

Sutureless Aortic Valves: Combining the Best or the Worst?

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Aortic valve replacement is a life saving intervention. Significant progress has been made toward reducing surgical trauma through minimally invasive surgery and transcatheter techniques. Each of these approaches has its advantages and limitations. Sutureless aortic valves have been proposed to overcome these limitations and have been in use in Europe. It is however less than clear whether these valves will prove advantageous and whether they will have a role in the future. We review the published literature for sutureless aortic valves and their performance against standard and transcatheter aortic valve replacements.

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INTRODUCTION

Aortic stenosis (AS) is a deadly disease, with an estimated survival of less than 5 years after symptoms develop.¹ Despite excellent outcomes with surgical aortic valve replacement (SAVR), a significant number of patients with critical AS either decline or are not offered surgery. In the EuroHeart survey in 2005, 33% of patients with severe symptomatic AS did not undergo surgery.² According to the Society of Thoracic Surgeons (STS) database, patients more than 80 years increased to amount for 24% of all AS patients, up from 12% 20 years ago. Today, the invasiveness of traditional heart surgery perceived by both physicians and patients is being seen in the context of an increasingly older population in need of aortic valve replacement (AVR).

To address this problem, less invasive strategies have been developed: minimally invasive aortic valve surgery (miAVS) and transcatheter aortic valve implantation (TAVI). Both approaches demonstrated efficacy in treating AS but neither approach was problem-free.

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The Magovern-Cromie sutureless valve.

Central Message

Sutureless aortic valves may have a role in the era of minimally invasive surgery and transcatheter valve technologies.

Perspective Statement

Aortic valve replacement saves lives. Minimally invasive surgery and transcatheter techniques made significant progress over the past decade. Each of these approaches has its advantages and limitations. Sutureless aortic valves have been proposed to overcome these limitations. It is less than clear whether these valves would prove advantageous and whether they will have a role in the future.

Minimally invasive valve surgery has been shown to be feasible, safe, and effective.³⁻⁸ Consistent benefits with decreased blood loss and transfusion, decreased pain, decreased length of stay, and faster recoveries have been reported.^{6,9-12} It is intuitive that a procedure that is less invasive with less postoperative pain would be more appealing and more satisfying to patients. Despite the benefits, adoption of these techniques by surgeons is problematic. It is true that minimally invasive cardiac surgery requires an additional surgical skill set that in turn require additional training. Also, reports of longer cross-clamp times (CCT) and bypass times (BPT) with minimally invasive techniques may dissuade some.^{3,4,8} Although the associations between longer CCT and BPT with morbidity and mortality are well established, this did not translate into any negative outcomes with minimally invasive valve surgery in general.¹³⁻¹⁵ Until now, the penetration of miAVS into the surgical community has been less than expected.

On the other hand, TAVI has been shown to save lives in extreme risk patients, and to have comparable results to SAVR in high risk patients.¹⁶⁻¹⁸ Outcomes with intermediate risk groups have also been promising.¹⁹ Problems associated with ileofemoral access have been addressed with several

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alternative access options.²⁰⁻²³ The Achilles' heel of TAVI, however, is related to the fact that the calcific native valve is not excised; rather it is radially pushed into the aortic annulus. This results into a high rate of atrioventricular conduction blocks (AVB) requiring permanent pacemaker implantation (PPMI) and more importantly, a high incidence of paravalvular leaks (PVL). Unfortunately, PVLs even if mild have been clearly shown to be associated with increased mortality.²⁴⁻²⁸

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The optimal strategy would be one that is least invasive, technically simple, avoids long clamp and BPTs and results in the least possible adverse events (mortality, stroke, dislodgement, failure, AVBs, and PVLs). At this point, neither miAVS nor TAVI fit these criteria. Sutureless aortic valves (suAVs) are expandable valves that are surgically implanted under direct vision after excision of the native valve and debridement of the annulus. Deployment is simple and fast, and can easily be done through minimally invasive approaches. Expectations from these valves have varied widely.

Combining the Good or the Bad?

Proponents argue that sutureless valves avoid the disadvantages of both miAVS and TAVI. They are technically less challenging with shorter learning curve, and CCTs and BPTs are consistently shorter with suAVs than with sutured valves. As opposed to TAVI, suAVs are implanted under direct vision after excision of the native calcific valve, minimizing the risk for PVLs. Thus proponents believe that it combines the best of both worlds.

The counter-argument is that suAVs actually combines the worst of the 2 worlds. Sutureless AVs even if implanted using minimally invasive techniques are more invasive and involve more surgical trauma compared to TAVI. Then, if a patient will not

get TAVI and will be subjected to surgery, it may be wise to implant the best-tested and nearly-guaranteed valve, i.e., a sutured valve. The associated longer CCT with sutured valves did not result in increased morbidity in the minimally invasive AVS literature.

Both arguments are valid and at this moment definitive answers are difficult. Both sides of the comparison are moving targets, especially with the quick evolution of newer transcatheter valves with a shorter profile and a better seal. In this context, the potential role for suAVs is yet to be determined.

History

The idea of a sutureless valve is not new. In fact, the first prosthetic valve ever implanted in a human being was sutureless. In 1953, Hufnagel and Harvey implanted a sutureless valve of their own design in the descending aorta for severe aortic regurgitation.²⁹ A decade later, Magovern et al³⁰ implanted the first sutureless valve in the aortic position. The Magovern-Cromie valve was made of a silicone ball in a titanium cage. When inserted and rotated, multiple pins engaged the aortic annulus (Fig. 1). The procedure was reported to be fast with CCTs <30 minutes, and morbidities and mortalities were in the lower expected range for SAVRs of the time. The valve seemed very durable, and functioning valves have been reported up to 44 years later.³¹ The valve was however abandoned because of high rates of thromboembolism, reoperations, PVLs, and AVBs.³² More than 5 decades later, the interest in sutureless valves was revived with improved technology. These are biological valves mounted on a self expanding nitinol or a balloon-expandable stainless steel frame. These are intended for fast deployment under direct vision after complete excision of the native aortic valve. Currently 3 valve systems are commercially available in Europe. All 3 valves are made of pericardial leaflets mounted on a self



Figure 1. The Magovern-Cromie sutureless valve. Adapted with permission from Magovern et al.⁶³

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