Guidelines for Port Access Assisted Surgery
Beth Israel Deaconess Medical Center, Division of Cardiac Anesthesia

1. Peripheral Access
   You will need the usual 2 large bore peripheral IV’s and radial arterial line. The arterial line should be placed on the opposite side of the incision if a thoracotomy is planned (right thoracotomy for mitral valve procedure). These should be placed in the holding area. If you have insufficient peripheral IV access, you can cannulate the LEFT IJ. Stay away from the right side of the neck which will be used for the endo-pulmonary vent (EPV) and endo-coronary sinus (ECS), referred to commonly as the “Heartport” catheters. The EPV will be used to attempt to drain the left ventricle during bypass and the ECS used to deliver retrograde cardioplegia.

2. Anesthetic Induction/airway management
   Anesthetic induction and technique is not influenced by the presence or absence of the minimally invasive, or Heartport catheters. All patients except the most debilitated are considered “fast track” candidates. Single lumen ETTs are adequate for minimally invasive AVR procedures and for other procedures occurring through full sternotomy incisions. Minimally invasive MVRs, or other procedures using an infra-mammary or thoracotomy incision, will require a double lumen ETT. Fiberoptic bronchoscopy must be available to confirm tube placement in these patients.

3. Transesophageal echocardiography
   The TEE probe is placed after anesthetic induction and prior to central line placement in all suitable patients. An abbreviated TEE study is performed at this time, focusing on:
   - The existence of a persistent left SVC. If this structure is present, it usually drains into the coronary sinus. Performing a bubble study through a left upper extremity IV (or even just squeezing the left upper extremity IV) and seeing bubbles entering the right atrium via a dilated CS is diagnostic of this condition. This is important since a persistent left SVC makes it impossible to give retrograde cardioplegia (since the cardioplegia solution will just go down the left arm) and thus there will be no need to place the ECS catheters. This will probably necessitate changing the surgical approach so it is extremely important to communicate this finding to the surgical team.
   - Aortic insufficiency. If significant AI is present, cardioplegia delivery will be highly reliant on the retrograde technique and you and the surgeon may want to secure an alternative (i.e., open) means of delivery.
   - Amount of atheromatous disease present in the descending thoracic aorta. This may prevent safe placement of a femoral arterial cannula and require a change in surgical plan.
   - The presence of a significant ASD which may make placement and efficacy of the venous cannula problematic.
The TEE probe is necessary throughout the remainder of the procedure. Mid-esophageal bicaval views will be used to confirm proper guide wire placements. At a later point in the procedure, it will be used to determine coronary sinus (CS) location and guide ECS/EPV catheter placement as well as surgical cannulae placement.

4. Cordis placement and Heparinization

The EPV and ECS catheters are packaged separately. The nurses will open and flush the ECS catheter for you. You will need only one universal access kit since the EPV catheter kit contains an access needle and wire. “Double-stick” the right IJ, placing both guide wires before either cordis. Draw a baseline ACT before placing the cordises. Since the catheters are NOT heparin coated, it is necessary to give 5000 units (50 mg) of heparin IV before, or shortly after, placing the cordises. It is also important to note that the catheters are NOT latex free. The ECS guidewire should be placed proximally (i.e., closer to the heart and further from you) and the EPV should be placed distally. It is recommended to place the wires > 1 cm apart to allow sufficient room for each cordis. Place the ECS cordis first. After de-airing the side-port, connect a carrier infusion using a microdrip.

5. Endocoronary Sinus (ESC) Catheter

The ECS catheter has three lumens:
1. Balloon inflation port
2. Pressure monitoring port
3. Cardioplegia infusion port.

The catheter also has an intraluminal wire that helps maneuver the catheter. There is also a yellow external “clamp” on the catheter that, when engaged, allows the user to better manipulate or steer the catheter. The nurses will flush the catheter ports for you and will have additional heparinized saline available for you. The ECS balloon is filled with 1.5 cc of saline, not air. Prior to placing the ECS, place a sterile half sheet on the patient and tear a small hole in the drape, centered over the cordis. This will give you a larger sterile field to work with.

Before you place the ECS:
- Make sure the intra-catheter guidewire is in the catheter and the “clamp” engaged.
- Connect the pressure monitoring port to the CVP transducer with a 12 inch long pressure tubing that the cardiac anesthesia technician will give you. The tubing will be connected to the CVP transducer and monitored on the 60 mm Hg scale.
- Make sure the balloon is intact and inflates easily.
- Turn the cardioplegia infusion port “off.”
- Cover the catheter with the supplied sheath.
- Obtain TEE image of the CS. The recommended image is the mid-esophageal bicaval view, though occasionally increasing the omniplane angle beyond 90°to 110-120° is helpful. Manipulate the probe slightly posteriorly so that the tricuspid valve is in the anterior field - the IVC (anterior) and CS (posterior) are to the left of the image, and the SVC is to the right. The catheter is advanced toward the
tricuspid valve and prior to going through the valve, it is rotated so that it points posteriorly. It should now be at the mouth of the CS and can be advanced into position. Confirmation of placement is by TEE (mid esophageal 4 chamber, probe advanced slightly and retroflexed) and by noting a ventricularized pressure tracing, analogous to an LV “wedge” pressure.

- Leave the ECS balloon inflated and the intra-luminal guidewire in place!!!!!!
  This will help prevent accidental dislodgement during EPV catheter placement. The guidewire will be removed just prior to giving cardioplegia.

6. Endopulmonary Vent (EPV) Catheter

The EPV catheter is similar to a standard PA line except that there is no thermodilution capability, there is no CVP monitoring port and there is multi-orifice lumen on the distal end. The design of this catheter reflects its intended purpose- to actively aspirate blood from the PA to decompress the LV. The side port of this catheter can serve as a volume infusion port if IV access is limited.

The catheter has two connections. One, on the distal end, is a pressure monitoring port which will be used to monitor PA pressure. The other port is to the multi-orifice lumen and will be connected to the perfusionist’s “vent” line, which will be passed to you through a hole in the drapes when the cardiopulmonary bypass lines are prepared in the surgical field. Keep the vent port closed until you go on bypass.

Placing the catheter is done in the same manner as for a standard PA line. TEE imaging is used to confirm that the tip of the catheter is in the main PA, i.e. distal to the pulmonic valve and proximal to the PA bifurcation.

Save the obturators for the EPV and ECS as well as the EPV cordis cap and PA line sheath that comes in the standard introducer kit – you will need these things at the end of the case when these catheters are removed and a standard PA catheter placed!!!!

7. Endo-aortic Catheter (EAC)

The EAC is a balloon-tipped device placed by the surgeon via a femoral artery and is used to delivery antegrade cardioplegia, vent the ascending aorta and act as an aortic cross-clamp from an intra-luminal position. Currently, this catheter is rarely used. If this catheter is used, you need to be vigilant that the balloon does not migrate either proximally past the sinotubular junction or distally past the innominate artery. This is done by TEE and sometimes by placement of both right and left radial arterial lines. In most patients, a single arterial line and TEE are sufficient. Pressure in both the balloon and catheter tip is monitored.

8. External Defibrillation Pads

For minimally invasive procedures (all procedures not done through a full median sternotomy) external defibrillating (“R2”) pads should be placed on the patient, paying close attention to not place the pads in areas that may be used for incisions or port access sites. The heart must sit between the 2 pads for them to be effective.
9. Hook Up and Use of EPV and ECS Catheters

Retrograde cardioplegia is delivered through the ECS catheter. Prior to administration of cardioplegia it is necessary to remove the guidewire from the ECS catheter, disengage the yellow “clamp” and inflate the balloon, if it had been deflated. The surgeon will cut a hole in the drape and pass off two tubes to the anesthesia team. Communication and vigilance is mandatory in connecting the appropriate tube to the appropriate catheter. One tube will be for cardioplegia delivery and will get hooked up to the cardioplegia port of the ECS. **THIS LINE HAS TO BE FLUSHED OF AIR PRIOR TO THE DELIVERY OF CARDIOPLEGIA!!!** Please coordinate with the perfusionist – you can flush into the emesis basin supplied on your anesthesia tray. The other tube will get hooked up to the distal, multi-orifice port of the EPV. Please check stopcocks for appropriate continuity. Continuous pressure monitoring is utilized during cardioplegia administration, which is controlled by the perfusionist.

10. Removing catheters at the end of the procedure

After the procedure is completed, remove the ECS catheter and place the appropriate obturator through the cordis. The EPV catheter is also removed (since it is not heparin coated and has no thermodilution capability) and can be replaced with a PA line of your choice, or you can just cap the cordis and monitor central venous pressure from one of the cordises. It is not necessary (or wise) to remove the cordises at the conclusion of surgery.