

MINIMALLY INVASIVE PROCEDURE USING INTERVENTIONAL RADIOLOGY TECHNIQUE FOR CANINE PATENT DUCTUS ARTERIOSUS OCCLUSION

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INTRODUCTION



PATENT DUCTUS ARTERIOSUS (PDA)

- Vascular communication between the pulmonary artery and the descending aorta (persistent after birth)
 - Failure of ductus arteriosus (DA) closure mechanism (DA: normal fetal structure that prevents blood flow through nonfunctional lungs)
 - One of the three most common congenital heart defects in dogs
 - Sporadic or inherited
 - Small breeds
- Blood flow direction:**
- Left-to-right
 - Right-to-left (reversed)
- Clinical consequences of PDA:**
- Pulmonary hypertension → volume overload of left side of the heart, pulmonary edema and circulatory congestion → congestive heart failure
 - Right-to-left flow: tachypnea, dyspnea, cough, lethargy, collapse, syncope, anorexia, "differential cyanosis", etc.

TREATMENT

- Medical therapy
 - Extravascular surgical occlusion
 - Ligation by thoracotomy
 - Occlusion with hemoclips by thoracoscopy
 - Endovascular occlusion →
- INTERVENTIONAL RADIOLOGY:**
- Fluoroscopy imaging
 - Endovascular approach

INTERVENTIONAL RADIOLOGY

FLUOROSCOPY IMAGING

- Real-time x-ray images
- Special protective elements: lead gowns, thyroid shields and gloves
- C-arm fluoroscopy



VASCULAR ACCESS and DUCTAL ANGIOGRAPHY

VASCULAR ACCESS

- Only in puppies weighing > 2,5 kg

DUCTAL ANGIOGRAPHY

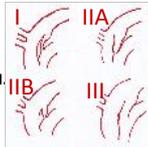
- Special catheter for contrast agent injection
- Ductal morphology, minimal ductal diameter (MDD), ostium diameter (1) and ampulla diameter (2).



PDA PHENOTYPES

Miller's classification¹ of canine PDA phenotypes: I, IIA, IIB and III

- PDA II - the most prevalent in dogs
- PDA III - not adequate area for device attachment



OCCLUDING DEVICES

EMBILIZATION COILS



- Surgical stainless steel, **prothrombotic fibers**
- Device to be used: minimum twice the MDD
- INDICATIONS: PDA with MDD < 4 mm and phenotypes IIA and IIB
- 2 or 3 coils are habitually needed to accomplish complete residual flow cessation
- COMPLICATIONS: pulmonary or arterial embolization, hemolysis

AMPLATZ VASCULAR PLUG (AVP)



- Self-expanding, cylindrical nitinol mesh, **NO thrombogenic material**
- Device to be used: 2 mm wider than the distal ductal ampulla diameter (not the MDD)
- INDICATIONS: PDA phenotypes IIA and IIB
- **NO special interest in this device** (due to specific device for canine PDA morphologies)

AMPLATZER CANINE DUCT OCCLUDER (ACDO)



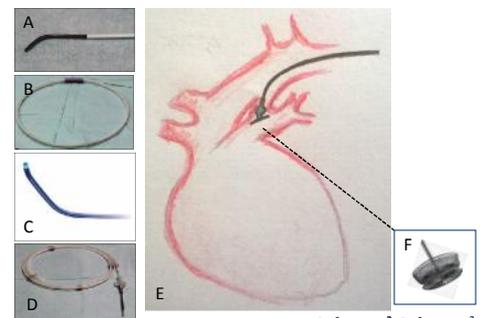
- Self-expanding, multi-layer nitinol mesh plug
- **Two disks** (flat distal disk and cupped proximal disk) **connected by central waist**
- Commercially available from January 2007
- **Especially adapted for canine PDA morphologies**
- Device to be used: the central waist 1,5-2 times the ostium diameter
- INDICATIONS: PDA phenotypes IIA, IIB and III

PROCEDURE OF THE ACDO DEPLOYMENT

Vascular access: all catheters are introduced through the femoral artery

PROCEDURE:

- **DEVICE SELECTION** (waist size: 1,5-2 times the ostium diameter)
- **ACCESS TO THE DUCTUS**
Introducer sheath → End-hole catheter (A) → Exchange wire (B) → Delivery sheath (C) (until main pulmonary artery (across the ductus))
- **DEVICE DEPLOYMENT**
Device loader connected to the delivery cable (D) → Pushing motion on the delivery cable → Deployment of **distal disk in the ductal ostium (E)** → Confirmation of correct position → Completion of ACDO deployment (**central waist positioned in the ductal ostium and proximal disk in the ductal ampulla**). In F is represented deployed ACDO device.



Reference², Reference³

CONCLUSIONS

1. PDA occlusion is the most performed cardiovascular surgery in dogs. Different techniques for the correction of this pathology have been described, being the more recent and in turn the least invasive the endovascular approach to the patent ductus.
2. All devices used for occlusion by interventional radiology have their limitations and complications and no single technique appears to be suitable for correction of all PDA types in dogs.
3. The major inconvenient of the minimally invasive technique is the high price of the equipment and occluding devices necessary for the surgical intervention of this type.
4. In addition to the aforementioned drawbacks it is important to note that extensive training and practice prior to the completion of the technique are needed.

REFERENCES

- 1 Miller M., Gordon S., Saunders A., Arsenaull W., Meurs K., Lehmkuhl L., Bonagura J., Fox P. 2006. Angiographic classification of patent ductus arteriosus morphology in the dog. *Journal of Veterinary Cardiology*, 8: 109-114.
- 2 Nguyenba T., Tobias A. 2007. The Amplatz canine duct occluder: A novel device for patent ductus arteriosus occlusion. *Journal of veterinary cardiology*, 9: 109-117.
- 3 Stauthammer C. 2015. Patent Ductus Arteriosus (Chapter 58). In: *Veterinary Image-Guided Intervention*. Editors: Weisse Ch. and Berent A. First edition, Wiley-Blackwell, New Jersey (USA): 564-574.