

Anesthesia for Minimally Invasive Cardiac Surgery: Made Ridiculously Simple

by Art Wallace, M.D., Ph.D.

Anesthesia for Minimally Invasive Cardiac Surgery: MID-CABG

I guess the first question should be what to call this new operation. It is minimally invasive CABG or minimal access CABG. Maximally difficult CABG. I don't know. A little cabbage is commonly known as a brussel sprout. Unfortunately, my affection for this operation parallels my affection for little cabbage testicles as we called them as a child.

There are several ideas about what this operation is all about. There is the Heart Port operation. The idea of the Heart Port System is to avoid that nasty sternotomy scar. An arterial inflow cannula is placed in a femoral artery and the venous outflow is placed through a femoral vein. A catheter with a balloon is advanced up the aorta and the balloon inflated in the ascending aortic arch. Aortic atherosclerotic disease is a definite contraindication for this operation. Picture sliding the catheter up a severely diseased aorta followed by retrograde perfusion from the groin. Cardioplegia is then delivered antegrade to the coronary arteries which have been separated from the systemic circulation by the ascending aortic arch balloon. A catheter is advanced from the internal jugular vein into the pulmonary artery for venting the left ventricle. The patient is placed on fem-fem bypass and cardioplegia established. A single vessel CABG is then performed either through a mini thoracotomy or thoracoscopically. The problem with this operation is simple. The risk from with a CABG is the extracorporeal circulation not the sternotomy. One of the major morbidities of CABG surgery is the neuropsychiatric changes and strokes. The Heart Port operation has a long bypass run for a single vessel CABG. It maximizes the risk of stroke while eliminating the sternotomy.

CTS (Chuck Taylor Surgical or Cardio Thoracic Surgical) and US

Surgical have worked to improve the technique popularized by Bennetti. It is in essence a mini-thoracotomy with no bypass. The standard is a single IMA to the LAD. The heart is stabilized by placing latex sutures under the LAD proximal and distal to the site of the anastomosis. A small foot presses on the myocardium while the sutures pull the heart into the foot. Blood flow is stopped in the target vessel by the stabilizing sutures. The technique requires improved technical skill on the part of the surgeon in that the heart is moving (contraction as well as respiratory movement). It also requires increased technical skill on the part of the anesthesiologist because an area of myocardium is ischemic, and non-functional, and prone to reperfusion arrhythmias. The advantage of the operation is reduced cost (no extracorporeal circulation, reduced hospitalization time) and reduced risk of stroke (no extracorporeal circulation). If surgeons and anesthesiologists can surmount the technical challenges (motion, bleeding, arrhythmias, hemodynamics, exposure) it offers great promise.

The equipment for MID-CABG is changing constantly. The problems have not. One of the first problems to address is what is the plan when the patient has ventricular fibrillation. If the surgical plan consists of a small thoracotomy what is going to happen when the ischemia caused by the stabilizing sutures or the reperfusion arrhythmias caused by releasing the sutures progresses to ventricular fibrillation?

My favorite plan is this.

1. Choose an anesthetic that lowers the heart rate (fentanyl, sufentanyl, alfentanyl, remifentanyl).
2. Do a median sternotomy first. The morbidity is small compared to the risk of prolonged ventricular fibrillation. Have the perfusionist in the room with the pump primed. Don't hand off the lines just be ready. If you can't convince the surgeon to do the case as a sternotomy from the start be ready for the emergency sternotomy when the patient fibrillates. The other advantage of the sternotomy from the start approach is multivessel CABG without extracorporeal circulation is possible. With the mini-thoracotomy multiple mini-thoracotomies are needed for the second and third distal anastomosis. If you end up doing a MID CABG with multiple mini-thoracotomies, consider using a double lumen tube

for better exposure. They are not essential but frequently help.

3. Anti-coagulate the patient just as you would for a CABG with extracorporeal circulation (Heparin 300 U/kg). If there is a problem it is easy to cannulate and go on pump.

4. External defibrillation pads should be placed and sterile paddles should be available in the room. Prophylax for arrhythmias with you favorite drugs. Magnesium 1 gram plus Lidocaine 100 mg followed by an infusion at 2 mg/min. I am a strong proponent of amiodarone (IV) but have not yet used it for MID CABG arrhythmia prophylaxis.

5. After the surgeon has placed the stay sutures and the occlusion foot, load the patient with volume (hespan) and maintain the pressure with vasoconstrictors. I try to avoid beta agonists for fear of the pro-arrhythmic effects.

6. Adjust the ventilator to reduce motion (small tidal volumes with increased rate).

7. Have a plan to lower the heart rate even more if necessary (esmolol, adenosine). If the heart rate is irregular or too low use atrial pacing. Do not use glycopyrolate or atropine when asked to increase the heart rate because they are hard to undo when the surgeon changes his mind.

8. Be ready for reperfusion arrhythmias with release of the stay sutures.

9. Reverse the heparin gently. Remember you don't have a bypass circuit ready to bail you out. Moreover, the dose of protamine may be reduced because of the lack of damage to the platelets. Check the ACT 1/3 and 2/3 of the way through the protamine to avoid overdosing.

10. Consider anticoagulation post reversal of protamine. CABG surgery benefits from prolonged damage to the coagulation system. When was the last time you saw a post CABG pulmonary embolus? When do they start anticoagulating after a valve? In a MID-CABG where the coagulation system was not exposed to an extracorporeal circulation circuit the coagulation system is normal. All of the problems with pulmonary embolus, graft closure, graft clotting that the vascular surgeons have will now occur with cardiac surgery. If graft closure causes a cold leg and a mid-night trip to the OR to remove the clot. MID-CABG graft closure causes an MI and possibly a cold blue patient and a trip to the morgue. Be very, very, very careful about post operative

MI's. Remember the anastomosis was done in less than optimal circumstances (movement, bleeding, limited positioning). The coagulation system is fully functional. We are trying dextran infusions to try to have some prolonged anti-coagulant effect without bleeding. The jury is still out though.

We have had thirty years to figure out all the tricks for normal CABG's. The MID-CABG is still in its infancy.

Good Luck: If there are any comments, changes, additions, errors in this text, I, Art Wallace, M.D, Ph.D., am responsible. Please e-mail me with suggestions.

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