**BAYLOR SCOTT AND WHITE MEDICAL CENTER - TEMPLE**

**DIVISION OF CARDIAC ANESTHESIA**

**DEPARTMENT OF ANESTHESIA**

**TOPIC: Anesthesia for Patients Undergoing Cardiac Transplantation**

**PROPOSED: 27 December 2016 APPROVED:**

**REVISED: 28 February 2020 APPROVED:**

**This guideline is meant to facilitate the understanding and execution of Anesthesia for adult patients undergoing cardiac transplantation at Baylor Scott and White Memorial Hospital. The individual patient’s condition may necessitate deviation from this protocol on occasion. This guideline will be reviewed and updated periodically as advances in care dictate.**

**General Considerations**

Patients presenting for heart transplantation frequently have severe left ventricular dysfunction and may manifest congestive heart failure, pulmonary hypertension, and end organ dysfunction, including hepatic, renal, cerebral, and hematological abnormalities. Immunosuppression is part of the transplantation procedure and **strict adherence to aseptic technique is critical in avoidance of infections**.

1. **Initiation of Transplant Procedure**

The general anesthesia staff (and sometimes the Cardiac Surgeon on call) on call will notify the cardiac attending anesthesiologist on call when a transplant is likely. Further communication will fine-tune the timing of the case. The cardiac attending on call should notify the cardiac anesthesia fellow on-call at an appropriate time. Pre-op evaluation/consent of the patient for all indicated procedures (GETA, vascular access, and TEE) should occur as soon as the case is posted.

1. **Operating Room Set-Up for Cardiac Transplant**

The operating room should be set up in the same manner as the other major cardiac cases. Ensure blood availability prior to OR, especially if the patient requires a redo sternotomy. A new airway circuit should be used. A typical blood order schedule would include 6 units PRBC’s and 6 units FFP for redo sternotomy cases.

Get into contact with the pacemaker clinic (St. Jude Reps: Ginger Funk: 512-925-6878, Heather Coleman: 512-925-6743, Sterling: 832-385-5168, Ben Hogan: 254-640-3396) (Medtronic Reps: Russell Humphrey: 254-717-8354, Jessica Savedra: 512-996-3216) in order to disable ICD tachyarrhythmia therapy. The circulator can help you coordinate this also.

Have a rapid blood transfusion device such as the Belmont or Level One in the room.

Special Note: Patients with a history of pulmonary hypertension may need nitric oxide; therefore, call the Respiratory service (24-7774) and have them bring it to the room, and set up prior to induction.

Typically, these patients are admitted to the CTICU and receive a sterile intravenous line. An arterial line can also be placed in the CTICU prior to going back to the OR. Sometimes, these patients also have LVAD’s in place, and ultrasound is needed to place the arterial line, with strict adherence to sterile technique (use an ultrasound probe cover). The left radial artery is preferred in a patient who is undergoing cardiac reoperation, transplant, or has a VAD in place. There are portable ultrasounds available which stay in the cardiac OR’s.

 Plan to be at the patient’s bedside with the circulator RN (+/- perfusionist for LVAD patients)

 15 minutes prior to OR time).

 We cannot be the source of delay.

**C. On Patient Arrival**

The patient is brought to the OR on a stretcher. Any oxygen administration is continued. Routine monitors are placed (ECG, NIBP, Pulse oximeter, arterial line monitored). **Defibrillating pads are placed in all patients, should the need for emergent defibrillation arise.** If the patient is not receiving oxygen on arrival to the OR, oxygen should be administered via face mask or nasal cannula. If peripheral venous access is poor, consideration should be given to gaining additional access via the internal or external jugular veins.

Pre-existing intravenous lines (those not placed at admission immediately prior to operation, including PICC lines) and central lines should be removed after adequate access has been obtained and the sites examined and dressed.

The patient should be kept comfortable until the final go-ahead for induction is received. Once the donor heart has been deemed acceptable for transplantation by the procurement team, the implanting surgeon will give the go ahead for induction. At this point, the sequence of induction is at the discretion of the attending anesthesiologist. Blood product availability should be confirmed and in the room prior to induction.

Preoperative antibiotics should be given as soon as possible along with induction or immediately afterwards including:

* Cefuroxime 1.5g or Cefazolin 2g(re-dosed every 4 hours)
* Vancomycin 1g
* Fluconazole 400mg (for patients with LVADs or any mechanical circulatory support device).
* Consider Ciprofloxacin 400mg (re-dosed every 8 hours) in PCN allergic patients.

**Coordination of multiple organ harvest teams at the site of the organ harvest, often from many institutions, is difficult and may cause unavoidable delay prior to induction (sometimes up to hours).**

**D. Central Venous Lines**

Central venous access is obtained with the usual adherence to sterile technique before induction. Lines are often placed while the patient is awake prior to induction on the OR table, while awaiting final go ahead to proceed. Currently we place a 9 Fr. MAC CVC and a PA catheter. Infusions may be administered via the brown port of the CVC instead of the VIP port of the PA catheter as the PA catheter is often withdrawn immediately prior to recipient cardiectomy. An additional 7 Fr. double/triple lumen CVC may be placed if needed. Previously we have utilized continuous cardiac cutput (CCO) PA Catheters which can only be advanced through a 9 French Central Line, and they need the Vigilance II CCO monitor which is currently unavailable. The PAC will sometimes be advanced into the pulmonary artery, and other times will only be advanced 20-25cm, until the donor heart is in place (either the surgeon can place it or it can be advanced after coming off bypass). This is the reason for the additional CVL (infusions). Right or left internal jugular sites can be used.

**E. Induction and Maintenance**

Transplant patients often have full stomachs and induction should proceed with appropriate precautions against aspiration. A foley catheter with temperature sensor is placed by the OR team. A transesophageal echocardiography probe and a nasopharyngeal temperature probe are placed.

Immunosuppresion regimens may change over time and we should always check with the surgical team prior to administration. These medications take time to prepare, especially at night. The immunosuppression induction regimen that is currently favored is:

* Methylprednisolone(Solumedrol) 1000mg IV, given immediately post-induction.
* Mycophenolate(CellCept) 1000mg IV infused over 2 hours, started immediately post-induction.
* Basalixumab(Simulect) 20mg IV given over 30 minutes(obtain from pharmacy as soon as the go ahead is given) should be administered after induction once the Methylprednisolone 1000mg IV finishes.
* Always check the type and dose of immunosuppressant’s the surgical team wants as these can change over time.

Anesthesia may be maintained by combinations of intravenous and inhaled agents plus neuromuscular relaxants.

An IV bolus and continuous infusion of Tranexamic Acid should be given to most patients after the induction of anesthesia.

**NOTE THE CROSS CLAMP TIME OF THE DONOR AND EVERY 30 MINUTES (GOAL IS TO GET DONOR HEART INTO THE RECIPIENT WITHIN 4 HOURS)**

**F. Pre-Bypass**

A baseline ABG, ACT, glucose, and TEG should be obtained. The baseline coagulation state in re-do hearts and re-transplantations should be checked because of the increased incidence of life threatening hemorrhage in these patients.

Unstable patients may require urgent cardiopulmonary bypass (CPB). In re-do patients, laceration of the heart or hypotension during cardiac manipulation may require urgent CPB, with dissection of the heart carried out on CPB. Longer CPB times and potentially, greater use of cardiotomy suction may increase damage to the coagulation cascade and platelets, necessitating massive transfusion post-CPB.

If the pulmonary artery catheter was fully advanced when placed, it must be withdrawn to 20-25cm prior to cardiotomy unless otherwise requested by the surgical team.

Upon discussion with the surgeon full heparinazation is accomplished by administering an IV bolus of heparin, therapeutic ACT is checked and must be in the therapeutic range prior to cannulation (>480).

**G. Cardiopulmonary Bypass**

Once the procurement team has landed at the local airport, cardiopulmonary bypass is established followed by the recipient cardiectomy.

Following cross clamp placement, the MAP should be kept at 50-60 mm Hg. Following cross clamp removal, the ischemic time (donor cross clamping to recipient unclamping) should be noted and the MAP kept 60-70 mm Hg.

The anticipated blood products needed to correct expected postoperative coagulopathy must be ordered and present in the room (TEG while on bypass can help with this).

**H. Weaning from Cardiopulmonary Bypass**

Chronotropic support as well as inotropic support are often needed. Combinations of agents

such as the following medications as well as placement of atrial and ventricular pacing wires

are typically necessary.Pulmonary hypertension with right ventricular dysfunction and

systemic vasoplegia may occur.

a. Epinephrine should usually be started in preparation for coming off bypass (target HR of 100-110)

b. Vasopressin, Phenylephrine, or Norepinephrine may be needed to treat systemic vasodilation

c. Milrinone, Dobutamine, and Inhaled Nitric Oxide @40 ppm may be used to treat pulmonary hypertension

d. Consider isoproterenol if emergency treatment of bradycardia needed without functional pacing wires (denervated transplanted heart will not respond to atropine).

e. **These recommendations for vasoactive medications are meant to serve as a guide to help initial selection of agents. There will be circumstances in which different medications or doses are necessary to treat individual patients. This should be decided upon in a collaborative fashion by the Attending Cardiac Surgeon and Attending Cardiac Anesthesiologist.**

**NO Amiodarone bolus and drip is given for heart transplant, unlike our usual protocol.**

**I. Following Cardiopulmonary Bypass**

Administer protamine in order to reverse the heparin. After ~3-5 minutes obtain an ABG, ACT, TEG, glucose and ionized calcium. Goals include a pH of 7.35-7.45, Hgb >7.0, ical >4.5, glucose <180, ACT back to baseline, and a normal TEG. Titration of vasoactive infusions and administration of blood products will occur.

Dexmedetomidine or propofol can be used for sedation for transport to the ICU and immediately on arrival to the ICU. The patient is transported with continuous monitoring to the ICU with emergency drugs available.