Considerations for patients with cardiovascular disease include drug choice (due to side effects, and direct cardiovascular effects), underlying disease process, concurrent disease processes (systemic hypertension, anemia, fluid overload, electrolyte imbalance), cardiac medications, temperament, age of the patient, reason for anesthesia, duration of procedure, and current or expected pain status. Laboratory tests including complete blood cell count, serum biochemistry, and urinalysis should be performed. Cardiac auscultation, electrocardiogram, and echocardiography should be performed in patients with severe cardiac disease prior to anesthesia. 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.

**Anesthesia for patients with cardiovascular disease**

The choice of anesthetic protocol should be determined based on cardiovascular side effects, as well as other effects of drugs. In most situations, drug choice should aim for maintaining these parameters at their current state whenever possible. Increasing the demands on the heart should be avoided. Based on the physical examination and testing, an ASA status should be determined.

**Sedatives/Tranquilizers**

**Acepromazine**

Acepromazine typically produces mild sedation in small animal patients. Acepromazine causes vasodilation and hypotension, due to alpha-1 blockade. Heart rate usually increases after acepromazine administration. Acepromazine decreases the incidence of catecholamine-induced arrhythmias.

**Alpha-2 agonists**

Alpha-2 agonists typically produce moderate to profound sedation in small animal patients, depending on the dose and route of administration. Alpha-2 agonists can cause profound vasoconstriction in small animal patients. Heart rate often decreased due to a reflex bradycardia as well as a centrally-mediated mechanism.

**Benzodiazepines**

The drugs are often used for muscle relaxation, and may cause sedation in some patients. The effects of benzodiazepines on the cardiovascular and respiratory systems are minimal.

**Anesthetic Induction Drugs**

**Propofol**

Propofol causes potent vasodilation and hypotension. Usually, this is short-lived. Caution should be used when administering propofol to hypotensive or volume-depleted patients. Heart rate usually increases after propofol administration. Propofol causes a dose dependent decrease in myocardial contractility.

**Ketamine**

Ketamine causes indirect cardiovascular stimulation via the sympathetic nervous system, which results in increased mean arterial blood pressure, heart rate, and cardiac output. Ketamine also results in direct myocardial depression, which manifests during hemodynamic shock and related conditions. Finally, ketamine increases myocardial oxygen consumption.

**Etomidate**

Cardiovascular stability is characteristic of induction of anesthesia with etomidate. Etomidate is associated with minimal changes in cardiac output, arterial blood pressure, and heart rate.
Intravenous Fluids
Type of fluid and rate of administration will be dependent on the type of heart disease present. In many cases, judicious use of fluids is recommended.

Monitoring
Heart rate, rhythm, and arterial blood pressure should be monitored in patients with cardiac disease.

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 cardiac patient with severe disease 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 PaO\textsubscript{2} should be confirmed using arterial blood gas analysis.