Video Presentation

Reconstruction of the aortic valve, relief of right ventricular outflow tract obstruction and double Dacron patch closure of the ventricular septal defect (UKC’s modification): a video presentation

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Introduction

Ventricular septal defect and aortic regurgitation syndrome include hearts in which aortic regurgitation is of congenital origin, caused by cusp prolapse or a bicuspid aortic valve. The ventricular septal defect is either doubly committed subarterial or perimembranous with outlet extension. The locations of the ventricular septal defects are in fact a continuum with the subarterial ventricular septal defect lying to the patients left and perimembranous ventricular septal defect with outlet extension lying more rightward and inferior than the subarterial and perimembranous juxtaaortic ventricular septal defect lying more rightward and inferior [1].

In 1921, Laubry and Pezzi described this syndrome of the ventricular septal defect with aortic regurgitation and Garamella and Starr successfully operated these lesions for the first time in 1960 [2-4]. Renewed interest of cusp reconstruction dates from publications of Spencer and Trusler and associates in 1973 which followed the work of Frater [5-7]. Among Caucasian patients with a ventricular septal defect and aortic regurgitation, ventricular septal defects are primarily located in the perimembranous area and among Asians, mostly it is of doubly committed subarterial variety. In about two-thirds of patients, the cause of aortic regurgitation is a prolapse of the right cusp and in the remaining one-third it is due to either a prolapse of the non-coronary cusp or both non- and right coronary cusps [8-11].

Protrusion of the cusps through the ventricular septal defect increases during diastole, thereby plugging the defect and limiting the shunt. The sinus of Valsalva adjacent to the prolapsed leaflet is often enlarged, thereby causing asymmetric splaying and dilatation of the aortic annulus [8-11].

Yacoub and colleagues proposed that the basic abnormality is a discontinuity of the aortic media from the hinge point of the aortic cusp and the ventricular septum in the region of the right coronary sinus [12]. The prevalence of aortic regurgitation among patients with a ventricular septal defect is uncertain. In the combined University of Alabama (USA)-Green Lane Hospital (New Zealand) (UAB-GLH) experience, the prevalence was 11% and at Boston Children Hospital, Nadas, reported a prevalence of 4.5% [1]. Aortic valve regurgitation does not usually appear until the age of 2-5 years [13,14].
Concomitant repair of aortic valve prolapse during the closure of ventricular septal defects depends on the extent of prolapse and severity of aortic regurgitation. In patients with mild aortic regurgitation, closing the ventricular septal defect alone may suffice. While in patients with moderate-to-severe regurgitation, consideration should be given to performing an aortic valvuloplasty [15]. Aortic valve replacement is indicated only when the aortic valve is deemed irreparable.

One or more leaflets may be repaired by the Trusler method of plication [7]. Hisatomi and colleagues proposed pledget stitch aortoplasty to make the aortic cusps protrude for even greater aortic valve coaptation [16,17]. Carpentier, Chauvaud and colleagues advocated triangular excision, reconstruction of the aortic cusp along with annuloplasty of the ventriculo-aortic junction [18]. Yacoub and colleagues have proposed another repair technique addressing almost all morphologic defects more completely [12]. No reliable comparison of outcomes after the various techniques of repair is available in the literature. Following the repair of moderate/severe tricuspid regurgitation using the Trusler technique, about two-thirds of patients have nil/trivial aortic regurgitation after surgery [16,17,19-22]. When the Carpentier method or Yacoub method of repair techniques are employed, in 65-70% of patients, the competence was restored. Fifteen-year freedom from aortic valve reoperation is 81%±19% after Trusler repair [9,15-19].

**Surgical techniques**

Intraoperative transesophageal echocardiography was performed using a Hewlett-Packard Sonos 5500 ultrasound system (Hewlett-Packard Co, Andover, MA) after induction of anesthesia for a final analysis of the aortic valve and ventricular septal defect.

Following median sternotomy, the thymus was subtotally 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 the 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 and a transverse aortotomy was done in between stay sutures. Myocardial protection was achieved by intermittent, selective ostial cardioplegia and topical cardiac cooling using iced saline every 30 minutes.

Right atriotomy was done parallel to the atrioventricular groove from right atrial appendage towards inferior vena cava. Stay sutures were placed to expose the tricuspid orifice.

The ventricular septal defect was closed using an appropriate sized Dacron polyester patch (Bard® Savage® filamentous knitted polyester fabric, Bard Peripheral Vascular Inc., Tempe, AZ, USA) and pledged interrupted 5-0 polypropylene sutures (Johnson and Johnson Ltd., Ethicon, LLC, San Lorenzo, USA). The patch was double-layered to provide an additional external buttressing effect underneath the aortic valve. The tricuspid valve was checked for competence injecting cold saline through the tricuspid valve into the right ventricle.

The aortic valve exposure was facilitated by three commissural stay sutures of 5-0 polypropylene. The centre points of the three cusps were approximated through corresponding corpora Arantii with a temporary suture of 6-0 polypropylene that allowed accurate comparison of the opposing three leaflets, thus determining the extent of the needed plication and the feasibility of aortic valve repair.

Another pledget supported mattress suture of 6-0 polypropylene was used incorporating the fold of excess valve tissue securely sandwiching against the aortic wall. The right coronary-non-coronary commissure was additionally reinforced with a third 6-0 polypropylene suture.

These pledget supported sutures made the aortic cusps protrude for greater aortic valve coaptation, thus performing commissuroplasty and aortoplasty. The temporary suture on the corpora Arantii was withdrawn.

The aortotomy was closed in two layers, horizontal mattress and over and over using 4-0 polypropylene suture. The right atriotomy was closed in two layers using 5-0 polypropylene suture.

The chest was closed in layers. Postoperatively, the patient had stable hemodynamics. Intraoperatively transesophageal echocardiography revealed good biventricular function, no residual ventricular septal defect and no aortic regurgitation.

**Short- and long-term results**

The postoperative recovery was uneventful. Follow-up visit at 14th 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.

**Conclusion**
Aortic valve reconstruction using a combination of leaflet plication, commissural resuspension and pledget stitch aortoplasty allows the aortic cusps to protrude for even greater aortic valve coaptation. The double-layered Dacron patch in addition to close the ventricular septal defect provided additional external support at the subcuspal level. We submit an increased appreciation of various aortic valve reparative procedures that may well contribute to improved future surgical management.

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