ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

https://jcardcrticare.org/

Journal of Cardiac Critical Care TSS

Cardiac Critical Care *Point of Technique*

Reconstruction of the Left Atrioventricular Valve with Pericardial Patch Closure of the Ostium Primum Atrial Septal Defect in a Patient with Partial Atrioventricular Septal Defect under Mild Hypothermic Extracorporeal Circulation and Cardioplegic Arrest (UKC's Modification): A Video Presentation

Ujjwal K. Chowdhury[1], Niwin George[2], B. Sushamagayatri[2], Sai Manjusha[2], Sraddha Gupta[2], Shikha Goja[2], Srikant Sharma[2], Poonam Malhotra Kapoor[3]

[1]Department of Cardiothoracic and Vascular Surgery, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, [2]Cardiothoracic Sciences Centre, All India Institute of Medical Sciences, [3]Department of Cardiac Anesthesia and Critical Care, CNC, All India Institute of Medical Sciences, New Delhi, India.

***Corresponding author:**
Ujjwal K. Chowdhury, Department of Cardiothoracic and Vascular Surgery, National Institute of Medical Sciences and Research, Jaipur, Rajasthan, India.
ujjwalchow@rediffmail.com

Received : 03 November 2022
Accepted : 25 December 2022
Published : 30 January 2023

DOI
10.25259/mm_jccc_Ujjwal-Partial-AV-Canal(Video)

Quick Response Code:

ABSTRACT

A 26-year-old male patient diagnosed with partial type of atrioventricular septal defect in sinus rhythm, cleft left atrioventricular valve with mild pulmonary arterial hypertension, and severe left atrioventricular valvular regurgitation successfully underwent reconstruction of the left atrioventricular valve and pericardial patch closure of the atrial septal defect using UKC's modification. The technical details of the surgical procedure have been elaborated in detail.

Keywords: Atrioventricular valve, Pericardial patch closure, Ostium primum ASD, Extracorporeal circulation

INTRODUCTION

The atrioventricular septal defect encompass a spectrum of lesions, in which the common etiology appears to be abnormal development of the superior and inferior endocardial cushions resulting in a deficiency or absence of the atrioventricular septum.[1-6] This deficiency of the atrioventricular septum results in an ostium primum defect immediately above the atrioventricular valves and a scooped out area in the inlet (basal) portion of the ventricular septum.

Atrioventricular septal defects include a spectrum of malformations. At one end of the spectrum is the partial or incomplete atrioventricular septal defect characterized by an interatrial communication, but no interventricular communication, two separate valve orifices, and a connection of variable width between the left superior and left inferior leaflets. At the other end is the most extreme form with large deficiencies in the atrial and ventricular septa, and a common atrioventricular valvular orifice, known as complete atrioventricular septal defect.[1-6]

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.
©2023 Published by Scientific Scholar on behalf of Journal of Cardiac Critical Care TSS

Following Carpentier's concepts on this malformation, the terms left atrioventricular valve and right atrioventricular valve are used instead of mitral valve and tricuspid valve, respectively.[7] The term septal commissure is used instead of cleft to indicate the gap between the left superior and left inferior leaflets.[3,7]

A fenestration or perforation of the left atrioventricular valve is an orifice, congenital or acquired in origin, well separated from the main orifice but not supported by a chordal apparatus. Accessory clefts or commissures, defined as radial openings from the free edge of a leaflet, is complete (up to the annulus) or incomplete (partially splitting the leaflet) [Video 1].[3,6,7]

Anomalous positions of the papillary muscles are common in atrioventricular septal defect and are difficult to classify. Malformations of papillary muscles include abnormally thick muscles with rudimentary or absent chordal apparatus inserted directly into the under surface of the leaflets and multiple thin muscles with abnormal insertions into the ventricular walls.[4,6,7]

Several anatomical features are shared among all types of atrioventricular septal defects.[1-6] These include: (a) absence of the usual wedged position of the aortic valve due to a common atrioventricular valve ring; (b) lengthened outlet septum-to-ventricular apex ratio, resulting in an elongated left ventricular outflow tract and a "goose-neck" appearance; (c) inferior displacement of the atrioventricular node and coronary sinus; (d) shortened dimension of the inlet septum-to-ventricular apex giving the interventricular septum a "scooped out" appearance; (e) apical displacement of the attachments of the atrioventricular valves to the ventricular crest; and (f) variable degrees of underdevelopment of the inlet septum, resulting in absence of a ventricular septal defect, a restrictive ventricular septal defect, or a large ventricular septal defect.[1-7]

Abnormal differentiation and remodeling of the cushion mesenchyme into valvuloseptal tissue is the mechanism for development of atrioventricular septal defects.[8] The wide variability in the degree of development of the endocardial cushions explains the variability in size and extent of the septal defects and varying grades of malformed atrioventricular valves.[9]

Left atrioventricular valve regurgitation is graded as per the recommendation of the American Society of Echocardiographic criteria.[10]

- 0→ None/trivial (<5% of left atrioventricular valve area)
- 1→ Mild (5–20% of left atrioventricular valve area)
- 2→ Moderate (20–40% left atrioventricular valve area)
- 3→ Severe (>40% left atrioventricular valve area).

Despite improved outcomes of partial atrioventricular septal defect repair overtime, several morphological and functional issues continue to be the causative factors for the post-operative left atrioventricular valve regurgitation, supraventricular arrhythmias, and late mortality and morbidity.[11-17]

One of the keys to successful repair of atrioventricular septal defect by any technique is intraoperative assessment using transesophageal echocardiography and after cardiotomy.

We report here-in the surgical repair of the partial atrioventricular septal defect with a cleft left atrioventricular valve. A 26-year-old male patient diagnosed with partial type of atrioventricular septal defect in sinus rhythm, cleft left atrioventricular valve with mild pulmonary arterial hypertension, and severe left atrioventricular valvular regurgitation underwent successful reconstruction of the left atrioventricular valve and pericardial patch closure of the atrial septal defect.

SURGICAL TECHNIQUES

Intraoperative transesophageal echocardiography was performed using a Hewlett-Packard Sonos 5500 ultrasound system (Hewlett-Packard Co, Andover, MA) to assess the morphology of the values, intracardiac anatomy, degree of valvular regurgitation, and ventricular function.

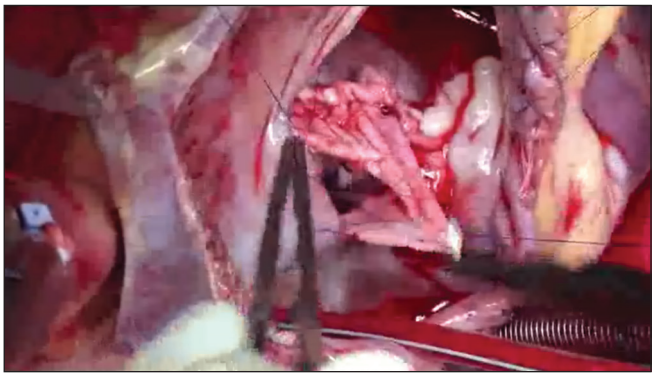
The operation

Following median sternotomy, the thymus was subtotally excised taking care not to expose the brachiocephalic vein. The pericardium was opened on the left side raising a right-sided flap in between stay sutures using scissors and not cautery to avoid inadvertent cautery-induced ventricular fibrillation. Precautions were taken to avoid excessive manipulation.

The operation was performed under mild hypothermic cardiopulmonary bypass with an aortic infusion cannula and venous cannulae into the superior and inferior caval veins. St. Thomas based cold hyperkalemic blood cardioplegia (1:4) and topical ice cooling was used for myocardial preservation.

The left ventricle was vented through the inter-atrial septum using a 14Fr sump suction vent through the patent foramen ovale. The analysis of the lesions was carried out. There were two atrioventricular valves with two separate orifices. There is an ostium primum atrial septal defect and the junction between the right and left atrioventricular valves was clearly delineated. The junction of the right and left atrioventricular valves was adherent to the ventricular septum and there was no ventricular septal defect. The boundaries of the atrial level defect could be delineated by the coronary sinus and margin of the atrioventricular septal defect.

The atrioventricular valve was distended by injecting cold saline with a bulb syringe into the left ventricular cavity to assess the morphology of the valves in the closed position and to assess the site(s) of leakage.



Video 1: Ujjwal-Partial AV canal.

The left atrioventricular valve was repaired utilizing the technique recommended by Carpentier.[7] Two elastomer vascular loops were used to retract the left superior and left inferior bridging leaflets. For reconstruction of the leaking septal commissure, a stay suture of 6-0 polypropylene was placed at the free leaflet margin opposing the atrial edge of the coaptation border. Multiple interrupted and non-pledgeted 5-0 polypropylene sutures were used to repair the septal commissure taking precautions to place the bites through the atrial edge and not the ventricular edge, as recommended by Carpentier, thus ensuring perfect competence.[7]

Cold saline was injected again into the left ventricular cavity to check for a competent left atrioventricular valve and to identify any additional leaking commissures. Following repair of the left atrioventricular valve, we ensured that the left atrioventricular valve opening commensurate with the indexed mitral valve orifice, thus avoiding iatrogenic mitral stenosis.

Multiple pledget supported 5-0 polypropylene suture (Johnson and Johnson Ltd., Ethicon, LLC, San Lorenzo, USA) were placed on the right side of the ventricular septum away from the ventricular septal crest. The sutures were, then, passed through the substance of the superior and inferior bridging leaflets at the projected intercept of the ventricular septum and valve leaflets and a patch of pericardium to be used to close the atrial septal defect. Extreme precautions were taken at both superior and inferior portion of the defect ensuring complete partitioning of the ventricular septum without residual communication. The pericardial patch was sutured to the edge of the ostium primum defect retaining the coronary sinus on the right atrium. Extreme precautions are taken to avoid injury to the bundle of His.

Cold saline was injected into the right ventricle to ensure competence of the right atrioventricular valve. The right atrium was closed in two layers using 5-0 polypropylene suture. The patient was weaned off cardiopulmonary bypass with stable hemodynamics.

SHORT- AND LONG-TERM RESULTS

The post-operative recovery was uneventful. At 8 months follow-up, the patient was asymptomatic, in sinus rhythm and no clinical evidence of cardiac failure with New York Heart Association Functional Class II. Echocardiography revealed normal biventricular function without atrioventricular valvular regurgitation. There were no residual atrial or ventricular septal defects.

CONCLUSION

Detailed assessment of the valve morphology by transesophageal echocardiography and intraoperative injection of cold saline with systematic individualized valvuloplasty techniques improves the outcome. In late presenters, the left atrioventricular valvular apparatus gets grossly deformed with dilated annulus and additional commissural leaks. Due to the morphological heterogeneity of the left atrioventricular valvular apparatus, left ventricular outflow tract, and displaced conduction system, an individualized management algorithm customized to each patient's anatomy would be desirable.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Jacobs JP, Burke RP, Quintessenza JA, Mavroudis C. Congenital heart surgery nomenclature and database project: Atrioventricular canal defect. Ann Thorac Surg 2000;69:S36-43.
2. Bharati S, Lev M, McAllister HA Jr., Kirklin JW. Surgical anatomy of the atrioventricular valve in the intermediate type of common atrioventricular orifice. J Thorac Cardiovasc Surg 1980;79:884-9.
3. Anderson RH, Zuberbuhler JR, Penkoske PA, Neches WH. Of clefts, commissures and things. J Thorac Cardiovasc Surg 1985;90:605-10.
4. Becker AE, Anderson RH. Atrioventricular septal defect: What's in a name? J Thorac Cardiovasc Surg 1982;83:461-9.
5. Anderson RH, McCartney FJ, Shinebourne EA, Tynan M. Pediatric Cardiology. Edinburgh: Churchill Livingstone; 1987. p. 571-613.
6. Anderson RH, Baker EJ, Ho SY, Rigby ML, Ebels T. The morphology and diagnosis of atrioventricular septal defects.

Cardiol Young 1991;1:291-305.
7. Carpentier A. Surgical anatomy and management of the mitral component of atrioventricular canal defects. In: Anderson RH, Shineboume EA, editors. Paediatric Cardiology 1977. London: Churchill Livingstone; 1978. p. 477-86.
8. Eisenberg LM, Markwald RR. Molecular regulation of atrioventricular valvuloseptal morphogenesis. Circ Res 1995;77:1-6.
9. Van Praagh R, Litovsky S. Pathology and embryology of common atrioventricular canal. Prog Pediatr Cardiol 1999;10:115-27.
10. Cheitlin MD, Armstrong WF, Aurigemma GP, Beller GA, Bierman FZ, Davis JL, *et al*. ACC/AHA/ASE 2003 Guideline update for the clinical application of echocardiography: Summary article. A report of the American college of cardiology/American heart association task force on practice guidelines (ACC/AHA/ASE Committee to update the 1997 guidelines for the clinical application of echocardiography). J Am Soc Echocardiogr 2003;16:1091-110.
11. Chowdhury UK, Airan B, Malhotra A, Bisoi AK, Kalaivani M, Govindappa RM, *et al*. Specific issues after surgical repair of partial atrioventricular septal defect: Actuarial survival, freedom from reoperation, fate of the left atrioventricular valve, Prevalence of left-ventricular outflow tract obstruction and other events. J Thorac Cardiovasc Surg 2009;137:548-5.e2.
12. Abruzzese PA, Livermore J, Sunderland CO, Nunley DL, Issenberg H, Khonsari S, *et al*. Mitral repair in complete atrioventricular canal. Ease of correction in early infancy. J Thorac Cardiovasc Surg 1983;85:388-95.
13. El-Najdawi EK, Driscoll DJ, Puga FJ, Dearani JA, Spotts BE, Mohney DW, *et al*. Operation of partial atrioventricular septal defect: A forty-year review. J Cardiovosc Surg 2000;119:880-9.
14. Al-Hay AA, Lincoln CR, Shore OF, Shinebourne EA. The left atrioventricular valve in partial atrioventricular septal defect: Management strategy and surgical outcome. Eur J Cardiothorac Surg 2005;27:932-3.
15. Manning PB. Partial atrioventricular canal: Pitfalls in technique. Semin Thorac Cardiovasc Surg Pediatr Card Surg Annu 2007;10:42-6.
16. Jenielity M, Perek B, Paluszkiewicz SZ, Dyszkiewicz W. Results of surgical repair of ostium primum atrial septal defect in adult patients. J Heart Valve Dis 2001;10:525-9.
17. Abbruzzese PA, Napoleone A, Bini RM, Annecchino FP, Merlo M, Parenzan L. Late left atrioventricular valve insufficiency after repair of partial atrioventricular septal defects: Anatomical and surgical determinants. Ann Thorac Surg 1990;49:111-4.

How to cite this article: Chowdhury UK, George N, Sushamagayatri B, Manjusha S, Gupta S, Goja S, *et al*. Reconstruction of the left atrioventricular valve with pericardial patch closure of the ostium primum atrial septal defect in a patient with partial atrioventricular septal defect under mild hypothermic extracorporeal circulation and cardioplegic arrest (UKC's Modification): A Video Presentation. J Card Crit Care TSS 2023;7:55-8.