Interventional cardiology in small animals

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ABSTRACT

Interventional cardiology is a branch of the medical specialty of cardiology that deals specifically with the catheter based treatment of structural heart diseases. A large number of procedures can be performed on the heart by catheterization. Although many cardiac diseases requiring open heart surgery are currently treated with cardiac interventions in human medicine, interventional cardiology is relatively recently introduced in veterinary medicine. Therefore, in this lecture, several interventional methods for various diseases of small animals, more focusing on interventional methods in heart diseases will be discussed.

INTERVENTIONAL CARDIOLOGY

A. Transcatheter coil embolization of Patent ductus arteriosus

Occlusion of a PDA with a percutaneous device is an alternative to surgical closure of a PDA. Closure of the PDA by an occlusion device has been described in dogs with naturally occurring PDAs (1). Transcatheter occlusion involves placing a device in the PDA that stimulates clot formation or that itself occludes the ductus to cominterrupt blood flow (2). Several devices have been described, including discs, coils, and sacks. Gianturco helical coils (Cook, Inc., Bloomington, Inc.) have been successfully placed in small dogs (5 to 20 lb) with naturally occurring PDAs. Placement of these devices requires anesthesia, cardiac catheterization, and a skilled operator. Gianturco coils are made of wire coated with strands of wool to promote thrombosis. The coils are deployed through a cardiac caththat is advanced from a femoral artery into the descending aorta and through the PDA into the pulmonary artery.

B. Transcatheter coil embolization of intrahepatic portosystemic shunt (PSS)

Because surgical ligation of intrahepatic portosystemic shunt is practically very difficult and very invasive, transjugular coil embolizaof canine intrahepatic PSS has been successfully applied in dogs (3). The short-term results are promising. For transjugular coil embolizaof canine intrahepatic

PSS, afluoroscopically guided catheter is advanced from the right jugular vein to the caudal vena cava and shunt vessel. Contrast studies and measurement of portal pressures before and after coil placeare performed. A cylindric wire mesh stent can be placed in the caudal vena cava at the level of the shunt to prevent coil migration. Catheter-delivered thrombogenic coils are then placed in the shunt. Complete or near complete occlusion of the shunt requires multiple-staged coiling sessions to prevent the development of acute portal hypertension.

C. Balloon dilation (valvuloplasty) of pulmonary stenosis

Balloon valvuloplasty has been particularly successful in humans with congenital valvular pulmonic stenosis, resulting in at least partial reduction of the obstruction in most patients (1). This technique is also widely used in dogs with pulmonary stenosis(4). The technique uses a catheter with a strong, cylindrical balloon at its end that is placed under fluoroscopic guidance via a vascular cut-down or percutaneous approach. The balloon is positioned across the obstruction and inflated with fluid under pressure. This fractures or stretches the obstructing tissue, increasing the effective size of the lumen. In general, balloon dilation techniques are simpler, less traumatic, less expensive, and less risky than open-chest surgical procedures.

D. Percutaneous heartworm removal

A technique for removing adult heartworms from the pulmonary arteries using a flexible alligator forceps has been described and used in elsewhere (1). The forceps (Ishihara alligator forceps, Fuji Photo Optical Ltd., Japan) are passed into the pulmonary arteries from a jugular vein access site in an anesthetized dog. The forceps are manipulated intothe pulmonary arteries using fluoroscopic guidance. The technique has been described in dogs as small as 5 kg (5). The worm retrieval rate has been reported to be between approxi80% and 100%. Minimal damage to cardiovascular structures has also been reported.

E. Pacemaker implantation for bradycardic conduction defects

A pacemaker is a device that delivers battery-supplied electrical stimuli through electrodes in contact with the myocardium to produce an artificially triggered depolarization. Since the first implantable pacemakers were developed, the equipment and techniques available have improved dramatically (1). Recent advances in pacemaker technology include new lead designs, microprocessor-based cirlong-life batteries, telemetric manipulation, and newer pacing routines that allow rate-responsive adaptations and dual-chamber pacing. Cardiac pacemakers are now much smaller and more durable than before, and newer batteries can provide up to 12 years of continuous function. Probably the most important technologic advance has been the refinement of percutaneous transvenous pacing leads that can be introduced into the heart through a peripheral vein. Successful application of pacemaker implantation has been reported in dogs with a third

degree atrioventricular block (6).

F. Self-expanding intraluminal stenting for tracheal collapse

Tracheal collapse is a condition characterized by incomplete formation or weakening of the cartilagenous rings of the trachea resulting in flattening of the trachea. Treatment for mild to moderate cases includes corticosteroids, bronchodilators, and antitussives. Medical treatment is successful in about 70 percent of tracheal collapse cases. Severe cases can be treated with surgical implantation of a tracheal stent (insideor outside of the trachea) or prosthetic rings. Intraluminal stenting has shown more promise for success with intrathoracic cases, especially using nitinol, a type of shape memory alloy composed of nickel and titanium (7). Potential problems include stent migration and fracture (8).

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