OSCAR, A 14-YEAR-OLD, CASTRATED DACHSHUND MIX, presented with a 1–2 day history of progressive cough, intermittent tachypnea with increased respiratory effort, and lethargy, and no interest in eating or drinking in the previous 12 hours. His 3-year history of heart murmur was characterized on imaging as myxomatous mitral valve (MV) disease with moderate left atrial enlargement; enalapril therapy was started at diagnosis. On examination, he was anxious and shaking. His heart and respiratory rates were 170 beats per minute and 60 breaths per minute, respectively. He was normothermic and normotensive. A grade IV/V systolic heart murmur was detected with a point of maximal intensity over the left apical region; heart rhythm was regular, and pulses were strong and synchronous. Lung sounds were increased, with no crackles or wheezes. Thoracic radiographs showing progressive left atrial and ventricular enlargements, mildly enlarged pulmonary veins, a moderate patchy unstructured interstitial pattern in the right caudal lung lobe, and a mild unstructured interstitial pattern in the left caudal lung lobe were consistent with pulmonary edema. Caudal mainstem bronchi were compressed on lateral projections secondary to the cardiomegaly and left atrial enlargement. Radiographic findings were compatible with left-sided congestive heart failure (CHF) secondary to MV disease.

Which of the following drugs would be appropriate in acute management of this patient?

Based on the information provided, how would you grade the following drugs and why?

**Turn the page and compare your results**

CHF = congestive heart failure, MV = mitral valve
Acepromazine

Acepromazine is a strong sedative with potent vasodilatory properties. Low-dose acepromazine may be added to the treatment protocol for a very anxious patient that cannot be managed with more cardiofriendly choices (eg, opioids). However, caution should be used in any dog with low blood pressure. The author’s preferred sedation in an anxious dog with CHF is butorphanol, because its dose–response effect is more predictable than that of acepromazine.

Atenolol

Atenolol is a selective \( \beta_1 \)-adrenergic blocker. Although this dog’s heart rate is fast and sympathetic nervous system activated, heart rate suppression with a \( \beta \)-blocker should be avoided because of possible worsening of heart failure caused by atenolol’s actions of lowering heart rate and decreasing contractility. Because this patient’s heart rate is not pathologically fast and is appropriate for his level of nervousness and cardiac insufficiency, it should be lowered by administering antianxiety drugs and successfully managing the pulmonary edema.

Butorphanol

Low-dose injectable butorphanol, a sedative and good antitussive, is safe to administer to an anxious dog with respiratory distress. A breathless sensation, unfamiliar environments, and patient–owner separation can accelerate the fight-or-flight response and lead to further decompensation.

Enalapril

Before this presentation, this dog had been receiving the ACE inhibitor enalapril for its proposed cardioprotective effects. Enalapril should be continued in this dog. However, in acute management of a dog with CHF, an ACE inhibitor could be withheld transiently until the dog is stable, eating, and drinking well, at which time the author generally reinstitutes and increases the enalapril dose to q12h.\(^1\)\(^-\)\(^4\) The primary benefit of ACE inhibitors (eg, enalapril, benazepril) is thought to be renin-angiotensin-aldosterone system (RAAS) inhibition, leading to a survival benefit in dogs with CHF. ACE inhibitors are only modest systemic vasodilators and thus may not provide adequate
afterload reduction in the acute management phase of CHF; they can also reduce renal perfusion pressure and decrease glomerular filtration rate, resulting in azotemia.

**Furosemide**

Injectable furosemide is the most effective immediate treatment for this dog’s cardiogenic pulmonary edema. The IV route is ideal because of its rapid-onset action and bioavailability. However, if IV administration is too stressful for a patient, the IM or SC routes would be acceptable alternatives. After the patient is more stable and breathing more comfortably, the transition to oral furosemide can be made.

**IV lactated Ringer’s solution**

Although this dog had not eaten or drunk for 24 hours before presentation, IV fluids (eg, lactated Ringer’s solution) are contraindicated because of the sodium load. This dog should be able to withstand transient lapse of fluid and food intake while heart failure medications improve his condition. However, it is important to keep oral water available at all times during hospitalization.

**Nitroglycerin**

Nitroglycerin is a topical venodilator that reduces preload by dilating the splanchnic vasculature. Nitroglycerin augments preload reduction but is not generally used as a sole vasodilator, as the effects are fairly weak. Nitroglycerin is generally used only in acute management of heart failure because of the potential for the patient to develop tolerance if used continuously.⁵

**Pimobendan**

In the U.S., pimobendan is available in large chewable tablets, which may be difficult for a dog with respiratory compromise to swallow. However, as soon as the dog is breathing more comfortably, oral pimobendan is indicated for emergency management. The peak effect of pimobendan, an inodilator, is within 1 hour of administration. Pimobendan is indicated in all cases of CHF secondary to MV disease.¹⁴
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REFERENCES

Spironolactone | CORRECT RESPONSE
Spironolactone is a potassium-sparing diuretic that blocks the aldosterone receptor at the renal distal tubule. The primary hypothetical benefits of spironolactone are its aldosterone-inhibition effects, leading to a potential survival benefit in dogs with MV disease and CHF. Because spironolactone is not a potent diuretic and does not have rapid-onset action, it would not be an appropriate choice for acute management of a dog with CHF. Spironolactone should be introduced after the patient has been stabilized with other heart failure medications.

Theophylline | CORRECT RESPONSE
Theophylline, like aminophylline, is a methylxanthine bronchodilator that is most helpful for small airway bronchodilation in dogs with chronic bronchial disease. Addition of a bronchodilator should only be considered if concurrent airway disease is highly suspected. Possible side effects of this class of drugs include tachycardia, diarrhea, and anxiety, all of which are particularly undesirable in patients with heart disease.

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