

Cardiopulmonary Bypass

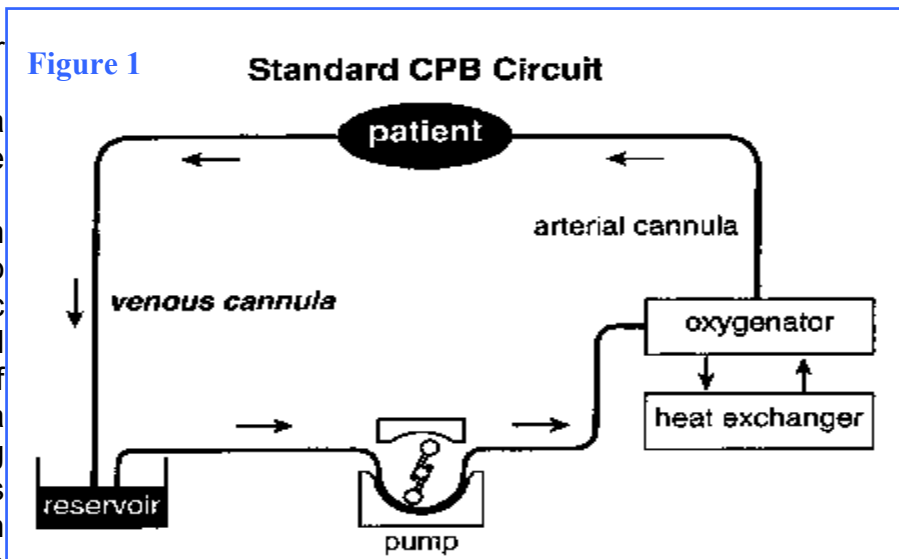
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Cardiopulmonary bypass (CPB) is a method of directing blood away from the heart and lungs while maintaining adequate perfusion of other essential organs such as the brain and kidney. The heart-lung machine allows open-heart surgery to be performed on a still, relatively bloodless heart without the patient suffering from hypoxia. Cardiopulmonary bypass is accomplished by the use of an extracorporeal circuit and pump.

The standard CPB circuit (**Figure 1**) consists of connective tubing, a blood reservoir, oxygenator, heat exchanger, and filter. Venous cannulae placed in the vena cavae or right atrium drain unoxygenated blood by gravity through connective tubing into a blood reservoir. The blood is then pumped to an oxygenator where oxygenation and carbon dioxide removal takes place. Blood temperature may be adjusted by the use of a heat exchanger. Generally, whole body hypothermia is induced while the patient is on CPB. Hypothermia decreases the body's oxygen consumption and allows for lower blood delivery rates. After the surgical correction is performed, the blood temperature can be warmed to a desired level. The blood is filtered to reduce the potential for an embolism and is pumped back to the body through an arterial cannulation. Prior to initiation of CPB, the extracorporeal pump circuit is primed with a balanced crystalloid solution and / or blood. Once CPB has been initiated, the heart is allowed to beat or it may be temporarily arrested by the administration of cardioplegia solution. Cardioplegia is a cold crystalloid or blood solution that contains a high concentration of potassium. The solution may be administered to the coronary vasculature in a normograde fashion through a cannula in the cross-clamped

aorta or retrograde through a cannula in the coronary sinus. The potassium is used to induce cardiac arrest. The cold temperature of the cardioplegia solution along with other drugs in the solution reduces the

oxygen requirements of the myocardium and helps to preserve the heart during the ischemic period.



In 1953, Dr. John Gibbon, Jr performed the first successful human open-heart surgery utilizing CPB. Since then, refinements in circulation technology have allowed CPB to become a common and relatively safe practice. Cardiopulmonary bypass is currently performed in people for coronary artery surgery, repair of congenital heart defects, heart valve repair and replacement, and heart transplantation.

Although experimental studies involving CPB have been performed on animals since the 1930's, the clinical use of CPB in veterinary medicine has developed only recently. Cardiopulmonary bypass requires extensive training in cardiac surgery as well as a qualified perfusionist to run the heart-lung machine. This fact, combined with the expense of specialized equipment, has limited the use of CPB in veterinary medicine. Early attempts at this procedure in veterinary medicine were plagued with high morbidity and mortality; however, recent improvements in circuit and pump technology, surgical technique, and critical care of the CPB patient have reduced complications. Cardiopulmonary bypass has been performed for valve replacement, valve repair, correction of congenital heart defects, and removal of cardiac neoplasia in dogs. A recent study indicates that this procedure may also be performed successfully in cats.

At MedVet we are proud to now offer a team of veterinary and human medical professionals dedicated to providing CPB for animals requiring open-heart surgical repair. Success of this procedure begins with early, accurate diagnosis of various cardiac conditions. The MedVet cardiology and surgery departments work together to offer the best medical and/or surgical options to owners with dogs and cats suffering from cardiac disease. While treatment of cardiac disease in dogs and cats has generally been limited to medical therapy or palliative closed heart surgical techniques, CPB now allow us to perform definitive open-heart surgical correction for a variety of heart conditions.



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