

First pathological report of successful transcatheter pulmonary valve implantation in a client-owned dog

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Introduction

Pulmonic stenosis is one of the most common congenital heart malformation in dogs and the Beagle breed has been reported as predisposed¹. A client-owned Beagle dog was diagnosed with severe congenital valvular pulmonic stenosis in 2016 and underwent balloon pulmonary valvuloplasty. Pulmonary regurgitation subsequently developed and worsened. Then, based on the procedure of choice for human patients^{2,3}, a bioprosthetic transcatheter pulmonary valve (TPV) implantation was scheduled. Melody™ TPV (Medtronic Inc., Minneapolis, MN, USA) was crimped with a second external stent (IntraStent™ Max LD biliary bare stent, Medtronic, Inc., Minneapolis, MN, USA) per manufacturer recommendation (to reinforce the stent) and implanted in December 2018 (Fig.1). Shortly afterwards, cardiac condition resolved⁴.

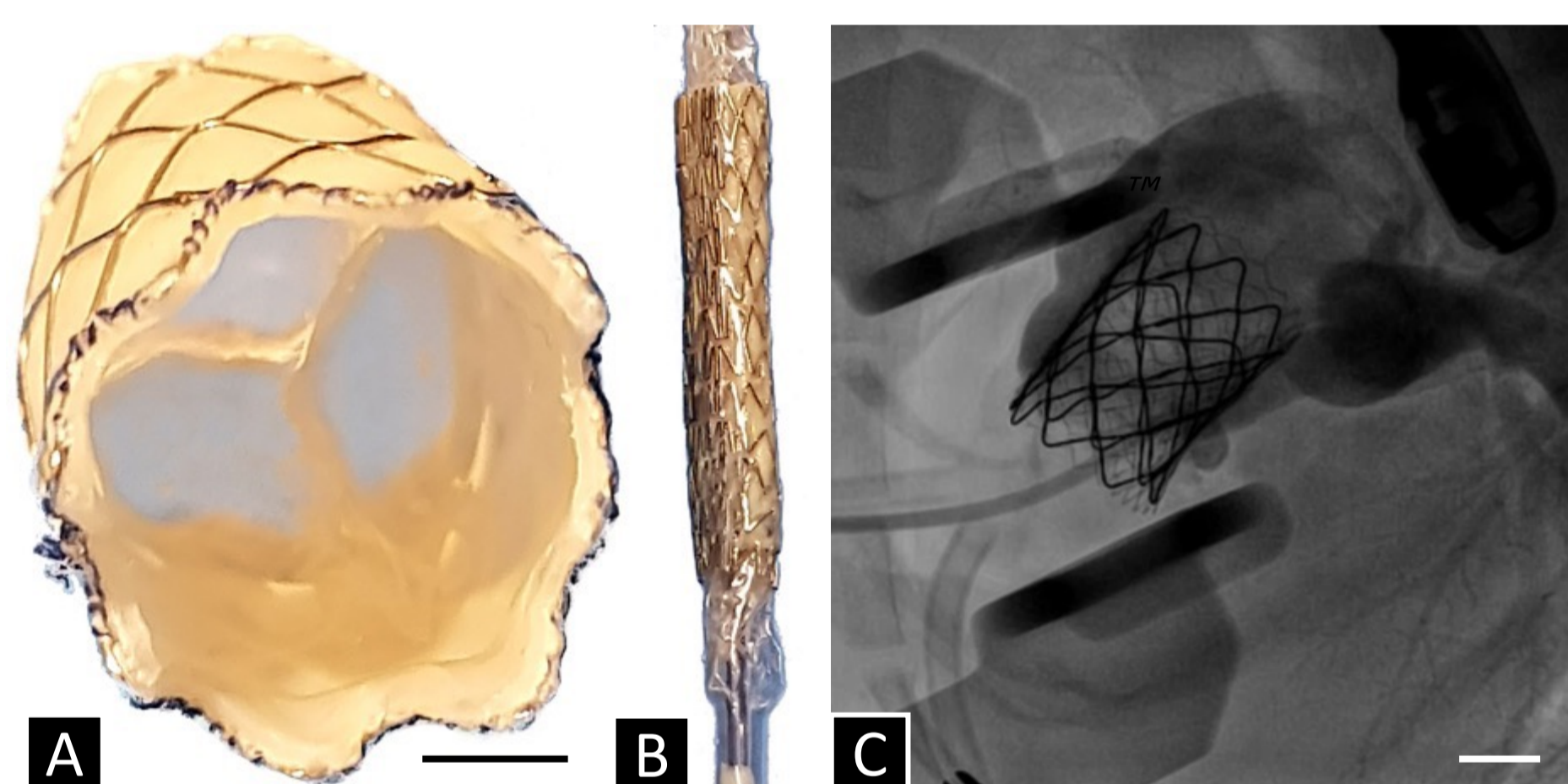


Fig.1. (A) Melody™ transcatheter pulmonary stented valve (Scale bar = 0.5 cm). (B) IntraStent™ Max LD biliary bare stent (Medtronic, Minneapolis, MN, USA) crimped over the Melody™ TPV. (C) Angiography showing the device in place after implantation on the day of procedure. Scale bar = 1 cm.

Unrelated mitral endocardiosis was detected in 2021, and left-sided congestive heart failure worsened in 2022. Euthanasia was elected in February 2023 and the dog was submitted for necropsy.

Materials & Methods

A comprehensive necropsy was performed. High resolution radiography of the stents and bioprosthetic cusps was performed using the Faxitron® Pro x-ray cabinet (Hologic Inc., USA). For histopathological evaluation, three levels of sections were obtained through the device and surrounding tissues at trimming, embedded in resin and stained with Hematoxylin and Eosin (HE). Sections of the isolated cusps, liver and lungs were routinely embedded in paraffin and stained with Hematoxylin-Eosin & Saffron (HE&S), and a variety of special stains.

Results

Four years after its implantation, the valve was still in place and functional (Fig.2).

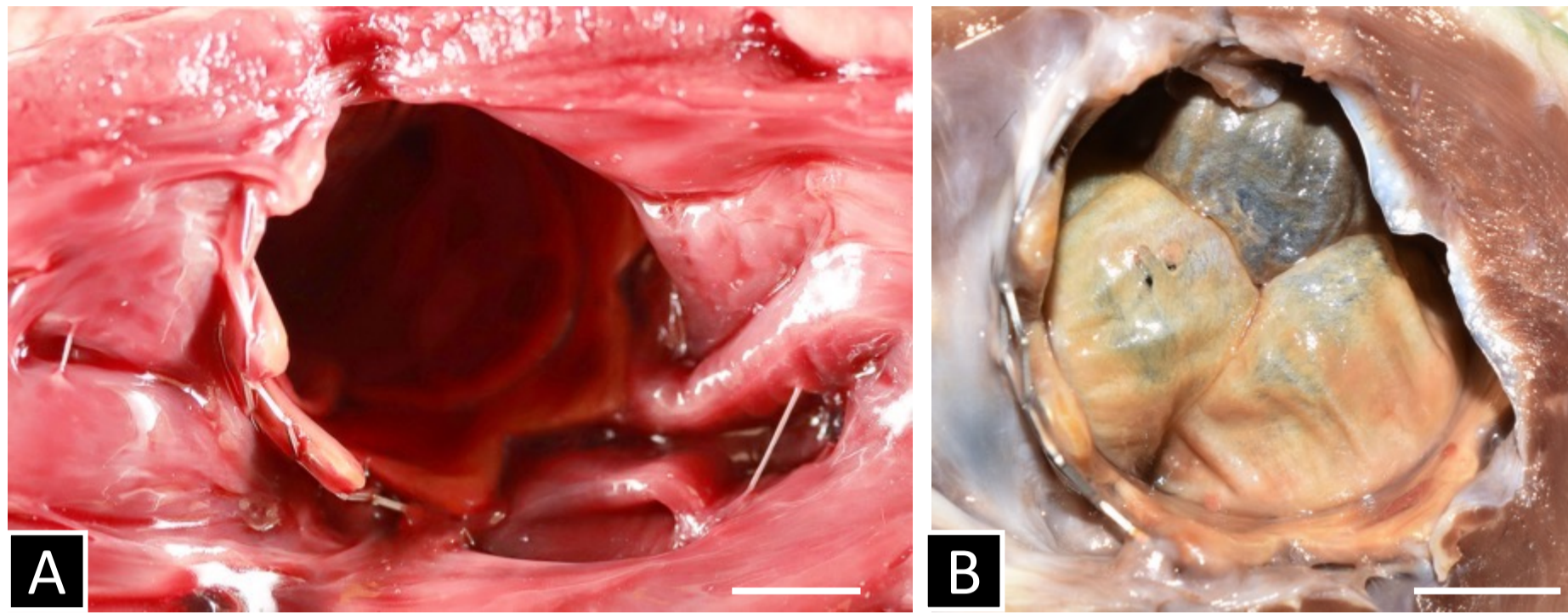


Fig. 2. (A) Necropsy picture showing the Melody™ TPV in the pulmonary artery. Inflow view. (B) Formalin-fixed pulmonary artery with stented valve. The three bioprosthetic cusps are made of bovine jugular vein. Inflow view. Scale bar = 0.5 cm.

At necropsy, severe myxomatous valvular degeneration of the mitral valve with dilation of the left atrium and ventricle was noted. Typical lesions of left-sided and right-sided congestive heart failure were present in the lung and liver respectively. Faxitron® revealed no stent fracture nor calcification of the bioprosthetic cusps (Fig.3).

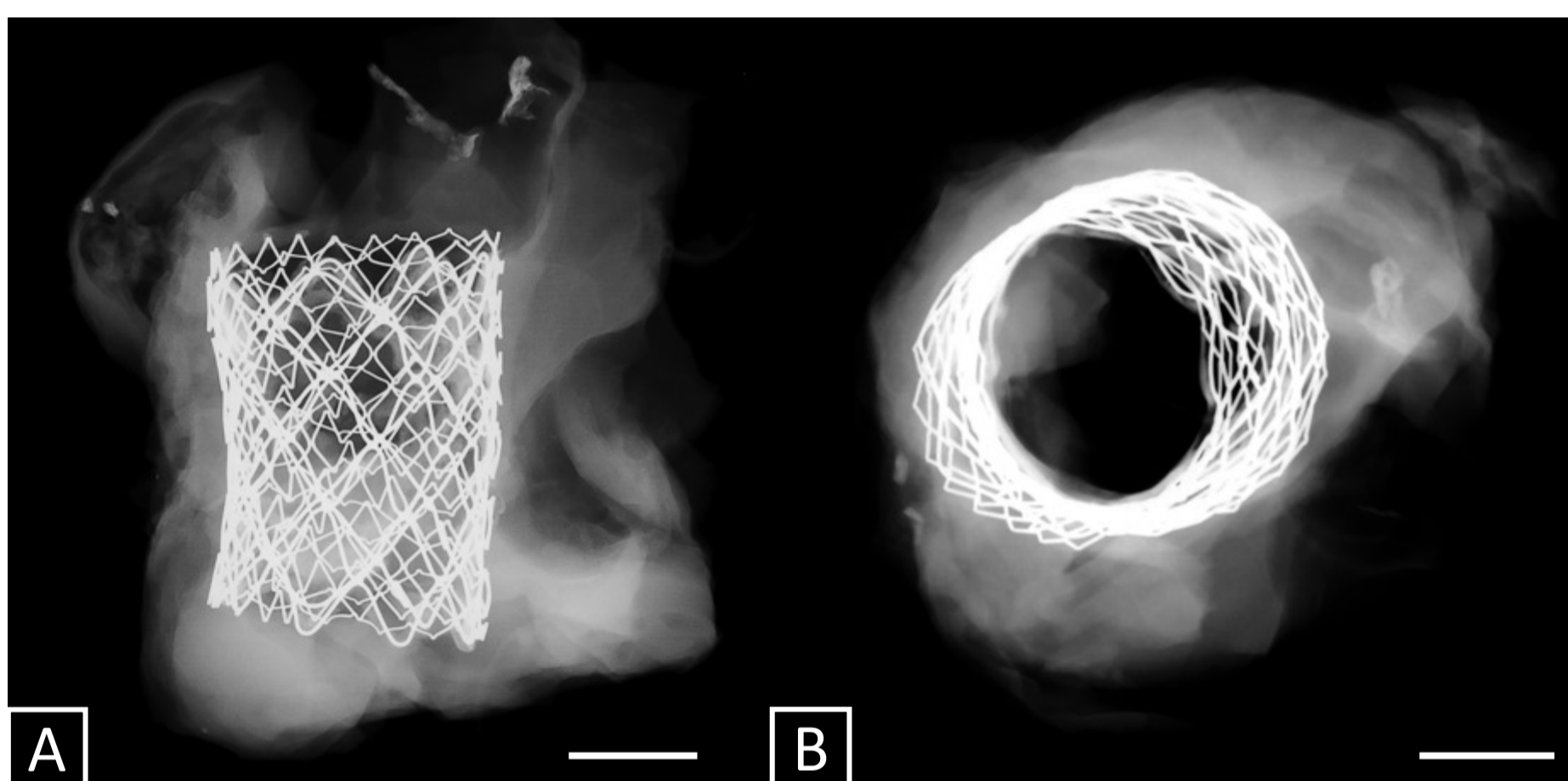


Fig. 3. (A) Lateral and (B) oblique views of Faxitron® high resolution x-ray imaging of the stents and bioprosthetic cusps. No stent fracture was visible. Scale bar = 1 cm.

Histologically, the two stents were visible and well integrated as a 500 µm-thick mature neointima was observed in the luminal aspect of the pulmonary artery around the stents (Fig.4 & Fig.5). There was neither thrombosis nor stenosis.

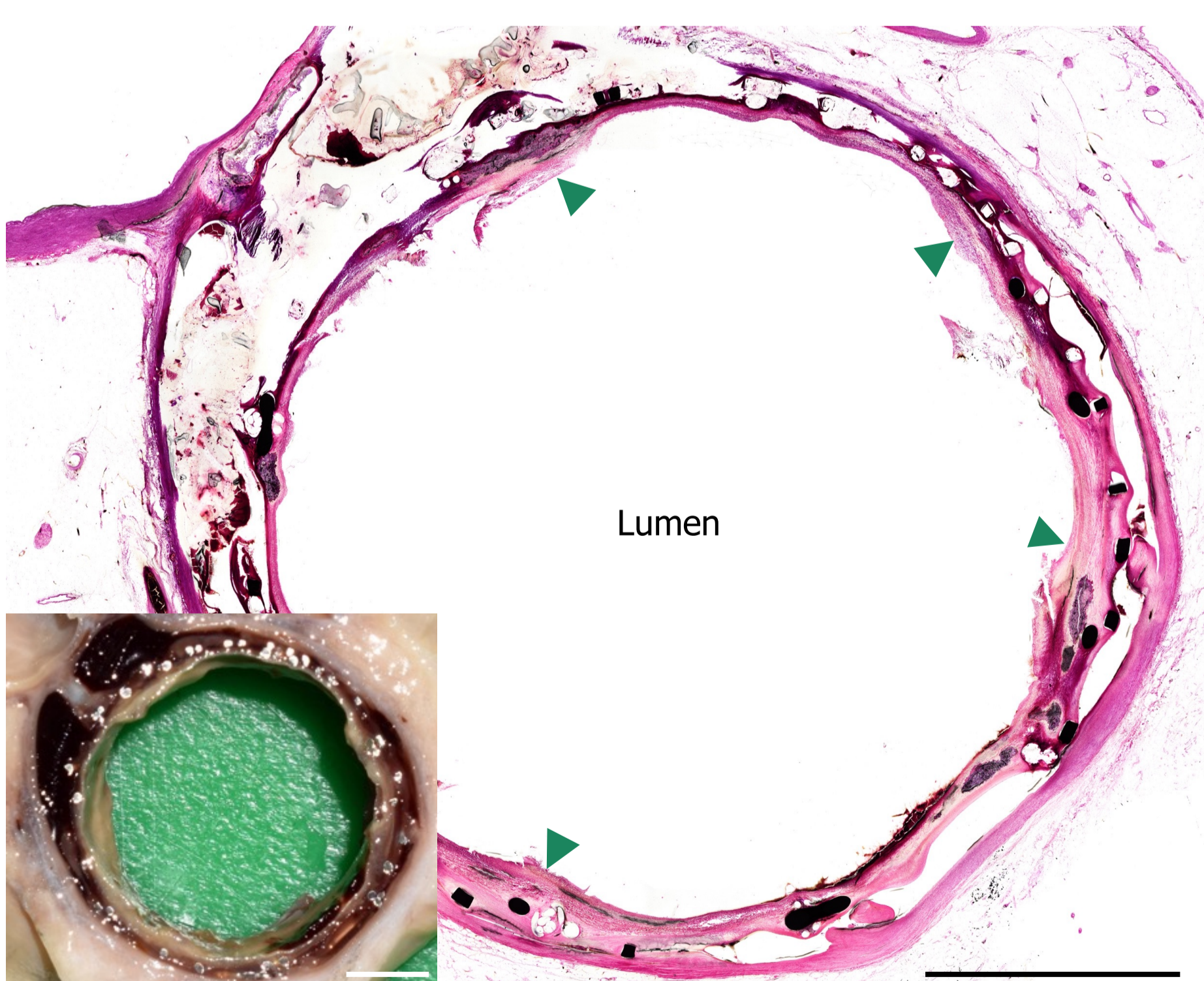


Fig.4. Transverse section of resin-embedded in situ pulmonary stents, after cusps removal. Inset: same section at trimming, before embedding. HE, composite image, original magnification x4. Scale bar = 0.5 cm.
▶ Neointima

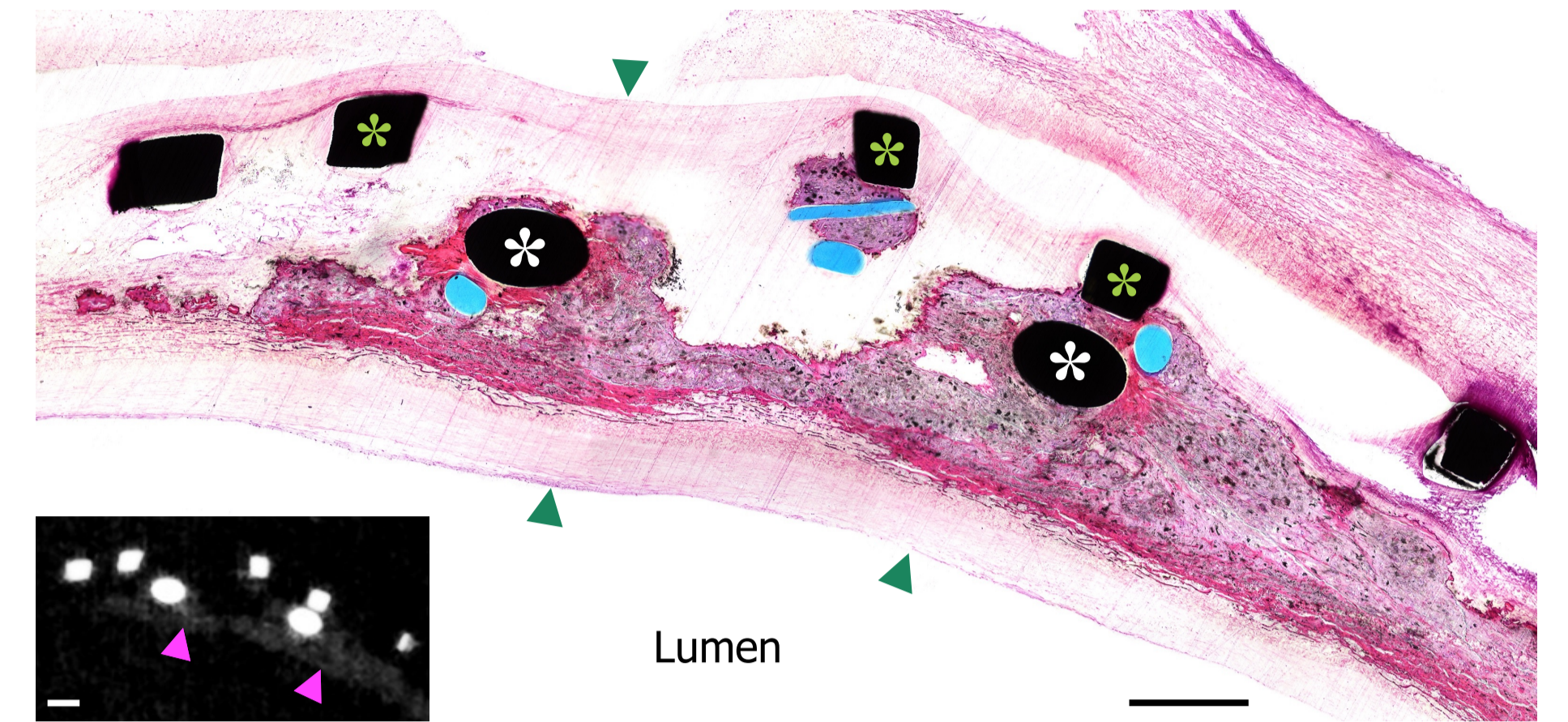


Fig.5. Transverse section of resin-embedded in situ pulmonary stents. The two stents are visible. Suture material appears blue. Osseous metaplasia is present around the struts. HE, composite image, original magnification x10. Scale bar = 0.5 mm. Inset: Faxitron® image of the section.

⊗ Internal stent struts (Melody™ TPV stent)
 ☆ External stent struts (IntraStent™ biliary stent)
 ▲ Neointima
 ▶ Mineralized material on X-rays: osseous metaplasia

Mild osseous metaplasia was observed within the neointima (Fig.5). Rare multinucleated giant cells were noted around the suture material. The bioprosthetic cusps displayed minimal mononuclear inflammation, mild fibrin deposits on both inflow and outflow sides as well as moderate dissociation and splitting of its collagen fibers. (Fig.6).

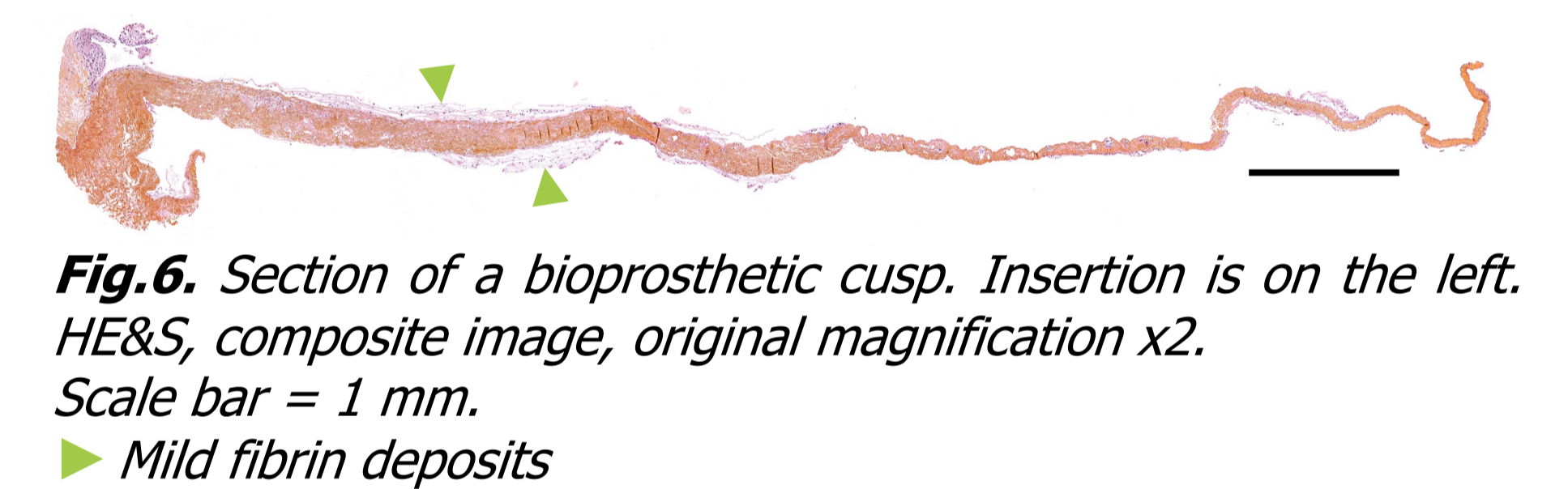


Fig.6. Section of a bioprosthetic cusp. Insertion is on the left. HE&S, composite image, original magnification x2. Scale bar = 1 mm.
▶ Mild fibrin deposits

Conclusion

Transcatheter pulmonary valve implantation was successfully performed in a dog. The bioprosthetic valve was still functional at the time of death. This case provides a proof-of-concept that such procedure can be performed in dogs with severe pulmonary valve disease and significantly improves the animal's quality of life.

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