Reconstruction of aorto-mitral continuity with a handmade aorto-mitral bioprosthetic valve for extensive bivalvular endocarditis†

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Abstract

Surgical treatment is effective to exclude all infected tissue in patients with infective endocarditis. Although various techniques have been reported, it has remained a great challenge for patients with extensive infected regions. A patient with extensive bivalvular endocarditis including the aortic and mitral valve and aorto-mitral continuity is described. A handmade aorto-mitral bioprosthetic valve was created to reconstruct the defect after extensive debridement. The patient was discharged on the 30th postoperative day without inflammatory signs.

Keywords: Infective endocarditis • Extensive bivalvular endocarditis

CLINICAL SUMMARY

A 73-year old man with a 4-month history of fever of unknown origin after left nephrectomy for renal cancer presented with infective endocarditis caused by Staphylococcus salivarius. Two-dimensional echocardiography revealed a vegetation involving the aortic valve and anterior mitral leaflet. Preoperatively, an asymptomatic subarachnoid haemorrhage was detected by computed tomography of the brain. To prevent heparin-related deterioration of the subarachnoid haemorrhage, nafamostat mesilate was used as an anticoagulant during cardiopulmonary bypass (CPB) as in an earlier report [1].

Under cardioplegic cardiac arrest, the ascending aorta was transected. The aortic valve had a vegetation extending to the circumference for aorto-mitral continuity. After removal of the aortic valve, the size of the aortic annulus was measured. The aortic annulus was divided on the commissure between the left and non-coronary cusps towards the anterior mitral leaflet. The roof of the left atrium (LA) was opened with a superior transseptal approach. The size of the mitral annulus was measured. All infected tissue, including the anterior mitral leaflet and aorto-mitral continuity, was excised extensively (Fig. 1a).

Vertical mattress sutures with pledgets were placed for 2/3 of the circumference of the aortic annulus (excluding 1/3 of the circumference for aorto-mitral continuity). Everted mattress sutures with pledgets were placed for the posterior mitral leaflet, including both trigones (Fig. 1b).

On another table, a handmade aorto-mitral bioprosthetic valve was created with a 21-mm Carpentier-Edwards Perimount Magna aortic valve (Edwards Lifesciences, Irvine, CA, USA), a 27-mm Carpentier-Edwards Perimount Plus mitral valve and a collagen-impregnated Dacron knitted fabric (MAQUET Cardiovascular LLC, Wayne, NJ, USA) (Fig. 2a). The handmade valve included a fold between the aortic and mitral bioprosthetic valves as a seam allowance to reconstruct the posterior wall of the ascending aorta and the roof of the LA after placement.

After placement of the mitral bioprosthetic valve, two additional 4-0 polypropylene mattress sutures with pledges were placed at both ends to reconstruct aorto-mitral continuity (Fig. 1c). For the antero-lateral commissure side, the first suture was applied to secure the aortic wall, the end of aorto-mitral continuity, the fold of the valve, the mitral sewing cuff and the LA. For the postero-median commissure side, the second suture was placed to secure the atrial septum, the aortic wall, the end of aorto-mitral continuity, the fold, the mitral sewing cuff and the right atrium (RA). After placement of the aortic bioprosthetic valve, two sutures for both ends of aorto-mitral continuity were tied to fix tightly the handmade aorto-mitral bioprosthetic valve.

To reconstruct the posterior wall of the ascending aorta and the roof of the LA, a trimmed Dacron fabric (2.5 x 8 cm) was inverted at the center. The fabric along the inverted line was sewn to the fold of the handmade valve (Fig. 1d). Then, the ascending aorta and LA were reconstructed with the fabric. Finally, the RA was reconstructed with an autologous pericardium. Aortic cross-clamping time was 159 min. CPB time was 213 min. Epicardial permanent atrial and ventricular pacing leads were placed before closure. After the operation, a generator was implanted because

Figure 1: (a) The stump of aorto-mitral continuity occupies \( \approx 1/2 \) of the circumference of the left coronary cusp on the aortic annulus. The non-coronary cusp situation is similar to the left coronary cusp. (b) Vertical mattress sutures with pledgets have been placed for 2/3 of the circumference of the aortic annulus (excluding 1/3 of the circumference for the aorto-mitral continuity). Everted mattress sutures with pledgets have been placed at the posterior mitral leaflet, including both trigones. (c) Two additional 4-0 polypropylene mattress sutures with pledgets have been placed at both ends to ensure firm anchoring of the valve. (d) A trimmed Dacron fabric (2.5 \( \times \) 8 cm) is inverted at the center. The fabric along the inverted line has been sewn to the fold of the handmade valve to reconstruct the posterior wall of the ascending aorta and the roof of the left atrium (LA).

Figure 2: (a) Aortic and mitral bioprosthetic valves are sewn to a trimmed fabric for 2/3 of the circumference of the aortic valve and 1/2 of the circumference of the mitral valve. The fabric has been doubled up to create a 1-cm fold as an allowance to reconstruct the posterior wall of the ascending aorta and the roof of the LA. (b) This is a recommended dimensional drawing of the fabric. Along the suture line for a handmade aorto-mitral bioprosthetic valve, a 2-mm allowance is included in this design. AVD: aortic valve diameter; MVD: mitral valve diameter.
of complete atrio-ventricular block. The patient was discharged on the 30th postoperative day without inflammatory signs.

DISCUSSION

A patient with extensive bivalvular endocarditis including the aortic and mitral valves and aorto-mitral continuity was treated surgically. A handmade aorto-mitral bioprosthetic valve was used to reconstruct the defect after extensive debridement. Although a monobloc aorto-mitral homograft would have been an ideal option in this case [2, 3], it was not commercially available in Japan at that time. Thus, we created a handmade bioprosthetic valve during the operation and achieved a successful surgical outcome in this complicated case.

In 2006, Obadia et al. [4] reported a monobloc mechanical valve, which was prepared before starting CPB, for extensive bivalvular endocarditis. Due to the possibility of not using a handmade bioprosthetic valve, we did not start preparation until direct observation of the infected lesion. Thus, we managed to keep the preparation time at a minimum with less suturing. The recommended dimensional drawing of the fabric is shown in Fig. 2b. Importantly, 240° for the aortic valve (i.e. the left and non-coronary cusps) and 180° for the mitral valve (i.e. the anterior mitral leaflet) are good enough to anchor the handmade valve. Furthermore, 24 mm of length between the aortic and mitral bioprosthetic valves includes a 2-mm allowance for both valves, resulting in a 1-cm fold.

In this procedure, one of the most important technical points is fixation of both ends of the new aorto-mitral continuity. Great care is needed for both mitral commissures to avoid the shunt flow between the LV and the LA. Thus, large bites were required to ensure firm anchoring of the handmade valve. Although complete atrio-ventricular block was a high-risk with this procedure, shunt flow due to incomplete fixation might cause a critical physical condition, such as heart failure or the recurrent infection.

Although complete and extensive debridement of the infected lesion is the fundamental principle for cardiac surgeons in infective endocarditis, it is very difficult to determine the appropriate procedure for patients with multiple infected lesions including the aorto-mitral continuity. When visible infection is not detected along the aorto-mitral continuity in patients with bivalvular endocarditis, double valve replacement would be appropriate surgery. However, a few unfortunate patients could die of postoperative infection in the aorto-mitral continuity despite surgical and medical treatment [5]. Accordingly, extensive and complete debridement including the aorto-mitral continuity might be indicated when the infected lesion is close to the aortic or the mitral annulus.

CONCLUSION

Although extensive debridement including the aorto-mitral continuity is a great challenge in infective endocarditis, complete removal of the infected lesion is very important to achieve a better outcome. This technique with a handmade aorto-mitral bioprosthetic valve is a reasonable surgical procedure for such complicated cases.

Conflict of interest: none declared.

REFERENCES