Thoracoscopic subtotal pericardiectomy and right atrial mass resection in a dog

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Case Description—A 10-year-old spayed female Corgi mix was examined for a 3-week history of lethargy and weight gain.

Clinical Findings—Physical examination findings included muffled heart sounds and a distended abdomen with a fluid wave on ballottement. Thoracic radiography revealed a globoid cardiac silhouette, and thoracic ultrasonography indicated pericardial effusion and a pedunculated mass originating from the right auricle.

Treatment and Outcome—Initial treatment consisted of pericardiocentesis. One week later, thoracoscopic right atrial mass resection was performed. No surgical complications were noted, and the dog was discharged approximately 28 hours after surgery. Results of histologic examination of the mass indicated a grade 2 hemangiosarcoma with incomplete margins. Treatment with doxorubicin was initiated 35 days after surgery. The dog survived for 177 days after mass resection, when it was euthanized because of complications related to metastatic disease.

Clinical Relevance—Findings suggested that thoracoscopic right atrial mass removal combined with adjunct doxorubicin treatment may be a viable alternative to thoracotomy in dogs with right atrial masses. (*J Am Vet Med Assoc* 2010;237:551–554)

A 10-year-old 20.7-kg (45.5-lb) spayed female Corgi mix was examined for a 3-week history of lethargy and weight gain. Evaluation revealed a distended abdomen and possible splenic mass with free abdominal fluid evident on abdominal radiographs. The patient was referred to a specialty hospital.

On arrival at the referral hospital, the dog was bright, alert, and responsive. Physical examination revealed a distended abdomen with a fluid wave on ballottement; muffled heart sounds were heard during auscultation of the thorax. Initial diagnostic testing included a CBC, serum biochemical evaluation, thoracic radiography (right lateral, left lateral, and ventrodorsal views), electrocardiography, and thoracic and abdominal ultrasonography.

Clinicopathologic abnormalities included thrombocytopenia (167,000 platelets/µL; reference range, 200,000 to 500,000 platelets/µL), hypoalbuminemia (2.2 g/dL; reference range, 2.5 to 4.4 g/dL), hypoproteinemia (4.8 g/dL; reference range, 5.4 to 8.2 g/dL), and mild hyperglycemia (117 mg/dL; reference range, 60 to 110 mg/dL). Evaluation of thoracic radiographs revealed a globoid cardiac silhouette. There was no evidence of neoplastic disease, and the radiographic appearance of the lung fields was considered within normal limits. Thoracic ultrasonography indicated pericardial effusion with a 3.8 × 3.3-cm pedunculated mass attached to the right auricle. Abdominal ultrasonography revealed congestion of the liver with dilatation of the hepatic veins and ascites. Ultrasonographic appearance of the spleen and kidneys was unremarkable. Evaluation of an initial ECG indicated sinus tachycardia with no ventricular beats.

Pericardiocentesis was performed, and approximately 180 mL of hemorrhagic fluid was removed. Sedation was not required because of the patient's quiet demeanor. There were occasional episodes of ventricular tachycardia during the procedure, and an occasional premature ventricular complex was seen up to 2 hours after pericardiocentesis was completed. A sample of abdominal fluid was obtained via abdominocentesis, and the pericardial and abdominal fluid samples were submitted for cytologic analysis. The pericardial fluid consisted of a combination of peripheral blood and evidence of prior hemorrhage. Some reactive mesothelial cells were seen, but there was no evidence of neoplasia. The abdominal fluid was classified as a modified transudate with nondegenerative neutrophils and reactive mononuclear cells. The dog was hospitalized overnight with continuous ECG monitoring; balanced crystalloid replacement fluid[a] at 50 mL/h (60 mL/kg/d [27.3 mL/lb/d], IV) and lidocaine (100 µg/kg/min [45.5 µg/lb/min], IV) were administered. The dog was discharged from the hospital the day after pericardiocentesis. Prior to discharge, multiple treatment options were discussed with the owner including repeated pericardiocentesis and surgical options such as palliative pericardiectomy and pericardiectomy with mass resection.

A week later, the dog was returned to the referral hospital for thoracoscopic pericardiectomy and right atrial mass resection. The owner reported that the dog had been doing well at home during the preceding week. The dog was premedicated with hydromorphone (0.05 mg/kg [0.023 mg/lb], SC), and anesthesia was induced with a combination of propofol (5 mg/kg [2.3 mg/lb], IV) and midazolam (0.2 mg/kg [0.09 mg/lb], IV) and was maintained with isoflurane in oxygen. A

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central venous catheter (via the jugular vein) and an arterial catheter were placed after anesthesia had been induced, prior to commencement of surgery. Blood typing was also performed before the start of surgery, and the dog was found to be DEA 1.1 positive. A continuous rate infusion of fentanyl (5 µg/kg/h, IV) was started before surgery. Cefazolin (22 mg/kg [10 mg/lb], IV) was administered at the start of surgery. The dog was monitored during surgery by use of pulse oximetry, continuous ECG, and capnography; arterial blood pressure was measured with a transducer. Manual ventilation was performed during surgery to control overall inflation of the lungs while providing adequate visualization of the surgical field.

The dog was positioned in dorsal recumbency, and a subdiaphragmatic portal was created for insertion of a 5-mm thoracoscope. Intercostal portals were created bilaterally at the fifth intercostal space. Mediastinal tissues were dissected to allow for visualization of the pericardium. The pericardium was incised, and a 6-cm window was established ventral to the phrenic nerves. A small amount of bloody fluid was released into the pleural space as the pericardium was opened. The right auricular mass was identified and excised at its junction with the atrium by use of thoracoscopic instruments, including a 45-mm-long linear stapler with 3.5-mm staples.[b] The mass was removed via enlargement of one of the intercostal portal incisions and submitted for histopathologic examination. A thoracostomy tube was placed, and the thorax was closed routinely. The thoracostomy tube was aspirated until negative pressure was obtained, and bupivacaine (2 mg/kg [0.9 mg/lb]) was then infused into the pleural cavity via the thoracostomy tube.

Recovery from anesthesia was routine. The dog was connected to a continuous ECG monitor, and supplemental oxygen was administered for the first 2 hours after surgery via a tight-fitting face mask. Postoperative treatments included IV administration of isotonic fluids containing electrolytes (50 mL/h); continuous rate infusions of fentanyl (2 to 5 µg/kg/h, IV), ketamine (2 µg/kg/min, IV), and lidocaine (35 µg/kg/min [15.9 µg/lb/min], IV); and IV administration of cefazolin (22 mg/kg, IV q 8 h). The thoracostomy tube was aspirated every 15 minutes for the first hour after surgery and then hourly until no fluid or air was obtained over a continuous 4-hour period. Thereafter, the tube was aspirated every 6 hours overnight. For adjunctive pain control, lidocaine (1 mg/kg [0.45 mg/lb], intrapleurally) and bupivacaine (1 mg/kg, intrapleurally) were administered through the thoracostomy tube every 6 hours after tube aspiration.

Arterial blood gas analyses were performed 1 and 2 hours after the completion of surgery. One hour after surgery, the alveolar-arterial gradient in partial pressure of O_2 was 14 mm Hg (reference limit, < 15 mm Hg); Pa_{O_2} and Pa_{CO_2} were within reference limits. Two hours after surgery, the alveolar-arterial gradient, arterial pH, Pa_{O_2}, and Pa_{CO_2} were all within reference limits. Central venous pressure, arterial blood pressure, and results of a continuous ECG were all within reference limits overnight.

The morning following surgery, the dog was bright, alert, and responsive. Physical examination at that time revealed some mild oozing from the intercostal incision site that was enlarged to allow mass removal, but results were otherwise unremarkable. Continuous monitoring of central venous pressure, arterial blood pressure, and the ECG was discontinued at this time. The PCV was 40%, and total protein concentration was 5.5 g/dL. Central venous pressure was 1 cm H_2O immediately prior to discontinuation of monitoring. The thoracostomy tube was removed because no fluid or air had been aspirated through the tube overnight; final doses of lidocaine and bupivacaine were administered intrapleurally just prior to tube removal.

The dog continued to do well the day after surgery. Intravenous administration of cefazolin, fentanyl, ketamine, and lidocaine was discontinued by midafternoon, and oral administration of tramadol (4 mg/kg [1.8 mg/lb], PO, q 8 h) was instituted for further pain control. The dog was discharged later that evening with directions that the owners return it 14 days later for a follow-up examination and staple removal.

Histologic examination of the right atrial mass revealed a grade 2 hemangiosarcoma with incomplete margins, and the attending pathologist remarked that there was a high risk of recurrence or metastasis of the tumor. The dog was referred to the internal medicine department for discussion of chemotherapy options when the results of histopathologic testing were obtained. The initial consultation with the internist was not scheduled by the owners until 22 days after surgery.

Treatment with doxorubicin (30 mg/m^2, IV, every 3 weeks, for a total of 5 doses) commenced 35 days after surgical resection of the mass. A CBC was performed, and PCV and total protein concentration were measured before each dose of doxorubicin was administered. Results were within reference limits each time. Before the second dose of doxorubicin was administered, the dog was premedicated with maropitant citrate[c] (1 mg/kg, SC) because of signs of nausea and vomiting that had developed following administration of the first dose of doxorubicin, and metoclopramide (0.24 mg/kg [0.11 mg/lb], PO, q 8 h) was prescribed. This same treatment protocol was used for each subsequent dose of doxorubicin. The only other complication reported was lethargy for 1 to 2 days after administration of each dose of doxorubicin. The dog's weight remained stable during treatment with doxorubicin, and the owner reported that the dog was otherwise doing well at home.

Approximately 50 days after the conclusion of chemotherapy (ie, 169 days after surgery), the dog was returned to the hospital with a chief complaint by the owner of a 2- to 3-day history of coughing when excited and labored breathing. The dog had otherwise been doing well, with a good appetite and normal activity level. Abnormalities noted on physical examination included tachypnea and harsh lung sounds. Results of cardiac auscultation were unremarkable. Thoracic radiography revealed diffuse miliary nodules throughout all lung fields, consistent with metastatic hemangiosarcoma. Prednisone (1 mg/kg, q 24 h, PO) was prescribed for palliation of the cough. Eight days later, the dog was reexamined

with a history of a worsening cough, tachypnea, and an inability to sleep comfortably owing to respiratory compromise. The owners elected euthanasia of the dog at that time because of a declining quality of life and evidence of metastatic disease. A necropsy was not performed.

Discussion

Hemangiosarcoma is a common neoplasm in dogs, representing approximately 5% of all noncutaneous primary malignant neoplasms.[1] Hemangiosarcomas originate from vascular endothelium and are known to rapidly metastasize.[2–4] Common sites of involvement include the spleen, right atrium, subcutaneous tissue, and liver.[3–5] Common complications of hemangiosarcoma, regardless of location, include spontaneous hemorrhage and anemia.[4] This type of neoplasm is strongly associated with disseminated intravascular coagulation, and patients with hemangiosarcoma are at high risk for spontaneous hemorrhage owing to the fragility of the abnormal vessels formed within the tumor. Clinical signs of cardiac hemangiosarcoma are generally related to pericardial effusion and signs of right-sided congestive heart failure, including ascites, exercise intolerance, and dyspnea.[2] Common abnormalities on physical examination include muffled heart sounds, tachycardia, pale mucous membranes, weak femoral pulses, an abdominal fluid wave, and dyspnea.[2,3]

In the dog described in the present report, subtotal pericardiectomy and right atrial mass resection were performed by means of thoracoscopy. Thoracoscopy has been used previously as a minimally invasive way to examine the thoracic cavity and obtain biopsy specimens.[6] In human medicine, thoracoscopy is being used for a number of applications.[7,8] More recently, there has been interest in thoracoscopic surgical procedures in small animals, including subtotal pericardiectomy for the treatment of dogs with bleeding cardiac masses or idiopathic pericardial effusion. Authors of a study[6] involving 13 dogs with neoplastic or idiopathic pericardial effusion that underwent thoracoscopic-guided pericardiectomy concluded that this was a viable option with several advantages over thoracotomy. No anesthetic complications were identified, and only 3 of the 13 dogs had procedural complications, including phrenic nerve transection, iatrogenic lung laceration, and moderate intraoperative bleeding. Recovery time was < 24 hours in 12 dogs; 1 dog with an iatrogenic lung laceration was hospitalized for 36 hours.[6] These results[6] and results from human patients[7–9] indicate multiple advantages of thoracoscopy in properly selected patients, with the major advantage being the less invasive nature of the procedure when compared with thoracotomy. Thoracoscopic procedures have the advantage of small incision sites and do not require rib retraction. Patients still require placement of a thoracostomy tube after surgery to allow evacuation of air from the pleural cavity, but they do not have the associated discomfort of a large incision.[10] In the previous study[6] involving 13 dogs that underwent thoracoscopic pericardiectomy, reported difficulties were mainly associated with proper visualization of the desired field of view.

Treatment of cardiac hemangiosarcoma in dogs may include medical and surgical options. Many patients will have evidence of metastasis at the time of diagnosis, which may lead owners to opt for palliative treatments, such as repeated pericardiocentesis with or without adjunct chemotherapy, instead of pericardiectomy and mass resection. In dogs with evidence of metastatic disease, mass resection is only palliative; therefore, many clinicians recommend subtotal pericardiectomy without mass resection.[3] However, a recent study[3] of 23 dogs that underwent median sternotomy or lateral thoracotomy for pericardiectomy and mass removal revealed promising results, with 20 of the 23 dogs surviving to discharge from the hospital.

Adjuvant chemotherapy protocols have been used previously in dogs with hemangiosarcoma with mixed results. Doxorubicin-based protocols reportedly have moderate efficacy, but protocols that do not include doxorubicin have had limited or no efficacy in dogs with hemangiosarcoma.[5] In a study[3] limited to dogs with cardiac hemangiosarcoma, mean survival time after mass resection without chemotherapy was 46 days, whereas mean survival time was 164 days for dogs that also received adjuvant chemotherapy.

To our knowledge, this is the first published report of a thoracoscopic subtotal pericardiectomy and right atrial mass resection in a dog. The patient in this report had a short postoperative hospitalization time and had no major anesthetic or operative complications. The success of the procedure in our patient was likely related, at least in part, to the experience of the surgeon in thoracoscopic and minimally invasive surgical procedures. Considerable training and experience and specialized equipment are required to safely perform this type of surgery, and these factors should be considered when referring a patient for similar treatment. Survival time in this dog after mass resection was 177 days, which was similar to mean survival time in a previous study[3] of dogs with right atrial hemangiosarcoma that underwent mass resection and adjuvant chemotherapy. These results suggest that thoracoscopic mass resection may be a viable alternative to thoracotomy in dogs with right atrial hemangiosarcoma. Possible complications of thoracoscopic right atrial mass resection are similar to those associated with mass resection via thoracotomy and include bleeding from the resection site, cardiac arrhythmia, and pain.[3] Complications unique to thoracoscopy include poor visualization of the surgical field and uncontrolled hemorrhage necessitating thoracotomy. However, in the dog described in the present report, none of these complications developed. The complete mass could be visualized during the procedure, and no problems were noted with placement of the linear stapling device around the base of the mass.

a. Normosol-R solution, Hospira Inc, Lake Forest, Ill.
b. Endo GIA Roticulator 45-3.5 SULU, Covidien Animal Health, Mansfield, Mass.
c. Cerenia, 10 mg/mL injectable solution, Pfizer Animal Health, New York, NY.

References

1. Ogburn PN. Cardiovascular system. In: Slatter D, ed. *Textbook of small animal surgery*. Vol 2. 2nd ed. Philadelphia: WB Saunders Co, 1993;2106–2111.
2. Thamm DH. Miscellaneous tumors. In: Withrow SJ, Vail DM, eds. *Small animal clinical oncology*. 4th ed. St Louis: Saunders Elsevier, 2007;785–795.
3. Weisse C, Soares N, Beal MW, et al. Survival times in dogs with

right atrial hemangiosarcoma treated by means of surgical resection with or without adjuvant chemotherapy: 23 cases (1986–2000). *J Am Vet Med Assoc* 2005;226:575–579.
4. Nelson RW, Guillermo Couto C. Selected neoplasms in dogs and cats. In: Nelson RW, Guillermo Couto C, eds. *Small animal internal medicine*. 3rd ed. St Louis: Mosby, 2003;1142–1155.
5. Sorenmo KU, Baez JL, Clifford CA, et al. Efficacy and toxicity of a dose-intensified doxorubicin protocol in canine hemangiosarcoma. *J Vet Intern Med* 2004;18:209–213.
6. Jackson J, Richter KP, Launer DP. Thoracoscopic partial pericardiectomy in 13 dogs. *J Vet Intern Med* 1999;13:529–533.
7. Das K, Rothberg M. Thoracoscopic surgery: historical perspectives. *Neurosurg Focus* 2000;9:e10.
8. Seder CW, Hanna K, Lucia V, et al. The safe transition from open to thoracoscopic lobectomy: a 5-year experience. *Ann Thorac Surg* 2009;88:216–225.
9. Landreneau RJ, Hazelrigg SR, Mack MJ, et al. Postoperative pain-related morbidity: video-assisted thoracic surgery versus thoracotomy. *Ann Thorac Surg* 1993;56:1285–1289.
10. Walsh PJ, Remedios AM, Ferguson JF, et al. Thoracoscopic versus open partial pericardectomy in dogs; comparison of postoperative pain and morbidity. *Vet Surg* 1999;28:472–479.

From this month's *AJVR*

Effects of topical administration of latanoprost, timolol, or a combination of latanoprost and timolol on intraocular pressure, pupil size, and heart rate in clinically normal dogs

Lynsey N. Smith et al

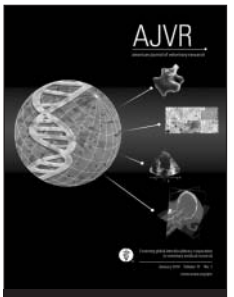
Objective—To determine effects after topical administration of latanoprost, timolol, or a commercially available latanoprost-timolol combination twice daily on intraocular pressure (IOP), pupil size (PS), and heart rate (HR) in clinically normal dogs.

Animals—17 clinically normal dogs.

Procedures—A randomized controlled clinical trial was performed with a treatment (n = 9) and saline (0.9% NaCl) solution group (8). Each dog in the treatment group received 3 treatments (latanoprost, timolol, and the latanoprost-timolol combination), with a 14-day washout period between treatments. Baseline values were established on day 1 of each treatment period. On days 2 through 5, drugs were administered topically every 12 hours to 1 eye of each dog in the treatment group. In both groups, IOP, PS, and HR were measured at 0, 2, 4, 6, 8, and 9 hours on days 2 and 5.

Results—Eyes treated with latanoprost or the latanoprost-timolol combination had a significant decrease in IOP and a significantly smaller PS, compared with results for dogs receiving only timolol or dogs in the saline solution group. Timolol and the latanoprost-timolol combination both significantly lowered HR, compared with HR following administration of latanoprost and the saline solution.

Conclusions and Clinical Relevance—Topical administration of latanoprost alone was as effective at lowering IOP as was administration of the latanoprost-timolol combination when both were given every 12 hours to clinically normal dogs. Timolol, either alone or in combination with latanoprost, appeared to have little or no effect on IOP in clinically normal dogs but was associated with a reduction in HR. (*Am J Vet Res* 2010;71:1055–1061)



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