation that can occur

c) Advantages/Recommended use

i) Decreases patient stress and anxiety

ii) Helps protect against catecholamine induced arrhythmias

iii) Decreases amount of induction and maintenance anesthetics

iv) The injectable product can be given orally @ 1.0 to 2.0 mg/kg (0.5 to 1.0 mg/lb) for tough animals

(1) For extremely difficult patients, acepromazine at above dose can be combined with 5 to 20 mg/kg (2.5 to 10 mg/lb) telazol solution and given orally on an empty to produce effective chemical restraint

(a) At the upper dose range expect laterally recumbent animals within 30 to 45 minutes

d) Cautionary Information

i) Use of acepromazine as a sole agent is not recommended

ii) Can have profound and prolonged effects when used on older or debilitated patients

iii) There are still references to acepromazine lowering the seizure threshold for epileptic patients (increased seizure risk)

(1) Many anesthetists feel this is not a significant risk at the doses currently recommended

iv) May **de**crease seizure **potential** in myelogram cases (decreased seizure risk)

v) May decrease PCV (up to 30%)

(1) Avoid in anemic patients

vi) Avoid in splenic disease patients

(1) Induces splenic enlargement/engorgement

vii) Not well tolerated by patients with liver disease

viii) Many feel that Boxers require lower doses than other dogs of similar size and disposition

e) Dosage Information

i) Dogs

(1) Dose ranges from 0.005 mg/kg to 0.1 mg/kg (0.0025 mg/lb to 0.05 mg/lb) IV, IM, SC
(a) Combine with an opioid
(b) Most commonly used at 0.010 to 0.040 mg/kg (0.005 to 0.02 mg/lb) when combined with an opioid
(2) Dosing is more appropriately considered based upon body surface area
(a) The heavier the patient, the lower the dose per unit of body weight
(3) Maximum total dose is 2 mg regardless of weight
(a) Some go as high as 3 mg total dose

ii) Cats
(1) Dose ranges from 0.020 to 0.10 mg/kg (0.01 mg/lb to 0.05 mg/lb) IV, IM, SC
(a) Combine with an opioid
(2) Smaller, younger patients usually require 0.06 to 0.10 mg/kg (0.03 to 0.05 mg/lb)
(3) When combined with a mu agonist opioid give 0.06 to 0.10 mg/kg (0.03 to 0.05 mg/lb)
(a) Inadequate acepromazine dose associated with undesirable excitement

f) Cost

i) Very low

2) AMANTADINE

a) Classification

i) Developed initially as a human antiviral drug, also used to treat Parkinson's disease

b) General Information

i) An oral prescription medication capable of NMDA antagonism useful in managing the central sensitization component of chronic pain management

ii) The dopamine selectivity of amantadine's monoamine reuptake inhibition appears to allow for coadministration with other less selective monoamine reuptake inhibitors (tramadol, TCAs, SSRIs, MAO inhibitors.

c) Advantages/Recommended use

i) Chronic pain management

d) **Cautionary Information**

i) Amantadine is excreted, primarily unchanged, in the urine

(1) Consider reduced doses, if used at all, for patients with impaired renal function

ii) May potentiate the effects of sedative medications

iii) Use with caution in nursing animals

e) Dosage Information

i) Dogs & Cats

(1) 3 to 5 mg/kg (1.25 to 2.5 mg/lb) SID PO

(2) Can be given continually or as a 7 to 14 day pulse therapy

ii) Available in 100 mg gelcaps and 10 mg/ml liquid

f) Cost

i) Low

3) AMITRIPTYLINE (TCAs)

a) Classification

i) Tricyclic antidepressant prescription drug

b) General Information

i) Monoaminergic reuptake inhibition (serotonin, norepinephrine) enhances central pain inhibition

ii) Possible opioid receptor activity as well or, at least, enhanced effectiveness of concurrently administered opioids

c) Advantages/Recommended use

i) Chronic pain management

d) Cautionary Information

i) Do not combine with other TCAs, SSRIs, MAO inihibitors, or tramadol due to the risk of serotonin syndrome.

ii) May potentiate the effects of sedative medications

iii) Has anticholinergic effects

e) Dosage Information

i) Dogs

(1) 1 to 2 mg/kg (0.5 to 1.0 mg/lb) SID to BID PO

ii) Cats

(1) 2.5 to 12.5 mg/cat SID

iii) Available in 10, 25, 50, 75, 100, and 150 mg tablets

f) Cost

i) Moderate

(1) May need to be compounded to allow for proper dosing

4) AMIDATE

a) Abbott’s brand name for Etomidate

5) ATIPAMAZOLE

a) Classification

i) Alpha-2 antagonist

(1) Much more selective antagonist than yohimbine (8500:1 versus 40:1 alpha-2/alpha-1 binding ratio)

b) General Information

i) Reversal agent for medetomidine or xylazine

c) Advantages/Recommended use

i) Completely, permanently reverses medetomidine effects

(1) Can be used at partial dose for partial effect

d) Cautionary Information

i) Reversing all of medetomidine's sedative effects will also lead to loss of analgesic effect

e) Dosage Information

i) Dogs

(1) Normally match route and volume of medetomidine given

(a) Reduce dose according if sedative effects of medetomidine have warn off

(b) Reduce dose accordingly if you prefer to retain some analgesic and sedative effect

ii) Cats

(1) Normally give 1/2 the volume of the medetomidine given as a starting point

(a) Reduce dose according if sedative effects of medetomidine have warn off

(b) Reduce dose accordingly if you prefer to retain some analgesic and sedative effect

f) Cost

i) High

6) ATROPINE

a) Classification

i) Anticholinergic

b) General Information

i) Decreases salivary secretions

(1) Can make them thicker, more ropey

(a) Only reduces serous portion of salivary secretions leaving the thicker mucoid portion

ii) Increases heart rate

c) Advantages/Recommended use

i) Prior to procedure that stimulate strong vagal effect

(1) Bronchoscopy

(a) May need to postpone until after respiratory diagnostics have been completed

ii) Prior to dental procedures to decrease salivary secretions

(1) Most would argue against routine use here

iii) Prior to brachycephalic anesthesia

(1) Brachycephalics tend to have higher vagal tone making routine anticholinergic use a consideration

(2) To decrease salivary secretions

(a) Most would argue against routine use here

iv) C-sections

(1) Atropine does cross placenta making it preferred for use in this situation should the bitch become clinically bradycardic

v) Cardiac emergencies involving bradycardia or cardiac arrest

(1) A more rapid, forceful effect

(2) Glycopyrrolate is a definite second choice in emergency cases

(a) Slower onset

(3) Hypothermia results in decreased depolarization of cardiac pacemaker cells, causing bradycardia. Since this bradycardia is not vagally mediated, it can be refractory to atropine.

d) Cautionary Information

i) Partial dosing can lead to a centrally mediated bradycardic effect

ii) Use with caution in tachycardic patients

(1) Tachyarrhythmias can be an undesirable effect

(2) Increased heart rate increases myocardial oxygen demand

iii) Pupilary dilation may be undesirable for certain ophthalmic procedure

iv) Duration of effect is much shorter than glycopyrrolate

(1) Only about 45 minutes

v) Be especially cautious when used with patients on amitriptyline as that behavioral medication possesses anticholinergic properties.

e) Dosage Information

i) Dogs & Cats
(1) 0.02 to 0.04 mg/kg (0.01 to 0.02 mg/lb) IV, IM, SC
(a) This works out to 1 cc per 10 to 20 kg (20 to 40 lb)

f) Cost

i) Very low

B

1) BENZODIAZEPINE

a) This is the name of the family of drugs that includes diazepam, midazolam, and zolazepam

2) BUPIVACAINE

a) Classification

i) Local anesthetic

b) General Information

i) Slower onset of action (20 - 30 minutes) but longer duration of effect (3 -5 hours) when compared to lidocaine

(1) Combine with either morphine or buprenorphine to extend the analgesic duration of local blocks to approximately 20 hours[5,6]

(2) Epidural effect is longer

ii) With local anesthetics, volume is more important than concentration

(1) Dilute with sterile water when blocking larger areas

(a) Commonly diluted to 50% to 33% bupivacaine (1:1 to 2:1 ratio of sterile water to bupivacaine)

c) Advantages/Recommended use

i) Local nerve blocks

ii) Epidural anesthesia

(1) May cause a lengthy motor block

iii) Intra-articular after joint closure

d) Cautionary Information

i) More potential for toxicity than lidocaine

(1) Calculate doses very carefully

(2) Never administer IV

(3) Toxic signs can be CNS or cardiac

(a) Cardiac toxicities are potentially fatal

e) Dosage Information

i) Local blocks

(1) Dog - generally 1.0 mg/kg up to a maximum dose of 2 mg/kg (1 mg/lb)

(2) Cats – maximum of 1.0 mg/kg (0.5 mg/lb)

ii) Intra-articular

(1) Generally whatever will fit after joint closure

(a) Dogs - up to the maximum of 2 mg/kg (1 mg/lb)

(b) Cats – up to the maximum of 1 mg/kg (0.5 mg/lb)

iii) Epidural

(1) Dogs and Cats – 1 mg/kg (0.5 mg/lb)

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[5] Buprenorphine added to the local anesthetic for axillary brachial plexus block prolongs postoperative analgesia. Candido KD, Winnie AP, Ghaleb AH, Fattouh MW, Franco CD: Reg Anesth Pain Med. 2002 Mar-Apr;27(2):162-7

[6] The addition of opioids to local anaesthetics in brachial plexus block: the comparative effects of morphine, buprenorphine and sufentanil. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P: Anaesthesia. 1997 Sep;52(9):858-62

iv) Other uses
    (1) Intercostal blocks
    (2) Brachial plexus blocks
    (3) Ring blocks
    (4) Dental Blocks

f) Cost

i) Moderate

3) BUPRENORPHINE

a) Classification

i) Opioid

(1) Partial mu agonist of extremely high affinity

(2) Some kappa antagonism

(3) Class III controlled drug

b) General Information

i) Good all around analgesic for mild to moderate pain free of any expected undesirable effect

(1) Anecdotal reports of dogs receiving 0.2 mg/lb IV on a QID basis for several doses without negative consequences (M. Richey, DACVA)

ii) Minimal, if any, sedative effect

iii) Buprenorphine has a delayed onset

(1) 30 minutes to peak effect when given IV

(2) 45 to 60 minutes to peak effect when given IM

iv) Duration of effect is influenced by dose

(1) 3 to 4 hours at 0.010 mg/kg (0.005 mg/lb) dose

(2) 6 to 8 hours at 0.020 mg/kg (0.010 mg/lb) dose

(3) 8 to 10 hours at 0.030 mg/kg (0.015 mg/lb) dose

(4) 10 to 12 hours at 0.040 mg/kg (0.020 mg/lb) dose

c) Advantages/Recommended use

i) General soft tissue surgery

ii) Light orthopedic surgery

iii) In cats, studies have shown that bioavailability is the same whether given IV, IM, or via buccal oral mucosa (bioavailability is poor from GI tract – give sublingually or in lateral cheek pouch)

(1) This transmucosal absorption is influenced by the alkaline pH of feline saliva

(a) There is, as yet, no support for effective oral absorption by the dog

(2) Excellent option for home analgesic management in cats

d) Cautionary Information

(1) Difficult to reverse ***if*** undesirable effects arise

(2) Would be expected to antagonize other pure mu agonists like morphine, hydromorphone, fentanyl, and oxymorphone

e) Dosage Information

(1) Dogs – 0.010 to 0.040 mg/kg (0.005 – 0.02 mg/lb) IM or IV

(2) Cats - 0.010 to 0.040 mg/kg (0.005 – 0.02 mg/lb) IM, IV, or Tramsmucosally

f) Cost

i) Moderate at low end of dose range - high at upper dose range

4) BUTORPHANOL

a) Classification

i) Opioid

(1) A mixed agonist/antagonist with primary agonistic activity at the kappa receptor

(a) Generally antagonistic at the mu receptor

b) General Information

i) Good all around analgesic for mild pain free of any expected undesirable effect

ii) Little, or no respiratory depression at clinical doses

iii) Duration of effect is 30 minutes to 1 hour in dogs and 1 to 3 hours in cats

c) Advantages/Recommended use

i) General soft tissue surgery

ii) More effective for visceral (soft tissue) than somatic (orthopedic) analgesic

d) Cautionary Information

i) Short duration of effect

(1) Dogs - 30 minutes to 1 hour

(2) Cats - 1 to 3 hours

ii) Higher doses can produce excitement and dysphoria

e) Dosage Information

i) Dog & Cats

(1) 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb) IV, IM, SC

(a) 0.2 mg/kg (0.1 mg/lb) is the most commonly selected dose

f) Cost

i) Moderate (to high if given every few hours)

C

1) CARPROFEN

a) Classification

i) A COX2 selective NSAID

b) General Information

i) Effective anti-inflammatory/analgesic generally free of significant GI side effects

c) Advantages/Recommended use

i) Short term use for acute pain

ii) Long term use in chronic pain for tolerant patients

d) Cautionary Information

i) As with any NSAID, GI side-effects can be substantial

(1) Discontinue use if GI signs develop

ii) Avoid use in:

(1) Combination with corticosteroids

(a) Potentially increased ulcerogenic effect

(2) Renal compromised patients, dehydrated or hypotensive patients, patients with hepatic disease, pregnancy, patients with pre-existing GI disease, coagulopathies

iii) Monitor liver enzymes of canine patients on chronic therapy

e) Dosage Information

i) Dogs – 4 mg/kg (2.0 mg/lb) IV one time initial dose followed by 2 mg/kg (1.0 mg/lb) SC, PO, IM, IV BID

ii) Cats – 1 to 4.0 mg/kg (0.45 to 1.8 mg/lb) SC one time only

f) Cost

i) Moderate

D

1) DERACOXIB

a) Classification

i) A coxib class COX2 selective NSAID

b) General Information

i) Effective anti-inflammatory/analgesic generally free of significant GI side effects

c) Advantages/Recommended use

i) Short term use for acute pain

ii) Long term use in chronic pain for tolerant patients

d) Cautionary Information

i) As with any NSAID, GI side-effects can be substantial

(1) Discontinue use if GI signs develop

ii) Avoid use in:

(1) Combination with corticosteroids

(a) Potentially increased ulcerogenic effect

(2) Renal compromised patients, dehydrated or hypotensive patients, patients with hepatic disease, pregnancy, patients with pre-existing GI disease, coagulopathies

iii) Monitor liver enzymes of canine patients on chronic therapy

e) Dosage Information

i) Dogs – 1 to 2 mg/kg PO SID for general pain management

(1) 3 to 4 mg/kg PO SID for up to 7 days for acute surgical pain

ii) Cats – use of deracoxib is not recommended at this time

f) Cost

i) Moderately high

2) DEXTROMETHORPHAN

a) Classification

i) An antitussive drug and an NMDA antagonist

b) General Information

i) Developed initially as a human cough suppressant

ii) An oral prescription medication capable of NMDA antagonism useful in managing the central sensitization component of chronic pain management

c) Advantages/Recommended use

i) Chronic pain management

d) Cautionary Information

i) Reduce dose or discontinue in patients with hepatic dysfunction

e) Dosage Information

i) Dogs & Cats

(1) 0.5 to 2.0 mg/kg (0.25 to 1.0 mg/lb) TID to QID PO

ii) Robitussin CoughGels® are an OTC gelcap that contains 15 mg dextromethorphan per capsule and no other drugs. Vicks Formula 44 Cough Relief® is a dextromethorphan only liquid OTC product that contains 2 mg/ml and comes in 118 ml bottles.

f) Cost

i) Moderate

3) DIAZEPAM

a) Classification

i) A benzodiazepine hypnotic sedative agent

b) General Information

i) Usually combined with ketamine or an opioid

c) Advantages/Recommended use

i) Combined with ketamine for:
   (1) Older patients
   (2) Some cardiac patients

ii) Combined with oxymorphone for:
   (1) Debilitated patients
   (2) Geriatric patients

iii) Cats
   (1) Several hour duration makes it suitable for short term sedation in the cat

iv) Spinal surgery cases
   (1) Give at extubation for muscle relaxation (decreases pain)

v) Diazepam is reversible using flumazenil

d) Cautionary Information

i) Propylene glycol base makes diazepam somewhat painful and less predictably absorbed than midazolam when given IM
   (1) Propylene glycol has potential to cause hemolysis and vasodilation if given in sufficient quantity

ii) Rapid IV administration may lead to short term arrhythmia

iii) Dogs
   (1) Extremely short duration makes it unsuitable for sedation as sole agent in the dog

e) Dosage Information

i) Dogs & Cats
   (1) Generally dose – 0.2 mg/kg to 0.4 mg/kg (0.1 to 0.2 mg/lb) IV, IM
   (2) IV induction #1 - combined with equal volume of Ketamine
      (a) Draw up 1cc of total mixture per 10 kg (20lb)
         (i) Give ½ initially, then to effect
         (ii) Reduce dose by 30% - 50% if depressed or heavily sedated by pre-meds
   (3) IV induction #2 - combined with fentanyl, hydromorphone, or oxymorphone – most useful for dogs
         (i) See Diazepam & an Opioid section under Induction Protocols for details
         (ii) Cats would need low dose Ketamine (1 to 5 mg/lb) or Propofol (0.5 to 2 mg/lb) to facilitate intubation
   (4) IV maintenance – most useful for dogs
      (a) See Diazepam & an Opioid section under Maintenance Protocols for details

(i) Main indication would be canine patient with difficult to manage hypotension while on inhalant agent

f) Cost

i) Low

4) DOBUTAMINE

a) Classification

i) Positive inatropic agent related to dopamine

ii) A direct beta 1-adrenergic agonist

b) General Information

i) Used to help increase blood pressure in hypotensive patients

c) Advantages/Recommended use

i) Used to increase blood pressure when IV fluids, anesthetic reduction, and colloids are inadequate

d) Cautionary Information

i) Discontinue if significant increase in heart rate or if any arrhythmia develops

e) Dosage Information

i) Dog - 0.004 to 0.4 mg/kg/min (0.002 to 0.20 mg/lb/min)

ii) Cats - use low end of dog dose range

iii) Recipe for 0.008 mg/kg/min (0.004 mg/lb/min) dose

(1) 4 ml @ 12.5 mg/ml = 50 mg

(2) Add to 250 ml 0.9% saline for 0.2 mg/ml

(3) Give 0.2 ml/min per 5 kg (10 lb) body weight

f) Cost

i) Moderate

5) DOMITOR

a) Pfizer's brand name for medetomidine
    i) See medetomidine

6) DURAMORPH

- **a) Classification**
  - i) Preservative free morphine
  - ii) Pure mu opioid agonist
- **b) General Information**
  - i) A specific preparation for epidural use
- **c) Advantages/Recommended use**
  - i) Epidural analgesia
- **d) Cautionary Information**
  - i) Single use 10 mg (10 ml) vials and 2 mg (2ml) vials - do not save residual meds
- **e) Dosage Information**
  - i) Epidural use
    - (1) Dog & Cat - 0.1 mg/kg (0.045 mg/lb)
      - (a) 1 cc per 10 kg
- **f) Cost**
  - i) Moderately high – significant wastage

E

1) EPINEPHRINE

a) Classification

i) Endogenous adrenergic agent with Alpha and Beta properties causing increased contractility and increased blood pressure

b) General Information

i) An emergency medication

c) Advantages/Recommended use

i) Anaphylactic allergic reactions

ii) Cardiac resuscitation (asystole)

d) Cautionary Information

i) Store in refrigerator

e) Dosage Information

i) Dogs

(1) Cardiac resuscitation - 1 ml per 10 kg (20 lb) IV (1:1000 dilution)

(2) Anaphylaxis – 0.010 to 0.20 mg/kg (0.005 to 0.10 mg/lb) IV

ii) Cats

(1) Cardiac Resuscitation - 1 ml per 10 kg (20 lb) IV (1:1000 dilution)

(2) Anaphylaxis – 0.010 to 0.20 mg/kg (0.005 to 0.10 mg/lb) IV

(3) Feline asthma - 0.1 ml SQ or IV (1:1000 dilution)

f) Cost

i) Very low

2) ETODOLAC

a) Classification

i) A COX2 selective NSAID

b) General Information

i) Effective anti-inflammatory/analgesic generally free of significant GI side effects

c) Advantages/Recommended use

i) Short term use for acute pain

ii) Long term use in chronic pain for tolerant patients

d) Cautionary Information

i) As with any NSAID, GI side-effects can be substantial

(1) Discontinue use if GI signs develop

ii) Avoid use in:

(1) Combination with corticosteroids

(a) Potentially increased ulcerogenic effect

(2) Renal compromised patients, dehydrated or hypotensive patients, patients with hepatic disease, pregnancy, patients with pre-existing GI disease, coagulopathies

iii) Monitor liver enzymes of canine patients on chronic therapy

e) Dosage Information

i) Dogs – 10 to 15 mg/kg (4.8 TO 6.8 mg/lb) PO SID

ii) Cats – use of etodolac is not recommended at this time

f) Cost

i) Moderately low

3) ETOMIDATE

a) Classification

i) An imidazole

b) General Information

i) Considered the best induction agent for dilated cardiomyopathy

ii) Comes in two forms

(1) Standard USA product in propylene glycol vehicle

(2) European lipuro form in hyperlipid emulsion similar to propofol

c) Advantages/Recommended use

i) For serious cardiac cases including cardiomyopathy cases

d) Cautionary Information

i) May cause myoclonus, retching, or excitement during induction or recovery – this is uncommon if patient is adequately sedate from the premeds or is clinically depressed

(1) Premed with one of the following:

(a) Oxymorphone 0.05 mg/kg (0.025 mg/lb) IM and midazolam 0.1 mg/kg (0.05 mg/lb) IM

(b) Hydromorphone 0.1 mg/kg (0.05 mg/lb) IM and midazolam 0.1 mg/kg (0.05 mg/lb) IM

(c) Butorphanol 0.2 mg/kg (0.1 mg/lb) IM and midazolam 0.1 mg/kg (0.05 mg/lb) IM

ii) Does suppress adrenocortical function for 3 hours after administration

(1) This effect can be overcome by corticosteroid administration if there is an existing adrenal concern

(a) Some believe this lack of a "stress response" may actually reduce patient morbidity

iii) The propylene glycol containing etomidate can trigger hemolysis that some consider a potential for renal stress

(1) Effect of possible pigment overload

(2) For renal or anemic patients use etomidate-lipuro

iv) Unused etomidate-lipuro should be discarded if not used that day

e) Dosage Information

i) Routine induction

(1) Dogs - 0.5 to 3.0 mg/kg (0.25 to 1.5 mg/lb) IV

(a) If patient is not already depressed or is not reasonably sedate from premeds, precede etomidate with 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb) diazepam IV

(2) Cats – 0.5 to 2.0 mg/kg (0.25 to 1.0 mg/lb) IV

(a) If patient is not already depressed or is not reasonably sedate from premeds, precede etomidate with 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb) diazepam IV

ii) Give the propylene glycol containing etomidate with IV fluids to minimize pain on injection and hemolysis

(1) This concern is due to the propylene glycol content of this preparation

f) Cost

i) Very high

F

1) FENTANYL

a) Classification

i) A pure mu agonist

b) **General Information**

i) Duration of effect is 30 to 45 minutes

c) Advantages/Recommended use

i) Short-term analgesia

(1) Excellent as an intra-operative "top up" analgesic

ii) Induction agent when combined with a benzodiazepine

iii) CRI analgesic use

d) Cautionary Information

i) May see panting and muscle rigidity

e) Dosage Information

i) Induction

(1) See Diazepam & an Opioid section under Induction protocols for details

ii) Analgesia

(1) Bolus – 0.002 mg/kg (0.001 mg/lb)

(2) CRI – 0.001 to 0.004 mg/kg/hr (0.005 to 0.002 mg/lb/hr)

(3) Duragesic patch – based upon weight

Patient	Dose	Fentanyl Content
Small Dogs ** (<5kg) & Cats	25 mcg/hr	2.5 mg
Dogs: 5-10 kg	25 mcg/hr	2.5 mg
Dogs: 10-20 kg	50 mcg/hr	5 mg
Dogs: 20-30 kg	75 mcg/hr	7.5 mg
Dogs: >30 mg	100 mcg/hr	10 mg

(a) Small dogs and cats, use the 25 mcg/hr patch but only expose ½ of the patch

(b) For even smaller cats consider exposing ¼ of the patch

(c) Never cut the patch

(d) Clip hair as closely as possible at planned patch site without irritating the skin. Gently wipe area once or twice with slightly dampened gauze to remove loose hair. Let area dry. Warm patch to body temperature. Remove backing and apply patch to skin. Hold firmly against skin with hand for 2 full minutes. White tape and Kling gauze are used to cover and support the patch when possible.

f) Cost

i) Low per IV use

ii) High per patch

2) FLUMAZENIL (ROMAZICON$_{(R)}$)

a) Classification

i) Benzodiazepine antagonist

b) General Information

i) Reversal agent for diazepam and midazolam

c) Advantages/Recommended use

i) To reverse any undesirable effects resulting from diazepam or midazolam use

d) Cautionary Information

i) None

e) Dosage Information

i) Dogs – 0.02 to 0.1 mg/kg (0.01 to 0.05 mg/lb) IV

ii) Cats – 0.02 to 0.1 mg/kg (0.01 to 0.05 mg/lb) IV

f) Cost

i) Very high

G

1) GABAPENTIN

a) Classification

i) An anticonvulsant drug

b) General Information

i) An oral prescription medication capable of helping reduce neuropathic and other chronic pain states

(1) Although its mechanism is unknown, it has been shown to affect central sensitization[7]

c) Advantages/Recommended use

i) Chronic pain management

ii) Generally free from adverse effects or drug interaction

d) Cautionary Information

i) May cause a transient drowsiness usually lasting no more than a few days

ii) Excreted unchanged in the urine

(1) Reduce dose or discontinue in patients with renal dysfunction

iii) Withdraw this drug gradually to avoid rebound pain

e) Dosage Information

i) Dogs

(1) 2.0 to 10 mg/kg (1.0 to 5.0 mg/lb) BID to QID PO

ii) Cats

(1) 2.0 to 5.0 mg/kg (1.0 to 2.5 mg/lb) BID PO

iii) May be able to gradually reduce to SID if doing well after extended therapy

iv) Available in 50 mg/ml liquid, 100 mg, 300 mg, and 400 mg capsules, and 600 mg and 800 mg tablets

f) Cost

i) Expensive

[7] Chronic Oral Gabapentin Reduces Elements of Central Sensitization in Human Experimental Hyperalgesia. Gottrup H, Juhl G, Kristensen AD, Lai R, Chizh BA, Brown J, Bach FW, Jensen TS: Anesthesiology. Dec;101(6):1400-1408, 2004

2) GLYCOPYRROLATE

a) Classification

i) Anticholinergic

b) General Information

i) Decreases salivary secretions

(1) Can make them thicker, more ropey

(a) Only reduces serous portion of salivary secretions leaving the thicker mucoid portion

ii) Does not cross blood brain-barrier or placenta

c) Advantages/Recommended use

i) Much longer duration of effect (2 to 3 hours) compared to atropine

ii) When bradycardia is clinically significant

(1) Partial dosing can be used for partial effect but it is not immune to paradoxical bradycardic effect at lower doses

(2) This is, perhaps, a gentler anticholinergic than atropine

iii) Prior to procedure that stimulate strong vagal effect

(1) Bronchoscopy

(a) May need to postpone until after respiratory diagnostics have been completed

iv) Prior to dental procedures to decrease salivary secretions

(1) Most would argue against this use

v) Prior to brachycephalic anesthesia

(1) Brachycephalics tend to have higher vagal tone making routine anticholinergic use a consideration

(2) To decrease salivary secretions

(a) Most would argue against this use

d) Cautionary Information

i) Glycopyrrolate is a definite second choice in emergency cases

ii) Can cause an initial paradoxical bradycardia and AV block when given IV

(1) This effect is usually overcome as plasma levels become therapeutic

iii) Hypothermia results in decreased depolarization of cardiac pacemaker cells, causing bradycardia. Since this bradycardia is not vagally mediated, it can be refractory to glycopyrrolate

iv) C Sections

(1) This large molecule does not cross the trans-placental barrier

(a) Avoid glycopyrrolate when fetal effect is desired as it will not reach the fetus

v) Use with caution in tachycardic patients

(1) Tachyarrhythmia can be an undesirable effect

vi) Increased heart rate can increase myocardial oxygen demand

vii) Pupilary dilation may be undesirable for certain ophthalmic procedure

ii) Be especially cautious when used with patients on amitriptyline as that behavioral medication possesses anticholinergic properties.

e) Dosage Information

(1) Dogs – 0.010 to 0.015 mg/kg (0.005 to 0.007 mg/lb) IV, IM, SC

(2) Cats – 0.010 to 0.015 mg/kg (0.005 to 0.007 mg/lb) IV, IM, SC

f) Cost

i) Very low

H

1) HALOTHANE

a) Classification

i) A halogenated hydrocarbon

b) General Information

i) A relatively fast acting inhalant anesthetic agent

ii) MAC

(1) Dogs - 0.76%

(2) Cats - 0.82%

c) Advantages/Recommended use

i) A good choice for general anesthetic use

ii) May facilitate bronchodilator for respiratory disease patients

d) Cautionary Information

i) Undergoes significant hepatic metabolism

(1) Less well suited to patients with hepatic disease

(2) Approximately 12% of absorbed drug is metabolized by liver

ii) More arrhythmogenic than isoflurane

(1) Avoid if cardiac trauma is suspected

iii) More likely to trigger malignant hyperthermia than isoflurane

iv) Vasodilation can create increased intracranial pressure

v) Preservatives in the product create residue within the vaporizers

(1) Yearly vaporizer maintenance is recommended

e) Dosage Information

i) Mask Induction

(1) Not recommended

ii) Induction following injectable agent

(1) Initiate flow rates of 1.0 to 1.5 liter per minute at 2.5 % - 4.0 %

(a) Reduce percentage as indicated by patients response

iii) Maintenance – Moderately low flow use

(1) Once stable, reduce oxygen flow to 500 ml to 1 liter

(a) The reservoir bag must remain reasonably full

(i) If not, the flow rate must be increased and the machine must be examined for leaks at the earliest possible convenience

(2) Remember that prior to surgical stimulation, a patient may appear adequately anesthetized only to show a dramatic response to stimulation

(a) An experienced anesthetist should be able to anticipate and minimize this event

(3) Effective analgesic & sedative premeds will significantly reduce the level of inhalant agent necessary for maintenance of a surgical plane of anesthesia

f) Cost

i) Low

2) HEPARIN

- **a) Classification**
  - i) Anticoagulant affecting both intrinsic and extrinsic pathways
- **b) General Information**
  - i) Does not cross placenta
  - ii) Protamine is the direct reversal agent
- **c) Advantages/Recommended use**
  - i) To produce heparinized saline solutions
  - ii) Treatment of DIC
  - iii) Treatment of thromboembolic disease
- **d) Cautionary Information**
  - i) Do not give IM
    - (1) Can cause hematoma formation
    - (2) Should be given IV or SC only
- **e) Dosage Information**
  - i) Heparinized saline - 1 ml heparin per liter of 0.9% NaCl
    - (1) Clearly identify bag contents and dating using a fluorescent orange label
- **f) Cost**
  - i) Low

3) HYDROMORPHONE

a) Classification

i) Pure mu agonist

(1) Class II

b) **General Information**

i) Duration of effect is 4 to 6 hours

ii) Considered to have similar overall properties when compared to oxymorphone although less potent

c) Advantages/Recommended use

i) General premed for anesthetic candidates in all categories

ii) Generally less panting than oxymorphone

iii) Unlike Morphine, should not cause transient hypotension

(1) IV use is **not** associated with histamine release

d) Cautionary Information

i) Bradycardia is common

ii) Vomiting is common after IM administration

iii) There is moderate sedative synergism between hydromorphone and acepromazine in the dog

(1) Acepromazine doses should be kept at the lower end of the dose range

iv) There is a tendency for cats to be agitated unless higher Acepromazine doses are used

e) Dosage Information

i) Dog – 0.01 to 0.4 mg/kg (0.05 - 0.20 mg/lb) IV, IM

(1) Generally 0.1 to 0.2 mg/kg (0.05 to 0.10 mg/lb)

ii) Cats – 0.10 to 0.2 mg/kg (0.05 - 0.10 mg/lb) IV, IM

(1) Generally 0.1 mg/kg (0.05 mg/lb)

iii) Induction

(1) IV induction #2 - combined with fentanyl, hydromorphone, or oxymorphone – most useful for dogs

(a) See Diazepam & an Opioid section under Induction Protocols for details

iv) Maintenance

(2) IV maintenance – most useful for dogs

(a) See Diazepam & an Opioid section under Maintenance Protocols for details

v) Epidural dose

(1) 0.03 to 0.10 mg/kg (0.015 to 0.05 mg/lb)

f) Cost

i) Low

I

1) ISOFLURANE

a) Classification

i) Fluorinated hydrocarbon

b) General Information

i) Considered one of the safest common inhalant agent for patients and staff

ii) Its low solubility provided for quick inductions, level adjustments, and recoveries

iii) MAC

(1) Dog - 1.2%

(2) Cats - 1.5%

c) Advantages/Recommended use

i) 2nd most rapid inductions and recoveries of common inhalants

ii) Does not sensitize the heart to epinephrine induced arrhythmia

iii) Along with sevoflurane, an inhalant anesthetic of choice for patients with:

(1) Liver disease

(a) Minimal hepatic metabolism

(2) Intracranial disease

(a) Less effect on CSF pressure when compared to Halothane

(b) Maintain $ETCO_2$ at 20 - 30 mm Hg to minimize increases in CSF pressure

d) Cautionary Information

i) Commonly causes respiratory depression

ii) At higher levels (esp. > 2 x MAC) can be potent cardiac depressant and vasodilator

iii) Can cause some increased CSF pressure

e) Dosage Information

i) Routine use

(1) Mask Induction (not recommended for routine use)

(a) Start with 100% oxygen @ 3 liters/min for 3 - 5 minutes

(b) Do not cover patients eyes

(c) After 3 - 5 minutes of O2, start isoflurane @ 0.5 %

(d) Increase by 0.5 % every 30 - 60 seconds until 2 % is reached

(e) Then increase to 3.5 % - 5 % to complete induction

(2) Induction following injectable agent

(a) Initiate flow rates of 1.0 to 1.5 liter per minute at 3.0 % - 5.0 %

(i) Reduce percentage as indicated by patients response

(3) Maintenance – Moderately low flow use

(a) Once stable, reduce oxygen flow to 500 ml to 1 liter

(i) The reservoir bag must remain reasonably full

1. If not, the flow rate must be increased and the machine must be examined for leaks at the earliest possible convenience

(b) Remember that prior to surgical stimulation, a patient may appear adequately anesthetized only to show a dramatic response to stimulation

(i) An experienced anesthetist should be able to anticipate and minimize this event

(ii) Effective analgesic & sedative premeds will significantly reduce the level of inhalant agent necessary for maintenance of a surgical plane of anesthesia

f) Cost

i) Moderately low

K

1) KETAMINE

a) Classification

i) Dissociative injectable anesthetic agent

b) General Information

i) Usually combined with Acepromazine or a Benzodiazepine (Diazepam or Midazolam) for induction

ii) Provides analgesia at low doses when used in conjunction with an opioid agent

c) Advantages/Recommended use

i) Routine induction

ii) Reasonable choice for stable valvular heart disease patients

iii) Give 5 mg/lb orally for fractious cats

d) Cautionary Information

i) Avoid if:

(1) History of seizures

(2) Intracranial disease is suspected

(3) Significant renal disease is present

ii) Corneal desiccation can occur

(1) Corneal protection is required

iii) Initially causes myocardial depression generally followed by indirect sympathetic stimulation

(1) Increased heart rate can be detrimental for:

(a) Hypertrophic cardiomyopathy

(b) Hyperthyroid patients

(c) Pheochromocytomas

e) Dosage Information

i) Routine induction - Ketamine & Diazepam

(1) Dog & Cat

(a) Draw up 1.0 ml of 50/50 mixture per 20lb

(i) Give ½ initially, then to effect

(ii) Reduce dose by 30% - 50% if depressed or heavily sedated by pre-meds

(b) 2 mg/kg (1 mg/lb) lidocaine bolus may be administered to dogs following initial ketamine/diazepam bolus to reduce total ketamine/diazepam need

(c) Keep the unused agent with the patient in the event that the endotracheal tube is dislodged, the patient suddenly becomes very light, etc.

(2) IM/SC use - not recommended as diazepam can be painful and less predictably absorbed

(a) Diazepam contains propylene glycol

ii) Routine induction - Ketamine & Midazolam

(1) Cats

(a) Ketamine – 5 to 10 mg/kg (2.5 to 5 mg/lb)

(i) For younger, fractious cats use 10 mg/kg (5 mg/lb)

(ii) For quiet, older cats reduce ketamine to 5 to 8 mg/kg (2.5 to 4 mg/lb)

(b) Midazolam – 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb)

(c) Mix together in same syringe and give IM

(2) Dogs – the expense of midazolam makes this unattractive for use in dogs

f) Cost

i) Low (for ketamine alone and for ketamine/diazepam combined)

2) KETOPROFEN

a) Classification

i) An NSAID

b) General Information

i) Effective anti-inflammatory/analgesic with significant GI side effects if used long term

c) Advantages/Recommended use

i) Long acting analgesic injectable for single dose post-op use

(1) Duration of effect is 12 to 18 hours

(2) Single dose post-op usage has been shown to be free of any side-effect concerns in normal dogs and cats

d) Cautionary Information

i) Avoid long term use

(1) GI side effects can be substantial

ii) Avoid use in combination with corticosteroids

(1) Potentially increased ulcerogenic effect

iii) Avoid in renal compromised patients

iv) Avoid in dehydrated or hypotensive patients

e) Dosage Information

i) Dogs – 2.0 mg/kg (0.9 mg/lb) SC one time only

ii) Cats – 2.0 mg/kg (0.9 mg/lb) SC one time only

f) Cost

i) Very low

L

1) LIDOCAINE

a) Classification

i) Local anesthetic and anti-arrhythmic agent

b) General Information

i) Quick onset

(1) 5 to 10 minutes

ii) Short duration

(1) About 1 to 2 hours

(2) Combine with bupivacaine and either morphine or buprenorphine to extend the analgesic duration of local blocks to approximately 20 hours[8,9]

c) Advantages/Recommended use

i) Local blocks for:

(1) Declaws

(2) Oral surgery

(3) Dermal growths

(4) Joint infusion

ii) Topical anesthesia for:

(1) Laryngeal desensitization to facilitate intubation

iii) IV use:

(1) To deepen anesthetic plane in dogs **after** initial induction agents given

(a) Helps to minimize total induction agent need

(2) As part of a CRI analgesic strategy

(a) See CRI section for details

d) Cautionary Information

i) Potential CNS toxicity

(1) Usually manifests as seizure activity if awake, cardiac depression when anesthetized

e) Dosage Information

i) Local blocks

(1) Dogs and Cats – 1 to 4 mg/kg (0.5 to 2.0 mg/lb)

(2) For awake patients, mix 0.9 cc Lidocaine, 0.1 cc sodium bicarbonate, and 2 cc of sterile water

(a) Reduced sting

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[8] Buprenorphine added to the local anesthetic for axillary brachial plexus block prolongs postoperative analgesia. Candido KD, Winnie AP, Ghaleb AH, Fattouh MW, Franco CD: Reg Anesth Pain Med. 2002 Mar-Apr;27(2):162-7

[9] The addition of opioids to local anaesthetics in brachial plexus block: the comparative effects of morphine, buprenorphine and sufentanil. Bazin JE, Massoni C, Bruelle P, Fenies V, Groslier D, Schoeffler P: Anaesthesia. 1997 Sep;52(9):858-62

ii) IV induction enhancement
    (1) Dogs only – 2.0 mg/kg (1.0 mg/kg) IV after initial induction agent
iii) Intra-articular
    (1) Generally whatever will fit after joint closure
        (a) Dogs – up to 6.0 mg/kg (3.0 mg/lb)
            (i) Generally 4 to 6 ml total volume
        (b) Cats – up to 4.0 mg/kg (2.0 mg/lb)
iv) Epidural
    (1) Dogs and Cats – 4.0 mg/kg (2.0 mg/lb)
v) Other uses
    (1) Intercostal blocks
    (2) Brachial plexus blocks
    (3) Ringblocks
    (4) Dental Blocks
    (5) CRI Infusions (exercise caution in cats)

f) Cost

i) Very low

M

1) MEDETOMIDINE

a) Classification

i) Alpha-2 agonist

b) General Information

i) Potent sedative/analgesic

ii) Moderately long duration of effect (4 - 6 hours)

c) Advantages/Recommended use

i) Best reserved for young healthy patients needing a reversible agent

ii) Significant reduction in induction agent and lower MAC of inhalants

(1) Thiopental need may drop to 0.5 mg/lb or *less*

iii) 10 times more selective for alpha-2 vs. alpha-1 than xylazine

iv) Can be used with ketamine and butorphanol as an IM anesthetic protocol for short procedures in cats

d) Cautionary Information

i) Do not use in older or more debilitated patients

ii) Extremely stressed patients may not respond as well

(1) Isolate in quiet, dark room if possible to facilitate effect

iii) Can cause dramatic bradycardia

(1) This can rarely be a an unresponsive, fatal bradycardia

(2) Anticholinergic use is not routinely recommended

(a) Anticholinergic need is best determined by monitoring patient blood pressures

iv) Alpha-2 agonists depress insulin production

(1) Use with caution or avoid in non-insulin dependent diabetics

e) Dosage Information

i) Dog & Cats

(1) 0.002 to 0.030 mg/kg (0.001 to 0.015 mg/lb) IV, IM, SC

(2) 0.005 to 0.020 mg/kg (0.0025 to 0.010 mg/lb) is usually very adequate for dogs and cats when combined with an opioid like butorphanol or hydromorphone

ii) IM protocol for cats

(1) (25 ug/kg Medetomidine, 5 mg/kg Ketamine, 0.2 mg/kg Butorphanol)

(a) For larger cats, consider lean body mass equivalent weight

(b) Consider insulin syringes especially for smaller cats

(2) IV catheters are still highly recommended

(3) Intubation is highly recommended

(a) Allows the easy addition of inhalant anesthetic agent should the patient be inadequately anesthetized for longer procedures

f) Cost

i) High (especially if atipamazole is used)

2) MELOXICAM

a) Classification

i) A COX2 selective NSAID

b) General Information

i) Effective anti-inflammatory/analgesic generally free of significant GI side effects

c) Advantages/Recommended use

i) Short term use for acute pain

ii) Long term use in chronic pain for tolerant patients

(1) This NSAID appears more suitable for longer term use in cats

(a) Cats, even more so than dogs, need to be monitored closely during therapy

d) Cautionary Information

i) As with any NSAID, GI side-effects can be substantial

(1) Discontinue use if GI signs develop

ii) Avoid use in:

(1) Combination with corticosteroids

(a) Potentially increased ulcerogenic effect

(2) Renal compromised patients, dehydrated or hypotensive patients, patients with hepatic disease, pregnancy, patients with pre-existing GI disease, coagulopathies

iii) Monitor liver enzymes of canine patients on chronic therapy

e) Dosage Information

i) Dogs – 0.1 to 0.2 mg/kg (0.05 to 0.1 mg/lb) IV, SC, PO SID on day one, then 0.05 to 0.1 mg/kg (0.025 to 0.05 mg/lb) IV, SC, PO SID

ii) Cats – 0.1 to 0.2 mg/kg (0.05 to 0.1 mg/lb) IV, SC, PO SID on day one, then 0.05 to 0.1 mg/kg (0.025 to 0.05 mg/lb) IV, SC, PO SID for 3 to 5 days, then 0.1 mg total dose PO SID every 24 to 72 hours if long term use is required

(1) You can use the meloxicam bottle (rather than the included syringe) to accurately dose this drug.

(a) 1 drop from the bottle is 0.05 mg of drug

f) Cost

i) Moderate

3) MIDAZOLAM

a) Classification

i) A benzodiazepine hypnotic sedative agent

b) General Information

i) Overall properties very similar to diazepam

ii) Usually combined with ketamine or an opioid

c) Advantages/Recommended use

i) Similar to diazepam but can be given IM without pain and with excellent absorption

d) Cautionary Information

i) Given alone, can cause dysphoria, agitation, and difficult restraint

e) Dosage Information

i) Dogs & Cats

(1) Generally 0.2 to 0.4 mg/kg (0.10 to 0.20 mg/lb) IV or IM

(2) Preanesthetic Use (Choose one)

(a) With Butorphanol 0.2 to 0.4 mg/kg (0.10 to 0.2 mg/lb) IV, IM

(b) With Hydromorphone 0.1 to 0.2 mg/kg (0.05 to 0.1 mg/lb) IV, IM

(c) With Oxymorphone 0.05 to 0.1 mg/kg (0.025 to 0.05 mg/lb) IV, IM

(d) With Ketamine 2 to 10 mg/kg (1 to 5 mg/lb) IV, IM

f) Cost

i) Moderate

4) MORPHINE SULFATE

a) Classification

i) A pure mu opioid agonist

b) General Information

i) Duration of effect is 4 to 6 hours

c) Advantages/Recommended use

i) General premed suitable for healthy animals

ii) Most commonly used in combination with acepromazine, an alpha-2 agonist, or a benzodiazepine sedative/tranquilizer

iii) May provide greater sedation than can be achieved with hydromorphone or oxymorphone

d) Cautionary Information

i) Higher dosages can cause bradycardia and respiratory depression

ii) More likely to cause transient hypotensive than hydromorphone, fentanyl, or oxymorphone

iii) Often causes vomiting and defecation when given IM or SC

iv) IV use is associated with histamine release

(1) This is generally considered to be a transient low level concern and is unlikely if administered slowly

v) There is significant sedative synergism between morphine and acepromazine in the dog

(1) Acepromazine doses must be reduced appropriately

vi) Should be used with caution in the cat if no sedative/tranquilizer is used

e) Dosage Information

i) Dog – 0.5 to 1.0 mg/kg (0.25 to 0.50 mg/lb) SC, IM, or slowly IV

(1) Acepromazine dose would be low end – 0.005 to 0.040 mg/kg (0.0025 to 0.020 mg/lb)

ii) Cats – 0.25 to 0.5 mg/kg (0.125 to 0.25 mg/lb) SC, IM, or slowly IV

(1) Acepromazine dose must be higher end – 0.06 to 0.1 mg/kg (0.03 to 0.05 mg/lb)

iii) Other uses

(1) Constant rate infusion – see section on CRIs

(2) Epidural – see section on epidurals

f) Cost

i) Low

N

1) NALOXONE

a) Classification

i) An opioid antagonist

b) General Information

i) A short acting, pure antagonist

c) Advantages/Recommended use

i) To reverse unwanted effects of opioid medications

(1) Can use small doses to partially reverse opioid effects

ii) Duration of effect is 1 to 3 hours

d) Cautionary Information

i) Generally of shorter duration than most opioid agonists

(1) Reversal effect may wear off before agonist has been cleared from body

(2) Redosing may be necessary after 1 to 3 hours if undesirable agonist influence returns

ii) Buprenorphine effects may not be reversible due to the high binding affinity

iii) Butorphanol may not reverse as completely as pure Mu opioid agonists

e) Dosage Information

i) Dog & Cats - 0.02 to 0.1 mg/kg (0.01 to 0.05 mg/lb) IM or IV

(1) Give 1/4 of calculated dose every 3 - 4 minutes until desired effect is achieved

f) Cost

i) Moderately low

O

1) OXYMORPHONE

- **a) Classification**
  - i) A pure Mu opioid agonist
- **b) General Information**
  - i) Duration of effect is 4 to 6 hours
- **c) Advantages/Recommended use**
  - i) General premed for anesthetic candidates in all categories
  - ii) Hypotensive patients
    - (1) Unlike morphine, should not cause transient hypotension
  - iii) Higher risk patient when the risk of vomiting needs to be minimized
- **d) Cautionary Information**
  - i) Bradycardia is common
  - ii) Noise hypersensitivity may be a problem
  - iii) There is moderate sedative synergism between oxymorphone and acepromazine in the dog
    - (1) Acepromazine doses must kept at the lower end of the dose range
  - iv) Should be used with caution in the cat if no sedative/tranquilizer is used
- **e) Dosage Information**
  - i) Dog – 0.05 to 0.2 mg/kg (0.025 - 0.050 mg/lb) IM, IV
  - ii) Cats – 0.025 to 0.05 mg/kg (0.01 - 0.025 mg/lb) IM, IV
    - (1) Combine with acepromazine 0.06 to 0.10 mg/kg (0.03 to 0.05 mg/lb)
- **f) Cost**
  - i) High

P

1) PROPOFOL

a) Classification

i) A phenol in a hyperlipid emulsion

b) General Information

i) A very fast acting injectable without cumulative effect

c) Advantages/Recommended use

i) Generally for:

(1) Cases when rapid recovery is desired

(2) Diabetes Mellitus

(a) Propofol is capable of providing a smooth and rapid return to a comfortable state if premedications are appropriately utilized

(b) Appetite appears increased in many patients for a short period of time after recovery from propofol

(3) Outpatient procedures

(4) Sighthounds

(5) C sections

(6) Liver disease

(7) Giant breed dogs when early ambulation is desired

ii) Can be given as intermittent bolus or constant rate infusion (CRI) for maintenance of anesthesia

iii) Can be combined with 2% Thiopental in a 50/50 ratio

(1) Improves stability/shelf life

(a) This combined product should be handled carefully and refrigerated for storage

(b) It should be used within 24 to 48 hours of the propofol's opening

(2) Dose at same volume you would calculate if using propofol alone

d) Cautionary Information

i) Predictable respiratory depression and hypotension if given rapidly

(1) Should not be a major concern if given slowly

ii) Hyperlipid emulsion easily promotes bacterial growth

(1) Once opened, must use contents within 6 - 8 hours

iii) When use in patients with hepatic dysfunction the clearance times may be doubled

(1) There is some pulmonary clearance

iv) Use caution when dealing with ill cats

(1) Phenol can induce Heinz body anemia

(2) This is most concerning with ongoing administration: intermittent bolus or CRI

e) Dosage information

i) Routine induction
   (1) Dogs
      (a) 4 to 6 mg/kg (2 - 3 mg/lb) if not depressed or sedate
         (i) Effective premeds or pre-existing CNS depression or debilitation can reduce the dose required for intubation to 1 to 4 mg/kg (0.5 to 2 mg/lb)
   (2) Cats
      (a) 6 to 8 mg/kg (3 - 4 mg/lb) if not depressed or sedate
         (ii) Effective premeds or pre-existing CNS depression or debilitation can reduce the dose required for intubation to 1 to 4 mg/kg (0.5 to 2 mg/lb) or less
ii) 25 % slowly IV every 60 seconds to effect
   (1) Rapid administration causes:
      (a) Apnea of short duration
      (b) Hypotension
      (c) Reduction in myocardial contractility
iii) If, at any point, the **canine** patient is nearly, but not quite, able to be intubated, the addition of 2 mg/kg (1 mg/lb) lidocaine IV, may deepen the anesthetic effect and facilitate successful intubation
   (1) This strategy is useful when minimizing the induction agent for more critical patients
   (2) Cats are more sensitive to the toxic effects of lidocaine (CNS stimulation, seizures). Lidocaine is not recommended for use in cats at this time.
iv) Diazepam 0.2 to 0.4 mg/kg (0.1 to 0.2 mg/lb) IV can decrease propofol need by 50%
v) Routes of administration
   (1) IV
   (2) Intraosseous

f) Cost

i) Moderate

R

1) Romazicon
    a) See Flumazenil
2) Rompun
    a) See Xylazine

S

1) Sevoflurane

a) Classification

i) Fluorinated hydrocarbon

ii) Chemical isomer of isoflurane

b) General Information

i) A volatile liquid of low solubility that is minimally metabolized by the liver

(1) Liver metabolism exceeds that of isoflurane

ii) Its extremely low solubility provided for the quickest inductions, level adjustments, and recoveries of the currently used inhalant anesthetics

(1) With the exception of patients experiencing extreme respiratory compromise sevoflurane is rarely of any advantage over isoflurane

iii) MAC

(1) Dog – 2.1 to 2.4%

(2) Cats – 2.6%

c) Advantages/Recommended use

i) This anesthetic agent is suitable for use with most veterinary patients

ii) As with isoflurane, sevoflurane does not sensitize the heart to epinephrine induced arrhythmia

iii) Along with isoflurane, an inhalant anesthetic of choice for patients with:

(1) Liver disease

(a) More liver metabolism than isoflurane (~5%) but no trifluoroacetic acid metabolites are produced

(2) Intracranial disease

(a) Less effect on CSF pressure compared to Halothane

d) Cautionary Information

i) As with any inhalant anesthetic, cardiac and respiratory depression result as anesthetic concentrations are increased

(1) Not all patients under sevoflurane will be able to maintain adequate blood pressures

(2) Switching to an alternative maintenance agent may be necessary

ii) Compound A (resulting from sevoflurane/sodasorb interaction) appears to be of little concern

iii) Although sevoflurane is considered a relatively safe agent as pertains to staff exposure, we should all strive to minimize our exposure to this or any other inhalant agent

e) Dosage Information

i) Routine use

(1) Mask Induction

(a) Start with 100% oxygen @ 3 liters/min for 3 - 5 minutes

(i) Do not cover patients eyes

(b) After 3 - 5 minutes of O2, start sevoflurane at 1 %

(c) Increase by 1 % every 30 - 60 seconds until 3 % is reached

(d) Then increase to 5 % - 7 % to complete induction

(2) Induction following injectable agent

(a) Initiate flow rates of 1.0 to 1 liter per minute at 3.5 % - 5.0 %

(i) Reduce percentage as indicated by patients response

(3) Maintenance

(a) Once stable, reduce oxygen flow to 500 ml to 1 liter

(i) The reservoir bag must remain full

1. If not, the flow rate must be increased and the machine must be examined for leaks at the earliest possible convenience

(b) Remember that prior to surgical stimulation, a patient may appear adequately anesthetized only to show a dramatic response to stimulation

(i) An experienced anesthetist should be able to anticipate and minimize this event

(c) Effective analgesic & sedative premeds will significantly reduce the level of inhalant agent necessary for maintenance of a surgical plane of anesthesia

f) Cost

i) high

T

1) TELAZOL

a) Classification

i) 50/50 mixture of a benzodiazepine (Zolazepam) & a dissociative agent (Tiletamine)

ii) Class III controlled drug

b) General Information

i) Similar to Ketamine and Diazepam

ii) Can be used for induction in dogs and cats or as the exclusive agent for short procedures in cats

iii) Tiletamine is capable of providing the loading dose for NMDA dorsal horn windup antagonism prior to ketamine CRI use

c) Advantages/Recommended use

i) Healthy animals in the Good to Excellent category

(1) More ideal for cats vs. dogs

(2) An acceptable induction agent for sighthounds

d) Cautionary Information

i) Avoid if:

(1) Intracranial disease is suspected (can raise ICP)

(2) Renal insufficiency is present (renal clearance)

ii) Somewhat more stormy recoveries in dogs compared to Ketamine/Diazepam

(1) The ½ life of zolazepam is much **longer** than the ½ life of the tiletamine in cats

(2) The ½ life of zolazepam is **shorter** than the ½ life of the tiletamine in dogs increasing the risk that the patients will be more agitated during the recovery

(a) This is less of an issue if a longer procedure over 1.5 hours

e) Dosage

i) Routine induction

(1) Dog & Cat – 2 mg/kg (1 mg/lb) IV bolus

(a) Sedated or pre-existing CNS depression or debilitation - draw up 2 mg/kg (1 mg/lb), give 25 - 50% as bolus then additional increments to effect

ii) Vicious, aggressive dogs

(1) 5 mg/kg (2.5 mg/lb) IM - usually reach lateral recumbancy within 10 minutes

(2) May be combined with acepromazine for more dramatic effect

iii) Routes of administration

(1) IV – allows for lower telazol doses

(2) IM more rapid in effect but more painful

(3) SC - somewhat less painful and somewhat lower effect but SQ administration is still a rapidly acting route

f) Cost

i) Moderately low

2) THIOPENTAL

a) Classification

i) Ultra-short acting thiobarbiturate

b) General Information

i) Various concentration (2.5% and 5% solutions are the most common)

c) Advantages/Recommended use

i) Healthy animals in the Good to Excellent category

d) Cautionary Information

i) It is safer to consistently use the same concentration solution within a given facility rather than stocking both 2.5% and 5% solutions

ii) Not recommended for use with sight hounds

(1) Lower volume of distribution and altered metabolism make for a very narrow therapeutic index

iii) Can cause significant decrease in PCV

(1) Thiopental (and Acepromazine) cause splenic pooling of RBCs leading to a rapid decrease in PCV of up to 30%

iv) Can induce myocardial irritability

(1) Usually bigeminal

(2) Treatment not required if stable cardiac output

v) There is an accumulative effect with this agent

vi) Extravascular thiopental may produce tissue necrosis

(1) Infiltrate area with saline, 0.5 to 1 mg of dexamethasone and 1 mg/kg (0.5 mg/lb) of lidocaine

(2) Additionally, a gauze soaked in DMSO can be wrapped over the site

vii) Unused thiopental should be discarded whenever any precipitate is noted in solution or when 4 weeks has transpired since mixing even if no precipitate is noted

e) Dosage Information

i) Dog & Cat

(1) Begin with 12 mg/kg (6 mg/lb)

(a) Administer 4 to 6 mg/kg (2 - 3 mg/lb) rapid bolus initially followed by additional small boluses to effect

(i) Excessively slow injection may precipitate unwanted excitement

(b) Reduce initial bolus in proportion to degree of sedation produced by premeds

(2) Maximum dose is 16 mg/kg (8 mg/lb)

(3) If at any point the **canine** patient is nearly, but not quite, able to be intubated, the addition of 2 mg/kg (1 mg/lb) lidocaine IV, may deepen the anesthetic effect and facilitate successful intubation

(a) This strategy is useful when minimizing the induction agent for more critical patients

(b) **Cats** are more sensitive to the toxic effects of lidocaine (CNS stimulation, seizures). Lidocaine is not recommended for use in cats at this time.

f) Cost

i) Moderate

3) TILETAMINE

a) Classification

i) A dissociative agent

b) General Information

i) Combined with tiletamine to produce Telazol

ii) For more information see Telazol

4) TRAMADOL

a) Classification

i) An analgesic medication with a dual mode of action

(1) Mu opioid receptor agonist

(2) Monoamine reuptake inhibitor

b) General Information

i) An uncontrolled, oral analgesic for use in dogs and cats

c) Advantages/Recommended use

i) Acute or chronic mild to moderate pain management

ii) May be combined with other classes of analgesics including NSAIDs, NMDA antagonists, and gabapentin

d) Cautionary Information

i) May decrease seizure threshold

ii) Do not combine with TCAs, SSRIs, or MAO inhibitors due to the risk of serotonin syndrome.

e) Dosage Information

i) Dog & Cat

(1) 1 to 2 mg/kg (0.5 to 1.0 mg/lb) BID to QID

(a) Most consider 10 mg/kg (5 mg/lb) to be the maximum total daily dose for general use

(b) Anecdotal reports include up to 5 to 10 mg/kg BID to QID for more severe postop pain

ii) Tramadol is available in 50 mg tablets

f) Cost

i) Moderately low

V

1) VALIUM

a) See Diazepam

X

1) XYLAZINE

a) Classification

i) An alpha-2 agonist

b) General Information

i) More likely to cause vomiting than medetomidine

ii) Less expensive than medetomidine

iii) All of our current low dose clinical experience is with medetomidine

(1) See Medetomidine above for information regarding alpha-2 agonists

Y

1) YOHIMBINE

a) Classification

i) alpha-2 antagonist

b) General Information

i) Inferior reversal agent to atipamazole

(1) Alpha-2/alpha-1 binding ratio = 40:1 versus atipamezole's 8500:1 binding ratio

Z

1) ZOLAZEPAM

a) Classification

i) Benzodiazepine

b) General Information

i) Combined with tiletamine to produce Telazol

ii) For more information see Telazol