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IN SAFE HANDS
Safely dealing with a geriatric patient requires the veterinary nurse to approach the case well informed and aware of potential complications.

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CONTINUING EDUCATION

ANESTHESIA

Anesthesia for Geriatric Patients

Ongoing developments and innovations in veterinary medicine have resulted in pets living longer, and the number of older patients requiring sedation and general anesthesia for various interventions has subsequently increased. A geriatric patient is often defined as one that has reached 75% of its average life expectancy; therefore, the exact age depends on breed and species.[1]

Geriatric patients may appear "healthy" for their age, but they often have multiple underlying organ dysfunctions that, when challenged by general anesthesia, can result in a cascade of detrimental events. Although age itself is not a disease, age-related physiologic changes must be evaluated for each patient to ensure that the most appropriate sedation and/or anesthesia plan is created.

PATIENT ASSESSMENT AND THE ANESTHETIC PLAN

In dogs and cats, increasing age, independent of patient physical status, is associated with an increased risk of anesthetic-related death.[2] The exact reasons for this are not known, but in humans, an anesthetic plan that includes the identification of specific age-related comorbidities and geriatric syndromes and the provision of appropriate preoperative intervention has been shown to improve postoperative outcomes.[3]

The anesthetic plan for a geriatric dog or cat should be tailored to the individual patient. Obtaining a

thorough physical examination and detailed medical history is essential to allow for preoperative optimization and to anticipate and prepare for patient-related problems. Additionally, the plan should incorporate surgical or procedural planning; anesthesia technique, including support and emergency drugs; physiologic monitoring; and anesthesia recovery.

In people, specific geriatric syndromes are well recognized and functional assessment tools are available to aid in perioperative planning. No such tools are available for veterinary patients; however, the preanesthetic evaluation should focus on geriatric-specific domains, including consideration of geriatric physiologic changes and common age-related comorbidities. For example, the following American Society of Anesthesiologists (ASA) subclassification of the geriatric population has been proposed:[4,5]

- **Class 1 or ASA status II:** Healthy geriatric patient with minor changes in organ function
- **Class 2 or ASA status III:** Geriatric patient with subclinical organ dysfunction, defined as decreased function of at least one organ (heart, liver, kidney)
- **Class 3 or ASA status IV, V:** Geriatric patient with an obvious disease, defined as severe clinical organ (e.g., heart, endocrine, kidney) dysfunction or neoplasia

Comorbidities may be the reason the patient presents for anesthesia or may be unrelated (e.g., geriatric cat with renal failure requiring anesthesia for a dental procedure). Regardless, the perianesthetic management of overt disease processes should be considered in conjunction with the normal geriatric physiologic considerations when developing the anesthetic plan.

GERIATRIC PHYSIOLOGIC CONSIDERATIONS

The process of aging is complex and multifactorial, and detailed reviews of the functional and physiologic changes associated with aging in dogs and cats are available elsewhere.[6,7] Put simply, aging affects the physiology of every major organ system, resulting in a seemingly healthy older patient having a diminished ability to handle physiologic stress. Major age-related changes that have implications regarding the perianesthetic management of geriatric dogs and cats are addressed below.

Cardiovascular System

Studies evaluating the effects of aging on the cardiovascular system of dogs and cats are limited; however, it is generally accepted that age-related changes exist and result in a decrease in functional cardiac reserve that renders that patient less able to respond to cardiac stress. Geriatric humans exposed to surgical stress have significantly lower cardiac index, heart rate, and oxygen delivery,[8] and it seems likely that the same is true in geriatric dogs and cats. Common age-related physiologic alterations contributing to the lack of functional cardiac reserve include decreased baroreceptor activity; changes in cardiac output, contractility, blood volume, and blood pressure; and a diminished ability to respond to hypotension.

For the most part, these age-related changes in the cardiovascular system are primarily due to changes in connective tissue.[9] Older patients often have less compliant vessels, myocardial hypertrophy, fibrosis, and valvular disease. Additionally, changes in the conduction system may make older patients more susceptible to arrhythmias. Cardiac disease is common in geriatric dogs and cats and may further reduce the cardiac reserve in these patients. Common diseases affecting the heart in older dogs include valvular heart diseases, dilated cardiomyopathy, pericardial diseases, arrhythmias, and systemic hypertension.[4] In cats older than 6 years, the most common cardiac disease is hypertrophic cardiomyopathy.[7]

Perianesthetic Considerations

As older patients have an increased incidence of cardiac comorbidities, a thorough history and physical examination are essential, and further diagnostic tests, including thoracic radiographs, hematologic testing, electrocardiography, and echocardiology, may be indicated. Patients that are receiving cardiac medications generally should continue to receive them on the day of surgery, although care with drugs that may potentiate hypotension (e.g., beta blockers) is advised. Preexisting cardiac arrhythmias should be evaluated preoperatively and treated if necessary.

Additionally, certain anesthetic drugs should be avoided with some types of cardiac disease; for example, higher doses of ketamine are contraindicated in patients with hypertrophic cardiomyopathy.[10]

Attenuating anesthesia-induced cardiovascular depression and hypotension is of the utmost importance. Careful monitoring of the cardiovascular system throughout the entire anesthetic period and the

ability to immediately respond to detrimental changes are essential in avoiding or reducing cardiovascular depression and resulting hypotension. Fluid therapy should be prescribed on an individual basis and the patient's response to fluid therapy continuously monitored, as many geriatric patients with preexisting heart disease are prone to fluid overload.

Respiratory System

In people, the risk of preanesthetic respiratory complications is significantly increased in older patients.[11] Age-related changes to the respiratory system include alterations in mechanical properties (e.g., reduced lung elasticity, chest wall compliance, and respiratory muscle strength resulting in decreased vital capacity), reduction of arterial oxyhemoglobin saturation, and an impaired response to hypoxemia and hypercapnia.[11] Older patients have lower tidal volumes and higher respiratory rates than younger patients.[9]

Consequently, older patients have a decreased respiratory reserve and are highly susceptible to hypoxia and hypercapnia in the perianesthetic period. Complications in recovery from anesthesia are of particular concern.

Perianesthetic Considerations

Preoxygenation with 100% oxygen before induction of anesthesia is essential, as increasing the oxygen fraction in the lungs helps prevent hypoxemia during induction and intubation. Care should be taken not to further stress dyspneic patients. The facilities and technical skills to secure an airway and ventilate are a prerequisite to general anesthesia in geriatric patients. Monitoring, including pulse oximetry, capnography, and possibly respiratory blood gas analysis, should continue into the anesthetic recovery period and supportive therapy (e.g., oxygen supplementation) should be continued as indicated.

Gastrointestinal System

Geriatric patients have reduced esophageal motility and gastric acid secretion and a delayed gastric emptying time, all of which place them at a higher risk for aspiration during anesthetic induction and in the postoperative period.[9] Fasting is recommended for patients undergoing elective general anesthesia, but in older patients, to minimize the risk of hypoglycemia, it should be kept to a minimum (generally not longer than 8 hours). Water should be withheld only for a short period of time to minimize dehydration.

Preoxygenation with 100% oxygen before induction of anesthesia is essential, as increasing the oxygen fraction in the lungs helps prevent hypoxemia during induction and intubation.

The liver experiences significant age-related changes, such as a reduction in volume and blood flow and a decline in phase 1 drug metabolizing activity.[3,9] These changes vary between animals but may result in delayed drug metabolism and prolonged duration of action of some anesthetic medications that undergo hepatic metabolism.

Perianesthetic Considerations

Owing to the increased risk of regurgitation and aspiration, appropriate risk management strategies, such as administering gastric protectants, ensuring the airway is secure, and suctioning the esophagus before extubation, should be considered. Patients with preexisting hepatic disease may require further workup, including preanesthesia albumin levels, liver function tests, and coagulation studies, to establish functional baselines. Patients may be prone to hypoglycemia, and blood glucose should be monitored and dextrose supplementation administered if required. Anesthetic and analgesic drugs that primarily undergo hepatic metabolism should be used with caution with appropriate dosing adjustments.[3]

Renal and Endocrine Systems

Renal function declines gradually with age; however, it is worth noting that studies in dogs suggest that age-related nephron loss of up to 75% may occur before clinical or routine biochemical changes indicative of renal disease are seen.[6,12] In cats, chronic kidney disease is relatively common, with the reported prevalence in cats aged 12 to 20 years ranging from 28% to 81%.[13,14] Age-related renal changes reported in

humans include diminished renal blood flow, changes in autoregulation, and renal tubular dysfunction, which may lead to fluid and electrolyte abnormalities.[3]

Increasing age is also associated with a decline in endocrine function secondary to a decrease in hormone production and tissue responsiveness.[3] Common endocrine disorders of geriatric dogs and cats include hyperadrenocorticism, diabetes mellitus, and hypothyroidism; further discussion of the anesthetic management of patients with endocrine disease is available elsewhere.[15]

Perianesthetic Considerations

Older patients will have some degree of renal insufficiency resulting in reduced renal reserve capacity and may be at an increased risk of perioperative acute kidney injury compared with younger patients. During the perioperative period, monitoring and maintenance of adequate blood pressure and renal perfusion are essential. Baseline blood pressure and electrolyte measurement and renal function tests are recommended. Fluid and electrolyte abnormalities should be corrected before surgery, and patients with uremia have been shown to benefit from preanesthetic fluid therapy.[16]

Intraoperative fluid therapy should be tailored to the individual patient, with specific fluid types and rates varying depending on patient presentation and response. Similarly, vasopressors and inotropes should be available to improve cardiac output, although exact indications for use will depend on the patient.

Central and Peripheral Nervous Systems

As the brain ages, its structure and function change, including a loss of brain volume (e.g., neuronal cell loss), increased permeability of the blood–brain barrier, and a decrease in cerebral metabolic rate. Neurotransmitters, such as dopamine and serotonin, also tend to decline. In dogs, an age-related cognitive and behavioral decline is well documented.[17] Combined, these changes in the neurologic system may predispose geriatric patients to postoperative cognitive complications. In people, disorders such as postoperative delirium (acute) and postoperative cognitive dysfunction (chronic) are well recognized;[3] although not well defined in veterinary patients, such disorders most likely occur. Additional changes that should be considered when anesthetizing geriatric dogs and cats include an impaired ability to thermoregulate and diminished sensory functions (e.g., smell, hearing, vision).

Changes in the peripheral nervous system in aged animals typically result in patients being more sensitive to the effects of local anesthetics and neuromuscular blocking drugs.[18]

Perianesthetic Considerations

Age-related changes in the neurologic system (central and peripheral) result in a reduced dose requirement for anesthetic, analgesic, and neuromuscular blocking drugs to produce the desired effect. Geriatric dogs and cats are more at risk than younger animals of experiencing cognitive and behavioural disorders, such as delirium and anxiety, in the postoperative period.

Hypothermia can lead to cardiac arrhythmias, delayed healing, a decrease in anesthetic requirements, increased infection rates, and metabolic acidosis. Hypothermia may also prolong and potentiate the effects of sedative and anesthetic agents.

FIGURE 1. An emaciated geriatric cat. This patient will have difficulty thermoregulating under anesthesia because of its body condition.

Musculoskeletal System

In people, sarcopenia is a geriatric syndrome defined as a progressive and generalized loss of skeletal muscle mass and strength in the absence of disease (**FIGURE 1**), and it has been identified as an independent predictor of mortality and morbidity.[19] A similar decline in musculoskeletal function is observed in dogs and cats, and recent research suggests that the pathophysiology in dogs may be similar to that observed in people.[20] An age-related decrease in lean body mass has been associated with a shortened lifespan in cats[7] and dogs.[21] While older dogs and cats are more likely to be underweight than younger animals, aging is also associated with an increase in adipose tissue and an increase in fat:lean ratio may negatively affect longevity. Extremes in weight have been associated with an increased risk of perianesthetic death in dogs and cats.[2]

Osteoarthritis and degenerative joint disease are common in older dogs and cats, and these patients are often receiving nonsteroidal anti-inflammatory drugs (NSAIDs).

Perianesthetic Considerations

Patients that have obvious muscle wasting or are obese may be at an increased risk of perioperative complications. Changes in body composition and concurrent NSAID use should be considered when choosing anesthetic and analgesic drugs and dosages. For example, maintenance of adequate blood pressure and renal perfusion during anesthesia is important to prevent renal injury in patients concurrently receiving NSAIDs.

PHARMACOLOGY

Normal age-related changes in physiology and subclinical organ dysfunction or coexisting disease may lead to alterations in pharmacokinetics and pharmacodynamics in geriatric patients. Older animals typically have decreased muscle mass, increased adipose tissue, and a reduction in body water. As a result, lipophilic drugs (e.g., many drugs used for anesthesia and analgesia) will have a larger volume of distribution and potentially longer duration of action.[22]

Changes in renal function may result in decreased clearance of drugs eliminated via renal mechanisms and increased sensitivity to drugs with the potential for renal damage. Additionally, drug metabolism in older patients is usually decreased due to reduced hepatic blood flow and a reduction in phase 1 reactions. Older patients may also have greater drug sensitivity; for example, age-related changes in the central nervous system may lead to potentiation of the central nervous system depressive effects of many anesthetics.

Consequently, drug dose adjustments and the selection of drugs with different routes of elimination and/or metabolism may be required to reduce the risk of overdose and toxicosis. If possible, short-acting, reversible drugs should be chosen, and judicious dosing and titration of drugs is advisable until the desired effect is achieved. It is much easier to administer additional drug than to manage the effects of an overdose.

No single anesthetic technique is suitable for all geriatric patients. A balanced anesthetic technique should be chosen that is individualized to the patient and considers the patient's current physiologic state, likely perianesthetic complications, and surgical or procedural goals (**BOX 1**).

Box 1 Balanced Anesthesia and Analgesia

A balanced, multimodal anesthesia and analgesia plan using regional blocks and/or systemic analgesics (e.g., opioids, ketamine) will help reduce the amount of maintenance anesthetic agent required. The concept of balanced anesthesia, introduced by John Lundy in 1926, combines premedication, regional anesthesia, and general anesthesia to obtain analgesia using a balance of drugs and techniques. The idea is to reduce overall drug doses and minimize dose-dependent side effects while retaining desirable analgesic effects. The exact technique and drug combination depend on the patient and surgery to be performed, but in general, local anesthetic techniques are very useful in older patients. As patients can be sensitive to the effects of local anesthetic agents, care should be taken when calculating doses to avoid potential toxicosis.

Premedication

Opioids, phenothiazines, benzodiazepines, and alpha-2 adrenergic agonists are commonly used for the sedation of geriatric patients. These drugs can be used independently or in combination.

Opioids

Opioids provide analgesia and sedation in geriatric patients, with pure μ agonists (morphine, meperidine,

fentanyl, oxymorphone, hydromorphone, and methadone) providing better analgesia than the partial μ agonist (buprenorphine) and the κ agonist/μ partial agonists (butorphanol, nalbuphine).[23] Administration of opioids can result in respiratory depression, and oxygen supplementation should always be available. Opioids cause minimal direct cardiovascular depression but may result in bradycardia that is responsive to anticholinergics.

Some opioids have a relatively short duration of action, which may be beneficial in geriatric patients. Perioperative use of opioids contributes to a balanced anesthetic technique and, depending on the timing of administration, decreases the dose of induction and maintenance anesthetic agents required.

Opioids require hepatic metabolism and should be used judiciously in patients with severe hepatic disease. A decrease in the dose or frequency of administration may be warranted. If adverse effects are seen with the administration of opioids, an opioid antagonist such as naloxone can be administered.

Benzodiazepines

Benzodiazepines (diazepam, midazolam) can be used for tranquilization of geriatric patients and are commonly combined with an opioid for premedication. They cause minimal cardiovascular and dose-related respiratory depressant effects and have a relatively short duration of action (particularly midazolam); however, some patients may become dysphoric and confused after administration.

Benzodiazepines are metabolized by the liver, and a prolonged duration of action may be seen in patients with hepatic disease. Flumazenil, a benzodiazepine antagonist, can be used as a reversal agent if necessary.

Acepromazine

Acepromazine is a phenothiazine with antiemetic, anxiolytic, and antiarrhythmic properties, but it should be used with caution in geriatric patients. Hypotension and hypothermia due to peripheral vasodilation are often observed after administration.

Acepromazine is metabolized by the liver, is not reversible, and has a long duration of action. Blood pressure monitoring and volume support are indicated if acepromazine is administered to a geriatric patient.

Alpha-2 adrenergic agonists

Alpha-2 adrenergic agonists, such as medetomidine and dexmedetomidine, provide effective sedation and analgesia; however, they should also be used with caution in geriatric patients based on their effects on the cardiovascular system (reduced cardiac output, bradyarrhythmias). This class of drug also requires extensive hepatic metabolism, and prolonged and more profound effects are expected in patients with reduced hepatic function.[24]

Anticholinergics

The anticholinergic drugs atropine and glycopyrrolate are used predominantly to treat sinus bradyarrhythmias. Anticholinergics should be used judiciously in geriatric patients because sinus tachycardia increases the myocardial oxygen demand and can result in myocardial hypoxia and arrhythmias.

Sinus tachycardia is poorly tolerated in geriatric patients with preexisting cardiac disease and may precipitate acute myocardial failure. Anticholinergic drugs should not be used routinely, but as necessary, when bradycardia is exacerbating hypotension. Glycopyrrolate may be a better choice in geriatric patients because it has fewer adverse effects. For example, it does not cross the blood–brain barrier, thus central nervous system effects are avoided.

Induction of Anesthesia

Induction of general anesthesia can be achieved by using injectable or inhalational anesthetic agents. Commonly used injectable agents are ketamine/benzodiazepines, propofol, etomidate, alfaxalone, and (outside the United States) thiopentone.

Increased circulation time may cause a delayed response to drug administration. Adequate sedation and careful drug titration assist in reducing the total dose of injectable induction drug required. All induction agents can cause significant respiratory depression. Preoxygenation with 100% oxygen is essential.

Of all the induction agents, only ketamine provides analgesia, so appropriate analgesic drugs should be used concurrently as indicated.

Propofol

Propofol is an injectable anesthetic agent that is rapidly

cleared from the body; some extrahepatic metabolism may occur. Propofol can cause dose-dependent cardiovascular and respiratory depression and should be administered slowly until the desired effect is achieved. Propofol can cause direct myocardial depression and vasodilation, which may result in arterial hypotension. Recovery from this drug is usually rapid and smooth.

Etomidate

Etomidate is a hypnotic induction agent characterized by a rapid onset of action and rapid recovery. Etomidate is an excellent drug choice for patients with preexisting cardiac disease, as after induction of anesthesia it results in good cardiovascular stability with minimal changes to heart rate and arterial blood pressure. Like propofol, it may cause dose-dependent respiratory depression and is best titrated to effect.

Etomidate may inhibit adrenocortical function and so should be used with caution in patients with impaired adrenocortical function (e.g., patients with Addison's disease). In unsedated patients, retching, vomiting, and excitation in the early recovery period have been noted.[25]

TABLE 1 Suggested Drug Doses for Geriatric Small Animals

DRUG	DOSAGE (MG/KG)[a]	COMMENTS
ANTICHOLINERGICS		
Atropine	0.02–0.04 SC, IM, IV	• Anesthetic adjuvant • Treatment of bradycardia
Glycopyrrolate	0.01–0.02 SC, IM, IV	
BENZODIAZEPINES AND TRANQUILIZERS		
Diazepam	0.1–0.4 IV, IM	• SC uptake unreliable • More effective when used in conjunction with an opioid
Midazolam	0.1–0.3 SC, IM, IV	• More effective when used in conjunction with an opioid • Shorter duration of action than diazepam
Flumazenil	0.01 IV	• Benzodiazepine antagonist • Short duration of action
Acepromazine	0.025–0.05 SC, IM, IV	• Use with caution
OPIOIDS (USE LOWER-END DOSES IN CATS)		
Methadone	0.05–0.3 SC, IM, IV	• Good analgesia
Morphine	0.05–0.3 SC, IM	• Good analgesia • Vomiting may occur
Buprenorphine	0.005–0.02 SC, IM, IV	• Slow onset of action • SC route not recommended in cats[27]
Fentanyl	0.005–0.01 IV	• Short acting
Butorphanol	0.1–0.3 SC, IM, IV	• Mild pain only • May provide good sedation
Hydromorphone	0.03–0.1 SC, IM, IV	• Good analgesia
Oxymorphone	0.03–0.07 SC, IM, IV	• Good analgesia
Naloxone	0.01–0.04 IV	• Opioid antagonist • All analgesia reversed • Short duration of action
INDUCTION AGENTS[b]		
Propofol	2–6 IV	• Hypotension and apnea common
Ketamine/diazepam	0.15–0.3/1.5–3 IV	
Etomidate	1–3 IV	
Alfaxalone	1–2 IV	

[a] *Extrapolated from healthy adult doses. Combining drug groups provides balanced premedication.*
[b] *Induction dose rates are for premedicated patients and should be titrated slowly to effect.*

Ketamine

Ketamine is a dissociative anesthetic agent. Anesthesia with ketamine is characterized by good cardiovascular stability; increased cardiac output and tachycardia may result from stimulation of the sympathetic nervous system. Tachycardia increases myocardial oxygen demand, which may result in myocardial hypoxia and subsequent cardiac failure in a compromised patient (e.g., one with hypertrophic cardiomyopathy). Seizures, muscular tremors, and vomiting have been observed with the use of ketamine as a sole anesthetic agent. It is often combined with a muscle relaxant, such as midazolam, to minimize these undesirable effects.

Alfaxalone

Alfaxalone in cyclodextrin is a steroidal anesthetic agent that is commercially available in preserved and unpreserved formulations. Alfaxalone acts rapidly and results in good muscle relaxation and cardiovascular stability with minimal respiratory depression observed at clinical dose rates.[26] It is noncumulative and rapidly metabolized by the liver. Recovery in premedicated animals is usually smooth and uneventful.

FIGURE 2. Monitoring a geriatric dog during anesthesia.

Barbiturates

Barbiturates cause significant cardiovascular and respiratory depression. They are also arrhythmogenic and best avoided in geriatric patients.

TABLE 1 summarizes drug dosages for geriatric patients.

Maintenance of Anesthesia

General anesthesia is commonly maintained with inhalational anesthetic agents. All inhalational agents produce some dose-dependent cardiovascular and respiratory depression. Isoflurane, sevoflurane, and desflurane are all appropriate choices for geriatric patients. These agents require minimal hepatic metabolism and renal elimination.

The minimum alveolar concentration of inhalational agents is reduced in geriatric patients, resulting in a decrease in inhalant anesthetic requirements. Lung changes (pulmonary fibrosis) and hypoventilation in these patients may lower the levels of inhalant reaching the brain and thereby prolong the time needed to reach a stable anesthetic plane.

ANESTHETIC MONITORING AND EQUIPMENT

Minimum monitoring for an anesthetized geriatric patient should include pulse oximetry, capnography, noninvasive blood pressure, ECG, and temperature. Additional monitoring as indicated by individual patient requirements may include invasive blood pressure, central venous pressure, blood gases, blood glucose, and urine output (**FIGURE 2**).

Each patient should have intravenous access, although care should be taken not to stress the patient during restraint for placement. Use of local anesthetic (e.g., EMLA® cream) may improve patient comfort and aid in placing the catheter. Geriatric patients should receive perianesthetic fluid support, but overzealous fluid administration may precipitate congestive heart failure or pulmonary edema, particularly in cats or patients with underlying cardiac disease. As patients are prone to hypothermia, appropriate perioperative warming, such as heated intravenous fluids, breathing circuits, and convective air warmers, should be used.

Geriatric patients have decreased organ reserve, and appropriate supportive drugs and equipment should be readily available. Doses for cardiovascular support and

emergency drugs should be calculated and the drugs drawn up in syringes and prepared if possible. Respiratory support equipment, including endotracheal tubes, oxygen, and equipment for assisted ventilation (e.g., breathing system, rebreathing bag, manometer, mechanical ventilator) should be prepared and checked.

RECOVERY FROM ANESTHESIA

Continued physiologic monitoring and planning for the recovery phase of anesthesia is essential for geriatric patients. Care must be taken to maintain body temperature, as shivering significantly increases oxygen consumption and may lead to hypoxia. Supplemental oxygen may be required until the patient is able to maintain adequate oxygenation on room air. Intravenous fluid therapy should be maintained until the animal has adequate intake of food and water and is hemodynamically stable.

Appropriate analgesia should be continued in the recovery period. Anesthetists should be prepared for postoperative delirium in geriatric patients, and sedatives such as acepromazine, medetomidine, dexmedetomidine, and opioids should be readily available. Distinguishing between pain and delirium in older patients can often be challenging; however, if in doubt, pain relief should always be provided. Geriatric animals often require extra attention and respond well to regular positive interactions with staff.

Hospitalization should be kept to a minimum because these patients often do better at home with their owners. Appropriate nutrition must be instigated as soon as feasible in the recovery period. Each patient should have an individual diet plan based on its current disease status and metabolic requirements.

Comfortable bedding and diligent nursing care should always be provided. Special care needs to be taken with providing support with the positioning of the recumbent or anesthetized patient. Extra padding and support for arthritic joints should be provided when positioning these patients on the surgery table. Geriatric patients with minimal body fat and decreased muscle mass often have bony prominences (hips, hocks, elbows, sternum) that may be susceptible to the formation of decubital ulcers if not padded and protected appropriately.[28]

CONCLUSION

Safely dealing with a geriatric patient requires the veterinary nurse to approach the case well informed and aware of potential complications. The importance of a thorough history and workup cannot be overemphasized for these patients. Drug doses should be reduced, slower response times may be seen, and drugs that have long durations of action are best avoided. The anesthetist needs to be vigilant and prepared to respond to a variety of situations. An understanding of the physiologic and anatomic differences in the geriatric patient will ensure that the anesthetist is well prepared for the successful management of these often complex, challenging, and difficult cases. TVN

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CONTINUING EDUCATION

Anesthesia for Geriatric Patients

LEARNING OBJECTIVES

Upon completion of this article, the reader should be able to:

- Describe the risks associated with administration of anesthetic agents to a geriatric patient.
- Understand basic physiology and pharmacology as related to a geriatric anesthesia patient.
- Understand the importance of developing an anesthesia plan for every patient.

TOPIC OVERVIEW

This article will provide veterinary nurses with the information they need to safely anesthetize geriatric patients, from surgical planning to anesthesia recovery.

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1. **A geriatric patient can be defined as one that has reached _____ of its life expectancy.**
   a. 50%
   b. 60%
   c. 75%
   d. 85%

2. **Age-related cardiovascular system changes in geriatric patients may include all of the following except:**
   a. Alterations in heart rhythm
   b. Diminished ability to respond to hypotension
   c. Myocardial hypertrophy and fibrosis
   d. Increased baroreceptor activity

3. **Age-related respiratory system changes in geriatric patients may include all of the following except:**
   a. Impaired response to hypoxemia and hypercapnia
   b. Decreased lung elasticity
   c. Lower tidal volumes
   d. Increased chest wall compliance

4. **Anticholinergics are administered to veterinary patients to:**
   a. Decrease the heart rate
   b. Treat sinus bradyarrhythmia
   c. Treat sinus tachyarrhythmia
   d. Decrease the heart rate and respiratory secretions

5. **Which drug does not cross the blood–brain barrier?**
   a. Glycopyrrolate
   b. Alfaxalone
   c. Propofol
   d. Atropine

6. **Hypothermia in an anesthetized patient may lead to all of the following except:**
   a. Cardiac arrhythmia
   b. Delayed wound healing
   c. Increase in anesthetic requirements
   d. Increase in infection rate

7. **Neurologic system changes that may predispose geriatric patients to postoperative cognitive complications include:**
   a. Increased permeability of the blood–brain barrier
   b. Neuronal cell loss
   c. Decreased cerebral metabolic rate
   d. Increased levels of neurotransmitters (e.g., dopamine, serotonin)

8. **_____ is one of the most common effects seen with the administration of acepromazine as part of an anesthesia protocol.**
   a. Peripheral vasodilation
   b. Peripheral vasoconstriction
   c. Tachycardia
   d. Bradycardia

9. **Preoxygenating a patient immediately before induction:**
   a. Increases the oxygen fraction in the lungs
   b. Increases uptake of the anesthetic induction agent
   c. Decreases uptake of the anesthetic induction agent
   d. Causes respiratory depression

10. **Which of the following regarding balanced anesthesia in geriatric patients is incorrect?**
    a. Balanced anesthesia techniques should be tailored to the individual patient.
    b. Balanced anesthesia combines premedication, regional anesthesia, and general anesthesia to obtain analgesia using a selection of drugs and techniques.
    c. Balanced anesthesia is intended to reduce overall drug doses and minimize dose-dependent side effects and analgesic effects.
    d. A balanced, multimodal anesthesia and analgesia plan using regional blocks and/or systemic analgesics helps reduce the amount of maintenance anesthetic agent required.