Pre-anesthetic Assessment
Considerations for critically ill patients include drug choice (due to side effects, and direct cardiovascular effects), underlying disease process, concurrent disease processes (systemic hypertension, anemia, fluid overload, electrolyte imbalance), temperament, age of the patient, reason for anesthesia, duration of procedure, and current or expected pain status. It should be clear what the goal of the anesthetic procedure should be and what needs to be accomplished based on the stability of the patient.

Evaluation of these patients should start with a complete physical examination with emphasis on the cardiovascular, respiratory, and central nervous systems. Thoracic auscultation should be performed to determine cardiac rate and rhythm, presence of murmurs, and characterization of lung sounds. An electrocardiogram should be performed prior to anesthesia. In addition, it is important to have an accurate body temperature and weight. Temperament of the patient should be evaluated to aid in determination of appropriate pre-medication.

Current pain status should be evaluated and expected pain from the procedure should also be determined. Pain assessment will include an evaluation of behavior, physiologic parameters, and should utilize a pain scoring system prior to administration of analgesics, and after analgesic administration to determine effectiveness of the drug, dose, and route of administration.

Laboratory tests including complete blood cell count, serum biochemistry, and urinalysis should be performed, when indicated. Additional tests, include thoracic and abdominal radiographs, blood typing and cross matching, tests of coagulation should be considered depending on the status of the patients and expected complications.

Based on the physical examination and testing, an ASA status should be determined.

Prior to anesthesia, the patient care team should meet to discuss goals of the procedure and determine criteria to indicate instability sufficient to require abandonment of the procedure.

Equipment/Monitoring Plan
Placement of a Doppler ultrasound probe on a peripheral artery will provide an audible signal and may help to give an early warning of changes in heart rate, rhythm, and blood pressure. The Doppler signal will typically sound quieter with hypotension or severe vasoconstriction.

Evaluation of arterial blood pressure in the critically ill should be performed using invasive blood pressure monitoring. In dogs and cats, placement of a catheter in the dorsal pedal artery will allow monitoring of systolic, diastolic, and mean arterial blood pressures. Additionally, this catheter can be utilized to obtain arterial blood samples for arterial blood gas monitoring intraoperatively, if necessary.

An ECG should be utilized to monitor rhythm from induction through recovery, especially in cases where arrhythmias are present prior to anesthesia.

Pulse oximetry should be utilized to determine oxygen saturation of hemoglobin and can give an indirect indicator of arterial blood gas tensions. A pulse oximeter estimates oxygen saturation of hemoglobin. A pulse oximeter is non-invasive, the information is continuous and in real time. Pulse oximeters are also cost-effective. Oxygen desaturation can occur at any time in an anesthetized patient, and pulse oximeters are useful in patients that are hypoxemic or have diffusion impairments. The pulse oximeter utilizes absorption of light as an indicator of oxygen saturation of hemoglobin. As such, pigmented tissue can be a source of error for pulse oximeters. Pulse oximeters do not function well in times of poor perfusion; often the pulse ox is unable to give a reading. The
monitor also becomes less accurate in low oxygen states and can be affected by patients with severe anemia or dyshemoglobinemias. In small veterinary patients, the pulse oximeter clip can apply pressure to tissues that results in compression and decreased blood flow. A normal oxygen saturation should be above 90%, and ideally greater than 95%. An oxygen saturation of at least 90% indicates an arterial oxygen tension of at least 60 mmHg, but PaO₂ should be confirmed using arterial blood gas analysis.

Following intubation, capnometry should be utilized to determine adequacy of ventilation. A capnograph measures the amount of carbon dioxide in the air that is breathed in and out by the patient. It is non-invasive, the information is continuous, and occurs in near-real time (depending on the equipment, there may be a small lag time). While capnography does not measure blood CO₂ directly, it is well-correlated to blood CO₂ in most small animal patients. Normal values in anesthetized patients for end-tidal CO₂ (EtCO₂) are 40 to 50 mmHg. These values correlated to blood CO₂ values of 45 to 55 mmHg. Capnometers utilize a sensor and computerized monitor. With some capnometers, the sensor is connected between the endotracheal tube and the breathing circuit (mainstream capnography). Other capnometers utilize an adaptor placed between the endotracheal tube and breathing circuit, and use sidestream sampling to remove air from the circuit, which is then analyzed by a monitor. There is a small lag time with side stream capnography. Capnography and evaluation of capnograms can be used to detect problems in anesthetized patients, such as: esophageal intubation, tracheal extubation, apnea, exhausted CO₂ absorbant, hypoventilation, hyperventilation, and rebreathing of CO₂.

It may also be helpful to place an esophageal stethoscope to determine heart rate in severe hypotensive states.

Additional catheters may be placed, including central line catheters, if administration of blood or blood products is anticipated. A central line catheter may also be utilized to monitor central venous pressure to indicate volume status. If a central line catheter is not an option, peripheral catheters may be utilized, remembering that large gauge short catheters allow for more rapid administration of fluids.

A properly checked anesthetic machine, several endotracheal tubes, a laryngoscope, tube ties, tape, eye lube, and anesthetic record should be available prior to the start of the procedure.

If there is concern about regurgitation, active suction should be available prior to induction to aid in the removal of stomach contents from the mouth prior to intubation. The patients need to be intubated quickly by skilled personnel to limit the risk of aspiration.

**Anesthetic Protocol**

Prior to administration of anesthetic drugs, ensure that all equipment needed for anesthesia and the procedure is ready and accessible. Patients should be pre-oxygenated if amenable. Placement of a facemask prior to anesthetic induction will prolong the time to desaturation.

Anesthetic protocols should utilize drugs that are reversible or short-acting, and with minimal effects on the cardiovascular and respiratory systems. In critical patients, drugs that provide profound sedation are rarely required.

Appropriate intravenous fluids should be administered based hydration status, pH, electrolytes, protein levels, colloid osmotic pressure, cardiovascular status, and to maintain a patent IV catheter throughout the procedure. The type of fluid and rate will be determined by these factors and intravenous fluids should be determined on an individual basis.

Monitoring, anticipation of complications based on the surgical/interventional procedure, and response to complications are important for a successful outcome. Emergency drugs should be readily accessible and doses calculated prior to the start of the procedure.

Increasing ASA status, duration of anesthesia, anesthesia outside of normal business hours, are associated with increased anesthetic risk.

**Recovery**

A plan for anesthetic recovery should also be made to determine location and equipment necessary. Oxygen, reversal drugs, emergency drugs, and monitoring equipment should be readily available.