Aortic Valve Replacement

AST STAFF

The heart is comprised of four valves: mitral, tricuspid, aortic and pulmonic. The aortic valve is located between the left ventricle and the aorta. There are two components of aortic valve disease. Aortic valve stenosis is when the valve leaflets that lead to the narrowing of the valve become stiff or thickened. This decreases blood flow. Aortic valve regurgitation, or leaky valve, is when this leaflets do not close all the way. Aortic valve disease may be abnormal at birth or become diseased over time. These two types are congenital aortic valve disease and acquired aortic valve disease, respectfully. Treatments to fix the valves include surgery dependent on what type of repair to the valve is needed.

HISTORY

The first aortic valve replacement procedure was performed in the 1960s. Back then, the procedure carried a 25% to 50% mortality rate. Today, those rates have improved considerably. One of the biggest risks of this procedure is age. The majority of cases of aortic valve replacement are older patients. However, even in elderly patients, the mortality rate is only a little over one percent for those patients who are 80 or older.[5] Age is a determining factor on whether surgery will be performed due to complications that older patients may endure. Coronary artery disease, oxygen-dependent chronic pulmonary disease, renal disease and peripheral vascular disease can have an adverse effect on the patient's outcome. These effects include the heightened risk of stroke or even death.

The procedure itself has also improved over the years and the prosthetic valves have undergone revisions. One of the biggest challenges for surgeons is to decide what patients make for the best cases for

LEARNING OBJECTIVES

- Examine the role the surgical technologist plays in an aortic valve replacement procedure
- Determine what monitoring lines may already be in place prior to the procedure
- Identify the instruments and equipment needed for an AVR
- Review the specific techniques of an aortic cannulation
- Learn about the practical considerations the surgical technologist needs to be aware of for an AVR

valve replacement.[3] A thorough medical history is needed and multiple tests are ordered before a patient can undergo such a procedure. A patient's heart history; age; co-existing organ disease, such as emphysema; or other medical conditions all affect whether the surgery would be the appropriate option to take.

OVERVIEW – CARDIAC OPERATIONS

Cardiac surgery is usually performed in one of the largest suites in the OR as these procedures have the most personnel and equipment needed for the operation. Because so many supplies are needed, the surgical technologist needs to verify them against the preference card and gather any missing items, including any optional instruments the surgeon prefers. Since there are many sterile items that will need to be opened, smaller items should be opened into the basin and larger items opened where they will be used during the operation to reduce motion during surgery.

Most cardiac patients will arrive into the OR with monitoring lines already in place. Some of the intraoperative lines may include:

- "An arterial line within the radial or femoral artery for measurement of direct arterial blood pressures and arterial blood gas studies,[4]
- "A Swan-Ganz pulmonary artery catheter that indirectly measures left atrial and left ventricular pressures by assessing the right atrial, right ventricular and pulmonary artery wedge pressures,[4]
- Other lines that may be inserted into the aorta or left atrium for pressure readings,
- "Urinary drainage catheter with temperature sensor for the measurement of urinary output and core temperature,[4]
- Transesophageal echocardiography.

Noninvasive intraoperative monitoring may include:

- BP cuff for the indirect measurement of arterial blood pressure
- Pulse oximeter for the measurement of oxygen saturation of hemoglobin
- ECG

Once a patient arrives in the operating suite, their chart needs to be checked for history, physical, consent, diagnostic findings and laboratory results. Diagnostic tests included for review are resting ECG, stress test ECG, chest X-ray, echocardiography, cardiac catheterization, digital subtraction cine-arteriograms of the left ventricle and coronary arteries, radionuclide imaging, thoracic aorta arteriograms and MRI studies and electrophysiology studies.1

AORTIC VALVE REPLACMENT

Draping/Patient Prep

A folded towel needs to be secured to the groin with towel clips or skin staples. The chest will be square-draped with towels. Plastic adhesive drapes will be placed over the top and a nonfenestrated heart sheet will be placed over the patient. The patient's pressure points should be identified and padded and his or her arms need to be placed at their side.

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Procedure

Once the patient has been placed in the supine position, a median sternotomy is performed and cardiopulmonary bypass is initiated by the surgeon. Bone wax is used to seal off bleeders from the sternal walls. A 2-0 silk pericardial stays retract the pericardium and is used to secure the sternal retractor. A left ventricular vent is placed through the right superior pulmonary vein and into the left ventricle. This action helps with the maintenance of a bloodless field and this sequence will be used for the cannulation as well. *(For cannulation technique, see Table 1)*. A cardioplegia solution will need to be prepared in case it is needed at this point in the operation.

The aorta is then cross-clamped and cardioplegia is infused in a retrograde fashion through the coronary sinus. Cardioplegia may be infused through the ascending aorta if the aortic valve is incompetent. A large Fogarty aortic cross-clamp with plastic, atraumatic inserts may be used to occlude the aorta. With retraction sutures ready, an incision is made with valve scissors into the aorta and the edges are retracted with valve retractors. The aortic valve is exposed and inspected. The surgical technologist should ready the valve sizers and have the prosthesis holder out. The circulator will then

The surgical sutures that hold the valve are in place and the new valve is ready to be lowered into the patient's aorta

be ready to open the proper valve. Leaflets are resected and any calcium deposits are removed from the annulus in order for the sutures to be placed. The annulus is sized and the prosthesis is selected. Tissue prosthetics must be rinsed prior by using a saline wash. The manufacturer's instructions will need to be followed for rinsing the porcine valves.

The surgical technologist needs to keep track of the sutures and needles that are used and returned by the surgeon. Saline will be used to wet the value and sutures become placing valve into annulus. The interrupted, nonabsorbable, multifilament sutures of alternating colors will be placed into the annulus and through the skirt of the valve. The valve will then be carefully pushed down and into place.

The surgical technologist should have a French-eyed needle available in case the surgeon needs to place another suture through the annulus after the needles have been cut off. The sutures will then be tied and the rotation of the leaflets will be tested. The aortic incision will be closed with a nonabsorbable suture – polyester is usually the suture of choice – and the cross-clamp will be removed. The air is then removed from the left ventricle and CPB is discontinued. The chest tubes are prepared along with the closing suture. A count is performed and once verified, the heart is restarted, the cannulas are removed and the chest is closed.

POST OP

The surgical technologist and back table need to remain sterile until the patient has left the OR. Wire cutters, sternal retractor, cannulation stitches loaded on needle holders and cannulae should be available in case the patient must be placed back on cardiopulmonary bypass. Attention to care is critical following the procedure and the patient must be safely transferred from the OR table to the CCU bed. The patient will be hooked up to monitoring lines, an IV, ET tube and urinary and chest drainage tubes so transferring needs to be closely watched as these can be disturbed if tension is placed on them during the move.[4] Complications may include postoperative infections, which can prove to be fatal. Implanted cardiac prosthetics increase the risk for infection and need to be handled with the strictest of sterile technique. An infection of a valve prosthetic can cause embolism, endocarditis or mechanical failure. All of these can prove to be fatal. Sternum infections usually require debridement.

PRACTICAL CONSIDERATIONS FOR THE SURGICAL TECHNOLOGIST

Cardiac operations usually only include surgical technologists that have been properly trained in open-heart and cardiac procedures. The surgical technologist should always be thinking steps ahead of the surgeon as changes can happen rapidly in cardiac procedures. Techs need to understand cardiac dysrhythmias and their relationship to the cardiac procedure as well as be knowledgeable about all pressure readings.

Room-temperature saline should be used up to the point of aortic cross-clamping followed by cold saline until the rewarming period. At the rewarming period, warm saline should be administered. The surgical technologist should be ready to go back on the pump at any time, especially at the end of the procedure. The cannulae should not be discarded and cannulation sutures need to be ready even after the patient is removed from CPB. Equipment and instruments need to be ready until the patient is safely removed from the OR.[4]

Other considerations include:

- Keep the field clear of water, blood-soaked sponges and instruments.
- Pass off defibrillation cables at the same time as electrosurgical cords in case the defibrillation paddles are suddenly needed.
- The valve prosthesis should not be opened until the surgical technologist and the surgeon verifies it is the one that is needed.
- Know the difference between atrial and arterial when passing cannulation stitches. One is for the right atrium and the other is for the aorta.
- The surgical technologist should verify that the valve sizers are for the valve being replaced.
- Always remember that the key to performing your role well is to know why you are taking the steps needed for the procedure and not just memorizing them. Things can change in a moment's notice.[4]

TABLE 1 :

AORTIC CANNULATION

After initiating median sternotomy, the self-retaining retractor is placed and an incision is made into the pericardium. Traction sutures are then placed into the pericardium and secured to the retractor or chest wall. With the aorta exposed, the two pursestring sutures will be placed high on the ascending aorta. This gives room for the proximal vein grafts and the cardioplegia/venting cannula. The previously cut 4-inch rubber catheters are placed over each pursestring suture and the needles are cut at the suture ends. A Rochester-Pean or Crile hemostat clamp is placed on the pursestring ends. A Satinsky partial-occlusion clamp may be placed on the aorta if the aorta is not calcified. An incision is then made into the aorta between the pursestring sutures by using the #11 knife blade. The bevel-end tip of the cannula is placed into the arteriotomy. The blood is allowed to fill the cannula and then held in place by a stopper on the proximal end. The rubber keepers hold the cannula in place and a heavy silk suture is tied around the cannula and rubber keepers.[4]

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AORTIC VALVE REPLACEMENT[4]

EQUIPMENT

- Cardiopulmonary bypass machine
- Hypothermia and temperature unit
- Hypothermia mattress
- Cell Saver
- External pacemaker
- Defibrillator unit
- Electrosurgical unit
- Suction system
- Ice (slush) machine
- Argon laser for sternal coagulation

INSTRUMENTS

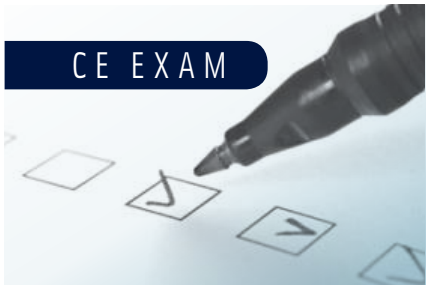
- Open heart sets
- Sternal saw
- Oscillating saw
- Valve sizers, handle and rings
- Valve retractors
- Valve scissors

OPERATIVE PREP

Anesthesia – General
Position – Supine
Prep – From jaw line to mid-thigh, to just above the level of the table on both sides

SUPPLIES

- Heart pack
- Double basin set
- Gloves
- Blades: #10, #11, #15, #20
- Drapes: nonfenestrated heart sheet
- Suture:
  - Cannulation sutures of surgeon's choice
  - Value suture
  - 0, 2-0, 3-0, 4-0 silk for pericardial stays, chest tube suture and ties
  - Stainless steel sternal wires
  - Closure sutures of the surgeon's choice
- Drains, chest tubes
- Dressings
- Drugs:
  - Sodium heparin mixed with sodium chloride
  - Antibiotic solution of surgeon's choice mixed with saline for irrigation
  - Various topical coagulants
- Internal defibrillator paddles and cord
- Venous and arterial cannulae
- Cardioplegia needle and administration set
- Cell saver suction tubing
- Alligator pacing cables
- IV tubing and needles for intra-chamber pressure readings
- Bone wax
- Gelfoam or Surgicel
- Electrosurgical pencil
- Teflon felt pledges
- Aortic punch
- Left ventricular sump catheter
- Pacemaker wires
- Closed-seal drainage unit
- Red rubber catheters for tourniquets and rubber shods
- Umbilical tape
- Y-connector for chest tubes
- Fogarty inserts for aortic cross-clamp
- Syringes
- Needles



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Aortic Valve Replacement

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1. The aortic valve is located between the _____ and the aorta.
a. Left ventricle
b. Right ventricle
c. Mitral valve
d. Tricuspid valve

2. For this procedure, the patient is placed into what position?
a. Trendenlenburg
b. Kidney
c. Prone
d. Supine

3. Bone wax is used to seal off _____ from the sternal walls.
a. The aorta
b. Bleeders
c. Valves
d. Clamps

4. After the aorta is cross-clamped, the cardioplegia is infused in a retrograde fashion through the _____.
a. Left ventricle
b. Aorta
c. Coronary sinus
d. Pulmonary vein

5. The multifilament sutures of alternating colors will be placed into the _____.
a. Annulus
b. Skirt of the valve
c. Left ventricle
d. Right ventricle

6. The surgical technologist should not break down the back table until the patient _____.
a. Is recovering
b. Has its heart restarted
c. Out of the OR
d. Is conscious

7. Complications from this procedure may include:
a. Valve prosthetic infection
b. Mechanical failure
c. Death
d. All of the above

8. The valve prosthesis should not be opened until the _____ and the surgeon verify it is the correct one needed for the procedure.
A. Manufacturer
B. Circulator
C. Surgical Technologist
D. Anesthesiologist

9. When performing the aortic cannulation, these sutures are placed high on the ascending aorta:
a. Bovine
b. Pursestring
c. 0 absorbable
d. Extruded collagen

10. In the 1960s, when this procedure was first performed, the mortality rate was as high as ____.
a. 37%
b. 44%
c. 50%
d. 65%

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