Anesthetic management of Pulmonary Vein Isolation using High Frequency Jet Ventilation

Preanesthetic Evaluation:

Standard preoperative evaluation including indication for PVI, other past medical/surgical history, anesthetic history, airway exam, and review of current medications should be performed. Special attention should be paid to patient height, weight, BMI, so as to assess for the appropriateness of high frequency jet ventilation for prolonged periods.

Laboratory evaluation should be reviewed with special attention to starting hematocrit and electrolytes. An INR should be drawn by the nurses in the holding area for those patients receiving Coumadin.

Diagnostic studies should be reviewed with special attention to baseline EKG and Echocardiogram.

An intravenous catheter will be placed by the nurses in the Cardiac Catheterization holding area.

Invasive arterial blood pressure monitoring can be placed pre-induction if clinically indicated. Otherwise the Electrophysiology fellows will place a femoral arterial line after induction.

Anesthetic management:

Unless the patient experience significant anxiety, administration of preoperative anxiolytic is best avoided as these patients often ambulate into the EP lab from the holding area or the hallway from their stretcher. Afterwards it is easiest for the EP nurses to place standard ASA monitors, pacing pads, and mapping patches with a cooperative patient seated on the EP table.

IV line should have several stopcocks for the connection of infusions close to the patient to minimize dead space and avoid inadvertent boluses of medications.

As the patient changes position to supine, midazolam may be administered if necessary. A BIS monitor may be placed at this time for baseline reading.

Induction of anesthesia should be performed at the discretion of the anesthesiologist. A combination of narcotic, propofol, and either a depolarizing or nondepolarizing muscle relaxant should be administered prior to intubation.

At this point, conventional ventilation via an endotracheal tube should be initiated. The patient can be maintained on an inhalational anesthetic and muscle relaxation per the anesthesiologist’s discretion.

An IV filter should be placed after induction on the IV line to prevent paradoxical air embolus due to the transseptal puncture performed during the procedure.

The patient will be positioned supine with both arms padded and tucked at the sides.

A lower body bair huggar will be placed by the EP nurses.

An esophageal temperature probe should be placed. The Electrophysiologists may ask for the position of the temperature probe to be manipulated during the procedure. The rationale being such that a significant temperature rise during ablation can be indicative of thermal injury to the atrial wall and possibly the esophagus.
An additional intravenous line can be placed at this time while the patient undergoes Transesophageal Echocardiography by the Cardiologists, and/or while the EP fellows obtain vascular access in the groins. Conversely, an IV line can also be placed on a femoral venous sheath placed by the Electrophysiologists. This separate line may be used for boluses of medications and fluids. The separate bolus line is preferred as inadvertent bolusing of infusions can result in unsatisfactory hemodynamic changes.

Unless a radial arterial catheter was placed preoperatively, the Electrophysiologists will place one at this time. The nurses will provide the anesthesiologists with the transducer and connect it to their monitors.

Once the Electrophysiologists begin mapping, the anesthesiologist should be notified that high frequency jet ventilation (HFJV) can be commenced. The tubing for the jet ventilator can be connected to the luer lock port on the elbow of the anesthetic circuit. The ventilator on the anesthesia machine can be turned off, oxygen at 1-2L/m can remain flowing, and the vaporizer turned off. Jet ventilation can then be initiated. A total intravenous anesthetic (TIVA) is now necessary. Titrated propofol infusion at 50-200mcg/kg/min and/or titrated remifentanyl infusion at .02-.2mcg/kg/min should be initiated. Conversely, titrated propofol infusion with fentanyl boluses can also be used. If not already infusing, a phenylephrine drip can also be initiated if patient situation warrants. These infusions should have already been placed on the stopcocks closest to the patient.

Patient biometrics should be considered when commencing and titrating HFJV. Reasonable ranges include frequencies of 80-120 breaths/min, driving pressures of 16-20psi, an inspiratory time of 30-40%, and an Fi02 of 50-100%. For large patients, settings should be modified to have larger driving pressures and perhaps higher frequencies. Smaller patients should have smaller driving pressures and lower frequencies. The cuff should remain inflated unless auto-peep is suspected.

Arterial blood gas monitoring should be performed every 30 minutes to monitor for physiologic derangements during HFJV. These ABGs are usually drawn with the ACTs every 30 minutes by the EP nurses. The EP nurses will also complete the ABG requisitions. They generally will only order the ABG, therefore if a hematocrit or electrolytes are desired by the anesthesiologist, it would be helpful to specifically ask the nurses to order it on the slip. If the patient is not tolerating HFJV, conventional ventilation is to be resumed.

Neuromuscular blockade can be helpful especially during the TIVA as to minimize unwanted patient movement & risk injury at critical portions of the procedure. Understanding that the Electrophysiologists will attempt to pace the phrenic nerve and watch for diaphragmatic movement as a means of assessing phrenic nerve injury is important so that the neuromuscular blockade is sufficient to avoid unsatisfactory patient movement but still allow for the assessment of phrenic nerve injury. This can be done with train of four monitoring and titrating a nondepolarizing muscle relaxant to 1-2 of 4 twitches.

Communication is essential throughout the procedure as hypotension can be indicative of pericardial effusion and tamponade. The Electrophysiologists will have intracardiac echocardiographic monitoring, and will assess for the presence of effusion at the anesthesiologist's request.
After the technical portion of the procedure is complete, HFJV can be stopped and conventional ventilation resumed with an inhalational anesthetic or the TIVA can be maintained. Neuromuscular blockade should be reversed, if warranted. The Electrophysiologists may remove the femoral sheaths. The anesthesiologist may be requested to administer protamine to reverse the heparinization. Long acting narcotics may be administered if appropriate. The narcotic requirement for this procedure is generally minimal.

The patient can be extubated per the anesthesiologists discretion, and brought to the post-anesthesia care unit (PACU) with appropriate monitoring. Transport in reverse trendelenberg is preferred to improve respiratory mechanics. To minimize risk of groin hematoma, the patient should not be permitted to flex the hips. If the patient had been unstable or suffered any complications during the procedure, CCU transfer may be appropriate.

**Post-anesthetic care:**

The patient will remain in the PACU for a few hours, may have sheaths removed by the Electrophysiologists if not done in the lab, and will be transferred to the floor for overnight observation.