General Thoracic and Cardiovascular Surgery (2018) 66:573–576
https://doi.org/10.1007/s11748-018-0887-0

CASE REPORT

Transatrial repair of post-infarction ventricular septal defect

Takanori Tokuda[1] · **Kazushige Inoue**[1] · **Takashi Murakami**[2]

Received: 22 October 2017 / Accepted: 9 January 2018 / Published online: 24 January 2018

Abstract
A 72-year-old woman presented with a post-infarction ventricular septal defect, presumably within 10 days after the onset of acute myocardial infarction. An emergency surgery was performed because of hemodynamic instability. Using the sandwich patch technique, we approached the posteriorly oriented defect through a right atriotomy and detached tricuspid valve. By avoiding either left or right ventriculotomy, additional damage to the already infarcted ventricle and risk of bleeding were avoided. The patient showed an uneventful postoperative recovery, with no residual shunt detected. A transatrial approach combined with a sandwich patch technique is a good alternative in cases where the pathological anatomy is suitable.

Keywords Post-infarction ventricular septal defect · Transatrial approach · Sandwich patch technique

Introduction

Although various techniques have been developed and employed for repair of post-infarction ventricular septal defect (VSD) [1–4], most methods achieve closure of the VSD through a left or right ventriculotomy, which might cause impaired ventricular function, arrhythmia, or bleeding complications. A transatrial repair was proposed [5] in 1986, and more recently, this technique has shown encouraging results in a group of patients presenting with a basal or posterior ventricular septal defect to avoid ventriculotomy-related complications [6–9]. We present a case of acute inferior myocardial infarction complicated with a ventricular septal defect, which was repaired via a transatrial approach.

Case

A 72-year-old woman presented to a local hospital with general fatigue and loss of appetite for 10 days prior to presentation. She was diagnosed with acute myocardial infarction and ventricular tachycardia and transferred to our hospital. Upon arrival, she was conscious, although her vital signs indicated she was in shock, for which she was treated with inotropes. Her electrocardiogram demonstrated ST-segment elevation in the inferior leads. The echocardiogram revealed a VSD at the basal inferoseptal wall with left-to-right shunt flow (Fig. 1) and akinesis of the inferior wall. Her estimated pulmonary artery pressure was 37.5 mmHg. Emergency coronary angiography revealed mid-right coronary artery occlusion and mild stenosis in the middle left anterior descending artery (Fig. 2). During angiography, an intra-aortic balloon pump (IABP) was employed, and the patient was transferred to the operating room for emergency surgery.

Through a median sternotomy, cardiopulmonary bypass was established with ascending aortic and bicaval cannulation. Myocardial protection was achieved using antegrade and retrograde cold blood cardioplegia. Through a right atriotomy, the ventricular septum was approached and explored, and a ventricular septal defect was identified at the inferior septum covered by trabeculation and tricuspid valve apparatus. Two-thirds of the septal and all the posterior leaflets of the tricuspid valve were detached approximately 5 mm from the annulus to achieve adequate exposure of the VSD (Fig. 3). The necrotic myocardium around the VSD and the trabeculation across and around the edge of the VSD were resected, revealing a defect measuring 20 mm in diameter. The posterior papillary muscle was preserved. A sandwich technique was employed using one equine pericardial patch (Edwards Lifesciences Corp., Tokyo, Japan) placed on the left ventricular (LV) side of the septum, combined with

✉ Takashi Murakami
takashimurakami24@hotmail.com

[1] Department of Cardiovascular Surgery, Hirakata Kosai Hospital, Osaka, Japan

[2] Department of Cardiovascular Surgery, Osaka City University Graduate School of Medicine, Osaka, Japan

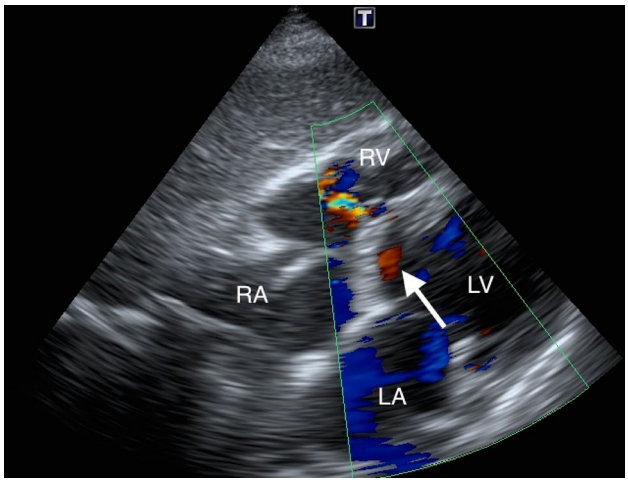

Fig. 1 Echocardiography revealing a posterior ventricular septal defect

another patch placed on the right ventricular (RV) side, as described previously [10, 11]. Interrupted mattress sutures (10 pairs buttressed with pledgets) were passed first through the patch, measuring 60 mm in diameter, and then from the left side of the septum to the right at least 1 cm away from the edge of the trimmed defect, where the myocardial tissue seemed relatively healthy. This LV side patch was introduced into the left ventricular chamber to ensure that the patch was placed widely on the LV side of the septum and secured in place, allowing a relatively large area (at least 2.0 cm rim) of the patch to be secured firmly to the septum due to the pressure generated by the left ventricle itself, leading to the theoretical beneficial sealing effect to avoid a residual shunt. Sutures were then passed through the RV side patch. Before completing fixation of the patch on the RV side, Bio-Glue (CryoLife, Inc., Kennesaw, GA) was applied between the two patches. The tricuspid leaflet was reattached to the

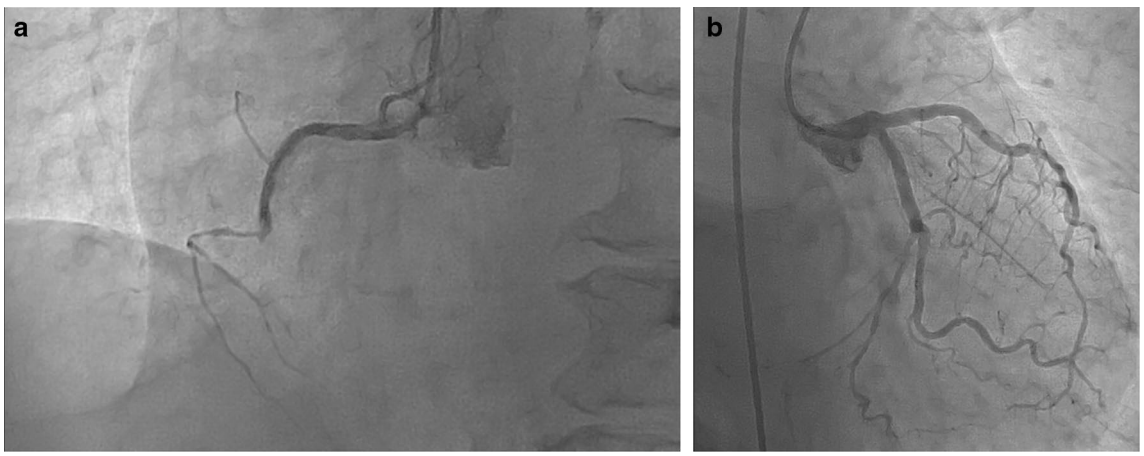

Fig. 2 Coronary angiography revealing mid-right coronary artery occlusion (**a**) and mild stenosis in the middle left anterior descending artery (**b**)

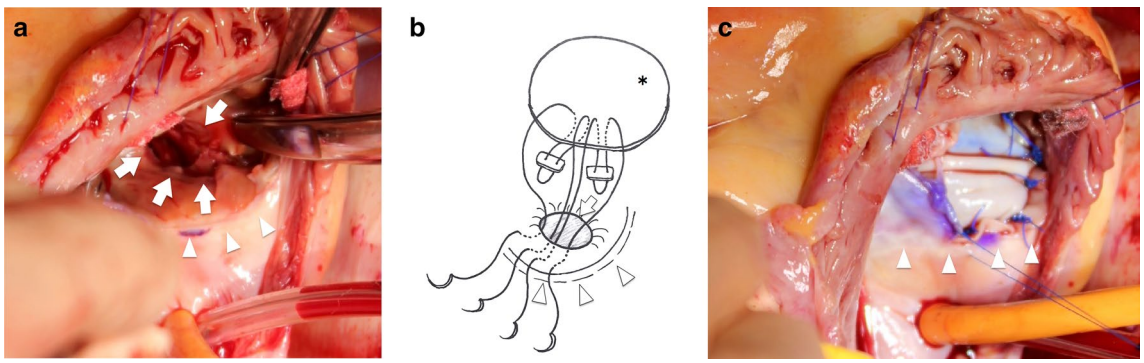

Fig. 3 Photographs of the operative field and schematic drawing of the sandwich patch technique. **a** After detachment of the septal and posterior leaflet of the tricuspid valve from the annulus (arrowheads) and resection of trabeculation of the right ventricular septum, the ventricular septal defect (arrows) has been exposed. **b** Mattress sutures buttressed with pledgets are passed through an equine pericardial patch (asterisk) and ventricular septum. **c** The right-sided pericardial patch is fixed

annulus using continuous 5–0 polypropylene sutures. The distal right coronary artery was bypassed using a saphenous vein graft, and the patient was successfully weaned from the cardiopulmonary bypass. Aortic cross-clamp time, cardiopulmonary bypass time, and duration of operation were 129, 212, and 305 min, respectively .

The IABP was removed on postoperative day (POD) 2. The patient was weaned from the ventilator on POD 4. Her postoperative course was uneventful except for an episode of ventricular tachycardia, which was successfully treated using an external defibrillator. The patient was discharged on the POD 36. An echocardiogram obtained 2 months postoperatively revealed no evidence of residual VSD shunt, mild tricuspid regurgitation, and akinesis of the inferior wall of the left ventricle with an ejection fraction of 49%.

Discussion

Post-infarction VSD remains a surgical challenge, with recent reports showing mortality rates ranging from 10% to as high as 33.5% [1, 10–13]. Although various surgical techniques have been developed, usually the operation is performed through a left ventriculotomy or infarcted free wall. Posteriorly located VSDs are difficult to access via a left ventriculotomy. Komeda et al. have reported the results of 31 patients treated with infarct exclusion method [1], for both anterior and posterior VSD. Secure stitches were placed at the mitral annulus for a posterior VSD. The infarct exclusion method was associated with an overall mortality of 10%, and a posterior VSD was not associated with a risk of mortality. David et al. have reported the use of infarct exclusion in 52 patients, with surgical mortality of 19% and actuarial survival of 59% at 8 years [14].

A left ventriculotomy can additionally cause deterioration of already impaired left ventricular function. Bleeding and fatal ventricular arrhythmias might complicate the postoperative course. To avoid these drawbacks of a left ventriculotomy, Asai et al. proposed a right ventricular approach, which was associated with improved outcomes [2]. This approach is indicated for both anterior and posterior VSDs.

VSD closure without performing a ventriculotomy could be an attractive surgical option when the pathological anatomy is suitable for exposure and manipulation of the VSD via a right atriotomy. Massetti et al. have reported 12 cases of a posterior VSD repaired through the right atrial approach, with early mortality of 25% [15]. Sharma et al. have compared the results between a transatrial and transventricular approach and found that operative mortality associated with post-infarction basal VSD was as high as 25% and was related to right ventricular failure and bleeding from the ventriculotomy [6]. Because of the rarity of this disease entity, the superiority of the transatrial approach could not be proved due to lack of sufficient scientific evidence. However, theoretically, the transatrial approach has benefits of avoiding disadvantages related to a ventriculotomy.

The sandwich patch technique was reported by Asai et al. [2], and favorable midterm follow-up results were presented by themselves and the others [10, 11]. Advantages of this technique are that it is simple and easily reproducible and avoids a left ventriculotomy, thereby causing neither additional damage to the left ventricular wall nor bleeding complications from the left ventriculotomy. Moreover, it can ensure secure sutures with less tension and achieve reinforcement using gelatin–resorcinol–formaldehyde glue. Although these abovementioned authors have described the sandwich patch technique [2, 10, 11] performed via a right ventriculotomy, it has also been performed via a right atriotomy [7, 9]. In our case, we could obtain excellent exposure of the VSD because the defect was limited to the posterior and inferior septum, with relatively healthy tissue on the entire circumference of the defect. There must be a limitation of this approach when the defect is more extensive, including the more apical and anterior septum. Furthermore, if the entire inferior septum is necrotic and fragile, stitches should be taken out of the ventricle and supported by felt on the diaphragmatic surface of the ventricle. In such a case, simultaneous exposure of both the defect and diaphragmatic surface of the ventricle could not be obtained, whereas the inferior right ventriculotomy could [2]. When exposure through a right atriotomy is not sufficient, an additional right ventriculotomy should be considered.

The tricuspid valve is usually sacrificed at the expense of avoiding ventriculotomy because its leaflets need to be detached for adequate exposure to perform this procedure. In our case, although extensive detachment including 2/3 of the septal and all the posterior leaflets was undertaken for consistent exposure of the defect, the leaflets were re-attached to the annulus after VSD closure, with acceptable tricuspid regurgitation noted postoperatively. In a case series reported by Sharma et al., all patients needed tricuspid valve replacement [6], whereas none of the patients reported by Massetti et al. needed tricuspid valve replacement [15]. When the right ventricular function is severely impaired, even moderate tricuspid regurgitation could barely be tolerated. Therefore, individualized assessment would be necessary.

Conclusion

Post-infarction posterior VSD can be successfully repaired through the right atrial approach using the sandwich patch technique. This approach provides excellent exposure and manipulation of the VSD without the need to perform a ventriculotomy in patients showing suitable pathological anatomy.

Conflict of interest The authors declare no conflicts of interest associated with this manuscript

References

1. Komeda M, Fremes SE, David TE. Surgical repair of post infarction ventricular septal defect. Circulation. 1990;82:243–7.
2. Asai T, Hosoba S, Suzuki T, Kinoshita T. Postinfarction ventricular septal defect: right ventricular approach-the extended "sandwich" patch. Semin Thorac Cardiovasc Surg. 2012;24:59–62.
3. Daggett WM, Burwell LR, Lawson DW. Resection of acute ventricular aneurysm and ruptured interventricular septum resection of acute ventricular aneurysm and ruptured interventricular septum after myocardial infarction. N Engl J Med. 1970;283:1507–8.
4. Hisatomi K, Eishi K, Hamawaki M, Hashizume K, Hazama S, Ariyoshi T, Taniguchi S, Miura T, Hashimoto W, Matsukuma S. Double patch technique for closing acute ventricular septal perforation. Gen Thorac Cardiovasc Surg. 2010;58:555–60.
5. Filgueira JL, Battistessa SA, Estable H, Lorenzo A, Cassinelli M, Scola R. Delayed repair of an acquired posterior septal defect through a right atrial approach. Ann Thorac Surg. 1986;42:208–9.
6. Sharma V, Greason KL, Nkomo VT, Schaff HV, Burkhart HM, Park SJ, Suri RM, Dearani JA. Repair of acute inferior wall myocardial infarction-related basal ventricular septal defect: transatrial versus transventricular approach. J Card Surg. 2013;28:475–80.
7. Kitabayashi K, Miyake K, Sakagoshi N. Right atrial approach for repairing a posterior ventricular septal rupture. Surg Case Rep. 2016;2:85.
8. Cho H, Kim WS. Transatrial approach for the repair of the posterior postinfarct ventricular septal rupture. Korean Circ J. 2016;46:107–10.
9. Myrmel T, Endresen PC, Schive B. A new double patch technique for early repair of postinfarction posterior ventricular septal rupture: Avoiding ventriculotomies. Scand Cardiovasc J. 2005;39:189–91.
10. Isoda S, Imoto K, Uchida K, Hashiyama N, Yanagi H, Tamagawa H, et al. Sandwich technique via right ventricle incision to repair postinfarction ventricular septal defect. J Card Surg. 2004;19:149–50.
11. Hosoba S, Asai T, Suzuki T, Nota H, Kuroyamagi S, Kinoshita T, Takashima N, Hayakawa M. Mid-term results for the use of the extended sandwich patch technique through right ventriculotomy for postinfarction ventricular septal defect. Eur J Cardiothorac Surg. 2013;43:e116–e20.
12. Committee for scientific affairs, Japanese association for thoracic surgery. Thoracic and cardiovascular surgery in Japan during 2014. Annual report by the Japanese Association For Thoracic Surgery. Gen Thorac Cardiovasc Surg 2016;64:665–97.
13. Fukushima S, Tesar PJ, Jalali H. Determinants of in-hospital and long-term surgical outcomes after repair of postinfarction ventricular septal rupture. J Thorac Cardiovasc Surg. 2010;140:59–65.
14. David TE, Armstrong S. Surgical repair of postinfarction ventricular septal defect by infarct exclusion. Semin Thorac Cardiovasc Surg. 1998;10:105–10.
15. Massetti M, Babatasi G, Le Page O, Bhoyroo S, Saloux E, Khayat A. Postinfarction ventricular septal rupture: early repair through the right atrial approach. J Thorac Cardiovasc Surg. 2000;119:784–9.