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Thoracoscopic confirmation of correct seating of minimally-invasive rapid-deployment aortic bioprosthesis

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Data Collection B
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There is a growing interest in minimally invasive access for aortic valve surgery. The upper hemi-sternotomy provides good aortic valve exposure, with numerous possible advantages. Nevertheless, some surgeons remain skeptical about limited access surgery because it is technically more demanding. Sutureless and rapid-deployment bioprostheses could alleviate these concerns by improving ease of implantation.

We herein describe the use of video-assisted visualization to verify the position of the balloon-expandable frame during rapid aortic valve deployment.

Sutureless and rapid-deployment bioprostheses improve implantation and make it easy to increase minimally invasive access for aortic valve surgery.

Key words: **aortic valve • minimally invasive surgery • sutureless aortic valves**

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Background

Minimally invasive approaches have been successfully implemented for isolated aortic valve treatment, most commonly via an upper hemi-sternotomy. Advantages of minimal-access surgery are predominantly a result of decreased surgical trauma and include reduced postoperative pain, respiratory insufficiency, length of hospitalization, and blood transfusion rates, as well as faster rehabilitation and improved cosmetic results [1–3]. Some experienced surgical centers have also extended minimally invasive surgery to include more demanding procedures such as aortic valve repair, Ross procedure, aortic root replacement, ascending aorta aneurysm repair, partial arch replacement, and complete aortic arch repair [4,5].

Some surgeons remain skeptical about minimally invasive access surgery due to reduced exposure, limited surgical manipulation, and the risk of emergency conversion to full sternotomy; therefore, the rate of minimally invasive aortic valve surgery in Germany, for example, remains a disappointingly low 12.5% (1.464/10.225) [6].

Sutureless and rapid-deployment bioprostheses could help overcome some of the problems associated with minimal access aortic valve surgery by improving ease of implantation, thereby leading to a wider adoption of these techniques by cardiac surgeons. We herein describe an important adjunct – video-scopic confirmation of valve positioning – to the implantation of a rapid-deployment valve via a minimally invasive approach.

Technique

A limited-median skin incision (5–8 cm) is performed 2–3 cm below the suprasternal notch. An upper J- or inverted T- hemi-sternotomy is performed using a standard or oscillating saw into the third or fourth intercostal space. After opening the pericardium, the distal ascending aorta is directly cannulated. A 2-stage venous cannulation is (with or without tunneling through the subxiphoid space) inserted into the right atrium, or percutaneous cannulation is performed via the right femoral vein. Normothermic or mild hypothermic cardiopulmonary bypass (CPB) is employed and antegrade crystalloid or cold blood cardioplegia administered. The pericardial well is continuously flooded with carbon dioxide. A transverse aortotomy is performed 1 cm above the sinotubular junction. Traction sutures may be used to improve aortic valve exposure. The diseased aortic valve leaflets are excised, taking care not to cause any defects in the aortic annulus. Aggressive decalcification of the aortic annulus should be avoided. The annulus should be circular, without any bulky calcifications, to maximize the chance of successful valve implantation.



Figure 1. The EDWARDS INTUITY rapid deployment aortic bioprosthesis.

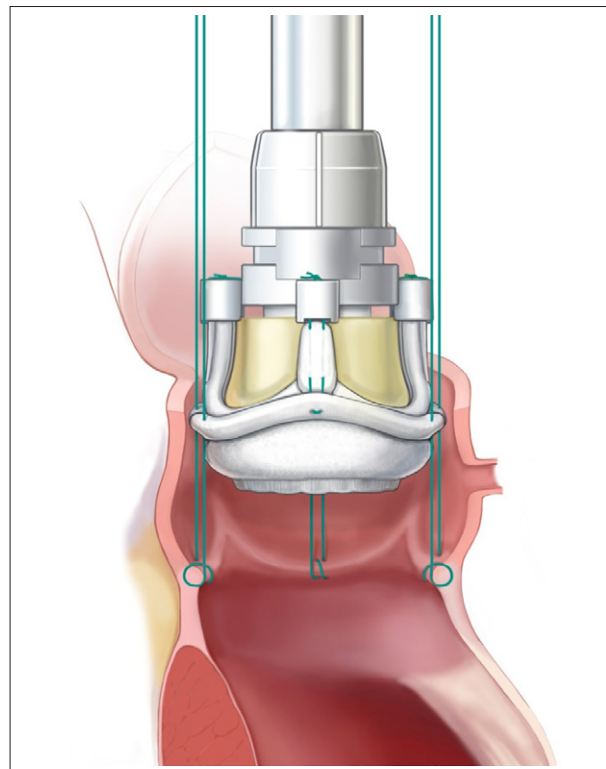


Figure 2. The EDWARDS INTUITY valve is secured into position using the three guide sutures and tourniquets.

The aortic annulus is carefully sized to correctly identify the appropriate EDWARDS INTUITY valve (Edwards Lifesciences, LLC, Irvine, CA). Three figure-eight polypropylene or polyethylene

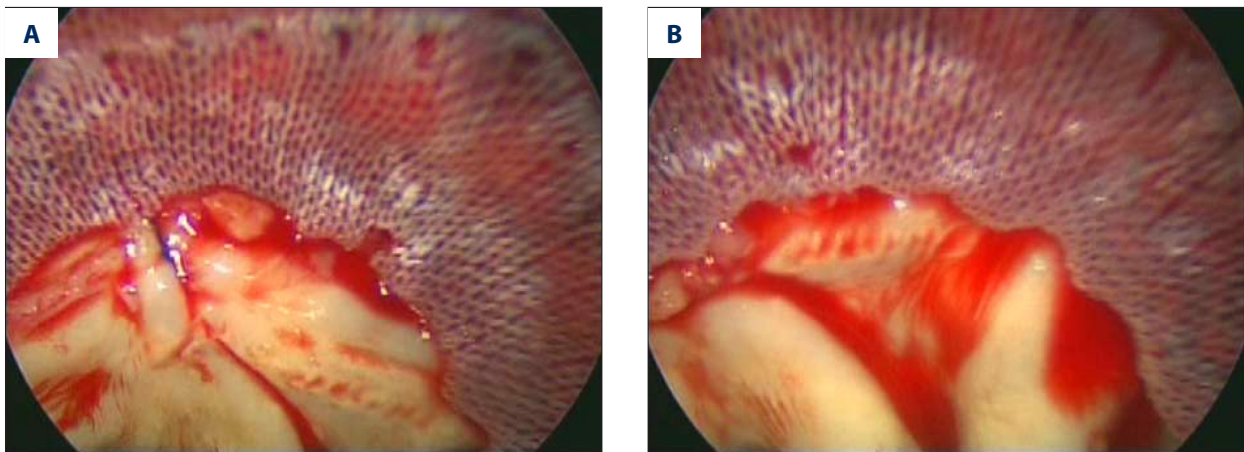


Figure 3. (A) Video assisted implantation of the EDWARDS INTUITY rapid deployment aortic valve. In this situation, the Intuity sutureless valve is not correctly positioned with a portion of the stent lying above the native aortic annulus. The guide suture is visible at the level of the annulus. (B) Videoscopic examination of the same patient following repositioning of the bioprosthesis. The EDWARDS INTUITY rapid deployment valve is now optimally positioned and the guide suture is no longer visible. Balloon inflation of the stent was successfully performed thereafter.

guiding sutures are placed through the annulus at the nadir of each sinus, and then passed through the black marks on the nadir portion of the valve suture ring (Figure 1). The rapid-deployment valve is positioned into the aortic annulus (with the stent and polyester sealing cloth being seated within the left ventricular outflow tract) using the guide sutures and 3 corresponding tourniquets (Figure 2). Because it may be difficult from the surgeon's perspective to confirm that the valve is properly seated within the annulus, we advance a 30-degree 5-mm scope (Karl Storz GmbH & Co. KG, Tuttlingen, Germany) through the valve holder prior to stent deployment. If videoscscopy reveals a portion of the stent-frame that lies above the aortic annulus (Figure 3A, (Video 1 – see web site)), then another attempt is made to adequately seat the valve within the annulus. Once the correct position is visually confirmed (Figure 3B, (Video 2 – see web site)), deployment of the balloon-expandable frame is completed with 10 seconds of balloon inflation. The camera can be passed through the valve leaflets to confirm stent deployment thereafter, but this step is usually not necessary. All 3 guiding sutures are tied and aorta closure is performed in the regular fashion.

Discussion

Minimally invasive surgery is known to improve aesthetic outcome, but, more importantly, it may have several additional advantages over full sternotomy surgery. Doll et al. [1], in a prospective study of 434 patients, investigated the advantages of minimally invasive access vs. conventional aortic valve replacement. In the minimally invasive group, postoperative outcome assessment showed a significant reduction of respiratory failure, intensive care unit stay, and hospital stay, as well as a lower incidence of perioperative mortality.

Similarly, Bakir et al. [2], in a study of 506 patients, demonstrated that hospital stays and blood loss was significantly reduced with a minimally invasive approach. Although these investigators also reported shorter aortic crossclamp and CPB times for patients undergoing minimal invasive surgery, other studies have consistently found longer operative times for minimally invasive patients likely because of the increased technical demands of a minimally invasive approach. To minimize these technical challenges and thereby increase the proportion of patients being offered minimal invasive surgery, it would be preferable to have a valve prosthesis that can be easily and quickly implanted.

Sutureless and rapid deployment bioprostheses have been proposed as an option to support this goal. To date, 3 different devices are available: the Edwards Intuity, the Perceval S (Sorin Biomedica Cardio Srl, Sallugia, Italy), and the Enable (Medtronic, Minneapolis, MN). All 3 bioprostheses have CE Mark approval in Europe, and we have clinical experience with the Intuity and Perceval S in our institution. In case of the Perceval S bioprosthesis, repositioning of the valve after initial deployment is possible, but requires re-crimping of the super-elastic nitinol frame and subsequent re-deployment. With the Intuity valve, repositioning is not possible after expansion of the stainless steel stent. If valve positioning on this annulus is not ideal, the prosthesis is designed to “pop out” of the annulus, thus requiring a second attempt or insertion of an alternate valve. To avoid this scenario, we prefer to confirm the correct position of the valve prior to its deployment, with the use of a standard 30-degree thoracoscope. In case the annulus is not completely covered by the balloon-expandable frame, the 3 guiding sutures are released and the valve can be easily repositioned.

Conclusions

Since implementing this approach to verify the correct position of the rapid deployment valve, we have successfully implanted

over 30 Edwards Intuity valves, with excellent hemodynamics and a very low incidence of paravalvular leak. We recommend the routine use of thoracoscopic guidance during implantation of rapid-deployment valves.

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