Cardiac Transplant
Anesthesia Guideline
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Overview

Recipients are usually in biventricular failure with low CI, low EF and elevated LVEDP. About half are ischemic, about half non-ischemic, with a small number of end-stage valvular or congenital heart disease. Pulmonary artery pressures may be elevated, although usually because of high left atrial pressure (pulmonary venous hypertension) rather than increased pulmonary vascular resistance. Patients may have ventricular assist devices (VAD), either an implanted VAD or an intraaortic balloon pump (IABP). Patients may be receiving an infusion of an inotropic drug. ICD’s are common, as is biventricular pacing for “resynchronization therapy”. These patients may have renal impairment, liver congestion, and suffer generally from physical deconditioning, weakness and malnutrition.

Practical implications include:

1) ICD’s have to be turned off prior to using cautery in the OR (see cardiac rhythm device protocol)

2) Patients with IABP or extracorporeal VAD will need to come directly to the OR with a perfusionist present during transport to manage the IABP.

3) Inotropic drug infusions should usually be continued until the patient is on cardiopulmonary bypass. If the patient comes from home with a home infusion pump it is usually more convenient to convert this to a standard IV infusion pump in the OR.

4) Patients with previous cardiac surgery present the challenges of redo cardiac surgery. Patients with a VAD may be particularly challenging. VAD explant is often accompanied by significant bleeding and/or technical issues during sternotomy and dissection of the mediastinum. Groin cannulation is often required for resternotomy.

The Procedure

Anesthesia Set-up

Patients will typically receive at least one peripheral IV, an arterial line, and a PA catheter. Note that patients with nonpulsatile VADs such as Heartmate II may have minimal pulsatility (the left ventricle can eject through a Heartmate II, so the degree of pulsatility depends upon left ventricular function and preload) of their arterial circulation, and ultrasound may be required to locate and cannulate arteries. Automatic blood pressure cuffs and pulse oximeters may or may not work in these patients, depending on the degree of pulsatility. Resternotomy and especially VAD explant may involve more than average bleeding prior to and following bypass, and adequate vascular access is particularly important for these cases.
Infusion drugs (routine)

- Epinephrine
- Vasopressin
- Phenylephrine
- Nitroglycerine
- Insulin

Optional drugs that may be required

- Isoproterenol
- Milrinone
- Nitroprusside
- Norepinephrine

All patients will receive aminocaproic acid because of its small but favorable effect on blood loss.

Nitric oxide is frequently used for pulmonary vasodilation, and should be immediately available.

Consider ordering blood components in advance. Primary heart transplant (not a reoperation) can be frequently accomplished without plasma or platelets, but reoperations, especially VAD explants, frequently require coagulation support. When platelets are ordered in advance, apheresis (single donor) platelets should be ordered since they do not expire (if left on the shaker in the blood lab) and apheresis platelets can be returned if not used. Pooled platelets have a 4 hour expiration, so timing for arrival close to the anticipated time of separation from bypass is important; timing this right can be difficult. Note that blood products for CMV negative recipients must also be CMV negative. There is not ordinarily a need for leukoreduced or irradiated blood products (Questions about blood should be directed to Dr. Terry Gernsheimer, our transfusion specialist).

The PA catheter may be difficult to float due to right heart dilation and poor function. Defibrillator and pacemaker cables may be in the way. In these circumstances options include the use of fluoroscopy to guide the catheter or floating the catheter can be deferred until after bypass. TEE can occasionally be helpful for guiding the PA catheter. In any case, the PA catheter will be pulled back into the introducer sheath prior to cannulating the superior vena cava (all patients will have bicaval cannulation).

Induction of Anesthesia

Take into account that most patients will be “full stomach”.

Bypass Management

Recipients are often vasodilated from afterload reducing drugs used to treat their heart failure. Low blood pressure on bypass caused by profound vasodilation (often called “vasoplegia”) may sometimes be difficult to treat. Phenylephrine, vasopressin, norepinephrine (which is a very good alpha agonist) and methylene blue (see methylene blue protocol) are the most commonly used vasoconstricters, and may have to be used in combination.
Post-Bypass Management

Pharmacologic management in the immediate postbypass period varies considerably depending upon the performance of the donor heart. Under ideal conditions, the donor heart may need little support. At the other extreme, rarely an IABP or VAD may be necessary. It may be useful to know some basic facts about the donor heart, for example the length of ischemic time before reperfusion (ideally <4 hours), any concerns about coronary disease or ventricular function of the donor heart, any difficulties during the harvest that might have compromised myocardial protection. The right ventricle (RV) is often a greater problem than the left. Care should be exercised to avoid overdistending the RV following bypass. RV function should be assessed frequently by observing the heart in the surgical field and by TEE. There is a preference to maintain a relatively high heart rate (>100) in the transplanted heart, and this can be achieved by the use of pacing or chronotropic drugs such as epinephrine or isoproterenol. There is a very low threshold for using nitric oxide to unload the right ventricle; some prefer to use it routinely. Although there are many approaches to inotropic support, we tend to prefer the use of epinephrine for milder cases of ventricular dysfunction and epinephrine in combination with milrinone for more severe cases of ventricular dysfunction. Although isoproterenol is sometimes used, severe peripheral vasodilation and hypotension may limit its use, particular in the immediate postbypass period.

Role of TEE

TEE is very useful particularly for the following issues:

1) Pre-bypass—Is there left ventricular clot? If so, alert the surgeon to avoid embolization
2) Pre-bypass hemodynamic management
3) Deairing the heart prior to coming off bypass
4) Post-bypass evaluation of ventricular function
5) Post-bypass evaluation of valvular function, particularly looking for tricuspid regurgitation.
6) Post-bypass hemodynamic management

Antibiotics and immunosuppressant drugs

Administer according to the drug checklist.

Glucose and potassium

Hyperglycemia may be exacerbated by the administration of methylprednisolone. Hypokalemia can be a problem because of insulin and catecholamine administration and potassium diuresis following bypass. Patients should be delivered to the ICU with a potassium solidly in the normal range and a glucose less than 180.
CARDIAC TRANSPLANT DRUG CHECKLIST

ALWAYS VERIFY THIS CHECKLIST AGAINST THE SURGERY PREOP ORDERS AND CONFIRM WITH SURGEON

Medications to be given upon admission

☐ 1) Phytonadione (Vitamin K) 10 mg IV over 30 minutes for all patients on oral anticoagulation with INR >1.5

Medications to be sent to pre-op holding and administered prior to surgery

☐ 1) Antibiotics: Cefuroxime 1.5 gram IV and Vancomycin 1 gram IV

☐ 2) Immunosuppressant: Mycophenolate (Cellcept) 1000 mg IV

Medications to be administered intra-operatively, SIX hours after the preoperative dose

☐ 1) Antibiotics: Cefuroxime 1.5 gram IV and Vancomycin 1 gram IV

Medications to be administered at CROSS-CLAMP REMOVAL

☐ 1) Methylprednisolone 500 mg IV

☐ 2) R-ATG (Thymoglobulin) _________ mg (1.5 mg/kg) IV over 6 hours

Round to nearest 10 mg

Pharmacy will send STAT to OR only upon call that donor organ is viable.