# Too Old for Anesthesia? It's Not the Number of Birthdays That Count

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## Abstract

Chronological age alone does not determine anesthetic risk. Instead, anesthetists should potentially mirror human gerontology and evaluate frailty, the cumulative effect of age-associated changes that reduce physiologic reserve or resiliency, and integrate that assessment with physical status classification by the American Society of Anesthesiologists (ASA). The frailty score gives a more in-depth picture of the age-associated changes, and the ASA status provides a structure on which to classify risk for anesthesia adverse events. Together, the scales can be used as the framework for the anesthesia plan, which will include not only the drug protocol but also the potential need for specific physiologic monitoring and support.

## Take-Home Points

- Chronological age is not a contraindication for anesthesia; rather, considerations for anesthesia plans for aged patients should be based on the level of frailty.
- Frailty results in decreased organ reserve, meaning that physiologic responses to stressors (e.g., hypotension, hypercarbia) during anesthesia are blunted.
- A veterinary nurse trained in anesthesia should be dedicated to the frail patient throughout the entire anesthesia process (from preanesthesia to full recovery).

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In discussing risk for anesthesia-associated adverse events with clients, patient age is a common concern. However, similar to human gerontologists, veterinarians should consider the effects of age, not the age itself. Knowledge of anesthesia concerns specific to aged patients is a critical component of everyday practice. Improved preventive care and support of aging patients in veterinary medicine has led to longer lifespans; the percentage of senior/geriatric dogs and cats in veterinary practices is estimated at 44% of the total patient population.[1] Patients of all ages, including senior/geriatric patients, are likely to require anesthesia for emergency procedures (e.g., gastrointestinal foreign body surgery, fracture repair) and/or routine procedures that are necessary to maintain a good quality of life (e.g., dental prophylaxis/surgery, removal of ulcerated masses).

However, not all aged patients are at equal risk for anesthesia-associated adverse events, and the determination of age-associated physiologic changes is exceedingly more relevant than actual patient age. Human gerontology studies emphasize that frailty, defined as reduced physiologic reserve and increased vulnerability to stressors, better predicts perioperative morbidity and mortality than age alone.[2-4] In human medicine, to differentiate between age and frailty, the term "senior" generally means number of years aged, whereas the term "geriatric" means an aged patient with age-associated health concerns. However, in veterinary medicine, these terms are not generally differentiated, and this article uses the terms "aged/frail" or "aged/healthy."

This article answers some of the most frequently asked questions general practice veterinarians have regarding the use of anesthesia in aged small animal patients.

## Q: What is the age cutoff for anesthetizing patients? Is it "senior at 7"?

There is no chronological age limit for anesthesia. Age is not a disease, and there is no basis for the phrase "senior at 7" (i.e., a patient is considered senior when it reaches 7 years of age). Definitions of the term "senior" in dogs vary due to the wide range of breeds and body sizes, meaning that all dogs do not age at the same rate; an exact senior age is not specified, but it is considered to be the last 20% to 25% of the animal's normal expected lifespan.[5] Cats are more uniform in size and breed, and the American Association of Feline Practitioners has defined senior cats as older than 10 years of age.[6] However, as with humans, dogs and cats are individuals and age at different rates.

## Q: Do the physical and physiologic changes of age affect anesthesia plans?

Yes, and the risk for anesthesia-associated adverse events is determined by physiologic age-associated changes rather than the number of years that the patient has lived. Patients of the same chronological age are not necessarily the same physiologic or biological age. For example, an 8-year-old Labrador retriever may be very mobile and active, cognitively sound, and physiologically healthy, whereas another Labrador retriever of the same age may exhibit impaired mobility, cognitive decline, and negative physiologic effects of aging. The anesthesia plans would differ between these 2 patients. Similarly, the plans for 2 younger dogs or cats, one with an American Society of Anesthesiologists (ASA) score of 1 and the other with an ASA score of 4, would differ.[7] Risk factors are based on health, not age, and the cumulation of age-associated health changes is often called "frailty."[2]

## Q: Exactly how does frailty affect patients?

Frailty describes the physical and physiologic changes that limit organ reserve, which means that in a frail patient, physiologic responses to anesthesia-associated stressors, such as hypotension and hypoventilation, would be blunted. As an example, if hypotension is noted in an aged/healthy patient at an appropriate plane of anesthesia, physiologic changes such as increased heart rate and vasoconstriction often occur in response to the blood pressure change and may alleviate the hypotension without anesthetist intervention. In an aged/frail patient with blunted organ reserve, the physiologic response to hypotension may not occur, and blood pressure support may require rapid anesthetist intervention. The same would be true of hypercarbia, which would initiate physiologic changes to increase alveolar ventilation in an aged/healthy patient; however, the anesthetist would likely need to breathe for the aged/frail patient.

**TABLE 1 Physical and Physiologic Characteristics of Aged/Frail Patients That May Affect Anesthesia Protocols[a]**

| PHYSICAL AND PHYSIOLOGIC CHARACTERISTIC |
|---|
| **General Characteristics** |
| ▪ Hypoalbuminemia<br>▪ Decreased skeletal muscle (sarcopenia)<br>▪ Increased body fat |
| ▪ Potential for underlying sources of pain (e.g., arthritis)<br>▪ May be thin with bony prominences (e.g., hips) |
| **Central Nervous System** |
| ▪ Neuronal degeneration<br>▪ Decreased brain mass; cerebral blood flow; and number of neurons, drug receptors, and neurotransmitters |
| ▪ Impaired thermoregulatory system |
| ▪ Dysphoria/anxiety, often resulting from cognitive decline/dysfunction; may be affected by hearing and/or vision deficits |
| **Cardiovascular System** |
| ▪ Myocardial hypertrophy or atrophy<br>▪ Endocardium fibrosis<br>▪ Decreased myocardial contractility (even in the absence of cardiac disease)<br>▪ Decreased ventricular compliance and cardiac reserve<br>▪ Decreased maximum heart rate<br>▪ Cardiac output stroke volume dependent<br>▪ Loss of vascular distensibility so vessels less compliant<br>▪ Sympathetic nervous system less responsive to stress (e.g., anesthesia)<br>▪ Changes in blood volume<br>▪ Decreased vasoconstrictor and baroreceptor responses |
| **Respiratory System** |
| ▪ Loss of ventilation muscle strength<br>▪ Reduced arterial oxyhemoglobin saturation<br>▪ Decreased respiratory response to hypoxemia and hypercapnia<br>▪ Rigid thorax, elasticity loss in lungs, decreased vital capacity, increased alveolar closing volume<br>▪ Higher respiratory rate, lower tidal volumes, less distensible lungs/thorax compared with younger patients[b] |
| **Renal/Urinary System** |
| ▪ Decreased renal blood flow, glomerular filtration rate, tubular function, number of functional glomeruli, and excretory capacity |
| **Hepatic System** |
| ▪ Decreased hepatic mass, blood flow, and function |
| **Gastrointestinal System** |
| ▪ Nutritional deficits possible<br>▪ Lower gastric pH and relaxed esophageal sphincter tone possible |

*[a]Listed changes are general changes associated with age and frailty, but not all are present in all senior/geriatric patients.*
*[b]Should be considered when supporting ventilation.*

| | EFFECT ON ANESTHESIA PROTOCOL |
|---|---|
| | ■ Pharmacokinetic changes can result in exaggerated effects from standard drug doses that would be administered to younger adult patients. Decreased drug dosages are generally required and recovery can be prolonged. Be prepared to provide prolonged support. |
| | ■ Use gentle handling and a robust analgesic protocol, especially for patients with preexisting pain.<br>■ Position and pad carefully. |
| | ■ Exaggerated and/or prolonged effects may occur with drug doses that are standard for younger adult patients and can cause excessive anesthetic depth and prolonged recoveries. Thus, drug dosages should be decreased and anesthetic depth should be carefully monitored; patients may need longer support during recovery. |
| | ■ Hypothermia is a major contributor to delayed recovery. Keep warm; patients may require proactive heat support. |
| | ■ Be prepared to prevent/treat dysphoria/anxiety with previsit anxiolytics and/or sedatives during recovery. Microdoses are generally adequate. |
| | ■ Cardiac reserve is decreased.<br>■ Compensatory changes that would be initiated because of hypotension and/or hypovolemia are less likely. Be prepared to administer blood pressure support proactively.<br>■ Cardiovascular support includes judicious use of IV fluids and inotropic drugs. Chronotropic drugs (e.g., anticholinergics) may be necessary but should be used judiciously as tachycardia will increase cardiac work, which may be detrimental if age-associated changes are present in the myocardium. However, acute changes in intravascular volume are less tolerated; therefore, prevent fluid underloading and overloading. |
| | ■ Respiratory reserve is decreased.<br>■ Work of breathing is increased and vital capacity is reduced; therefore, hypoxemia and hypercapnia are more common and less tolerated. Oxygen and ventilatory support may be required for many patients and may need to be continued into recovery. Preanesthesia supplemental oxygen is recommended.<br>■ In recovery, shivering resulting from hypothermia can cause oxygen consumption to exceed delivery (i.e., oxygen debt). Keep the patient warm and consider oxygen support during recovery, especially if shivering. |
| | ■ Prolonged duration of action of renally cleared drugs may prolong recovery time and decreased tolerance to fluid load. Do not overhydrate. Check electrolytes! |
| | ■ Prolonged duration of hepatically cleared drugs, and potentially decreased cardiac output with subsequent decreased delivery of drugs to the liver, may prolong recovery time. Hepatic disease may also cause hypoalbuminemia and hypoglycemia. |
| | ■ Poor body condition can contribute to hypothermia and pressure-associated tissue damage. Support normothermia and use good padding, especially over bony prominences.<br>■ Regurgitation and aspiration may be more likely and more damaging to the lungs. Use antiemetics and secure the airway with the endotracheal tube cuff inflated as soon as the tube is placed in the trachea. |

## Q: Are frailty scores available for veterinary patients, and should we be using them?

Yes, some veterinary frailty scores are still in development; however, clinical tools and a robust body of research information are also currently available for use.[8-20] Because of the increasing number of aged (senior/geriatric) patients, frailty scores should be considered when assessing these patients in general, not just for anesthesia. The scoring systems, or scales, may seem a bit daunting due to the frequently large number of questions, but much of the information included in the frailty scores is the same information as that assessed for a routine preanesthesia (or any other) examination. Included are physical examination findings, health history, blood/serum analyses, and specific tests (e.g., electrocardiography). Also included are findings more commonly seen in aged patients (e.g., decreased mobility, changes in hearing and vision, cognitive decline). Thus, frailty scores/scales are very robust evaluations that enable appropriate ASA status assignment.

## Q: What organ systems can be affected by age-associated changes?

Any organ system can be affected by the aging process, resulting in diminished reserve of that system (**TABLE 1**). The systems for which aging changes are most concerning for the anesthetist are the central nervous, cardiovascular, respiratory, renal, and hepatic systems, which may respond poorly or inappropriately to anesthetic changes. The patient may have arrhythmias, hypotension, hypercarbia, or hypoxia or

**TABLE 2 Anesthesia/Analgesia Protocols for Aged/Healthy and Aged/Frail Patients**

| ANESTHESIA STAGE | AGED/HEALTHY | AGED/FRAIL |
|---|---|---|
| Preparation | ▪ Use anxiolytics for anxious patients.<br>▪ Consider antiemetics.<br>▪ Control preexisting pain if possible as acute pain (surgery) in addition to chronic pain amplifies the overall pain level. | ▪ Use anxiolytics for anxious patients (common among frail patients), but use the low end of the dose to decrease sedation.<br>▪ Administer antiemetics; regurgitation is more common in geriatric patients.<br>▪ Control preexisting pain, if possible, as acute pain (surgery) in addition to chronic pain amplifies the overall pain level, which adds to physiologic stress already present. |
| Premedication | ▪ Consider sedatives used in younger patients with an equivalent ASA score (e.g., $\alpha_2$ agonists, acepromazine).<br>▪ Opioids are used as analgesics and may contribute to sedation. | ▪ Reversible drugs may be optimal because drug duration can be prolonged.<br>▪ Opioids alone may provide adequate sedation.<br>▪ Acepromazine duration can be prolonged in patients with hepatic dysfunction and can contribute to inhalant-induced hypotension. |
| Induction | ▪ Consider induction drugs used in younger patients with an equivalent ASA score (e.g., propofol, alfaxalone, ketamine+benzodiazepine). | ▪ Use short-duration drugs (e.g., propofol, alfaxalone), and administer doses lower than those administered to aged/healthy patients.<br>▪ Administer at a slower rate to allow full effect before administering more drug.<br>▪ Wait longer between "top up" dosages. |
| Maintenance | ▪ Administer low-dose inhalants, and keep dose low by using appropriate analgesics (e.g., local anesthetics). | ▪ Administer lowest dose of inhalants possible, and keep dose low by using appropriate analgesics (e.g., local anesthetics).<br>▪ Handle tissue gently while performing local blocks (true for all patients, but even more critical for frail patients because their tissues are often fragile and easily damaged). |
| Recovery | ▪ Meet patient needs (e.g., more sedation, analgesia, reversal drugs [rarely]). | ▪ Meet patient needs.<br>▪ Expect longer recoveries; may need benzodiazepines or low-dose sedatives if dysphoric.<br>▪ Frail patients are more likely than nonfrail patients to need reversal drugs. |

*ASA=American Society of Anesthesiologists*

may be overly sensitive to drugs and slow to eliminate drugs. Close monitoring and rapid responses are essential for aged/frail patients.

## Q: Which drugs are safest for aged/frail patients?

The answer depends on underlying age changes or disease (**TABLE 2**); however, for aged/frail patients, the safest choices are often fast onset/offset drugs that can easily be titrated to effect and quickly eliminated and/or drugs that have reversible effects. No drugs are contraindicated due to patient age, but underlying disease processes will affect choices. For example, $\alpha_2$ agonists might be avoided for patients with dilated cardiomyopathy and NSAIDs might be avoided for patients with International Renal Interest Society stage 3 chronic kidney disease. Acepromazine might be avoided in patients with moderate-to-severe hepatic disease as hepatic elimination of the drug is required for cessation of drug effects.

When determining an anesthesia protocol, drug dose is often more important than actual drug choice. Frail patients may require little to no sedation or may be adequately sedated with opioids alone. Induction drug dosages should be lower than those required for aged/healthy patients, and the drug should be administered more slowly than to aged/healthy patients because circulation is often impaired, meaning that the time to reach the brain is longer. To remember not to overdose the patient by actual dose or rate of administration, use the phrase "go low and slow" when inducing anesthesia in frail patients. Anesthesia should be maintained with the lowest dose of inhalant possible because the cardiovascular and respiratory depressant effects of inhalants can be quite profound in aged/frail patients. The dose of inhalants can be decreased by using robust analgesia, especially local/regional blocks or longer-acting opioids for premedications, or continuous rate infusions during the procedure.

- **At home:** Before the patient is brought to the office, consider having the client administer low-dose anxiolytics (e.g., trazadone, gabapentin) and potentially antiemetics (e.g., maropitant). For patients with preexisting pain, analgesics should be started. Be cautious with use of NSAIDs as the risk for hypotension and possible renal damage can be greater in the frail patient.
- **Premedication:** For some patients, premedicate for sedation/analgesia with opioids alone or add a low dose of $\alpha_2$ agonists (reversible) for those with no heart disease. If $\alpha_2$ agonists are contraindicated, a low dose of alfaxalone could be added to the intramuscular opioid. However, the current concentration of alfaxalone limits the intramuscular route of administration to cats and small dogs. Adequate sedation or calming is critical—do not wrestle with the patient. The physiologic stress of being excessively restrained is highly dangerous for aged/frail patients due to their low physiologic reserve.
- **Induction:** Use a benzodiazepine/propofol "sandwich" (propofol-benzodiazepine-propofol).
- **Maintenance:** Use low-dose inhalants plus analgesics.
- **Recovery:** Tailor care to the individual patient.

## Q: What do you say to clients who are concerned about anesthetizing their aged pets?

Honesty is crucial. The client should understand that anesthesia-associated physiologic changes can negatively affect aged pets and that the effect may be magnified if their pet is frail. Concerns should not be dismissed with phrases such as, "Don't worry; nothing bad will happen." Instead, reassure the client that a thorough assessment of their pet's needs will be determined with diagnostics indicated by the individual pet and that a plan tailored to their pet will be developed. Assure them that a team member will be dedicated to their pet's care, and let them meet that team member if possible.

## Q: What do we need to know to safely anesthetize frail patients?

The quick answer is do not use chronological age to determine the risk for anesthesia-associated adverse events. Thoroughly assess the patient, use the information in the frailty score, and assign an ASA status, as with patients of any age (**TABLE 3**). Control preexisting pain. Build physiologic support into the anesthesia plan, assign the patient to a dedicated veterinary nurse with anesthesia experience, diligently monitor the patient's physiologic status throughout all stages of anesthesia, and quickly correct any negative physiologic changes.

**TABLE 3 Checklist for Anesthesia/Analgesia of the Aged/Frail Patient**

| ANESTHESIA STAGE | TASK* |
|---|---|
| **Preanesthesia (before the day of anesthesia)** | ▪ Perform a thorough health analysis that includes physical examination, extensive medical history, laboratory analysis (e.g., serum chemistry, CBC, urinalysis), plus any other pertinent diagnostics (e.g., electrocardiography, imaging, echocardiography).<br>▪ Stabilize all comorbidities to the greatest extent possible, including acute disease (e.g., in-hospital IV fluids for 1 to 2 hours before anesthesia) and chronic disease (e.g., at-home administration of pimobendan for 30 days before anesthesia).<br>▪ Control preexisting pain. |
| **Preanesthesia (day of anesthesia)** | ▪ Maintain at-home dosing of prescribed anxiolytics, or consider adding anxiolytics if not a component of the patient's current medication. Use low-end dosages.<br>▪ Maintain at-home dosing of prescribed analgesics. Administer antiemetics at home or in hospital.<br>▪ Refer to guidelines for more information on drugs to continue or discontinue.[4]<br>▪ Schedule the procedure early in the day to allow time for preparation and slow recoveries and to decrease hospitalization time, which can be stressful for some patients, especially those with preexisting anxiety, cognitive decline or other mentation changes, impaired vision, and/or impaired hearing.<br>▪ Assign a dedicated, experienced veterinary nurse to the patient who will be with the patient from start to finish.<br>▪ Repeat any necessary tests (e.g., blood/serum analyses, electrocardiography, blood pressure).<br>▪ Respect changes in mobility and ensure that the patient can move securely (e.g., nonslip mats, harnesses).<br>▪ Handle the patient gently, and be aware of preexisting pain (e.g., patients with elbow osteoarthritis should not have the front leg fully extended for catheter placement).<br>▪ Administer drugs for preventive analgesia (e.g., opioids, NSAIDs if appropriate).<br>▪ Administer a low dose of sedatives; consider using reversible drugs.<br>▪ After the patient is calm, start monitoring (monitoring is never too early)!<br>▪ After the patient is calm, preoxygenate the patient for 5 minutes. If the patient resists, consider adding more sedative drugs. |
| **Induction** | ▪ Use the "low/slow" technique (low drug doses administered slowly to give the drugs time to reach the brain before redosing).<br>▪ Intubate rapidly and inflate the cuff (patients may regurgitate).<br>▪ May need to start breathing for the patient. |
| **Maintenance** | ▪ Pay full attention to physiologic monitoring and support.<br>▪ Be prepared to respond quickly to physiologic changes. Do not wait for them to correct themselves. May need to breathe for the patient and support blood pressure.<br>▪ Keep the inhalant dose as low as possible, which is facilitated by appropriate use of analgesia.<br>▪ Maintain normothermia, which may require more support in frail than healthy aged patients.<br>▪ Keep surgery time as short as possible; physiologic changes can be exacerbated by long duration of anesthesia.[21] |
| **Recovery** | ▪ Be sure a veterinary nurse stays with the patient until the patient is fully conscious.<br>▪ Continue monitoring and support as needed. Most unexpected anesthetic deaths occur during recovery.[21]<br>▪ Continue to support normothermia.<br>▪ Can reverse sedatives if necessary, but warm the patient first; hypothermia is often a major contributor to prolonged recoveries. Do not reverse analgesic drugs; the exception could be reversal for noninvasive procedures (e.g., imaging) but only in the absence of preexisting pain.<br>▪ Assess pain score! Administer analgesic drugs if pain is present.<br>▪ Consider low-dose sedation if the patient is dysphoric. Also, ensure good patient support (e.g., human attention). After the patient is extubated and physiologically stable, consider having the client continuing recovery with the patient, which is often very calming for the patient. Communicate to the client the expected patient responses, and provide a means to call for assistance if needed.<br>▪ Decrease hospitalization time by discharging the patient as soon as it is fully awake and physiologically stable.<br>▪ Schedule postanesthesia/surgery recheck for 3 to 4 days postoperatively, depending on the level of frailty. |

**Underlined tasks are critical tasks that should not be omitted.*

## Summary

Advanced patient chronological age is not a contraindication for anesthesia; however, age-associated physiologic changes that increase frailty (i.e., decreased physiologic reserve) can affect the anesthetic protocol and require increased monitoring and support. The frailty score should be incorporated into the ASA status determination. The keys for safe anesthesia include not only a thorough evaluation of patient health and stabilization of preexisting conditions (e.g., cardiac disease, chronic pain) but also a veterinary nurse dedicated to the patient and an anesthesia team that is prepared to recognize and correct any adverse intra-anesthesia physiologic effects. TVP


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