Three-dimensional template-based planning for transapical aortic valve implantation

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Despite the lack of randomized trials comparing transapical aortic valve implantation (TA-AVI) with surgical aortic valve replacement, there is consensus that the approach may be advantageous for a high-risk group of patients. Nevertheless, several complications are associated with TA-AVI. Paravalvular leak resulting in aortic insufficiency of grade II or more is reported at a high incidence and promotes left ventricular dysfunction, hemolysis, and endocarditis. The onset of atrioventricular block (AVB) is correlated with the implantation of large-diameter valves in patients with a small annulus diameter.

Patient Modeling
The generation and use of intraoperative DynaCT images (Syngo DynaCT; Siemens AG Healthcare Sector, Erlangen, Germany) to facilitate TA-AVI were recently described. These are 3-dimensional images reconstructed from contrast-enhanced angiography projections intraoperatively acquired with a ceiling-mounted rotation angiography system (Figure 1, A).

The 3-dimensional planning system uses these images as a basis for implantation planning. A virtual model of the aortic root is extracted (Figure 1, B). To facilitate orientation and implant registration, anatomic landmarks can be identified to indicate the position of the coronary ostia, the commissures, and the hinge points (Figure 1, C). These landmarks help the operator in identifying a cut plane through the dataset that represents the annular level on which the Sapien implant is positioned.

Interactive Implant Selection
The system automatically registers 3-dimensional templates that represent the available valve models and sizes (Edwards-Sapien 23- and 26-mm valves and Ventor Embracer [Medtronic Ventor Technologies Ltd, Netanya, Israel]) with the dataset according to the landmarks and annulus plane (Figure 1, D). The operator can switch between different valves and adjust their virtual position. In the current study, the criterion for valve selection was the valve diameter, which was optimized to exceed the mean diameter of the aortic root at the level of the valvar hinges by 1 to 2 mm.

RESULTS
One patient died of renal and pulmonary insufficiency. Another patient had left main stem occlusion during implantation related to inadequate positioning. AVB grade III was treated with pacemaker implantation in 4 patients. Temporary symptomatic bradycardia was diagnosed in 2 patients, but pacemaker implantation was not required. Notable aortic insufficiency was diagnosed in 11 cases.
Planning Results

Figure 2 summarizes the variation between the implant selection based on 3-dimensional template-based planning and the original implant selection based on transesophageal echocardiography and computed tomography. In 17 cases, the planning decision was in accordance with the actually implanted valve size. Aortic insufficiency was seen in 3 of these cases, and 2 patients required pacemaker implantation.

In 2 cases, template-based planning promoted a 23-mm valve in patients who had been treated with a 26-mm valve. Both cases required permanent pacemakers to treat grade III AVBs.

In 2 cases with 23-mm valve implants, planning recommended the implantation of a 26-mm valve. One of these patients had paravalvular leakage with mild to moderate aortic insufficiency. In the other patient, no complications were reported. In 7 patients who were treated with the 26-mm implant, planning suggested that the 26-mm valve...
A 4-year-old boy weighing 14 kg had dyspnea on exertion and palpitations with increased precordial activity gradually worsening over the prior 2 years. On diagnostic workup, which included echocardiography, cardiac catheterization, and magnetic resonance angiography, he was found to have a circumflex aorta with coarctation and hypoplasia, and magnetic resonance angiography, he was worked up, which included echocardiography, cardiac catheterization and palpitations with increased precordial activity. He was referred for repair.

CLINICAL SUMMARY

A 4-year-old boy weighing 14 kg had dyspnea on exertion and palpitations with increased precordial activity gradually worsening over the prior 2 years. On diagnostic workup, which included echocardiography, cardiac catheterization, and magnetic resonance angiography, he was found to have a circumflex aorta with coarctation and hypoplasia of the retroesophageal portion of the arch. The origin of the left subclavian artery (LSCA) was stenotic. The vessels of the ascending aorta were the left common carotid artery, the right common carotid artery, and the right subclavian artery. A coarctation was present at the base of right subclavian artery, with hypoplasia of the retroesophageal portion of the arch. The origin of the left subclavian artery (LSCA) was stenotic. The vessels of the ascending aorta were the left common carotid artery, the right common carotid artery, and the right subclavian artery. A coarctation was present at the base of right subclavian artery, with hypoplasia of the retroesophageal portion of the arch.

The operative approach to the management of coarctation in the presence of hypoplastic circumflex, retroesophageal aorta is not well defined.1-3 We present the case of a 4-year-old boy who had coarctation with hypoplastic retroesophageal arch. This was managed by translocation of hypoplastic retroesophageal arch anteriorly and creation of a left neoaortic arch through a median sternotomy without the use of cardiopulmonary bypass. We believe that median sternotomy is the approach of choice in the management of coarctation of the circumflex aorta.

CONCLUSIONS

In 10 of 15 patients with postoperative AI or AVB, the new system would have promoted a different valve selection. These observations suggest that the template-based planning approach is a viable aid in preoperative assessment of the atrioventricular geometry and valve selection. To substantiate the reported findings, larger studies are necessary.

References


Anterior arch translocation for coarctation of circumflex aorta using median sternotomy without cardiopulmonary bypass

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The Journal of Thoracic and Cardiovascular Surgery • Volume 141, Number 6 1543

Brief Technique Reports

From the Department of Pediatric Cardiac Surgery, Frontier Lifeline and Dr K.M. Cherian Heart Foundation, Chennai, India.

Disclosures: Authors have nothing to disclose with regard to commercial support. Received for publication July 4, 2010; revisions received Sept 14, 2010; accepted for publication Oct 17, 2010; available ahead of print Dec 17, 2010.

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J Thorac Cardiovasc Surg 2011;141:1543-5
0022-5223/$36.00