新しい肺血管抵抗モデル開発のための基礎検討

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Preliminary study for the development of a sophisticated pulmonary vascular resistance model

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The authors have been developing a pulmonary mechanical simulator in order to establish a design parameters of a novel artificial cardiovascular devices. In pulmonary circulation, interactive pressure-flow changes are regulated by pulmonary impedance characteristics. We focused on the native impedance characteristics variation in the pulmonary circulation. To examine the effect of respiratory control on pulmonary resistance, we measured pulmonary arterial pressure and flow in adult goat under the different respiratory settings with open/closed-chest condition. Pulmonary input impedance in two respiratory conditions under the anesthetized open-chest positive pressure ventilation (PPV) and the awake spontaneous respiration (SR) were calculated. Longitudinal impedance at 0 Hz in SR showed lower than in PPV. In order to examine the hemodynamic response for newly designed artificial cardiovascular devices. In pulmonary circulation, interactive pressure-flow changes are regulated by pulmonary impedance characteristics.

血液粘度が溶血指数に与える影響

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the influence of blood viscosity on the normalized index of hemolysis

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Hemolysis test has been used to predict the hemocompatibility of blood pump. However, many factors can influence the results of hemolysis index. Blood viscosity will change by shear stress, and hemolysis induced by shear stress in blood pump. Pump drive condition varies with the change of blood viscosity. Only load condition of pump is prescribed by ASTM and blood viscosity has not been considered. In this study, the influence of blood viscosity on NIH will be investigated. Using fresh porcine blood, which was diluted with dextran 40 and 0.9% saline, we made two kinds of test blood which varied in viscosity at the same hematocrit (Ht). The hemolysis tests were performed in the same load condition using an equivalence pump. In addition, we also made two kinds of test blood which varied in Ht with the same viscosity. The hemolysis tests were performed. When blood viscosity was different, the difference of NIH was observed. In the condition which has the same blood viscosity and load condition, the significant difference was not seen in NIH. From the result, it’s considered that it’s necessary to match blood viscosity, rather than match Ht for the adjustment of blood in hemolysis test.

選択的腎動脈補助用カテーテル式補助循環装置の開発とin vitro評価

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Development and in vitro evaluation of a minimally invasive mechanical circulatory support device for assisting selective renal blood circulation

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The main purpose of this study is to develop a minimally invasive mechanical circulatory support (MCS) device which can perform renal-selective blood perfusion (RSP) with low invasion on ischemic kidney. In this study, we developed a catheter-based miniature blood pump for MCS device and evaluated its hydrodynamic performance. The miniature blood pump consisted of an impeller, a brushless DC motor, a motor housing and a pump casing and ejects the blood by rotating the impeller which was installed inside the pump casing by the brushless DC motor. The miniature blood pump has two outlet ports against one inlet port for assisting both renal arteries at the same time. The diameter and total length of the prototype pump was 9 mm and 37 mm, respectively. The pump performance of the prototype miniature blood pump was assessed by in vitro testing using a mock circulation circuit. A flow rate of 1 L/min for a 30 mm Hg pressure head was achieved at rotational speed of approximately 20,000rpm. The prototype pump displayed sufficient performance for assisting both renal arteries.

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