Journal of Veterinary Cardiology (2017) 19, 256—267

ELSEVIER

Journal of Veterinary Cardiology
ESVC

www.elsevier.com/locate/jvc

Mitral valve repair in dogs using an ePTFE chordal implantation device: a pilot study☆

M. Borgarelli, DVM, PhD [a,*], O. Lanz, DVM [a], N. Pavlisko, DVM, MS [a], J.A. Abbott, DVM [a], G. Menciotti, DVM [a], M. Aherne, MVB [a], S.M. Lahmers, DVM, PhD [a], K.K. Lahmers, DVM, PhD [b], J.S. Gammie, MD [c]

[a] *Department of Small Animal Clinical Sciences, Virginia-Maryland College of Veterinary Medicine, Blacksburg, Phase II, Duck Pond Dr., VA 24061, USA*
[b] *Department of Biomedical Sciences & Pathobiology, Virginia-Maryland College of Veterinary Medicine, Blacksburg, 205 Duck Pond Dr., VA 24061, USA*
[c] *Division of Cardiac Surgery, University of Maryland School of Medicine, 110 S. Paca St., MD 21201, USA*

Received 6 July 2016; received in revised form 7 February 2017; accepted 28 March 2017

KEYWORDS
Canine;
Heart valve;
Valve surgery;
Transapical;
Beating heart

Abstract *Objective:* Mitral valve (MV) regurgitation due to degenerative MV disease is the leading cause of cardiac death in dogs. We carried out preliminary experiments to determine the feasibility and short-term effects of beating-heart MV repair using an expanded polytetrafluorethylene (ePTFE) chordal implantation device (Harpoon TSD-5) in dogs.
Animals: This study involved six healthy purpose-bred Beagles (weight range 8.9—11.4 kg).
Material and methods: Following a mini-thoracotomy performed under general anesthesia, the TSD-5 was used to place 1 or 2 artificial ePTFE cords on the anterior MV leaflet or the posterior MV leaflet via a left-ventricular transapical approach.

☆ A unique aspect of the Journal of Veterinary Cardiology is the emphasis of additional web-based images permitting the detailing of procedures and diagnostics. These images can be viewed (by those readers with subscription access) by going to http://www.sciencedirect.com/science/journal/17602734. The issue to be viewed is clicked and the available PDF and image downloading is available via the Summary Plus link. The supplementary material for a given article appears at the end of the page. Downloading the videos may take several minutes. Readers will require at least Quicktime 7 (available free at http://www.apple.com/quicktime/download/) to enjoy the content. Another means to view the material is to go to http://www.doi.org and enter the doi number unique to this paper which is indicated at the end of the manuscript.

* Corresponding author.
E-mail address: mborgarelli@gmail.com (M. Borgarelli).

http://dx.doi.org/10.1016/j.jvc.2017.03.002

The procedure was guided and monitored by transesophageal echocardiography. Postoperative antithrombotic treatment consisted of clopidogrel or a combination of clopidogrel and apixaban. Dogs were serially evaluated by transthoracic echocardiography at day 1, 7, 14, 21, and 30. The hearts were then examined for evaluation of tissues reactions and to detect signs of endothelialization.
Results: One or two chords were successfully implanted in five dogs. Four dogs completed the 30 days follow-up. One dog died intra-operatively because of aortic perforation. One dog died early post-operatively from a hemorrhagic pleural effusion attributed to overly aggressive antithrombotic treatment. One dog developed a thrombus surrounding both the knot and the synthetic cord. Postmortem exam confirmed secure placement of ePTFE knots in the mitral leaflets in all dogs and the presence of endothelialization of the knots and chords.
Conclusions: These preliminary results demonstrate the feasibility of artificial chordal placement using an ePTFE cordal implantation device in dogs.

Abbreviations

ACT	activated clotting time
AMVL	anterior mitral valve leaflet
CHF	congestive heart failure
ePTFE	expanded polytetrafluoroethylene
MMVD	myxomatous mitral valve disease
MR	mitral regurgitation
MV	mitral valve
TEE	transesophageal echocardiography
TTE	transthoracic echocardiography

Introduction

Current treatment for dogs affected by myxomatous degeneration of the mitral valve (MMVD) consists of medical therapy once they develop congestive heart failure (CHF) or they have significant cardiac remodeling [1]. Medical treatment has been shown to improve clinical status and increase longevity of affected dogs with CHF, as demonstrated in several clinical trials and studies [2—5]. However, medical therapy has no effect on the degree of mitral regurgitation (MR), the pathophysiological mechanism responsible for the development of clinical signs in dogs with MMVD. For this reason, dogs receiving medical treatment experience progression of their disease and eventually die from CHF. The standard of care for humans affected by MMVD is surgical mitral valve (MV) repair that abolishes MR, abrogates symptoms and restores normal life expectancy [6,7]. Conventional MV repair procedures in humans require cardiopulmonary bypass and cardioplegic cardiac arrest in order to directly visualize the MV and carry out repair. Techniques for repairing the MV include resection of the prolapsed segment of the valve as well as resuspension of the diseased segment with artificial expanded polytetrafluorethylene (ePTFE) chords in a fashion that mimics primary chordae tendineae, in association with ring annuloplasty [8]. The aim of these procedures is to reduce the severity of leaflet prolapse, restore leaflet coaptation, and therefore decrease the amount of MR. This in turn reduces left atrial pressure and ventricular preload, leading to a relief of clinical symptoms and reverse cardiac remodeling. For these reasons, these procedures require a very well trained team of surgeons, anesthetists, and perfusionists, along with specific and expensive perfusion equipment. These limitations, and the consequent high cost of these techniques, are mainly responsible for the limited availability of surgical MV repair in veterinary medicine although MMVD represents the most common cardiac disease in dogs. In fact, more than 20 years after the first report of MV repair in dogs [9], routine successful MV repair surgery is still confined to a few centers worldwide [10,11]. Recently, new MV repair devices have been developed that are designed to be delivered percutaneously or transapicaly [12,13]. These devices have been successfully employed in humans with increasing frequency [14—17]. The main reason for employing a novel device instead of a conventional repair is the relative simplicity of the technique, which is also less invasive and performed on a beating heart, without the need for cardiopulmonary bypass [15—19].

The Harpoon Medical TSD-5[d] is a new device (Fig. 1) that facilitates MV repair on a beating heart through a transapical approach and has the

[d] TSD-5, Harpoon Medical, Baltimore, MD.