Neonatal, Pediatric, and Geriatric Anesthesia
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- Neonates are not considered routine candidates for veterinary anesthesia. Due to their size and anatomical and physiological differences, puppies and kittens be challenging to anesthetize safely.
- Early spays and neuters before adoption is a common practice, and knowledge regarding pediatric physiology and pharmacokinetics of anesthetic drugs is essential for successful anesthesia.
- Like us, our pets are living longer. Although most of the customary principles of veterinary general anesthesia are applicable to geriatric patients; there are important differences that should be considered.

Definitions: neonatal, pediatric puppies and kittens
- In humans, the neonatal period is from birth to 4 weeks and the pediatric period is 4 weeks to approximately 2 years old. Adults are considered twenty years and older.
- In small animal veterinary medicine, puppies and kittens are considered neonates from birth to 2 to 4 weeks old, and pediatric patients are 4 to 8 weeks old. Beyond 8 to 12 weeks, puppies and kittens are considered young adults.

Physiological differences of neonatal and pediatric small animal patients.
- Respiratory system: Neonatal puppies and kittens have a greater prevalence of upper airway obstruction due to their large tongues and small airway openings. As they age and tissues grow, these unique anatomical challenges improve in most species except in brachycephalic breeds.
- Rapidly growing puppies and kittens have a high oxygen demand; therefore, they require a high minute ventilation compared with adults. Their tidal volume and functional residual capacity are fixed; therefore they depend on respiratory frequency to meet metabolic oxygen demands. Respiratory control and autonomic responses are immature and easily depressed by anesthetic drugs. Puppies and kittens under the age of 8 weeks old are highly susceptible during anesthetic procedures to apnea and hypoxia.
- Cardiovascular system: Neonates and puppies/kittens (<8 – 12 weeks old) depend on HR to alter cardiac output. They have limited ability to adjust their myocardial contractility, thus stroke volumes are fixed. Unfortunately, they are also prone to bradycardia due to immature sympathetic responses and susceptibility to hypoxemia. Because of their immature vascular and autonomic systems, they cannot rely on vascular tone to help regulate mean arterial pressures (MAP) or tissue perfusion. Neonatal and pediatric blood pressure is almost entirely a function of cardiac output.
- Bottom line: Neonatal and pediatric puppies and kittens require oxygen supplementation and ventilation support, whereas bradycardia should be avoided during general anesthesia.
- Hematology: Neonatal and especially pediatric puppies and kittens under 12 weeks old, do not tolerate blood loss. Hematopoiesis does not begin effectively until approximately 12 weeks of age and fetal hemoglobin is rapidly being removed, making these young patients highly susceptible to anemia. Adult small animal patients can tolerate up to a 20% surgical blood loss, while neonatal and pediatric patients are limited to a loss of 4%.
- Renal and hepatic systems: Although neonatal, pediatric puppy/kitten kidneys and livers are anatomically developed, they are immature functionally until 8 to 12 weeks of age. Their ability to biodegrade anesthetic drugs is slow, resulting in rapid pharmacodynamic effects and slow recoveries. Their renal function, fluid balance, and ability to concentrate urine are undeveloped, making these young animals susceptible to dehydration and intolerant of excessive fluid administration. Glycogen production and storage are inadequate making them susceptible to hypoglycemia.
- Thermoregulation: Neonatal and pediatric small animal veterinary patients have a high surface area with underdeveloped ability to thermoregulate. Severe hypothermia is of great concern during general anesthesia in small patients and may cause brady-arrhythmias, delayed recoveries and possibly death.

Anesthetic considerations for neonatal and pediatric small animal patients.
- Do not fast neonatal and pediatric patients before anesthesia; otherwise, there is a risk of hypoglycemia. The current recommendations are to allow the baby to nurse or feed until anesthesia for patients < 6 weeks old, withhold food no more than 2-3 hours for 6 to 8 week olds, monitor blood glucose at least every 30 to 60 minutes, and administer IV 2.5% dextrose if blood glucose drops below 80-100 mg/dl.
- Anesthetic drugs will produce profound effects and last longer in neonatal and pediatric veterinary patients. Use injectable and premedications judicially. More often it is better to mask induce neonatal patients, intubate, and place an IV catheter without using premedications.
When using injectable drugs, it is recommended to avoid those known to have slow half-lives and require extensive biodegradation (acepromazine for example). Water soluble, short acting drugs, with known antagonists (midazolam, methadone, butorphanol, for example), at lower doses are better choices. Due to the risk of marked bradycardia and decrease cardiac output, alpha two agonists are not recommended in puppies and kittens under 8 weeks old.

Avoid blood loss and use caution when administering IV fluids so as to not overload delicate cardiovascular systems.

Monitor heart rate, ventilation, and oxygenation, body temperature, and blood glucose closely during general anesthesia. Employ external warming devices and bubble wrap extremities to help maintain body temperatures near normal.

Post-operative care should include supplemental oxygen and heat, monitor blood glucose, and supplemental dextrose, as needed, and provide appropriate analgesics.

**Definitions: geriatric dogs and cats**

- Dorland’s Medical Dictionary (27th ed.) defines geriatric as “old age” or elderly. Most people consider human geriatrics as 65 years old because Medicare eligibility begins. Technically, there is no specific age that defines “geriatric” in humans.
- Dogs that have lived 75 – 80% of their lifespan are considered geriatric, which for small breeds is greater than 10 years old, large breeds 6 – 10 years old.
- Cats are considered geriatric when they are 12 years old and older.

**Important considerations for veterinary geriatric anesthesia patients**

- Increased age is NOT equivalent to increased risk of general anesthesia unless there are concurrent disease processes. Brodbelt, et al., estimated the risk of anesthetic depth increased up to 7 times for veterinary geriatric patients greater than 12 years old.
- Biological and physiological age is more important than chronological age when considering anesthesia in older patients.
- Geriatric veterinary patients have blunted homeostatic responses, including autonomic and somatic reflexes.
- Underlying disease processes and urgent care should be treated before commencing to general anesthesia.

**Physiological/pharmacological considerations for veterinary geriatric anesthesia patients**

- Due to decreased metabolic demand, minute ventilation and cardiac output are reduced. The geriatric pulmonary system is less compliant, resulting in an increased work of breathing. Assisted ventilation during general anesthesia is recommended.
- Increased age results in a greater influence of vagal tone and reduced cardiac sympathetic responses. Myocardial and/or degenerative cardiac changes are seen more frequently in elderly veterinary patients, including valvular endocardiosis in small breed dogs and HCM in hyperthyroid cats.
- Although renal and hepatic organ systems continue to work sufficiently in older patients, with age there is a gradual loss of functional capacity. It is advisable to include a CBC and plasma chemistries as part of the pre-anesthetic work-up with geriatric patients. Decreased cardiac output results in decreased hepatic blood flow, which can lead to prolonged drug metabolism and slower patient recoveries.
- Geriatric veterinary patients generally handle most anesthetic drugs and protocols without concern. Clinical differences include increased sensitivities to anesthetic drugs, decreased MAC of inhalant anesthetics, and prolonged recoveries. The exact cause of increased sensitivities to anesthetic drugs seen with geriatric patients is unknown.
- Anesthetic drug recommendations for veterinary geriatric anesthesia patients include lower drug doses and use of short acting, water soluble anesthetic drugs that have known antagonists. Examples of anesthetic drugs used commonly with geriatric veterinary patients include benzodiazepines, opioids, propofol, alfaxalone, isoflurane, sevoflurane, and others.
- Low doses of alpha two agonists are safe to use in geriatric dogs with normal cardiac function. Dexmedetomidine is the drug of choice for elderly cats with HCM; however, ketamine should be avoided.
- Geriatric patients have a higher risk of cognitive dysfunction, which may make them more susceptible to emergence delirium and confusion during anesthesia recovery.
- Judicial dosing of Tramadol is necessary for geriatric patients receiving serotonin/norepinephrine uptake, or MAO inhibitors (selegiline), to avoid serotonin syndrome.

**References**
