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CASE REPORT

Permanent dual chamber epicardial pacemaker implantation in two dogs with complete atrioventricular block

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Abstract Between November 2013 and December 2013, two dogs with complete atrioventricular (AV) block had a permanent, dual chamber epicardial pacing system implanted. Steroid-eluting unipolar, button-type epicardial leads[a] were sutured to the right atrial appendage and right ventricular wall via a right thoracotomy in both dogs. The pacemakers were programmed in VDD mode. Permanent dual chamber epicardial pacemaker implantation was successful in both dogs with no intra-operative complications. One dog had an acute onset of neurologic signs two days post-operatively that resolved within 24 h. Both dogs have had complete resolution of the clinical signs related to the bradyarrhythmia, and one dog has had complete resolution of chylothorax. One dog had a major lead complication characterized by intermittent loss of capture that resolved by increasing the pacemaker output. Based on the outcome of these two cases, implantation of permanent dual chamber epicardial pacing systems is possible in dogs providing an alternative to dual chamber transvenous systems.

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Abbreviations

ACVIM	American College of Veterinary Internal Medicine
AP	artificial cardiac pacing
AV	atrioventricular

Case 1

A seven-year-old spayed female Cavalier King Charles spaniel was referred to the cardiology service at the Colorado State University Veterinary Teaching Hospital for evaluation of an approximately four-day history of lethargy, exercise intolerance, and decreased appetite with an inappropriate bradycardia (heart rate = 40 bpm). Initial diagnostics included an ECG, echocardiogram, Doppler blood pressure, complete blood count, biochemical profile, thoracic radiography, and urinalysis. Testing for heartworm, Lyme disease, *Anaplasma phagocytophilum*, *Ehrlichia canis*, *Ehrlichia ewingii* and *Anaplasma platys* was also done.[b] The ECG showed third-degree atrioventricular (AV) block with a ventricular escape rhythm that was unresponsive to atropine (0.04 mg/kg SQ; no AV nodal conduction noted post atropine). The Doppler echocardiogram showed degenerative mitral valve disease (ACVIM stage B2[1]), degenerative tricuspid valve disease with severe tricuspid regurgitation, severe right atrial and right ventricular dilation, and moderate pulmonary hypertension (estimated pulmonary arterial systolic pressure based on tricuspid regurgitant jet velocity was 78.0 mmHg). A definitive etiology for the pulmonary hypertension was not identified on thoracic radiographs, heartworm testing, or echocardiography although it may have been secondary to chronic left-sided heart disease. During the echocardiogram, the transducer was directed toward the abdomen and a small volume of ascites was noted which was presumed to be secondary to right-sided heart failure. An underlying etiology for the bradyarrhythmia was not identified, and no evidence of significant non-cardiac disease was found. Treatment with a permanent artificial cardiac pacemaker was advised and, due to the severe structural heart disease and heart failure present, a dual chamber pacemaker system was recommended in attempt to optimize cardiac performance by maintaining AV synchrony and intrinsic heart rate variability. Furthermore, the risk of lead dislodgement, intracardiac thrombus, and myocardial perforation were deemed considerable with transvenous pacing due to the severe right ventricular dilation. For these reasons, dual chamber pacing with epicardial lead placement was recommended.

The dog was premedicated with fentanyl (1 μg/kg IV). A flow-directed, temporary transvenous pacing lead[c] was introduced percutaneously into the right jugular vein through a 6 Fr vascular sheath[d] and advanced using fluoroscopic guidance into the right ventricle. The lead was attached to a temporary transvenous pacemaker[e] for chronotropic support during anesthesia. Anesthesia was then induced using fentanyl (1 μg/kg IV), midazolam (0.0.21 mg/kg IV), and etomidate (0.72 mg/kg IV). After induction of general anesthesia, a permanent dual chamber epicardial pacemaking system,[a,f] was implanted using the surgical procedure described in detail below. The pacemaker was programmed in VDD mode[2] to provide atrioventricular synchrony as well as ventricular tracking of the sinus rate. Initial pacing parameters were programmed as follows: lower rate limit 100 bpm; upper tracking rate 180 bpm; sensed AV delay 110 ms; paced AV delay rate adaptive 90—140 ms; post ventricular atrial refractory period 180 ms; post ventricular atrial blanking 180 ms; ventricular refractory period 230 ms; atrial lead sensitivity 0.5 mV; ventricular lead sensitivity 2.8 mV; pulse amplitude 3.5 mV; pulse duration 0.4 ms.

The dog recovered uneventfully from anesthesia and was discharged the next day. A brief echocardiogram immediately prior to discharge showed reduction of right ventricular dilation and severity of tricuspid regurgitation as well as improvement in the estimated pulmonary artery pressure (estimated pulmonary arterial systolic pressure based on tricuspid regurgitant jet velocity decreased from 78.0 mmHg to 46.4 mmHg). The dog was rechecked at one month post-implantation where T-waves were frequently misidentified as P-waves on pacemaker interrogation. The T-wave amplitude measured from the ventricular lead was 0.6 mV, and the P-wave amplitude measured from the atrial lead was 2 mV. Therefore, the atrial lead

[a] CapSure Epi® (model 4965) pacing lead, Medtronic Inc., Minneapolis, MN, USA.
[b] SNAP 4Dx Plus Test, IDEXX Laboratories, Westbrook, ME, USA.
[c] Swan-Ganz bipolar pacing catheter (model 970-120-5F), Edwards Lifesciences, Irvine, CA, USA.
[d] FAST-CATH™, St. Jude Medical, Plymouth, MN, USA.
[e] Single chamber temporary pacemaker (model 5248), Medtronic Inc, Minneapolis, MN, USA.
[f] Adapta® ADDRL1 pacing generator, Medtronic Inc, Minneapolis, MN, USA.