IMPROVED MYOCARDIAL PROTECTION IN MINIMALLY INVASIVE AORTIC VALVE SURGERY WITH THE ASSISTANCE OF PORT-ACCESS TECHNOLOGY

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The recent introduction of minimally invasive approaches for aortic valve surgery, particularly through the ministernotomy incision, limits the ability of the surgeon consistently to place coronary sinus catheters for the retrograde delivery of cardioplegic solution.

Heartport, Inc (Redwood City, Calif) has introduced a variety of instruments and catheters for minimally invasive heart operations.² Some of these may be used in an expanded role, as we have done for the EndoSinus Catheter (ESC; Heartport) for retrograde delivery of cardioplegic solution. Because it is placed percutaneously,³ it can be used even when the right atrium is out of reach in the surgical field and its use reduces the clutter of numerous cannulas in a small operative field.

We describe an aortic valve replacement (AVR) for severe aortic insufficiency through a ministernotomy incision using the Heartport ESC for retrograde delivery of cardioplegic solution.

Techniques

Anesthetic techniques. General endotracheal anesthesia was induced by standard techniques and monitoring. Baseline intraoperative transesophageal echocardiography (TEE) confirmed the preoperative findings. The coronary sinus was then identified with the 4-chamber view at the gastroesophageal junction.

The ESC was then placed. The patient's head was turned to the left, and an 11F introducer (Heartport) was placed in the right internal jugular vein. The ESC was prepared as per the manufacturer's recommendations. The patient was given 5000 units of heparin intravenously, and the ESC was advanced into the coronary sinus with fluoroscopic (Fig 1) and TEE guidance. The position of the ESC was confirmed by dye injection into the coronary sinus and by observation of the ventricularization of the transduced pressure waveform of the catheter (Heartport-recommended method). A thermolulution catheter (Swan-Ganz; Baxter Healthcare Corp, Edwards Division, Santa Ana, Calif) was advanced through the 9F introducer, up to the 20-cm mark to avoid dislodging the coronary sinus catheter.

Fig 1. Fluoroscopic-radiographic picture of ESC into the coronary sinus.

Surgical technique. The patient was positioned supine. An 8-cm ministernotomy incision was performed, and it was "Teed" off into the right third intercostal space. After heparin was administered, the ascending aorta and the right atrium were cannulated for cardiopulmonary bypass (CPB) (22F, Straight Aortic Cannula, Research Medical, Inc, Salt Lake City, Utah; 29F/37F, Two-Stage Venous Cannula, Research Medical). Once CPB was instituted, the patient's temperature was lowered to 28°C. The aorta was crossclamped. Cold blood cardioplegic solution was administered both antegradely and retrogradely. The aortic valve was replaced with a No. 23 St Jude Medical valve (St Jude Medical, Inc, St Paul, Minn). The left ventricle was vented directly through the aortic anulus and then through the valve with a small red rubber catheter.

Myocardial protection. Cold blood cardioplegic solution was used. After an initial dose of antegrade cardioplegia, myocardial protection was entirely dependent on retrograde cardioplegia. Retrograde administration of cardioplegic solution required coordination between the surgeon, the perfusionist, and the anesthesiologist. Doses of 500 mL were given at 10-minute intervals. The flow of delivery was gradually increased by the perfusionist as the ESC balloon was slowly inflated by the anesthesiologist. Flows of 100 to 140 mL/min

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with coronary sinus pressures of 35 to 40 mm Hg were consistently maintained. The cardioplegic efflux could be seen from the left and right coronary ostia.

After the chest closure, the ESC catheter was removed. Intraoperative TEE demonstrated a properly functioning well-seated prosthetic valve without perivalvular leaks. Aortic crossclamp and CPB times were 97 and 131 minutes, respectively. The patient was extubated without difficulty after 11 hours.

Comment. One of the fundamental principles of minimally invasive cardiac surgery is that the quality of the results should be maintained.⁴ This, of course, includes the quality of the myocardial protection. Delivering oxygenated blood in the coronary sinus for myocardial protection was originally described in 1957.⁵ Since then, the use of retrograde cardioplegic delivery has become a valuable technique. For some specific procedures such as aortic valve surgery, particularly in the presence of aortic insufficiency, retrograde cardioplegic delivery has become the mainstay of myocardial protection.

The use of the ministernotomy approach for minimally invasive AVR limits the ability of the surgeon to place coronary sinus catheters consistently. The awkward angle to negotiate (coming from a more cephalic position), the difficulty of maneuvering in a reduced surgical field, and the inability of manually checking placement and correcting its trajectory if needed are alleged to be the most common causes of failure for its placement.

It is inconvenient to rely solely on antegrade cardioplegic delivery while performing aortic valve operations. The need to interrupt the operation to deliver cardioplegic solution through each coronary ostium and the risk of dissection of the coronary arteries or inadequate myocardial protection if cardioplegic solution cannot be properly channeled into the coronary circulation are some of its disadvantages.

In this particular case, the use of retrograde cardioplegia allowed us to decrease substantially the aortic crossclamp and the CPB times of this operation as compared with the rest of our small series of minimally invasive AVR, where a retrograde cardioplegia cannula was not placed. More important, we were able to provide myocardial protection as reliably as we would in a conventional AVR and to avoid the restricted visualization and maneuvering caused by an extra catheter in the field.

In this operation we combined emerging technology, which was initially used in 2 different modalities of minimally invasive cardiac surgery, to optimize myocardial protection, to improve surgical exposure, and more important, to achieve the best possible results while decreasing the overall surgery-related trauma.

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