Severe Mitral Valve Insufficiency Caused by Standard Surgical Aortic Valve Implantation and Its Reparation Using Suture-Less Prosthesis. Case report

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Case report

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Abstract

Background: aortic valve stenosis is the most frequent cardiac valve pathology in the western world. Surgical aortic valve replacement is the gold standard for the treatment of significant degenerative aortic valve diseases.

Case presentation: this case report highlights an unexpected abnormal iatrogenic shortening of the aorto-mitral continuity and its deformity, during traditional AVR using sutured stented aortic prosthesis as the first choice, which caused significant mitral valve regurgitation. The suture-less prosthesis was a rescue choice to restore the geometry and eliminate the deformation of the aorto-mitral continuity.

Conclusions: aortic valve replacement using suture-less prosthesis could be a valuable optional choice for lowering the risk of deformation of the aortic annulus and aorto-mitral continuity. It might provide better outcomes in combined procedures.

Background

aortic valve stenosis is the most frequent cardiac valve pathology in the western world, with a prevalence of 3% for individuals over the age of 75 years (1). The incidence of aortic valve stenosis is growing as the reflection of the rapid ageing of the population (2). Surgical aortic valve replacement is the gold standard for the treatment of significant degenerative aortic valve diseases (3). During the surgical aortic valve replacement procedure it is important to take into account, among other things, the closely adjacent anatomical structure of the aorto-mitral continuity and the influence of the aortic valve replacement on the functionality of the native mitral valve.

This case report is an overview of a complication of surgical aortic valve replacement procedure using the standard sutured stented valve implantation. A deformity of the aorto-mitral continuity has occurred after the implant, causing severe native mitral valve regurgitation based on the loss of mitral valve leaflets coaptation by newly formed traction force on the base of the anterior mitral valve leaflet. The situation has been solved using the suture-less aortic bio-prosthesis redo-implant option trying to decompress the aorto-mitral continuity and restore the normal function of the native mitral valve.

Another potential advantage of using the suture-less aortic valve prosthesis is a reduction of cardiopulmonary bypass time including reduced cross-clamp time. The use of suture-less aortic valve prosthesis allowed to facilitate minimally invasive as well as complex cardiac surgery procedures while maintaining satisfactory or even improved hemodynamic performance with low incidence of para-valvular leaks (4) over the regular stented surgical bio-prosthesis or TAVI valves. With this case we report another possible advantage using the suture-less valve.

This case report highlights an unexpected abnormal iatrogenic shortening of the aorto-mitral continuity and its deformity, during traditional AVR using sutured stented aortic prosthesis as the first choice, which

caused significant mitral valve regurgitation. The suture-less prosthesis was a rescue choice to restore the geometry and eliminate the deformation of the aorto-mitral continuity.

Case Presentation

We present a 57-year-old patient with hemodynamically significant aortic stenosis and normal mitral valve function as reported on echocardiogram before surgery. The patient underwent a surgical aortic valve replacement (SU AVR) by traditional stented aortic prosthesis implanted using pledgeted U-stitches. About a week after SU AVR the control echocardiogram revealed good function of the aortic valve, trace to small intra prosthetic regurgitation with gradient 37/16 mmHg, and severe mitral valve regurgitation which has occurred as a result of slightly restrictive anterior leaflet, impaired apposition and non-coaptation of the mitral valve causing significant eccentric mitral regurgitation, presumably due to the aortic prosthesis implantation (Figure 1). Furthermore, the patient developed a third-degree atrioventricular block, which required permanent pacemaker implantation.

Redo SU AVR was indicated, the aortic valve prosthesis was explanted and a new stented valve prosthesis implanted again using pledgeted U-stitches. The perioperative echocardiogram showed aortic prosthesis with good function with small intra prosthetic regurgitation, again complicated with significant mitral valve regurgitation.

To correct the severe mitral regurgitation, the mitral valve repair using annuloplasty ring was attempted. Left atriotomy was performed, but the mitral valve was absolutely inaccessible and the surgeon was not able to expose and reach properly the mitral valve. Therefore, the option of mitral valve repair surgery was abandoned and the left atriotomy was closed.

Subsequently, as a rescue option, the sutured aortic bio-prothesis was explanted to restore the original geometry of the A-M continuity and the missing aortic valve was replaced with the suture-less aortic bio-prosthesis (Perceval S, LivaNova ®, XL size based on annulus measurement). The perioperative and early postoperative echocardiograms showed good results: small regurgitation of the mitral valve, no paravalvular leaks of the suture-less prosthesis and even lower transvalvular gradients (22/12 mmHg) than the previously used stented aortic prosthesis (Figure 2- A, B). Control echocardiograms after one and two years showed normal function of mitral valve, the suture-less prosthesis with stable function and excellent hemodynamics parameters (transvalvular gradients 22/11 mmHg after one year, 24/12 mmHg after two years) (Figure 2- C), and persistent absence of any paravalvular leaks.

Discussion

The interest in less invasive cardiac surgery procedures grows steadily in the community of cardiac surgeons. They could allow competing with the non-invasive cardiology procedures and having better long-term results and less patient trauma. The aortic suture-less bio-prosthesis implantation is a technically feasible and safe procedure capable to fulfill this demand. Suture-less aortic valve

replacement (AVR) becomes an emerging alternative to standard AVR (5) especially performed with minimally-invasive approach (partial sternotomy/parasternal approach).

Potential advantages include shorter aortic cross-clamp times due to easier and faster implantation during minimally invasive surgery or combined cardiac surgery procedures (6). Several case series have shown good early clinical and hemodynamic outcomes with the use of suture-less prosthesis (7, 8, 9).

In addition, the design of the suture-less Perceval S valve with the flexible stent allows to better preserve physiologic movements and geometry of the aortic root and to avoid the deformation of aorto-mitral continuity. Indeed, there are studies showing that suture-less aortic valves have larger effective orifice area than stented valves (10).

According to our case report the Perceval S suture-less bio-prosthesis was an effective rescue choice compared to standard sutured bio-prosthesis, which allowed avoiding significant deformities of the aortic annulus and aorto-mitral continuity with consequent mitral regurgitation.

Conclusion

Aortic valve replacement using suture-less prosthesis could be a valuable optional choice for lowering the risk of deformation of the aortic annulus and aorto-mitral continuity. It might provide better outcomes in combined procedures with mild mitral regurgitation without indication for mitral surgery and avoid the possible iatrogenic lesion in such cases.

Further studies are needed to investigate the relationship between suture-less prosthesis and the adjacent anatomical structures of the aorto-mitral continuity, aortic root and annulus. Also effects on the mitral valve function (with or without surgical Intervention in the mitral valve itself) deserve further attention.

Abbreviations

TAVI
Transcatheter Aortic Valve Implantation, AVR:Aortic valve replacement, SU AVR:surgical aortic valve replacement, mmHg:millimeter of mercury, A-M:aorto-mitral continuity, XL:X large, AVR:aortic valve replacement

Declarations

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Author Contributions

Conceptualization, M.A.-O., M.K. (contributed equally); M.A.-O., M.K. designed the study and performed the surgeries.

Collect and analyzed the data M.A.-O., M.K; resources, M.A.-O.; writing—original draft preparation, M.A.-O., M.K.; writing—review and editing, M.A.-O., M.Š.; supervision M.Š.; project administration, M.A.-O., M.Š.; funding acquisition, M.Š.

All authors have read and agreed to the published version of the manuscript.

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Availability of data and materials

The data set supporting the conclusions of this article is included within the article, and any other inquiry is available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The case is presented anonymously, and patient consent and hospital approval have been obtained for publication.

Consent for publication

Verbal informed consent was obtained from the patient for publication of this case report and accompanying images.

Competing interests

The authors declare that they have no competing interests.

References

1. Nkomo VT, Gardin JM, Skelton TN, et al. Burden of valvular heart diseases: a population-based study. Lancet. 2006;368:1005–11.
2. Vahanian A, Otto CM. Risk stratification of patients with aortic stenosis. Eur Heart J. 2010;31:416–23.
3. Nishimura RA, Otto CM, Bonow RO, Carabello BA, Erwin JP III, Guyton RA, et al. 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary: A Report of the American College of Cardiology/ American Heart Association Task Force on Practice Guideline. Circulation. 2014;129:2440–92.
4. Ghoneim A, Bouhout I, Demers P, Mazine A, Francispillai M, El-Hamamsy I,et al. Management of small aortic annulus in the era of sutureless valves: acomparative study among different biological

options. J Thorac CardiovascSurg. 2016;152:101928.

5. Cagdas Baran MD, Mustafa Serkan Durdu MD, PhD, Fatih Gumus MD, Mehmet Cakici MD, Mustafa Bahadir Inan MD. Mustafa Sirlak, MD, and Ahmet Ruchan Akar, MD Sutureless aortic valve replacement with concomitant valvular surgery. The American Association for Thoracic Surgery https://doi.org/10.1016/j.jtcvs.2017.12.154.
6. Mazine A, Teoh K, Bouhout I, Bhatnagar G, Pelletier M, Voisine P, et al. Sutureless aortic valve replacement: a Canadian multicentre study. Can J Cardiol. 2015;31:63–8.
7. Eichstaedt HC, Easo J, Harle T, Dapunt OE. Early single-center experience in sutureless aortic valve implantation in 120 patients. J Thorac Cardiovasc Surg. 2014;147:370–5.
8. Flameng W, Herregods MC, Hermans H, Van der Mieren G, Vercalsteren M, Poortmans G, et al. Effect of sutureless implantation of the Perceval S aortic valve bioprosthesis on intraoperative and early postoperative outcomes. J Thorac Cardiovasc Surg. 2011;142:1453–7.
9. Ranucci M, Frigiola A, Menicanti L, Castelvecchio S, de Vincentiis C, Pistuddi V. Aortic cross-clamp time, new prostheses, and outcome in aortic valve replacement. J Heart Valve Dis. 2012;21:732–9.
10. Ghoneim A, Bouhout I, Demers P, Mazine A, Francispillai M, El-Hamamsy I, et al. Management of small aortic annulus in the era of sutureless valves: a comparative study among different biological options. J Thorac Cardiovasc Surg. 2016;152:1019–28.

Figures

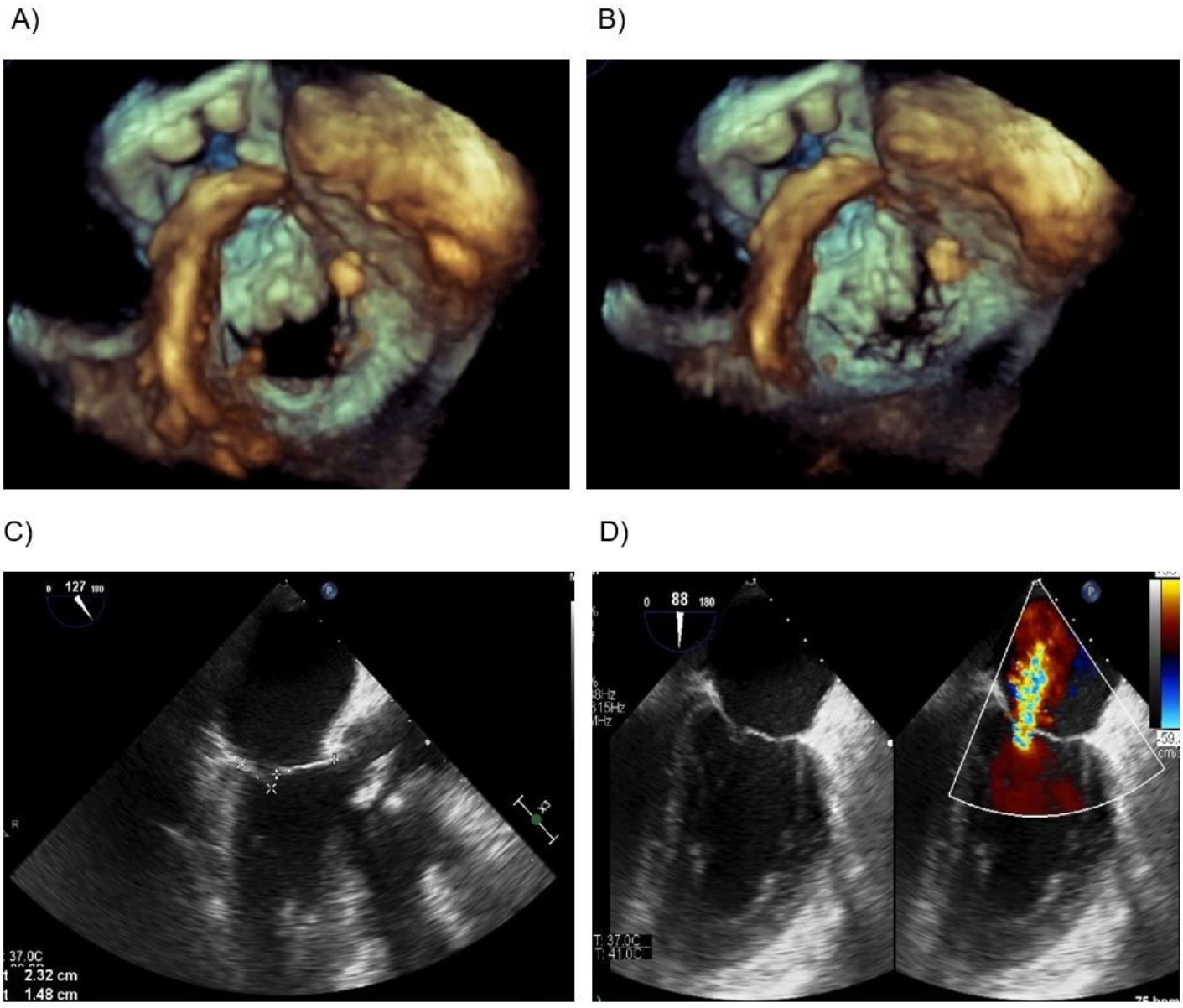

Figure 1

Echocardiogram images after SU AVR using traditional sutured stented aortic prosthesis. A) Mitral valve orifice - diastolic opening B) Mitral valve dysfunction during systolic leaflet closure, loss of coaptation C) Slightly restrictive anterior leaflet, impaired apposition and loss of coaptation of the mitral valve. D) Severe mitral regurgitation showed by color Doppler echocardiography.

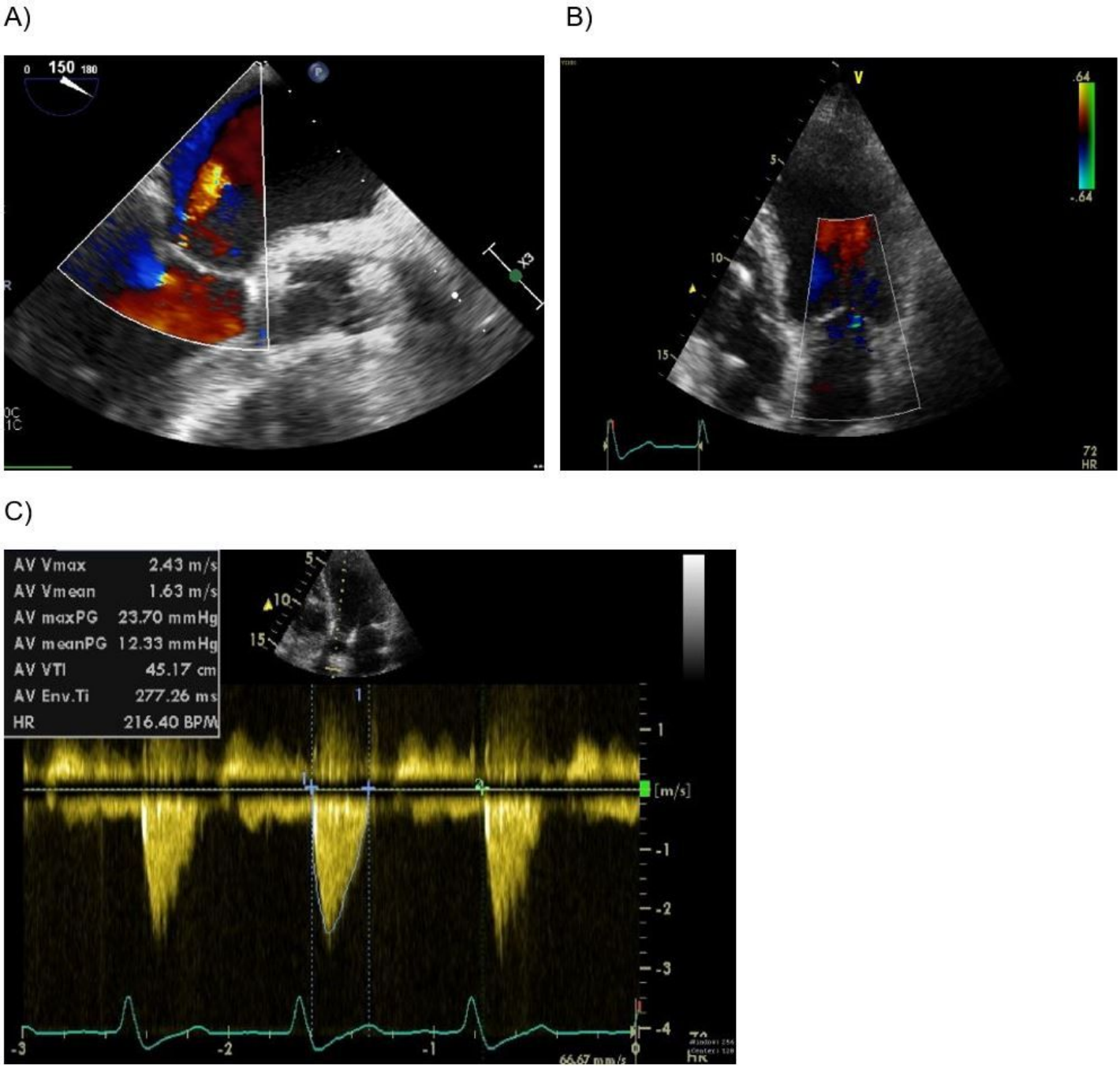

Figure 2

Control Echocardiograms after using suture-less bio-prosthesis (end-results). A) Perioperative control showing small regurgitation of the mitral valve. B) Restoration of the mitral valve geometry and function after 1 year. C) Hemodynamic parameters of suture-less prosthesis after 2 years.

Supplementary Files

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