学位論文内容の要旨

博士の専攻分野の名称　博士（医　学）　氏名　飯　島　誠

学位論文題名

A Novel Percutaneous Cardiopulmonary Bypass Support System Combined with a Closed-chamber Type Venous Blood Reservoir for Cardiac unloading during Circulatory Assist.

（閉鎖チャンバー式静脈血リザーバを併用した
経皮的心肺補助装置の左室前負荷軽減に関する研究）

Objective: The use of percutaneous cardiopulmonary bypass support (PCPS) is a device that allows the percutaneous establishment of an extracorporeal circulation from the peripheral arteries and veins without thoracotomy. However, PCPS has several disadvantages in terms of cardiac loading conditions. PCPS does not allow reduction of left ventricular loading, preload and afterload. The reduction of preload or afterload considerably affects myocardial oxygen consumption. We have newly designed a PCPS circuit combined with a closed-chamber type venous blood reservoir which can control the venous blood removal volume for preventing left ventricular distension during circulatory assist for relatively long time. Using this simple circuit, we examined whether we can control the left ventricular preload both at base line and after left ventricular ischemia in 5 pigs.

Methods: The use of animals, 5 cloned Landrace large White Duroc class pigs that were 3.5 months of age was consistent with the US National Institute of Health (NIH Publication No.85-23, revised 1996). PCPS was established by insertion of a perfusion cannula in the thoracic descending aorta and a drainage cannula in the right atrium. These cannulas were connected to a centrifugal pump and a membrane oxygenator. The venous blood reservoir was placed in the middle of the venous blood drainage line. In protocol 1, 15 minutes after introduction of general anesthesia, the venous blood of 100, 200, 400 mL was sequentially removed into the venous blood reservoir. All the blood volume in the venous blood reservoir was then returned to the PCPS circuit, and the left ventricular venting was started. The hemodynamic parameters were recorded at the each time point after the procedures: systolic arterial pressure, mean arterial pressure, left ventricular end-diastolic pressure (LVEDP), left atrial pressure (LAP), and right atrial pressure. In protocol 2, acute left ventricular ischemia was induced by ligation of the left anterior descending coronary artery (LAD). The protocol thereafter was the same as protocol 1.

Results: Compared with the base line, LVEDP and LAP significantly increased after acute left ventricular ischemia by LAD ligation due to reduced left ventricular contractile function. In protocol 1, the effects of the venous blood removal procedures on hemodynamic parameters were not evident. In protocol 2(after acute ischemia), LVEDP (5.1±1.2 v.s.10.4±1.2 mmHg) and LAP (5.6±1.8 v.s.11.4±1.5 mmHg) significantly decreased when the maximum venous blood volume was removed into the venous blood reservoir compared with those after PCPS introduction. All the blood volume in the venous blood reservoir was then returned to the PCPS circuit, and the venting from the left ventricular apex was started at the maximum rate. Fifteen minutes after the left ventricular venting was started, LVEDP and LAP also significantly decreased compared with those after PCPS introduction. No significant difference was found in LVEDP and LAP values between maximum removal of venous blood and left ventricular venting alone.

Conclusions: By adjusting blood removal volume using the venous blood reservoir, we can achieve a significant decrease in left ventricular preload similar to the degree by left ventricular venting alone, which might prevent over-distension of the failed heart.