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Permanent Transvenous Cardiac Pacing in a Beagle Dog With a Third Degree Atrioventricular Block

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Abstract : A 2.8-year-old intact female Beagle dog (weighing 11 kg) was referred with the primary complaint of exercise intolerance with occasional syncope. Physical examination revealed irregularly irregular heart rhythm with persistent pulse deficits. The 12-lead surface ECG showed a third degree heart block. Permanent transvenous cardiac pacing with a bipolar implantable pacemaker was performed in the right ventricle. After pacemaker implantation, the dog did not show syncopal episode and is currently able to take a walk with an owner. No side effects associated with permanent pacemaker implantation has been observed to date.

Key words : Cardiac pacing, Beagle, bipolar pacemaker, heart block, bradyarrhythmia.

Introduction

Cardiac pacing is used in the treatment of bradyarrhythmias in small animals. While temporary cardiac pacing achieved by temporary pacemaker generator (e.g. Model 3085 Dual chamber temporary pacemaker, St Jude medical, USA) is generally used in dog with high risk of cardiac arrest in general anesthesia, permanent cardiac pacing achieved by small implantable pacemaker is widely used to treat bradycardic rhythm disturbances (e.g. high grade heart block, sick sinus syndrome, vasovagal syncope) in dogs (7).

A pacemaker is a small, battery-powered device that is implanted permanently into the body. The pacemaker monitors the electrical impulses in the heart and, when needed, delivers electrical stimuli to normalize heart rhythm disturbances. A pacemaker consists of a battery and electrical circuitry (pulse generator). The battery powers the pacemaker. The circuitry checks the heart rate and produces tiny electrical pulses that keep the heart beating at the correct pace. Based on the location of pacing, the pacemaker is divided into atrial pacing, ventricular pacing and dual pacing (4). The pacemaker is also divided into single chambered (Pacemaker use only one lead placed into the right atrium or the right ventricle), dual chambered (Pacemaker has two leads. One is placed in the right atrium, the other in the right ventricle) or cardiac resynchronization therapy pacemaker (Pacemaker has three leads. One is in the right atrium, one is in the right ventricle, and one is placed through the coronary sinus to the left ventricle) (7).

Since this technique was first utilized in a dog with congestive heart failure (CHF) due to complete (third degree) atrioventricular (AV) block in 1967 (2), permanent pacemaker implantation is now widely used to treat dogs with bradycardiac arrhythmias. In this case report, we described the successful transvenous pacemaker implantation in dogs with a third degree heart block for the first time in Korea.

Case

A 2.8-year-old intact female Beagle dog (weighing 11 kg) was referred at Veterinary Teaching Hospital of Kangwon National University with the primary complaint of exercise intolerance with occasional syncopes. The dog had severe exercise intolerance with occasional syncopal episodes espe-

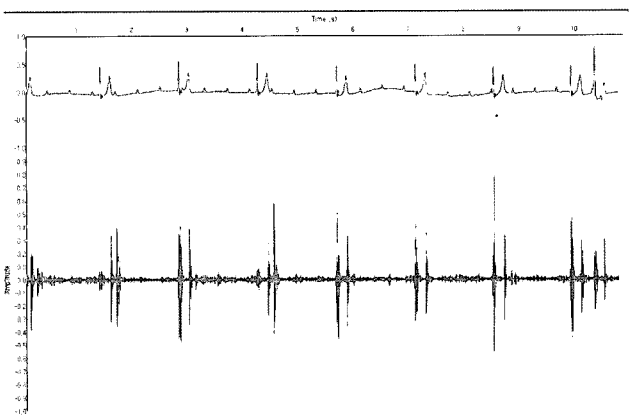

Fig 1. Phonocardiography revealed irregularly irregular heart rhythm with persistent pulse deficits.

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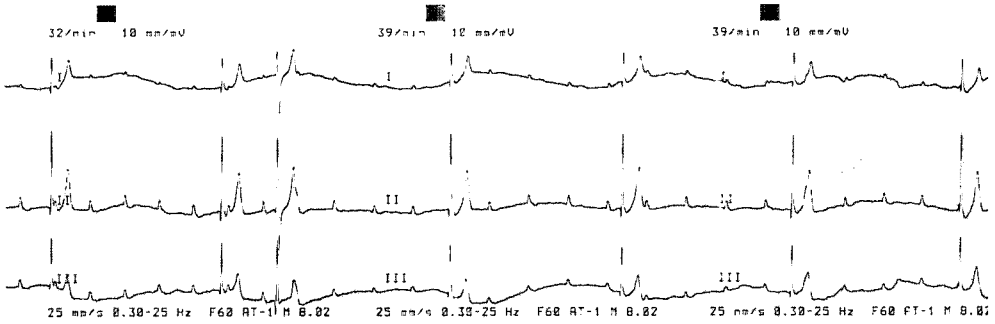

Fig 2. The 12 lead-electrocardiographic (ECG) showed escape beats and severe P and QRS dissociation (atrial rate 120-130 bpm, ventricular rate 40-50 bpm) indicating a third degree atrioventricular (AV) block.

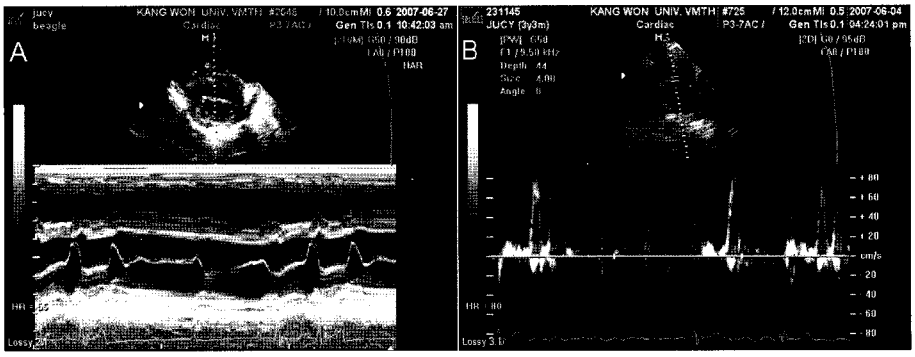

Fig 3. Echocardiography of this case. A: The M-mode echocardiogram demonstrated irregular and absent ventricular contraction. B: Spectral Doppler echocardiogram demonstrated occasional absence of E wave (ventricular contraction). The E and A waves were clearly visible in the first contraction. However, there were only A wave in the 2nd and 3rd contraction, corresponding with P-QRS dissociation in the ECG.

cially after the excitement and exercise. In thoracic auscultation, the heart rhythm was irregularly irregular with persistent pulse deficits (Fig 1). However, no murmur was detected in both side of the heart. Complete blood cell count (CBC) and serum chemistry profiles have no significant abnormalities. Furthermore full neurological examination failed to detect any abnormalities. On the day of presentation, 12 lead-electrocardiographic (ECG) studies revealed escape beats and severe P and QRS dissociation (atrial rate 120-130 bpm, ventricular rate 40-50 bpm) indicating a third degree atrioventricular (AV) block (Fig 2). No prominent abnormalities were observed in the thoracic radiography, suggesting etiology might be an isolated rhythm disturbance rather than arrhythmias secondary to anatomical heart disease. The echocardiographic study revealed irregular ventricular contraction and left reduced ventricular function (Fig 3). Based on diagnostic findings, the case was diagnosed as third degree atrioventricular block.

To improve clinical condition of this dog, a permanent transvenous cardiac pacing with a bipolar implantable pacemaker was decided. For pacemaker implantation, the dog was premedicated by atropine (0.05 mg/kg, SC) and butorphanol (0.2-0.4 mg/kg) followed by induction of anesthesia with the combination of ketamine (10 mg/kg) and diazepam (0.2 mg/kg). After tracheal intubation, the anesthesia is maintained by isoflurane with 2-5% concentration.

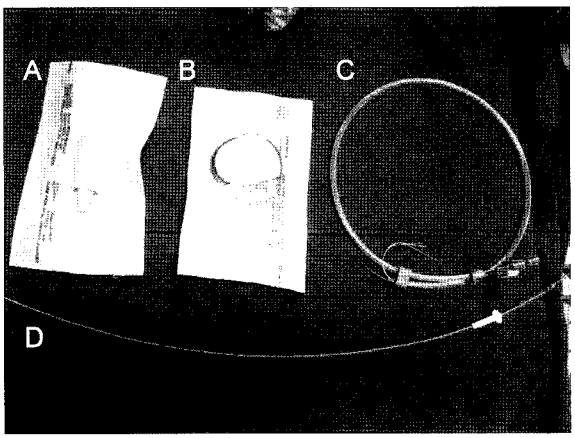

Fig 4. Instruments for pacemaker implantation. A: Wire stylets for the placement of a Screwdriver for connecting the leadwire to the pulse generator, B: Pulse generator (Kappa KSR903, Medtronic, USA) for cardiac pacing, C: Screwdriver for connecting the leadwire to the pulse Wire stylets for the placement of a leadwire D: Pacing leadwire (CAPSUREFIX® NOVOUS 5076, Medtronic, USA).

After achieving surgical anesthesia, a full thickness incision

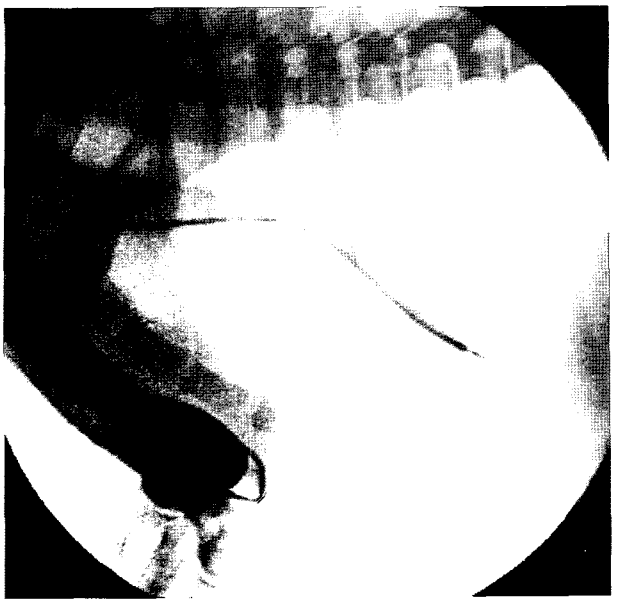

Fig 5. Leadwire placement under fluoroscopic guidance. The pacing leadwire (CAPSUREFIXR® NOVOUS 5076, Medtronic, USA) was placed to the right ventricular apical wall.

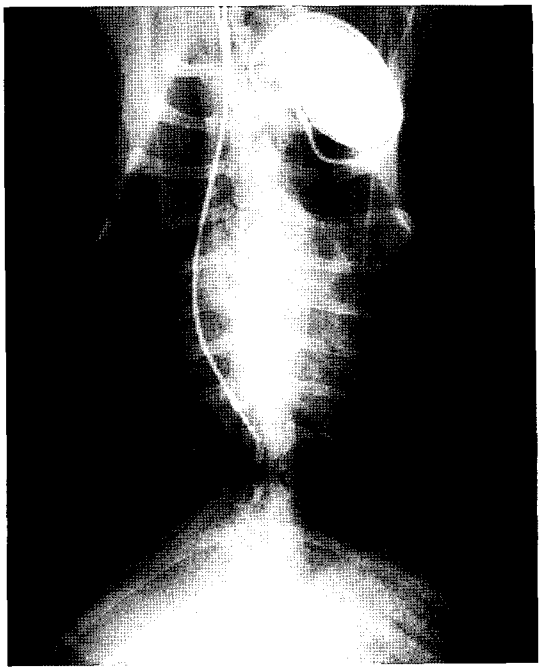

Fig 6. Thoracic radiography showed revealed proper positioning of the leadwire (CAPSUREFIX® NOVOUS 5076, Medtronic, USA) and pulse generator (Kappa KSR903, Medtronic, USA).

is made parallel to the jugular vein approximately 3 cm in length. The jugular vein is then isolated completely from the surrounding tissue by using blunt dissection. Following vein isolation, a moistened strand of cotton umbilical tape was place around either end of the isolated vein and secured using mosquito forceps. A wire stylet (CAPSUREFIXR® NOVOUS 5076, Medtronic, USA; Fig 4C) was then placed into the lumen of the leadwire to allow for easier positioning. Using a small pair of iris scissors, a transverse incision was made in the jugular vein. After a jugular venotomy had been made, the pacing leadwire (CAPSUREFIXR® NOVOUS 5076, Medtronic, USA; Fig 4D) with an intraluminal stylet was introduced into the vein. The leadwire tip was then gently passed to the right ventricle. After the lead was securely in place, it was attached to the pulse generator (Kappa KSR903, Medtronic, USA; Fig 4B). The screw on the generator was tightened using the supplied screwdriver (Fig 4A). The permanent pacemaker function was verified on the surface ECG by seeing an appropriately timed pacing artifact followed by a ventricular depolarization. After ensuring that the device was functioning, the lead was secured in the jugular vein with a white rubber sleeve. Three ligatures are placed using the grooves in the sleeve as guides. Following the placement of each ligature, the position of the lead in the right ventricle was verified with fluoroscopy (Fig 5).

A second incision and pocket were then created for placement of the pulse generator. The incision was made in the dorsolateral aspect of the neck using blunt dissection, a pocket was created in the subcutaneous tissues. The generator was placed in the subcutaneous pocket and securely anchored to the deep tissue with continuous suture. The skin incision was closed with simple interrupted sutures. After pacemaker implantation, the

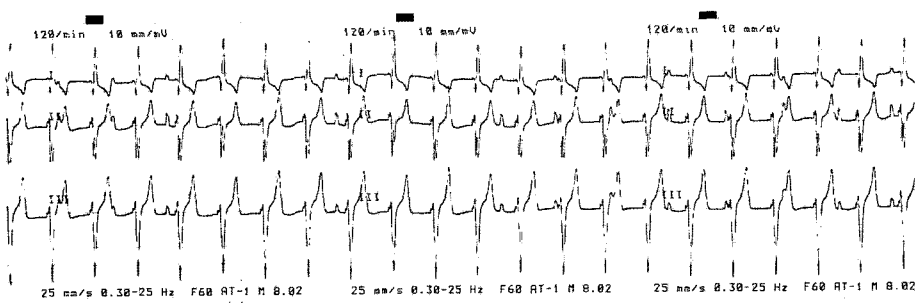

Fig 7. The 12 lead-electrocardiographic (ECG) showed successful ventricular pacing with characteristic pacemaker spikes at 120 beat per min of heart rate.

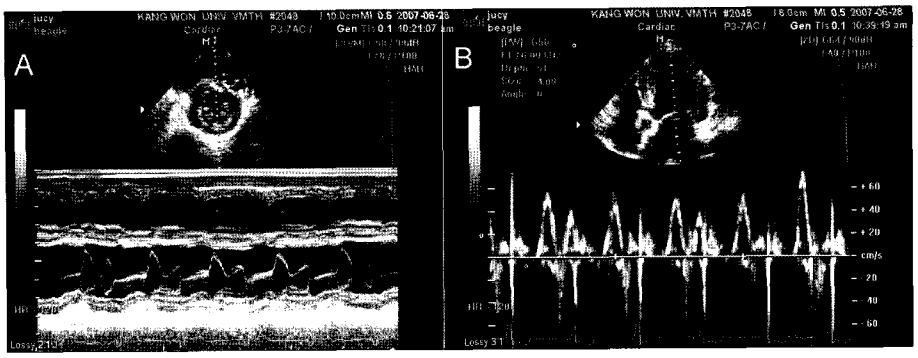

Fig 8. Echocardiography taken after pacemaker implantation. A: The M-mode echocardiogram showed regular and consistent left ventricular contraction. B: Spectral Doppler echocardiogram showed consistent coupling of E and A wave. The E wave is a larger and laminar flow. There was no absence of the E wave after pacemaker implantation.

dog was monitored in the postoperative period with a continuous ECG. Systemic antibiotic drug (cefazoline, 15 mg/kg) was given for prevention of infection. Thoracic radiography was re-taken and revealed proper positioning of the leadwire and pulse generator (Fig 6). The dog was discharged from the hospital after 24 hours following surgery with recommendation of exercise restriction.

After pacemaker implantation, the dog did not show syncopal episode and is currently able to take a walk with an owner. ECG study revealed successful ventricular pacing with characteristic pacemaker spikes at 120 beat per min of heart rate (Fig 7). Subsequent echocardiographic study revealed regular left ventricular contraction with proper functioning ventricular function (Fig 8). No side effects associated with permanent pacemaker implantation has been observed to date.

Discussion

Pacemaker implantation is indicated for symptomatic and chronic bradyarrhythmias. The most common arrhythmias requiring pacemaker implantation in the dog include advanced atrioventricular blocks (high second degree and third degree), sinus arrest, and sick sinus syndrome (2,4,7). The dog had advanced degree atrioventricular block with clinical signs of syncope and exercise intolerance. Therefore the dog was required to proper cardiac pacing for reducing syncopal episodes associated with severe bradyarrhythmia.

Early studies of pacemaker implantation in dogs documented high complication rates using epicardial leads (1) or transvenous untined leadwires, leading to a high rate of lead migration (8). However higher success rate and lower complication rate have been reported in the transvenous implantation with tined leadwires (3). The leadwire used in this study was tined and covered with silicone and has a helical anchor securing the wiretip to the ventricular wall. Tight anchoring of leadwire to the right ventricular wall ensured successful and stable cardiac pacing in this case.

Recent human study found the dual-chamber pacing had advantageous over single chamber pacing (6). Dual-chamber pacing is more physiological with sensing of the intrinsic beats triggering activation of the ventricles in the correct sequence and after an appropriate interval. This pacing mode can increase the quality of life and activity of patients (9). However because only small numbers of dogs have been documented as undergoing dual chamber pacing in veterinary literatures, we are unable to compare the efficacy and outcome between single chamber and dual chamber modes of pacing. Besides, overall results for single-chamber pacing are still encouraging and proved that pacing is clinically effective, safe and practicable (5). Our case study also found the single chambered pacing was very effective and safe for controlling advanced bradyarrhythmias.

In conclusion, this case study described a successful pacemaker implantation with single chambered mode of pacing in a dog with advanced grade of atrioventricular block. This is the first case report for pacemaker implantation in Korea.

Acknowledgements

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경피적 접근을 이용한 영구 박동조절기(pacemaker) 장착을 통한 3도 방실 차단이 있는 비글종 개의 치료

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요 약 : 2.8살 된 암컷 비글종 개 (체중 11 kg)가 운동 불내성과 간헐적인 실신증상을 보여 내원하였다. 청진상 불규칙하게 불규칙한 심장박동과 지속적인 맥박결손이 청진되었다. 심전도상에 3도 방실차단 소견이 관찰되었다. 환자는 임상증상 개선을 위하여 경정맥을 통한 영구적인 박동조절기(pacemaker)를 장착하였다. 그 결과 환자는 더 이상 실신증상을 보이지 않았고 주인과 함께 산책을 나갈 수 있을 만큼 임상증상이 개선되었다. 현재까지 박동조절기 장착과 관련된 합병증 없이 잘 생존하고 있다.

주요어 : 심장박동 조절, 비글, 양극성 박동조절기, 심장 전도차단, 서맥성 부정맥