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Video Presentation

Dacron Patch Closure of Ventricular Septal Defect, Subaortic Aneurysm, Ruptured Aneurysm of Sinus of Valsalva and Concomitant Aortic Valve Replacement using a Mechanical Prosthesis: A Video Presentation

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Introduction

Congenital sinus of valsalva aneurysms are thin-walled saccular or tubular out pouchings, often looking like a windsock that are usually located in the right sinus or the anterior aspect of the non-coronary sinus. The aneurysm usually has an intra-cardiac course, but may protrude into the pericardial space. They may rupture into the right (or rarely) the left heart chambers to form an aortocardiac fistula, or into the pericardial cavity. Associated cardiac anomalies are common [1-3].

The first description of ruptured sinus of valsalva aneurysm is attributed to Hope in 1839 [1]. Lillehei was the first to successfully use cardiopulmonary bypass for surgical correction of ruptured sinus of valsalva aneurysm [2]. Sakakibara and Konno proposed the first classification system for congenital sinus of valsalva aneurysm. Their classification includes only aneurysms originating from the posterior, middle or anterior-third of the right sinus (types I, II, IIIa or IIIv respectively) or anterior-third of the non-coronary sinus (type IV). Sub-classification is based on the presence of absence of ventricular septal defect (e.g. type I-VSD). This classification does not account for all three possible sinuses of origin and does not account for the variety of intra- and extra-cardiac sites of penetration [4-6].

Based on the sinus of origin, chamber of penetration and acuity of presentation (ruptured or unruptured) with a modifier added for etiologic factor, Congenital Heart Surgeon Society proposed another classification [7]. Between 30-50% of all patients with sinus of valsalva aneurysm have associated ventricular septal defects. In Asian series, the incidence is 50-60% and in Western series the incidence is 35-40%. These defects are found in 60% to 70% of cases of right sinus of valsalva aneurysm and in only 10% of cases of non-coronary sinus of valsalva aneurysm. Aortic regurgitation occurs in 20 to 30% of patients [8-12]. The genesis of sinus of valsalva aneurysm, ventricular septal defect and sub aortic aneurysm has been postulated to be congenital in origin resulting from weakness of the alveolar fibrosa between the mitral and aortic annuli as well as medial weakness defect in the sinus of valsalva and dehiscence of the fibro vascular union [12-14]. Published literature documents the association of aneurysm sinus of valsalva, ventricular septal defect, sub aortic aneurysms and congenital aortic valvular stenosis. Their

occurrences in young age group, association with submitral aneurysm support the concepts of a congenital etiology [13-15].

Most patients in the reported literature with ruptured sinus of valsalva aneurysm died between 1-3.9 years after diagnosis [6,16-19]. Because of these observations, surgical repair is indicated for all patients with ruptured sinus of valsalva aneurysm. Unruptured sinus of valsalva aneurysm which are progressively enlarging and/or causing hemodynamic derangements should be surgically repaired. The role of surgery for small or moderate sized Unruptured aneurysm with the present state of knowledge in controversial [11,16-19].

Three approaches to repair of sinus of valsalva aneurysm have been described in the literature: i) through the chamber of origin (i.e. aorta), ii) through the chamber of termination (atrium or ventricle or pulmonary artery) and iii) bicameral i.e. trans aortic and trans pulmonary.

For ruptured sinus of valsalva aneurysm, bicameral approach provides optimal exposure for addressing all components. Unruptured aneurysms involving the non-coronary sinus without penetration into an adjacent chamber, those penetrating the ventricle septum and the rare case involving the left sinus may be repaired through an aortic approach alone. The component of aortic regurgitation should be corrected after repair of sinus of valsalva and ventricular septal defect to avoid distortion of the aortic valve repair. For aortic valve repair, aortic valvuloplasty or annuloplasty utilizing the techniques of Trusler, Carpentier or Cosgrove may be necessary [16,20]. Severely deformed and regurgitant aortic valve or stenotic bicuspid valve, endocarditis and failed aortic valve repair mandate aortic valve replacement. Composite aortic root replacements are rarely indicated unless multiple sinuses are involved or the patient has Marfan/Marfanoid syndrome.

Intraoperative transesophageal echocardiography is strongly recommended for evaluation of sinus of valsalva aneurysm, the aortic valve and associated cardiac anomalies such as a ventricular septal defect or sub aortic aneurysm.

Several contemporary modern surgical series have no operative mortality after repair of ruptured aneurysm of sinus of valsalva and aortic valve replacement. The long-term results are excellent with an actuarial 10-year survival between 85%-100%. Approximately 80%-90% patients are in New York Heart Association functional class I/II. Complete heart block occurs in 2% to 3% of patients postoperatively [21,22].

We present herein a 17-year old male patient presenting with palpitation at rest, recurrent episodes of paroxysmal nocturnal dyspnea and shortness of breath (New York Heart Association Class IV) of 3 years duration. Transthoracic M & 2D-Color Doppler echocardiography revealed an aneurysm sinus of valsalva rupturing into the right ventricular outflow tract, severe aortic regurgitation, a small ventricular septal defect and an additional large defect in the subaortic region underneath the right coronary sinus presumably may be an associated ruptured subaortic aneurysm. The patient underwent Dacron patch closure of the ventricle septal defect, subaortic aneurysm, ruptured sinus of valsalva and aortic valve replacement using a mechanical prosthesis.

We present herein a 13-year old male patient presenting with

palpitation and shortness of breath (New York Heart Association functional class III) of 2 years duration. Transthoracic M and 2D-Color Doppler echocardiography revealed a moderate size ventricular septal defect, double chambered right ventricle and aortic regurgitation of grade III in severity. The patient underwent reconstruction of the aortic valve, relief of right ventricular outflow tract obstruction and double Dacron patch closure of the ventricular septal defect as stated under.

Surgical Techniques

Intraoperative transesophageal echocardiography was performed using a Hewlett-Packard Sonos 5500 ultrasound system (Hewlett-Packard Co, Andover, MA) to assess the origin of the aneurysm of sinus of valsalva, the degree of aortic regurgitation, and presence of ventricular septal defect if any.

Following median sternotomy, the thymus was sub totally excised taking care not to expose the brachiocephalic vein. The pericardium was opened in the midline in between stay sutures using scissors and not cautery to avoid inadvertent cautery-induced ventricular fibrillation.

The operation was performed with moderately hypothermic cardiopulmonary bypass through angled venous cannulas into superior and inferior caval veins and aortic cannulation. After aortobicaval cannulation, the fat pad between the aorta and pulmonary artery was incised for later selective aortic cross clamping.

The left ventricle was vented through right superior pulmonary vein prior to aortic cross-clamp on a partially filled heart, stopping ventilation to prevent inadvertent air suction. The aorta was cross-clamped using an atraumatic aortic vascular clamp. An oblique horse-shoe shaped aortotomy was done 2 cm above the right coronary sinus, with its lower end terminating 1 cm above the mid-portion of the non-coronary sinus. Myocardial protection was achieved by intermittent, selective ostial cardioplegia and topical cardiac cooling using iced saline every 30 minutes.

The orifice of the aneurysm of the right sinus was visualized. A transverse pulmonary arteriotomy was done in between stay sutures 2 cm above the pulmonary ring. The windsock of the ruptured aneurysm was seen overlying the ventricular septal defect located in the sub pulmonary infundibulum. The ventricular septal defect was 8 mm in size. Underneath the windsock, an additional large ruptured subaortic aneurysm measuring 4 x 4 cm was visualized.

The ventricular septal defect is closed using an appropriate sized Dacron polyester patch (Bard® Savage® filamentous knitted polyester fabric, Bard Peripheral Vascular Inc., Tempe, AZ, USA) and pledgeted 5-0 polypropylene sutures (Johnson and Johnson Ltd., Ethicon, LLC, San Lorenzo, USA). The patch was sutured around the inferior rim of the ventricular septal defect and the hinge line of the right aortic cusp taking care not to injure the conduction system.

The thinned-out portion of the windsock containing the perforation was excised, taking care not to damage the hinge line of the right aortic cusp. At this stage, a large ruptured subaortic aneurysm located underneath the windsock in the subaortic infundibulum was detected.

The ruptured sinus of valsalva and the subaortic aneurysm was

repaired using a single patch of Dacron polyester and 19 interrupted pledgeted 5-0 polypropylene sutures.

The aortic valve exposure was facilitated by 3 commissural stay sutures. The valve was examined and was deemed irreparable. The aortic valve was excised and sized using an aortic valve sizer. The aortic valve was replaced using a 23 mm St. Jude mechanical aortic prosthesis and interrupted, pledgeted 2-0 Ticron coated braided polyester sutures (M/s Covidien, Santo Domingo, Dominican Republic, USA).

The aortotomy was closed in two layers: horizontal mattress and over and over, using 4-0 polypropylene suture. The aortic cross-clamp was released, thus restoring coronary perfusion.

The pulmonary artery was closed in two layers; horizontal mattress and over and over suture using 5-0 polypropylene. The patient was weaned off cardiopulmonary bypass in stable hemodynamics. The chest was closed in layers. Intraoperative, transesophageal echocardiography revealed good biventricular function, no residual ventricular septal defect and no paravalvular leak.

Short- and Long-term Results

The postoperative recovery was uneventful. Follow-up visit at 4th month revealed the patient in New York Heart Association functional class-I with good biventricular function, no residual ventricular septal defect and no aortic regurgitation.

Conclusions

The potential benefits of this bicameral (transaortic, transpulmonary) approach are optimal surgical exposure of the aortic valve, aneurysm of sinus of Valsalva and associated cardiac anomalies. Associated subaortic aneurysm and ventricular septal defect can be closed under optimal visualization avoiding residual ventricular septal defect and surgical heart block.

References

- Hope J. A treatise of disease of the heart and great vessels, 3rd Ed., London: Churchill 1839.
- Lillehei CW, Stanley P, Varco RL. Surgical treatment of ruptured aneurysms of the sinus of Valsalva. *Ann Surg.* 1957; 146: 460-472.
- Barragry TP, Ring WS, Moller IH, Lillehei CW. 15- to 30-year follow-up of patients undergoing repair of ruptured congenital aneurysm of the sinus of Valsalva. *Ann Thorac Surg.* 1988; 46: 515-519.
- Sakakibara S, Konno S. Congenital aneurysm of the sinus of Valsalva: anatomy and classification. *Am Heart J.* 1962; 63: 405-424.
- Sakakibara S, Konno S. Congenital aneurysm of the sinus of Valsalva associated with ventricular septal defect: anatomical aspects. *Am Heart J.* 1968; 75: 595-603.
- Sakakibara S, Konno S. Congenital aneurysm of the sinus of Valsalva: criteria for recommending surgery. *Am Heart J.* 1963; 12: 100-106.
- Ring WS. Congenital Heart Surgery Nomenclature and Database Project aortic aneurysm, sinus of Valsalva aneurysm, and aortic dissection. *Ann Thorac Surg.* 2000; 69: 147-163.
- Chu SH, Hung CR, How SS, Chang H, Wang SS, Tsai CH, et al. Ruptured aneurysms of the sinus of Valsalva in Oriental patients. *J Thorac Cardiovasc Surg.* 1990; 99: 288-298.
- Vergheze M, Jairaj PS, Babuthaman C, Sukumar IP, John S. Surgical treatment of ruptured aneurysms of the sinus of Valsalva. *Ann Thorac Surg.* 1986; 41: 284-286.
- Mayer J, Wukasch DC, Hallman GL, Cooley DA. Aneurysm and fistula of the sinus of Valsalva. *Ann Thorac Surg.* 1975; 19: 170-179.
- Bapat VN, Tendolkar AC, Khandeparkar J, Dalvi B, Agrawal N, Kulkarni H, et al. Aneurysms of sinus of Valsalva eroding into the interventricular septum: etiology and surgical considerations. *Eur J Cardiothorac Surg.* 1997; 12: 759-765.
- Chu SH, Hung CR, How SS, Chang H, Wang SS, Tsai CH, et al. Ruptured aneurysms of the sinus of Valsalva in Oriental patients. *J Thorac Cardiovasc Surg.* 1990; 99: 288-298.
- Abrahams DG, Barton CJ, Cockshott WP, Edington GM, Weaver EJ. Annular left ventricular aneurysms. *Q J Med.* 1962; 31: 345-360.
- Chesler E, Mitha AS, Edwards JE. Congenital aneurysms adjacent to the annuli of the aortic and or mitral valve. *Chest.* 1982; 82: 334-337.
- Dalvi BV, Sathe SV, Lokhandwala YY, Kulkarni HL, Kale PA. Coexistence of congenital and aortic sinus aneurysms. *Am Heart J.* 1990; 119: 419-421.
- Trusler GA, Moes CAR Kidd BSL. Repair of ventricular septal defect with aortic insufficiency. *J Thorac Cardiovasc Surg.* 1973; 66: 394-403.
- Bigelow WG, Hames WT. Ruptured aneurysm of aortic sinus. *Ann Surg.* 1959; 150: 117-121.
- Smith WA. Aneurysm of the sinus of Valsalva with report of two cases. *JAMA.* 1914; 62: 1878.
- Mayer ED, Ruffmann K, Saggau W, Butzmann B, Schatton N, Schmitz W, et al. Ruptured aneurysms of the sinus of Valsalva. *Ann Thorac Surg.* 1986; 42: 81-85.
- Carpentier A. Cardiac valve surgery: the "French correction". *J Thorac Cardiovasc Surg.* 1983; 86: 323-327.
- Quiang GJ, Dong ZX, Xing XG, et al. Surgical treatment of ruptured aneurysm of the sinus of Valsalva. *Cardiol Young.* 1994; 4:347
- Van Son JA, Danielson GK, Schaff HV, Orszulak TA, Edwards WD, Seward JB. Long-term outcome of surgical repair of ruptured sinus of Valsalva aneurysm. *Circulation.* 1994; 90: II20-29.