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EDITORIAL COMMENT

Access for Transcatheter Aortic Valve Replacement

Which Is the Preferred Route?*

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Transcatheter aortic valve replacement (TAVR) has been performed in an estimated 50,000 patients worldwide in 46 countries. Significant advancements in delivery techniques and devices, including lower profile delivery systems and expandable sheaths have served to decrease the access-related complication rates while expanding the population of patients who can safely undergo the procedure (1). There are multiple avenues for delivery of TAVR devices, including the transfemoral (TF) route; transapical (TA) access; direct aortic (DA) or transaortic; and subclavian or axillary sites. The antegrade transfemoral venous approach originally employed by Cribier et al. (2) has been abandoned due to the facility of the other approaches. In a few extraordinary cases in which these more common routes have been precluded, the carotid arteries or conduits sewn onto the iliac arteries have been used. Each method of delivery access has advantages and disadvantages both to the patient receiving the valve as well as to the operator performing the procedure.

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The TF method is the most commonly used approach with over one-half of TAVR devices being deployed by this approach. Originally performed by a surgical cutdown technique, most TF procedures are now done using a percutaneous "pre-closure" technique (1). Major vascular complications, which occurred not infrequently in the early years and were associated with a significant mortality, have become much less of an issue because most local vascular complications, including dissection, are now able to be managed by endovascular techniques and the patients most at risk for complications are now able to be treated by alternative access routes. The advantages of the TF techniques include the fact that it is the least invasive approach, especially when performed percutaneously and the fact that it can be performed in most patients with lower profile (18-F) delivery systems. Disadvantages include inability to place in patients with small vessel size (<6 or 7 mm depending on the delivery system) and in patients with significant aorto-iliac occlusive disease. There have also been concerns raised regarding an increased risk of cerebral embolization due to transit of the device and delivery system across the aortic arch, potentially causing atherosclerotic debris, but the clinically evident stroke risk relative to other routes that do not transit the aortic arch has not borne out to a significant degree (3).

The TA approach is the second most common access route for TAVR. Advantages of this approach include: 1) that virtually all patients are candidates technically for this approach; and 2) the straight line to the aortic valve, short delivery distance, and more rigid delivery system ("valve on a stick" rather than valve on a catheter) all facilitate accurate valve placement (4). Disadvantages, however, include the invasiveness of the surgical thoracotomy necessary for this approach especially in elderly, debilitated patients and those with significant lung disease. Early bleeding complications related to cardiac apical tissue fragility have largely disappeared due to refinements and standardization of apical purse string suturing techniques. Development of apical access and closure devices promise the potential of a "percutaneous, trocar-based" TA approach to provide a secure, less invasive technique.

A technique that has gained a lot of interest and use recently is the DA approach. Originally developed for use with the Medtronic CoreValve (Medtronic, Inc., Minneapolis, Minnesota) because the longer device profile precluded use of this valve by the TA approach in patients with TF access issues, it is now being used more commonly with both this device as well as the Edwards Sapien (Edwards Lifesciences, Irvine, California) device (5). The advantage of the direct aortic approach is the operator friendliness, which includes direct delivery at a short distance from the aortic valve through a purse string suture in the ascending aorta with which all cardiac surgeons are proficient. The disadvantage, however, is that a surgical incision is still required, either an upper partial sternotomy or small right anterior thoracotomy; although both of which arguably may be less invasive than the incision required for the TA approach. Concerns have also been raised about the presence of calcification in the ascending aorta precluding use in some patients, but heretofore this has not been a major issue. In this issue of *JACC: Cardiovascular Interventions*, Bapat et al. (6) demonstrate that virtually all patients are candidates for this approach even when ascending aortic calcification is present.

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The fourth and least commonly used approach is the subclavian or axillary artery approach (7). Originally used for access for the CoreValve devices when the TF approach was not possible, it appears to be losing favor compared with the DA approach. Both left and right subclavian arteries have been used, although the left is used more commonly due to better delivery angulation relative to the aortic valve. Surgeons are very conversant with the subclavian artery for arterial access, using it frequently with a conduit sewn on to it as a method for instituting cardiopulmonary bypass especially when performing surgery on the aortic arch or when circulatory arrest is performed. Although the artery is not frequently diseased, it can be relatively small in caliber and is subject to dissection or disruption on manipulation due to the relative lack of a muscular component to the arterial wall. A further concern is use of the left subclavian in patients with previous coronary artery bypass surgery and a patent left internal mammary artery due to the possible risk of occlusion.

The subclavian or axillary access approach performed by a percutaneous technique is the subject of a study published in this issue, the so-called "Hamburg Sankt Georg Approach" (8). The investigators report their experience in 24 patients: 16 performed from the left side and 8 from the right. Two different vascular closure devices were used with varying degrees of success. Although no patient required immediate surgical repair, 7 (29%) patients required an immediate endovascular stent graft to be placed; 2 (8.3%) patients required a second procedure due to dissection or stent thrombosis; and another required a surgical repair of a brachial artery pseudoaneurysm. Although no patient suffered a major complication according to Valve Academic Research Consortium (VARC) definitions, 29% did suffer minor VARC complications (9). The investigators describe a technique that puts a "safety net" around the procedure that requires 3 arterial access sites—ipsilateral brachial, subclavian, and transfemoral—so the axillary artery can be reliably accessed and so that an occlusion balloon for proximal control of the subclavian artery at the time of sheath removal can be placed over an arterio-arterial monorail system.

The investigators are to be congratulated on the innovative techniques they have employed to provide percutaneous access for TAVR. However, it seems to be a much more complicated procedure to perform given the facility and wide use of the alternative access routes now available, including simply a surgical cutdown of the subclavian or axillary artery, thus violating the principle of keeping it simple. Although the complication rate was relatively high in this series, the rate did seem to decrease as the investigators gained more experience. It should be a technique that all operators are knowledgeable about so that it can be used when the more widely used and easier to employ access routes are not available. However, due to the broader experience, lower complication rate, and operator friendliness of the 3 other access techniques, I would recommend that this technique remain held in reserve until there are no other good alternatives.

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