AAHA Anesthesia Guidelines for Dogs and Cats*

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ABSTRACT

Safe and effective anesthesia of dogs and cats rely on preanesthetic patient assessment and preparation. Patients should be premedicated with drugs that provide sedation and analgesia prior to anesthetic induction with drugs that allow endotracheal intubation. Maintenance is typically with a volatile anesthetic such as isoflurane or sevoflurane delivered via an endotracheal tube. In addition, local anesthetic nerve blocks; epidural administration of opioids; and constant rate infusions of lidocaine, ketamine, and opioids are useful to enhance analgesia. Cardiovascular, respiratory, and central nervous system functions are continuously monitored so that anesthetic depth can be modified as needed. Emergency drugs and equipment, as well as an action plan for their use, should be available throughout the perianesthetic period. Additionally, intravenous access and crystalloid or colloids are administered to maintain circulating blood volume. Someone trained in the detection of recovery abnormalities should monitor patients throughout recovery. Postoperatively attention is given to body temperature, level of sedation, and appropriate analgesia. (*J Am Anim Hosp Assoc* 2011; 47:377–385. DOI 10.5326/JAAHA-MS-5846)

*There are no safe anesthetic agents, there are no safe anesthetic procedures.
There are only safe anesthetists.—Robert Smith, MD*[a]

Introduction

The purpose of this article is to provide guidelines for anesthetizing dogs and cats, which can be used daily in veterinary practice. This will add to the existing family of American Animal Hospital Association (AAHA) guidelines[b] and other references, such as the anesthesia monitoring guidelines published by the American College of Veterinary Anesthesiologists (ACVA)[c].

This article includes recommendations for preanesthetic patient evaluation and examination, selection of premedication, induction and maintenance drugs, monitoring, equipment, and recovery. In recognition of differences among practices, these guidelines are not meant to establish a universal anesthetic plan or legal standard of care.

Preanesthetic Evaluation

The preanesthetic patient evaluation identifies individual risk factors and underlying physiologic challenges that contribute information for development of the anesthetic plan. Factors to be evaluated include the following:

- History: Identify risk factors, including responses to previous anesthetic events, known medical conditions, and previous adverse drug responses. Identify all prescribed and over-the-counter medications (including aspirin) and supplements to avoid adverse drug interactions.[1]
- Physical examination: A thorough physical examination may reveal risk factors, such as heart murmur and/or arrhythmia or abnormal lung sounds.

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AAHA *American Animal Hospital Association;* ACVA *American College of Veterinary Anesthesiologists;* ASA *American Society of Anesthesiologists;* AVMA *American Veterinary Medical Association;* ET *endotracheal;* PLIT *Professional Liability Insurance Trust*

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- Age: Advanced age can increase anesthetic risk because of changes in cardiovascular and respiratory function. Disease processes occur more commonly in aged patients. Very young patients can be at increased risk from hypoglycemia, hypothermia, and decreased drug metabolism.
- Breed: Few breed-specific anesthesia issues are documented. Brachycephalic dogs and cats are more prone to upper airway obstruction. Greyhounds have longer sleep times after receiving some anesthetics such as propofol or thiopental[d]. Some breeds of dogs (e.g., Cavalier King Charles spaniel) and cats (e.g., Maine coon) may be predisposed to cardiac disease as they age.[2]
- Temperament: An aggressive or fractious temperament may pose a danger to staff and can limit the preanesthetic evaluation or make examination impossible. The selection of an alternative preanesthetic drug or drug combination may be required for the aggressive or overly fearful animal due to the need for higher-than-usual drug doses. Conversely, a quiet or depressed animal may benefit from lower doses for sedation or anesthesia.
- Type of procedure: Evaluate the procedure's level of invasiveness, anticipated pain, risk of hemorrhage, and/or predisposition to hypothermia. Some procedures may limit physical access to the patient for monitoring.
- Using heavy sedation versus general anesthesia: This choice depends on the procedure, patient temperament, and the need for monitoring and support. In general, sedation may be appropriate for shorter ($<$30 min) and less-invasive procedures (e.g., diagnostic procedures, joint injections, suture removal, and wound management). Sedated patients, just as those under general anesthesia, require appropriate monitoring and supportive care. They may require airway management and/or O_2 supplementation. Be prepared to intubate if necessary.
- Experience and qualifications of personnel: Previous training in local and regional anesthesia techniques will facilitate their perioperative use. Also, a more experienced surgeon may be faster and cause less tissue trauma to a patient than a less experienced one.

Risk factors and individual patients' needs provide a framework for developing individualized patient plans and may indicate the need for additional diagnostic testing or stabilization before anesthesia.

Individual practice procedures may include a minimum database of laboratory analysis, electrocardiogram, and diagnostic imaging for different patient groups. There is no evidence to indicate the minimum time frame before anesthesia within which laboratory analysis should be performed. However, the timing should be reasonable to detect changes that impact anesthetic risk. The type and timing of such testing is determined by the veterinarian based on the previously mentioned factors, as well as any change in patient status or the presence of concurrent disease.

Categorization of patients using the American Society of Anesthesiologists (ASA) Patient Status Scale provides a framework for evaluation (**Table 1**). Patients with a higher ASA status are at greater risk for anesthetic complications and require additional precautions to better ensure a positive outcome.[3]

Client communication is important at all times, but especially before anesthetic procedures. Obtain written informed consent[e] after discussing the patient assessment and risks, the proposed anesthetic plan, and any available medical or surgical alternatives with the client. Include such information in informed consent documents as guided by local and state regulatory agencies.[4]

Individual Plan

Patient Preparation

Before the day of surgery, communicate with the client about how to prepare the pet for anesthesia, such as any recommended changes in administration of medications. Allow free access to water (which may be allowed until the time of premedication).

Recommend fasting before anesthesia to reduce the risk of regurgitation and aspiration, understanding that gastric emptying times vary widely among individual patients and with the contents of the food ingested.[5] Young animals require shorter fasting times. Food should not be withheld for $>$4 hr before surgery for those from 6 wk to 16 wk of age due to the risk of perioperative hypoglycemia. Although there is evidence to suggest that shorter fasting times ($<$6 hr) might be sufficient to decrease the risk of regurgitation for those $>$16 wk of age, overnight fasting is recommended for procedures scheduled earlier in the day.[6]

With emergency procedures, fasting is often not possible, thus attention to airway management is critical. Do not delay emergency procedures when the benefit of the procedure outweighs the benefit of fasting.

TABLE 1

ASA Physical Status Classification System

1. Normal healthy patient
2. Patient with mild systemic disease
3. Patient with severe systemic disease
4. Patient with severe systemic disease that is a constant threat to life
5. Moribund patient who is not expected to survive without the operation

Based on the Physical Status Classification System of the American Society of Anesthesiologists, 520 N Northwest Highway, Park Ridge IL 60068-2573; www.asahq.org. ASA, American Society of Anesthesiologists.

Diabetic patients may or may not be fasted depending on the veterinarian's preference and anticipation of procedure time. Adjust insulin administration accordingly with food intake. Regardless of how the patient has been fasted, manage the airway of every patient as if its stomach were full.

Anesthetic Plan

Create an individualized plan for patient management based on the anesthetic risks identified in the preanesthetic evaluation, understanding that no single plan is appropriate for all patients. Resources such as staffing, equipment, and drug availability also influence plan development. A complete anesthetic plan addresses perioperative analgesia, pre- and postanesthetic sedation and/or tranquilization, induction and maintenance drugs, ongoing physiologic support, monitoring parameters, and responses to adverse events. The plan should be flexible to allow for dynamic patient responses during anesthesia.

Preanesthetic Medication

The advantages of preoperative sedation and analgesia include lowered patient and staff stress, ease of handling, and reduction of induction and inhalant anesthetic doses, most of which have dose-dependent adverse effects.

There can be disadvantages to the administration of preanesthetic medications, such as dysphoria related to benzodiazepines, bradycardia related to α-2 agonists and opioids, and hypotension related to acepromazine. These disadvantages can be mitigated by appropriate dosing and selecting the right combination of drugs for the individual. Patients in critical condition may not require any premedication.

Pain Management

Choose drugs and techniques that provide both intraoperative and postoperative analgesia. Because there is a high variability in patient response to sedation and analgesia, individually tailor the medication type, dose, and frequency based on the anticipated intensity and duration of pain. In addition to opioid premedication, perioperative analgesic techniques include nonsteroidal anti-inflammatory drugs, local and regional nerve blocks, as well as IV infusions of opioids, *N*-methyl-D-aspartate receptor antagonists (e.g., ketamine), and/or lidocaine. Multiple analgesic techniques should be considered for more painful procedures. Frequently reassess patient comfort and adjust pain management as needed. The AAHA Pain Management Guidelines and many other sources provide descriptions of and suggestions for pain management[f].[7–9]

Anesthetic Management of Patients with Comorbidities

Certain conditions require modification of the anesthetic protocol. Extensive discussion of the anesthetic management of the diseased patient is beyond the scope of these guidelines. However, brief mention of diabetes, renal, cardiac, and hepatic disease is warranted.

Diabetes

Perform periodic blood glucose measurements at sufficient intervals throughout the perianesthetic period to detect hypoglycemia or hyperglycemia before it becomes severe. Ideally, diabetic patients should be well regulated before anesthesia induction unless the procedure cannot be delayed.

Renal Disease

No one anesthetic drug or drug combination is better for renal disease; most important is to maintain blood pressure and adequate renal perfusion. Diuresis of moderately or severely azotemic patients before anesthetic induction may be warranted. Base the specific fluid types and rates on patient condition and response, but generally 1.5–2 times maintenance crystalloid administration for the 12–24 hr before anesthesia will reduce the magnitude of the azotemia. Continue fluids into the postoperative period as patient needs dictate. Fluid rates up to 20–30 mL/kg/hr during anesthesia have been recommended in patients with renal dysfunction.[10,11]

Patients with renal insufficiency may benefit from mannitol-induced diuresis and the associated increased renal medullary perfusion.[12,13] To be effective, low-dose mannitol must be given before the ischemic episode; at higher doses it can cause renal vasoconstriction.

Vasopressors and inotropes have been recommended, but strictly to maintain cardiac output. It has not been concluded that they contribute to increased renal perfusion or renal protection.

Cardiac Disease

In patients with severe cardiac disease, carefully titrate IV fluids to avoid inducing congestive heart failure from fluid overload. Patients will vary in how much fluid and at what rate they can tolerate. Guide fluid administration by monitoring any of the following: systemic blood pressure, central venous pressure, oxygenation, or auscultation of lung sounds.

Preoperatively evaluate cardiac arrhythmias for consideration of perianesthetic treatment. Cardiac medications should be administered normally the day of surgery. Some medications may potentiate hypotension (e.g., angiotensin-converting enzyme inhibitors and β blockers). Be prepared to administer inotropes or other supportive measures if needed.[14]

Opioid analgesics are useful during anesthesia of the patient with cardiovascular compromise. Certain anesthetic medications may be less appropriate in some types of cardiac disease (e.g., at higher doses, ketamine may increase heart rate, which could be a problem in patients with hypertrophic cardiomyopathy; avoid α-2 agonists in dogs with mitral valve disease).[15] A multimodal approach using drugs from multiple pharmacologic categories is preferred to minimize extreme cardiovascular effects of any one drug.[16]

Liver Disease

True liver dysfunction also warrants special attention; however, increases in the liver enzymes of an otherwise healthy patient are not an absolute reason to avoid anesthesia. In patients with liver dysfunction, hypoglycemia can be a concern due to insufficient glycogen storage and impaired gluconeogenesis. Dextrose supplementation may be necessary. If hypoproteinemia is present, the administration of fresh frozen plasma may be warranted. In general, delayed anesthetic recovery can be expected with the use of any anesthetic agent metabolized by the liver. Therefore, inhalants and drugs with specific antagonists such as opioids and α-2 agonists can be useful.

Areas of Controversy

The authors recognize that opinions vary regarding the administration of certain perianesthetic drugs. Some of these are briefly outlined here.

There are misconceptions about the effects of acepromazine in patients with seizure history. There is no evidence to show that acepromazine increases the risk of seizures in epileptic patients or patients with other seizure disorders.[17,18]

Indiscriminant use of anticholinergic drugs such as atropine and glycopyrrolate as part of a premedication protocol is controversial. Some think they should not be used routinely because the action will be short, and they may cause tachycardia, which increases myocardial O_2 consumption and the potential for myocardial hypoxemia.

In contrast, the pre-emptive use of anticholinergics may be indicated for procedures with an increased risk of vagal bradycardia (e.g., ocular surgery) as well as in conjunction with opioid administration, to offset the potential bradycardic effects of the opioid. Anticholinergics may also be indicated in dogs with brachycephalic syndrome, which is associated with airway obstruction and higher resting vagal tone, making these dogs more prone to developing bradycardia than are other breeds.[19]

The simultaneous use of anticholinergics with α-2 agonists has been debated. Some practitioners prefer to administer anticholinergics to reduce the magnitude of bradycardia and associated drop in cardiac output. However, the combination creates the potential for myocardial hypoxemia to develop as a result of increased myocardial work. Use of anticholinergics should be based on individual patient risk factors and monitored parameters such as heart rate and blood pressure.[20,21]

Anesthesia Preparation

Ensure that all equipment and medications deemed necessary for the procedure to be performed are readily accessible and in working order before induction of anesthesia. Regularly ensure proper maintenance and function of all anesthetic equipment. **Table 2** provides a convenient maintenance checklist. Have emergency supplies and protocols available before any anesthetic procedure (e.g., tracheal suction; emergency lighting in the event of power failure). Conspicuously post a chart of emergency drug doses or preemptively calculate such doses for each patient. Familiarize yourself with the most current recommendations for cardiopulmonary cerebral resuscitation and stock appropriate drugs. Useful emergency drug dose charts are available in many texts and also from the Veterinary Emergency and Critical Care Society[g].

Prepare a written anesthetic record for each patient, beginning with preparation for the anesthetic event and continuing through the recovery period. Record preanesthetic patient status and all perianesthetic events, including drugs and dosages administered, routes of administration, patient vital signs, events, and interventions. Record resuscitation orders in the anesthetic record at the time consent is obtained. Regularly record patient parameters at 5–10 min intervals, or more frequently if sudden changes in physiologic status occur. An anesthetic record template is available from AAHA[h].

Patient Preparation

Preparing a patient for anesthesia may include some or all of the following:

- Inserting an IV catheter and administering IV fluids. This helps to avoid perivascular administration of induction drugs. It facilitates intravascular volume support, which may correct hypovolemia resulting from vasodilation and blood loss that can occur during surgery. It also allows for rapid administration of emergency medications.
- Connecting monitoring equipment appropriate for the disease condition present and that the patient will tolerate before induction (**Table 3**).
- Stabilizing hemodynamically unstable patients, including but not limited to:
  - Administering IV fluid boluses. Hypovolemic patients may require isotonic crystalloids, colloids, and/or hypertonic

TABLE 2

Anesthetic Equipment Check List

CO_2 absorbent	Change the CO_2 absorbent regularly based on individual anesthesia machine manufacturer recommendations.
	The useful lifespan of absorbent varies with the patient size and fresh gas flow rate.
	Color change is not always an accurate indicator of remaining absorption capacity.
Oxygen	Ensure supply lines are attached.
	Ensure the flowmeter is functioning.
	Ensure the supply tank and at least one spare tank is sufficiently full.
	To calculate the estimated remaining tank volume, follow this example: An E-cylinder contains 660 L, and has a full-pressure of 2,200 psi. Pressure drop is proportional to remaining O_2 volume. A tank with 500 psi has 150 L. When used at a flow rate 1 L/min, it will last approximately 2 ½ hr.[22]
Endotracheal tubes and masks	Have access to various sizes of masks and endotracheal tubes.
	Provide a light source such as a laryngoscope.
	Check cuff integrity and amount of air needed to properly inflate the cuff.
Breathing system	Refer to anesthesia machine's documentation for proper leak-checking procedures.
	Conduct a check before every procedure.
	Select the appropriate size and type of reservoir bag and breathing circuit.[23]
	Non-rebreathing systems are generally used in patients weighing less than 5–7 kg or when the work of breathing associated with the circle system might not be easily sustainable by an individual patient.[24]
Inhalant	Ensure vaporizer is sufficiently full.
Waste scavenging equipment	Verify a functioning scavenging system.
	If using a charcoal absorbent canister, ensure there is sufficient capacity remaining for the duration of the procedure.
	Observe all regulations concerning the dispersion of waste anesthesia gases.[25,26]
Electronic monitoring equipment	Ensure devices are operational and either connected to a power source or have adequate battery reserve.
	Check alarms for limits and activation.

saline to improve vascular filling, cardiac output, and tissue perfusion.

- Managing cardiac arrhythmias.
- Providing blood products. Hypoproteinemia, anemia, or coagulation disorders can aggravate the decreased delivery of O_2 to the tissues that normally occurs as a result of hypoventilation and recumbency.
- Preoxygenation reduces the risk of hemoglobin desaturation and hypoxemia during the induction process. Preoxygenation is especially beneficial if a prolonged or difficult intubation is expected or if the patient is already dependent on supplemental oxygenation. However, preoxygenation may be contraindicated if it agitates the patient. Removing the rubber diaphragm from the facemask may increase patient tolerance of the mask.[29]

TABLE 3

Anesthesia Monitoring Tools

Electrocardiogram
Pulse oximeter (SpO_2)
Arterial blood pressure monitor
Direct intraarterial BP: Most accurate, but technically difficult to perform
Noninvasive BP (Doppler or oscillometric monitor): Technically easy, but can be inaccurate.[27,28] Evaluate trends in conjunction with other patient parameters. Select cuff width of 40–50% of circumference of limb.
Thermometer: Esophageal probe or periodic rectal temperature with conventional thermometer
Anesthetic gas analyzer (measures inspired and expired inhalant concentration)
Capnometer/capnograph (measures and/or displays CO_2 in expired and inspired gas, and respiratory rate)
Physical observations
Visualization (e.g., eye position, mucous membranes, chest excursion, blood loss, bag volume, and movement with ventilation, equipment function)
Palpation (e.g., pulse quality, jaw tone, palpebral reflex)
Auscultation (heart, lungs): Precordial or esophageal stethoscope

BP, blood pressure; SpO_2, saturation level of O_2.

Once the patient is as stable as possible, proceed according to the individual patient plan.

Anesthetic Induction

Anesthetic induction is best achieved using rapid-acting IV drugs, although this may not always be a reasonable option for fractious patients.[30] IV induction allows for rapid airway control and allows for titration of the induction drug to effect within the given dosage range. Sick, debilitated, or depressed patients will require less drug than healthy, alert patients. A patient's response to pre-anesthetic drugs can influence the amount and type of induction drug needed.

Mask or chamber inductions can cause stress, delayed airway control, and environmental contamination.[31] Adequate room ventilation must be present to minimize exposure to personnel. Reserve these techniques for situations where other alternatives are not suitable.

Ensure endotracheal (ET) tubes and intubation aids (e.g., stylets, laryngoscope) are readily available. Establish and maintain a patent airway using an ET tube as soon as possible. Use the largest diameter ET tube that will easily fit through the arytenoid cartilages without damaging them; this will minimize resistance and the work of breathing. Insert the ET tube such that the distal tip of the tube lies midway between the larynx and the thoracic inlet. Applying a light coating of sterile lubricating jelly improves the cuff's ability to seal the airway against fluid migration.[32]

Inflate the cuff sufficiently to create a seal for adequate positive pressure ventilation, being aware that overinflation may cause tracheal damage.[33] When changing the patient's position after intubation, take care to not rotate the ET tube within the trachea. This might induce tracheal tears, especially if the cuff is relatively overinflated. The American Veterinary Medical Association (AVMA) Professional Liability Insurance Trust (PLIT) has indicated that tracheal tears are a significant issue in anesthetized intubated cats[i].[34] However, tracheal intubation when properly performed and maintained is an essential part of maintaining an open and protected airway.

Apply corneal lubricant postinduction to protect the eyes from corneal ulceration.

Maintenance and Monitoring

Anesthesia is typically maintained using inhalant anesthetics, although maintenance can also be achieved with continuous infusions or intermittent doses of injectable agents, or a combination of injectable and inhalant drugs. An O_2-enriched gas mixture is necessary for the safe and effective administration of inhalant anesthesia.[23,29]

O_2 flow rates depend on the breathing circuit used. For a circle rebreathing system, use a relatively high flow rate when rapid changes in anesthetic depth are needed, such as during the transition from injectables to inhalants (induction) or when turning the vaporizer off at the end of the procedure. During the maintenance phase, total O_2 flow rate should typically be between 200 and 500 mL. The system must be leak free for these flow rates to be effective. These are, perhaps, lower O_2 flow rates than many are accustomed to. The benefits of lower flow rates include decreased environmental contamination and the economy of decreased consumption of O_2 and volatile anesthetic gases. Lower flow rates also conserve moisture and heat. Disadvantages to lower flow rates include increased times to change anesthetic depth. Administer an O_2 flow of approximately 200 mL/kg/min to patients connected to a non-rebreathing circuit.[22]

Guidelines for anesthesia monitoring are available from The American College of Veterinary Anesthesiologists (ACVA).[35] Continue the cardiovascular monitoring and physiologic support measures that began in the patient preparation and/or induction periods. Monitoring includes evaluation of oxygenation, ventilation, cardiac rate and rhythm, adequacy of anesthetic depth, muscle relaxation, body temperature, and analgesia. Blood pressure, heart rate and rhythm, mucous membrane color, and pulse oximetry provide the best indexes of cardiovascular function.

Multiparameter electronic monitors are available and serve as tools to assess physiologic parameters during the perianesthetic period (Table 3). One must always evaluate the data the monitor is conveying in light of all other parameters and make treatment decisions based on the whole picture. Vigilant monitoring, interpretation, and responding to patient physiologic status by well-trained and attentive staff are critical.

Provide thermal support and monitor body temperature throughout the perianesthetic period. Supplemental heat may include warm IV fluids, use of a fluid line warmer, insulation on the patient's feet (e.g., bubble wrap), circulating warm-water blankets, and/or warm air circulation systems. Do not use supplemental heat sources that are not designed specifically for anesthetized patients as they can cause severe thermal injury.[36]

Troubleshooting—Anesthetic Complications

Recognize and then quickly and effectively respond to complications as they develop. Anesthesia-related complications are responsible for a significant number of AVMA PLIT insurance claims[j].

Hypoventilation is an expected effect of general anesthesia and can be estimated by observing respiratory rate and depth, but can be quantified using capnometry. Observation of respiratory tidal volume is subjective, and it can be difficult to distinguish a normal from abnormal tidal volume. Normal end-tidal CO_2 is approximately 35–40 mm Hg in awake patients and approximately 40–50 mm Hg in patients in a light surgical plane of anesthesia. With increasing CO_2, identify causes such as excessive anesthetic depth, provide initial patient support by positive pressure ventilation, and adjust anesthetic management as indicated.

Hypotension is a common complication during anesthesia. Diagnose hypotension through blood pressure monitoring and evaluation of other physiologic parameters. Therapies for hypotension include decreasing the depth of anesthesia, administering crystalloid and/or colloid boluses, and/or administering vasopressors and inotropes.

Monitor for arrhythmias via auscultation, electrocardiography, or by observing pulse–heart rate discongruity when using Doppler ultrasound. Common perioperative arrhythmias include bradycardia and ventricular arrhythmias. The decision of whether to treat a given arrhythmia should be based on the severity, the effect on other hemodynamic parameters (e.g., blood pressure), and the likelihood of deterioration to a more significant arrhythmia.

There are limited data to provide insight into the causes of anesthetic and perianesthetic deaths in dogs and cats.[37] Many complications and deaths occur during recovery. Most anesthetic deaths are unexplained because of insufficient information regarding the event. Increased monitoring and early diagnosis of physiologic changes and earlier intervention may reduce the risk of anesthetic death.

After an anesthetic death, offer clients the option of having a necropsy performed. Necropsy may detect pre-existing disease that contributed to anesthetic death, which was not detectable with preoperative evaluation. Empathetic communication may help clients deal with loss, anger, and the grief process.

Recovery

Recovery is a critical phase of anesthesia that includes a continuation of patient support, monitoring, and record keeping. It begins when the anesthetic gas is turned off. It does not end at the time of extubation.

Patients recovering from anesthesia require monitoring by someone trained in the recognition of complications. Although many complications occur throughout anesthesia, most anesthetic-associated deaths occur during recovery, especially in the first 3 hr. Forty-seven percent of canine anesthesia mortalities and 60% of feline anesthesia moralities have been reported to occur in the postoperative period.[38]

Continue regular monitoring of parameters until they return to near baseline. Pulse oximetry, blood pressure monitoring, and periodic auscultation are valuable in detecting life-threatening complications. Continue to monitor the electrocardiogram and blood pressure in those patients at significant risk of life-threatening hypotension or dysrhythmias.

Respiratory depression persists during the early recovery from anesthesia. Continue supplemental oxygen until SpO_2 measurements are acceptable when breathing room air.

Extubate when the patient can adequately protect its airway by vigorously swallowing. Deflate the cuff immediately before removing the ET tube. With patients that have undergone a dental procedure or oral surgery, it is beneficial to position the nose slightly lower than the back of the head and leave the ET tube cuff slightly inflated during extubation. This will help clear blood clots and debris from the trachea and deposits any fluid or debris into the pharyngeal region, where it can drain from the mouth or be swallowed, thereby reducing the risk of aspiration.

Recovery from anesthesia can be prolonged in hypothermic patients, resulting in increased morbidity.[39] Provide adequate thermal support until the patient's temperature is consistently rising and approaching normal.

Re-apply eye ointment during the recovery period, especially if an anticholinergic was administered, until an adequate blink reflex is present. Express the bladder if distended to minimize any distention-related discomfort.

Re-assess the patient's pain level and, if necessary, adjust the plan for postoperative pain management. Adequate analgesia and a quiet environment encourage smooth recoveries. Evaluate patients for dysphoria, emergence delirium, and pain. Treat if necessary.[7]

Discharge of patients having undergone anesthesia should only occur after the patient is awake, aware, warm, and comfortable. Evaluate the animal for its responses and its ability to interact safely with owners and maintain physiologic homeostasis. Provide written instructions for owners, outlining the dose and potential side effects of analgesics and other medications to be given to the patient at home.

Summary/Conclusions

Anesthesia includes more than the selection of anesthetic drugs. A comprehensive individualized anesthetic plan will minimize perioperative morbidity and optimize perioperative conditions. Monitoring, the ability to discern normal from abnormal, and expedient intervention are critical to ensure that potentially reversible problems do not become irreversible. Vigilance and patient support must be maintained during the recovery period.

Successful anesthetic management requires trained, observant team members who understand the clinical pharmacology and physiologic adaptations of the patient undergoing anesthetic

TABLE 4

Websites for More Information

Group	Web URL	Resources available
American Animal Hospital Association (AAHA)	www.aahanet.org > Resources > Guidelines	AAHA–AAFP Pain Management Guidelines for Dogs & Cats AAHA Senior Care Wellness Guidelines
American College of Veterinary Anesthesiologists (ACVA)	www.acva.org	Small Animal Monitoring Guidelines; Position statements
American Society of Anesthesiologists (ASA)	www.asahq.org	Patient status scale
Colorado State University	www.cvmbs.colostate.edu/clinsci/wing/emdrughp.htm	A custom emergency drug list with dosages may be printed for each patient
International Veterinary Academy of Pain Management	www.ivapm.org	Pain management information
Veterinary Anesthesia & Analgesia Support Group (VASG)	www.vasg.org	Anesthesia information

AAFP, American Association of Feline Practitioners.

procedures, as well as the use of anesthetic and monitoring equipment. Staff must be able to assess abnormal patient responses quickly and respond efficiently, by being familiar with the expected responses seen with different anesthetic drugs and with the changes seen in the phases and/or depth of general anesthesia. Provide training and review procedures with staff upon hiring, at regular intervals, and after adverse events occur, as part of routine morbidity and mortality discussions.

Anesthesia and anesthetic drugs continually evolve with advances in pharmacology and technology. Numerous anesthesia continuing education opportunities exist, and periodically refreshing your anesthesia knowledge is mandatory. Referral to a board certified veterinary anesthesiologist should be considered for complex cases that are outside of a practitioner's comfort zone (**Table 4**).

FOOTNOTES

[a] This quote appears as an introduction to Chapter 1 of: Muir W, Hubbell J, Bednarski R. Introduction to anesthesia. In: Muir WW, Hubbell JAE, Bednarski RM, Skarda RT, eds. *Handbook of veterinary anesthesia*. 4th ed. St. Louis: Elsevier, 2007;1. However, the original source of the quote is not referenced.

[b] See www.aahanet.org resources

[c] See www.acva.org

[d] At the time of this publication, thiopental is not available in the United States

[e] A standard consent form may be found at www.avma.org/issues/policy/consent_form.asp

[f] Veterinary Anesthesia & Analgesia Support Group, www.vasg.org; International Veterinary Academy of Pain Management, www.ivapm.org

[g] See www.veccs.org

[h] See www.aahanet.org > AAHA store > Books and products > Anesthesia record

[i] Personal communication, March 2011, AVMA PLIT

[j] Personal communication, March 2011, AVMA PLIT

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