Dental Prophylaxis in a Dog

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THE CASE

Benny, a 7-year-old spayed beagle, is presented for dental prophylaxis with possible extractions.

Benny is up to date on vaccinations and monthly heartworm, flea, and tick preventive and is fed a maintenance dry food twice a day. She spends most time indoors and only goes outside for short leash walks, which, according to the owner, tire her out quickly. Her BCS is 6/9. A heart murmur was detected at a veterinary examination the previous month, and furosemide (1 mg/kg PO q12h) and enalapril (0.25 mg/kg PO q12h) were prescribed.

A clinician had previously recommended against anesthesia for the prophylaxis, but the client remains concerned about halitosis and a painful tooth that may require extraction. A grade II/VI left systolic heart murmur is confirmed on physical examination. Stage 3 periodontal disease is also present.

A thorough preanesthetic workup is recommended. The client agrees to a CBC, serum chemistry profile, urinalysis, blood pressure measurement, electrocardiogram (ECG), and thoracic radiography but declines referral to a cardiologist for an echocardiogram. CBC and serum chemistry profile show a slightly elevated blood urea nitrogen (BUN) of 39 mg/dL (reference range, 10-32 mg/dL) and a creatinine of 1.8 mg/dL (reference range, 0.6-1.4 mg/dL). The urine specific gravity is 1.024. Systolic blood pressure measurements on Doppler average 140 mm Hg (normal, 110-160 mm Hg). The ECG does not reveal any significant abnormalities, and thoracic radiographs do not show any cardiac enlargement or lung changes associated with congestive heart failure.

A premedication of acepromazine (0.02 mg/kg IM) and morphine (0.5 mg/kg IM) is administered. An IV catheter is placed, and she is induced with propofol (3 mg/kg IV). She is intubated and placed on isoflurane for maintenance. IV lactated Ringer's solution (5 mL/kg/hr) is initiated. The pulse oximeter, ECG leads, Doppler, blood pressure cuff, and sphygmomanometer are attached; an anesthetic record is kept and a dental imaging study conducted. The procedure progresses well until Benny is repositioned from right to left lateral recumbency and systolic pressure drops to 70 mm Hg.

WHAT ARE THE APPROPRIATE NEXT STEPS?

CHOICE 1

Quickly administer a 10 mL/kg bolus of lactated Ringer's solution.

CHOICE 2

Assess the anesthetic depth, and turn down the vaporizer.

BUN = blood urea nitrogen
ECG = electrocardiogram

CHOICE 1

Quickly administer a 10 mL/kg bolus of lactated Ringer's solution.

A 10 mL/kg bolus of lactated Ringer's solution is administered over 5 minutes. Several minutes postadministration, the pulse oximeter reading drops from 97% to 90%. The systolic pressure on the Doppler is 75 mm Hg. On closer examination of the endotracheal tube, white foamy fluid is noted. Auscultation of the patient's lungs reveals bilateral crackles and increased respiratory rate. Furosemide (1 mg/kg IV) is administered. Thoracic radiographs reveal interstitial to alveolar infiltrates highly suggestive of cardiogenic pulmonary edema due to iatrogenic fluid overload. The patient's respiratory rate slows, and the pulse oximeter reading rises to 95%. However, the decision is made to discontinue anesthesia and recover the patient for further evaluation of the degree of cardiovascular disease.

CHOICE 2

Assess the anesthetic depth, and turn down the vaporizer.

The anesthetic depth is assessed by checking jaw tone, palpebral reflexes, and eye rotation. The patient appears to be in an adequate plane of anesthesia, so the vaporizer setting is decreased from 2% to 1.5% isoflurane. The blood pressure cuff and Doppler are also checked to ensure no inadvertent movement occurred when the patient was repositioned.

After 5 minutes, systolic blood pressure remains 70 mm Hg. The patient has a slow palpebral reflex and increased jaw tone. Dobutamine is administered as a constant-rate infusion (CRI) at 5 µg/kg/min via a syringe pump. Dobutamine has a rapid onset of action (≈2 minutes), so blood pressure should increase soon after the infusion is initiated.

At the next blood pressure reading ≈5 minutes later, systolic pressure is 80 mm Hg. Although this is an improvement, >90 mm Hg would ensure a mean arterial pressure >60 mm Hg and maintenance of perfusion of the vital organs. Dental radiographs are almost complete, but Benny swallows and starts to show signs of being in a light plane of anesthesia. A bolus of fentanyl (5 µg/kg IV) is administered to allow a lower concentration of isoflurane. The bolus was successful, so a CRI of fentanyl (9 µg/kg/hr) is started; this rate has been shown to decrease the mean alveolar concentration of isoflurane in dogs by ≈50%.[1]

A few minutes after starting the fentanyl infusion, the vaporizer is adjusted to 0.75% isoflurane. The patient develops sinus bradycardia (heart rate, 52 bpm) and is still hypotensive, potentially exacerbated by administration of the opioid infusion. Glycopyrrolate (0.01 mg/kg) is administered, with one-half the dosage administered IV and one-half administered IM. Within a few minutes, the patient's heart rate rises to ≈90 bpm, and systolic blood pressure is 94 mm Hg.

A caudal maxillary nerve block is administered using 0.5 mL of bupivacaine (0.5%) with a 25-gauge needle a few minutes before extraction of the third premolar on the left upper maxilla (207). The extraction takes place with no further complications. Benny is given carprofen (4.4 mg/kg SC) in recovery, extubated within 15 minutes of discontinuing anesthesia, and closely monitored for 2 hours. A forced-air warming blanket is used to return body temperature to normal. After a few more hours, Benny is alert and able to walk. She is released. The owner is instructed to offer a small amount of soft food that evening, and a follow-up phone call is scheduled for the next afternoon to check on Benny's recovery.

Knowledge of the extent of cardiovascular compromise based on a thorough cardiac diagnostic investigation may help with selecting anesthetic drugs.

DISCUSSION

In this case, the recommendation for the echocardiogram could have been more strongly emphasized. Stressing the importance of an accurate diagnosis and knowledge of the extent of cardiovascular compromise based on a thorough cardiac diagnostic investigation may help with selecting drugs used in the anesthetic period and may lead to a recommendation of avoiding anesthesia.

Other potential changes for this case that could have been discussed on initial evaluation include assessing BCS and discussing the option of withholding enalapril on the day of anesthesia. Drug doses should be based on lean body weight rather than actual body weight. Because Benny had a BCS of 6/9, the final drug doses of acepromazine and propofol could have been scaled back to correlate with her ideal body weight. Clinician preference may dictate whether cardiac medications should be administered on the day of anesthesia. If cardiac medications are controlling a dysrhythmia or promoting cardiac contractility, these drugs should not be discontinued. In the author's experience, withholding an angiotensin-converting enzyme inhibitor (eg, enalapril, benazepril) on the day of anesthesia prevents a detrimental decrease in afterload that is not well tolerated in anesthetized dogs. In a recent study, enalapril administered to healthy dogs 90 minutes before isoflurane anesthesia increased the degree of intra-anesthetic hypotension and the number of interventions required to correct moderate-to-severe hypotension.[2]

Drug Selections

On review of the anesthetic plan, the choice of premedication with acepromazine and morphine followed by induction with propofol

CRI = constant-rate infusion

could also be scrutinized. Acepromazine causes tranquilization but can also lead to hypotension due to α-1 adrenergic blockade. Because it is a long-lasting drug with no reversal agent, acepromazine is typically avoided in patients with cardiovascular disease. Morphine used alone in older dogs and those with cardiovascular disease often produces adequate sedation. An alternative opioid choice for this patient would be an equivalent dose of hydromorphone, which does not have the potential to cause vasodilation due to the release of histamine that can occur with morphine, although vasodilation is usually only seen after IV morphine administration.

Propofol was not the ideal induction agent for this patient and should have been avoided if possible. Propofol can cause respiratory depression, cardiovascular depression, and marked vasodilation, which is transient and will not cause complications in most healthy patients. However, in patients with pre-existing cardiovascular disease, the reduction in systemic vascular resistance and negative inotropic effects from propofol administration can lead to a dose-dependent hypotension that would be detrimental to the patient. A safer induction agent for patients with cardiovascular disease may be etomidate (1 mg/kg IV) because of its small effect on heart rate or blood pressure. It is often administered immediately following a dose of a benzodiazepine (eg, 0.2 mg/kg IV midazolam or diazepam) to produce a smoother induction quality. Etomidate is typically affordable and can be stocked by general practitioners for induction of patients with cardiovascular disease.

An alternative induction plan for Benny could have been fentanyl (5 µg/kg IV) with a benzodiazepine (midazolam or diazepam at 0.2 mg/kg IV), ketamine (5 mg/kg IV) and midazolam or diazepam (0.2 mg/kg IV), or alfaxalone (1-2 mg/kg IV). These drug combinations are typically more cardiovascular sparing than propofol alone. Maintenance anesthesia with isoflurane can be cost effective but can cause dose-dependent hypotension. Sevoflurane is another choice of inhalant for anesthesia; adjustments to the vaporizer would occur more quickly, which can be beneficial in patients with deep hypotension. However, opinion varies about whether the adjustability of sevoflurane is of significant benefit as compared with isoflurane in such cases. Balanced anesthesia using fentanyl CRI from the start of anesthesia could have offered minimum alveolar concentration reduction and decreased the likelihood for hypotension.

Fluids

Further review of this case could prompt the anesthetist to select a lower IV fluid rate (eg, 3 mL/kg/hr), as there was no significant blood loss involved in the procedure. Physical examination should have detected any underlying issues with hydration. BUN and creatinine were slightly elevated, but these changes are expected for a patient receiving furosemide. Historically, low-sodium IV fluids (eg, 0.45% NaCl/2.5% dextrose) were recommended; however, hypovolemic patients warrant a balanced electrolyte solution (eg, lactated Ringer's solution) instead of a hypotonic crystalloid

FACTORS THAT MAY REDUCE ANESTHETIC RISK IN PATIENTS WITH CARDIOVASCULAR DISEASE

- Accurate diagnosis of underlying cardiac disease before anesthesia
- Avoiding drugs that have profound cardiovascular effects (eg, α_2-agonists, acepromazine, propofol)
- Providing adequate physiologic monitoring before, during, and after the procedure
- Preoxygenating patient ≈5 minutes before induction
- Adequately planning for a case and preoperative patient preparation
- Considering a multimodal approach to reduce inhalant anesthesia requirements
- Using IV fluids conservatively

during anesthesia at a conservative rate. Hypotonic solutions have a large volume of distribution and could potentially lead to cellular swelling if given as a replacement fluid.

Colloid solutions should be avoided, as they will expand the intravascular volume for a longer period of time as compared with crystalloid solutions and therefore could lead to volume overload in a patient with cardiac dysfunction. Even a bolus of crystalloid solution should be carefully considered in this patient. A patient that is euvolemic or hypervolemic should not be given a fluid bolus. If a patient with known but unclassified cardiac abnormalities requires a fluid bolus, the dose should be reduced significantly; it should be administered over a longer period of time and carefully monitored.

There are many ways to reduce anesthesia risk in veterinary patients (see ***Factors that May Reduce Anesthetic Risk in Patients with Cardiovascular Disease***). A primary goal when administering anesthesia should be to decrease the time under anesthesia when possible.

BUN = blood urea nitrogen

CRI = constant-rate infusion

References

1. Simões CR, Monteiro ER, Rangel JP, Nunes-Junior JS, Campagnol D. Effects of prolonged infusion of fentanyl, with or without atropine, on the minimum alveolar concentration of isoflurane in dogs. *Vet Anaesth Analg*. 2016;43(2):134-144.
2. Coleman AE, Shepard MK, Schmiedt CW, Hofmeister EH, Brown SA. Effects of orally administered enalapril on blood pressure and hemodynamic response to vasopressors during isoflurane anesthesia in healthy dogs. *Vet Anaesth Analg*. 2016;43(5):482-494.

Suggested Reading

Mama K, Ames M. Anesthesia for dogs with myxomatous mitral valve disease. *Clinician's Brief*. 2016;14(8):99-105.