

EDITORIAL COMMENT

3D Thinking for Mini-AVR*

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Minimally invasive approaches to aortic valve replacement have been in use now for over 15 years. The most popular have been the partial upper sternotomy (1,2) and the right second interspace anterior thoracotomy (3,4). A vertical right parasternal approach that was used early on has been abandoned (5,6). The primary objective is to minimize the extent of surgical trauma in an effort to increase patient satisfaction and decrease pain and morbidity. One of the keys to achieving these objectives is to use an incision that allows appropriate access to the aorta for cannulation, clamping, and aortotomy. Access to the atrium for cannulation and retrograde cardioplegia administration is a secondary consideration because both venous drainage and coronary sinus cannulation can be done by peripheral access in many institutions but not all. A paper from Cleveland (7) demonstrates nicely that the options can all be considered in a truly anatomical fashion before the operation by means of 3-dimensional (3D) reconstruction of multidetector computed tomographic angiography (CTA). This is a very significant advance in thinking.

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Giving the surgeon a realistic view of the location of the aorta and right atrium relative to the sternum and adjacent ribs makes it possible to plan the approach in an optimal fashion. As demonstrated by the authors, the most limiting and difficult-to-extend incision is the anterior thoracotomy, but if the correct interspace is

chosen and the aorta bulges a bit to the right of the sternum, this is a very reasonable choice. The partial sternotomy is usually done from the top, but knowing how far down to take it is important. If the sternotomy is angled off into the third interspace, it is not a good idea to extend it later by another rib or two if the aortic root is found to be too low. (The safer option in this case is to extend to a full sternotomy.) With the kind of imaging demonstrated in this article, the choice of interspace need not be left to chance and, occasionally, the approach changes to a partial sternotomy from the bottom up instead of the top down.

In order to make these images practically useful, it is optimal for them to be available in the operating room in an interactive electronic manner just as coronary angiograms are routinely available in bypass surgery cases. This allows the surgeon to demonstrate the anatomy to the team before the operation and to reconfirm the appropriate location and extent of the incision. The proximity of the right atrial appendage to the incision is important if central venous cannulation is to be used. This can make the decision regarding how low to take a partial sternotomy or which interspace to use for anterior thoracotomy.

The least invasive aortic valve replacement is now the transcatheter valve, which sometimes requires direct aortic access because of size or disease of peripheral vessels. There are additional constraints in cases in which aortic calcification is extensive. Distance and angle to the aortic annulus are also considerations. The 3D imaging answers all of these questions and also gives the surgeon accurate information about the kind of incision to use. The second interspace can be opened or the second costal cartilage can be resected in the manner used for mediastinotomy, and the pericardium can be

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entered often without entering the pleural space if the aorta presents enough of itself to the right side of the sternum at this level (personal experience). Alternatively, the imaging may point out that partial sternotomy is a better choice for access. Clearly, if a patient is too sick for a standard aortic valve operation, the direct access should be done in a way that minimizes pain and pulmonary morbidity that is often the basis of the high risk.

Finally, CTA is very helpful in defining the presence and course of anomalous coronary arteries. It is also more effective than cardiac catheterization in defining the size and extent of ascending aortic dilatation/aneurysm. An occasional coarctation can also be delineated nicely.

In summary, just as intraoperative transesophageal echocardiography has become the standard of care for valvular heart surgery, 3D CTA has much to offer in planning the safe conduct of minimally invasive aortic valve surgery. Sometimes it makes one realize that the best approach is a full sternotomy. To paraphrase an old California mining song:

With the 3D reconstruction of a cardiac CT

There are aces doing cases through incisions
mighty wee.

There are valves and even Bentalls being done
creatively

They can choose the right incision with this new
technology.

But there's always an exposure to be gotten easily

And it's worth consideration when we're doin'
this for free.

Oh my darlin', oh my darlin', give me full sternotomy

With a cross clamp and a headlight and my
loupes so I can see!

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