Patent Ductus Arteriosus (PDA) in a German Shepherd Puppy

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SUMMARY:

This paper describes the correction of a Patent Ductus Arteriosus (PDA) in a 5 month old male German Shepherd Dog named “Beast” using the Amplatz Canine Ductal Occluder (ACDO). Beast was referred to the Cornell University Hospital for Animals on 1.9.08 as a referral from his rDVM for a continuous heart murmur with a point of maximal intensity (PMI) on the left. He showed no clinical signs on presentation and a grade 4/6 murmur was noted around the left third intercostal space along with bounding pulses. Echocardiography was performed which confirmed the presence of a PDA and Beast returned on 2.25.08 to have his PDA repaired using the ACDO. The occlusion device was placed successfully while the dog was under general anesthesia, effectively occluding blood flow through the PDA.

INTRODUCTION:

Patent Ductus Arteriosus (PDA) is the most common congenital heart defect in dogs.[1,7] While it is highly amenable to treatment, if left uncorrected it usually leads to complications, often including heart failure and death within the first few months of a dog’s life.[2] There are several options for the management and treatment of PDA. The first, though not generally recommended, is medical management, in which the PDA is not definitively closed but medications are used to help temporarily ward off or manage the heart failure that ensues. This is never curative however. The next option which is used quite frequently is surgery via thoracotomy, in which the PDA is ligated. This is often the option of choice in very small dogs, but is associated with a high invasiveness

and risk of major complications relative to occlusion devices.[3] Lastly, the PDA can be occluded using Embolization Coils or the new Amplatz Canine Ductal Occluder (ACDO). These devices are placed via cardiac catheterization within the PDA so as to block blood flow through the abnormal vessel. While coils are still often used with great success, the ACDO holds promise as a new and effective method of PDA repair and was the method of choice to occlude the PDA in this case study.

CASE HISTORY:

"Beast" was a 5 month old intact male German Shepherd Dog that first presented to the Cornell University Hospital for Animals on 1.9.08 as a referral from his rDVM who noticed a continuous heart murmur on his two initial wellness exams. During the first exam in October of 2007 the murmur was documented as a grade 1/6 with PMI on the left, and had progressed to a grade 3/6 on a subsequent visit. Beast showed no abnormal clinical signs, aside from one episode of vomiting at home, which was incidental. There had been no history of syncope, respiratory difficulty, or coughing according to his owners, and his activity level had been normal for a dog his age. Based on the continuous quality of the murmur, the rDVM preliminarily diagnosed Beast with a PDA and referred him to Cornell for a full cardiac work-up.

On presentation Beast was bright, alert, and responsive with pink mucous membranes. He was eupneic and his lung fields ausculted normally with no crackles or wheezes noted. Bounding pulses were palpated in his femoral artery, and a grade 4/6 continuous heart murmur with PMI at the left third intercostal space was ausculted. Due

to aggression Beast was sedated for his tests. Thoracic radiographs were taken which revealed moderate left cardiomegaly, particularly the left ventricle, and a mild focal enlargement of the ascending aorta with prominent pulmonary vasculature. An ECG was performed which produced tall R waves, indicating an enlarged left ventricle, and a long P wave, indicative of an atrial enlargement. Beast maintained a normal sinus rhythm and his heart rate was 126bpm. His echocardiogram revealed a left-to-right shunting PDA, along with a mildly enlarged left ventricle. A complete blood cell count (CBC) and chemistry panel were performed which revealed mild anemia. The rest of his blood values were within normal limits.

TREATMENT:

During Beast's next visit on 2.25.08 for closure of the PDA, another echocardiogram was performed to confirm the continued presence of the ductus. The PDA was again noticed along with a small amount of aortic insufficiency and a dilated pulmonary artery, both likely the cause of the volume overload that occurs with this condition. The function of his heart was noted to be normal. His fractional shortening at this time was 33%, and Doppler echocardiography revealed continuous flow of blood across the ductus with high velocity. His murmur was documented as grade 3/6.

Beast was placed under general anesthesia and a transesophageal echocardiogram (TEE) was performed in order to choose the appropriate size occluder for this particular PDA. The minimal ductal diameter (MDD) was 3.8mm, so a 7mm ACDO was chosen for Beast, as the device waist diameter should be approximately twice the MDD.[4]

Beast was placed in right lateral recumbency and a cut-down to the right femoral artery was performed. The artery was catheterized with a 21 guage Seldinger needle for placement of a 7Fr introducer. A guide catheter containing a guide wire was fed via the femoral artery up through the aorta, through the PDA, and into the main pulmonary artery. Once its position was visualized with TEE, the guide catheter was removed while the guide wire was left in place. Next, the Amplatz delivery catheter, containing the occluder, was fed over the guide wire and directed such that the distal end was in the main pulmonary artery. Once its position was confirmed, the Amplatz occluder was partially deployed into the main pulmonary artery. Once the distal disc was fully deployed, the delivery catheter was pulled so that the distal disc engaged with the pulmonic ostium. As gentle traction was placed on the catheter the rest of the ACDO deployed so that the waist and proximal disc were situated inside the PDA. TEE was again performed to confirm the correct positioning of the ACDO and to be sure that the flow through the ductus had stopped. The heart was ausculted and the murmur had been eliminated. To further ensure the correct size and position of the ACDO the delivery catheter was gently pushed and pulled, and once the position was again confirmed, the delivery catheter and guide wire were removed, leaving the ACDO in the PDA. The femoral artery was ligated with four ligatures of 2-0 silk and the subcutaneous tissue was closed using 2-0 PDA in a simple interrupted pattern. The skin was apposed using a subcuticular pattern.

Beast recovered well from general anesthesia, was monitored in the hospital overnight, and was discharged to his owners the following day. His owners were given instructions to bring Beast back in 6 weeks for a recheck echocardiogram, try to keep

Beast quiet for 4 weeks in order to prevent embolization of the device, and to monitor Beast for any signs of embolization, including coughing, syncope, hind-limb weakness, or dyspnea.

DISCUSSION:

It has been known for years that PDA is most commonly hereditary in dogs. Toy and miniature poodles, German Shepherds, collies, Pomeranians, Shetland Sheepdogs, Maltese, English Springer Spaniels, keeshonds, and Yorkshire terriers have been considered to be predisposed to having this condition.[1] Whether the cause is sporadic or hereditary, the major cause of the PDA is abnormal tissue architecture within the walls of the ductus itself. Hypoplasia of the ductus muscle is most often seen histologically. A secondary cause that is often seen is the presence of elastic tissue in areas that should have had more muscle, and this normally results from insufficient ductus growth. These factors prevent the normal closure of the Ductus Arteriosus around the time of parturition and result in a PDA.[8]

The Amplatz Canine Ductal Occluder was created at the University of Minnesota in 2007.[4] The occluder itself is made of a nitinol mesh formed so that, when fully deployed, a distal disc will sit on the pulmonary artery side of the pulmonic ostium and a proximal disc will conform to the shape of the ductal ampulla in order to effectively block blood flow.[5]

Though the ACDO is very safe and quite effective, there are four major contraindications of its use. The ACDO should not be used if there is a thrombus at the intended site of implant or in any of the vessels that will be catheterized because this could cause the thrombus to embolize. In addition, the presence of a thrombus could indicate a coagulopathy, in which case introducing a foreign object into the vasculature could create problems. The ACDO should also not be used if there is evidence of any infectious process, as the introduction of a foreign material may cause damage to the site. Very small dogs often have blood vessels too small to accommodate the ACDO catheters, so this method of occlusion cannot be used with them. Surgery is a more viable option in this case even though it is associated with a higher risk of major complications relative to occlusion devices.[3] Finally, the ACDO should not be used if the anatomy of the PDA would cause the device to interfere with aortic blood flow, as might be the case with short or window-type PDAs.[2,5] It is important to note that not all PDAs are amenable to closure with the ACDO because they do not always have the same shape. In the dog, luckily, 87% of PDAs encountered are categorized as type II, which are shaped in such a way that the ACDO can be used safely.[6]

Risks associated with using the ACDO are rare if performed correctly, but can include perforation of a blood vessel, an arrhythmia, embolization, bacterial endocarditis, thrombus formation, or death from a variety of causes.[5] One of the most potentially severe adverse effects is embolization, which can usually be prevented by sizing the device properly. Determining the size of the PDA's minimal ductal diameter (MDD) at the pulmonic ostium can be performed using transesophageal echocardiography (TEE) and/or angiography. Once the size of the MDD is determined, the device chosen should

be approximately twice the size of the MDD.[2,4,5] If the device is too small it can easily embolize into the pulmonary vasculature or even the systemic circuit potentially resulting in major complications. If, however, the device is too large, it will not deploy properly and will not effectively block flow through the ductus. It may even damage the ductus or cause a rupture. Despite the possibilities, the ACDO has been used since its introduction with great success and has proven to be the safest and one of the least invasive methods of PDA repair.

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