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Geriatric Anesthesia & Analgesia

The physiologic deterioration that occurs with age may cause complications during anesthesia.[1] Awareness of differences in geriatric patients and appropriate planning can help the practitioner avoid problems.

The definition of "geriatric" in this context is important. Most references have reverted to using a percentage of life span for a particular breed (usually 75%–80%) versus a concrete number (such as 8 years old).[2,3] This definition allows for the huge variability in breed life spans. For example, a 6-year-old Chihuahua is not considered geriatric whereas a 6-year-old Great Dane might be.

Geriatric Physiology

Cardiovascular Decline

Functional reserve is reduced with age due to myocardial fibrosis and ventricular free wall thickening.[4] These changes reduce efficiency, filling, and cardiac output. If the pacemaker cells are involved, heart rate may be affected as well. Therefore, to compensate for a decrease in cardiac output, geriatric patients increase stroke volume more than heart rate.[4] This increase is accomplished mainly through increased preload and increased atrial kick.

An increased rate of heart disease is seen in geriatric patients, most notable in dogs are valvular incompetence and conduction abnormalities. Chronic valvular disease is the most common heart disease in the canine geriatric

Preoxygenation prevents hypoxia and cyanosis that may occur immediately after induction.

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Monitoring and support should continue until the patieint regains full control of all physiologic functions.

population; as many as 58% of dogs older than 9 years of age show evidence of chronic valvular disease.[5] Common arrhythmias seen include heart block, bundle branch block, ventricular premature complexes, and atrial fibrillation.[6]

Pulmonary Changes

The pulmonary system also shows widespread changes with age. Mechanically, the patient loses thoracic compliance, has atrophy of the intercostal muscles, and loses alveolar elasticity.[7] These changes cause a decline in the arterial oxygen concentration.[7] The response to decreased oxygen or increased carbon dioxide is also blunted, which creates a slower ventilatory response to respiratory depression or apnea.[8]

Renal Insufficiency

The renal system shows dramatic structural changes that may not be evident clinically.[9] A 50% decrease in functional nephrons is not unusual in the aging animal.[8] The kidney also has decreased renal blood flow and glomerular filtration rate.[6] Drugs that are renally excreted, such as ketamine in cats, will have a longer duration in these patients.

In addition, older patients have difficulty retaining sodium and water, and the renin–angiotensin system becomes less responsive.[7] This decline leaves the patient less able to tolerate hypovolemia and electrolyte and acid–base disturbances. Excreting excess water loads may also be difficult, and overly vigorous fluid or electrolyte therapy can lead to edema or heart failure.[4]

Hepatic Function Decreases

Two factors can cause a significant decrease in the rate of drug metabolism and excretion. First, geriatric patients may have a decrease in liver mass of up to 50%, which leads to decreases in available hepatic enzymes.[4] Second, the age-related decrease in cardiac output decreases blood flow to the liver. Products of the liver, such as coagulation factors, plasma proteins, and glucose, may also be decreased.

Central Nervous System Changes

Total requirement for anesthetics declines as cognitive and sensory functions diminish.[2] The exact cause of this apparent increased sensitivity to anesthetics is not known, but theories include neuron loss, depletion of neurotransmitters, decreased receptor affinity, and changes in myelination.[4,7]

Altered Body Composition & Metabolism

Aging can affect the body's overall composition and metabolism.[10] Geriatric patients tend to have less muscle mass and total body water but a larger percentage of fat, which changes the distribution of fat- or water-soluble drugs.[7] Basal metabolic rate decreases, and poor thermoregulation may lead to hypothermia, which can produce arrhythmias, decreased coagulation, decreased minimum alveolar concentration, and increased risk for infection.[11]

Prevention

Proper patient preparation and monitoring (as summarized in **Table 1**) are the best defense against anesthetic problems in the geriatric animal. In one study, nearly 30% of geriatric animals were found to have undiagnosed, subclinical disease, and 10% had anesthesia canceled because of these disease processes.[12]

Preparation

Proper preparation should begin with a complete history, including all previously diagnosed diseases and current drug administration to avoid interactions. For example, all the cognitive drugs used for geriatric animals can have serious to even deadly interactions with anesthetic or analgesic drugs—tramadol and fluoxetine may potentially cause serotonin syndrome if used concurrently (manifesting as fever, muscle rigidity, seizures, and potential risk for death).

Table 1. Geriatric Patients: Preparation & Monitoring

Preparation

- History (including current medications)
- Physical examination with cardiopulmonary auscultation
- Complete blood count
- Serum biochemical profile
- Electrocardiogram
- Urinalysis

Monitoring

- Blood pressure
- Electrocardiogram
- End-tidal capnography
- Pulse oximetry
- Temperature

Next, a physical examination should be performed, giving particular care to auscultation of the heart and lungs. A complete blood count, serum biochemical profile, and urinalysis should be ordered, and a clotting profile is recommended before any invasive surgical procedure. An electrocardiogram should be obtained, and radiographs, ultrasound, or echocardiography may be indicated in some patients. Attempts should be made to correct any significant fluid or electrolyte abnormalities before administering anesthesia.

Monitoring

Intravenous catheters should be placed in all patients to allow fluid therapy as well as emergency drug administration. Oxygenation prior to induction will help increase the fraction of oxygen in the lungs and arterial blood, which helps prevent hypoxemia during the induction period. Intubation is highly recommended in anesthetized geriatric patients to protect the airway as well as to provide a method for positive pressure ventilation should it become necessary.

Fluids should be provided judiciously during anesthesia to replace fluid losses and counteract the vasodilatory and hypotensive effects of anesthetic agents. Use of a burette system or syringe pump in smaller patients may help prevent inadvertent administration of large volumes of fluids.

In addition to pulse oximetry, monitoring parameters should include electrocardiography, end-tidal carbon dioxide, blood pressure, and temperature. Monitoring urine production (1–2 mL/kg/hr is normal) may also help ensure proper renal perfusion in patients with preexisting renal disease.

Treatment

There is no "ideal" anesthetic combination for a geriatric animal. The decision should be based on the needs of each individual patient and tailored to the individual's responses. However, the dose required for geriatric patients may be reduced by as much as 50% to account for increased sensitivity and reduced distribution, metabolism, and excretion. **Table 2** provides dose recommendations for drugs commonly used in geriatric patients.

For procedures lasting longer than 15 minutes, inhalant anesthetics that are minimally metabolized (such as isoflurane or sevoflurane) are usually recommended. These can be combined with opioid or sedative continuous rate infusions to help reduce negative dose-related side effects.

Hypotension

If the depth of anesthesia can be decreased, this should be attempted first. Either the anesthetics can be decreased or the injectable drugs may be reversed if this will not cause inappropriate analgesia. Substituting a less vasodilating drug may also help; for example, providing a continuous rate infusion of fentanyl (2–10 mcg/kg/hr) may reduce the percentage of inhalant anesthetic needed.

Administering a 5- to 10-mL/kg fluid bolus will help rule out hypovolemia. Ionotropic support maybe needed if the patient cannot tolerate fluids. Dopamine (2–5 mcg/kg/min) and dobutamine (1–10 mcg/kg/min) are beta agonists that cause the heart to beat stronger; however, this action will increase the demand on the heart, so they should be titrated to the lowest possible rate.

Bradycardia

Depth of anesthesia should be assessed. If possible, lighten the plane of anesthesia. An anticholinergic may be necessary but should be used cautiously in geriatric patients because such drugs increase the workload and oxygen demand of the heart. Hypothermia is a common cause of bradycardia as well. If the patient is severely hypothermic (< 91° F), an anticholinergic may not be effective at the time of administration but may create tachycardia after the patient is warmed.

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Table 2. Drugs Commonly Used in Geriatric Dogs & Cats

Drug	IV Dose (mg/kg)	Duration (H)
Premedications & Analgesics*		
Acepromazine	0.025–0.05 (1 mg max)	4–8
Atropine	0.01–0.02	1
Buprenorphine	0.005–0.01	6–8
Butorphanol	0.2–0.4	1–4
Diazepam	0.2–0.4	0.5–3
Fentanyl	0.003–0.01	0.5
Glycopyrrolate	0.005–0.01	2–3
Hydromorphone	0.1–0.2	2–4
Midazolam	0.1–0.3	0.5–2
Morphine	0.05–0.1	2–6
Oxymorphone	0.05–0.1	2–4
Induction Agents		
Etomidate	0.5–1.5	
Ketamine†	2–5	
Propofol	4–6	

* Some premedications can be combined and used as induction agents in certain patients (eg, fentanyl/midazolam)
† Ketamine should be given only in combination with another drug, such as diazepam.

Hypoxemia

The immediate action taken for the hypoxemic animal should be to provide oxygen if you have not already done so. Hypoxemia can be broken into two causes: mechanical or physiologic. First, rule out mechanical malfunction with the anesthetic machine, endotracheal tube, or oxygen supply. Next, confirm that the patient is ventilating adequately. If necessary, provide assisted or controlled ventilation. Positive pressure ventilation should be performed gently, not to exceed 10 to 15 cm H_2O, to prevent overinflation or barotrauma. Finally, auscultate the chest to rule out bronchial intubation, pneumothorax, pulmonary edema, atelectasis, or severe decrease in cardiac output.

Insufficient Anesthetic Depth

Reaching a stable anesthetic plane often takes a prolonged period and is difficult to maintain in the geriatric patient. Physiologic changes and hypoventilation can cause inhaled anesthetic to reach the patient at a slower rate, leading to lower levels. Providing adequate premedication and assisting with ventilation will help smooth anesthesia administration. The addition of constant rate infusion of an adjunctive analgesic during anesthesia may also be helpful.

Prolonged/Rough Recovery

Recovery can be the most difficult period for older patients; monitoring and support should continue until the patient can regain full control of all physiologic functions. Doses of postoperative drugs should be reduced or carefully titrated to establish a good level of analgesia for each particular patient. If profound or prolonged depression occurs, reversal agents may be necessary.

Fluids should be continued throughout recovery to help maintain good perfusion. Older patients are prone to hypothermia, which will slow metabolism and recovery as well. The patient may be unable to increase its own temperature, therefore external heat should be provided. Supportive care, such as additional padding for arthritic patients and bladder expression, will also help keep the animal comfortable and enable a smooth recovery. Dysphoria is common with our more senile patients. Once pain has been ruled out, very low doses of acepromazine may help calm the distressed or dysphoric patient.

See Aids & Resources, back page, for references, contacts, and appendices.

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Collecting urine in a bag allows quantification of urine output.