

DEVELOPMENT OF THE DIAPHRAGM TYPE LEFT VENTRICULAR ASSIST SYSTEM DESIGNED FOR INTRACORPOREAL IMPLANTATION

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We developed an implantable diaphragm type left ventricular assist system (LVAS) for bridge to transplant of rather small body-sized adults. The size of pump, which was made of segmented polyether polyurethane (TM series, Toyobo Co.), was 86 mm in diameter and 50 mm in height, and its nominal stroke volume was 70 ml. A percutaneous drive line was connected with an external pneumatic control drive unit (CDU). For continuous monitoring of pump performance and pump control, a new electrical impedance-based monitoring and control system (Z system) was installed in the CDU. In the Z system, the electrical impedance of the blood pump is actually measured by charging an alternating current with a constant amplitude (50kHz and 0.4mA) between two metal inlet and outlet connectors. Automatic calibration was performed periodically for several seconds while the driving condition was changed to ensure the full-fill state of the blood pump. Chronic animal experiments were performed to evaluate this system using 11 adult goats weighing from 50 to 78 kg. The pump was installed between the LV apex and the descending aorta and was placed in the abdominal wall. Pump output (Op) ranged from 2.5 to 5.8 l/min. Goats showed good physical condition for up to 14 weeks. There was no prominent thromboembolic symptoms without antithrombogenic agent nor signs of infection around the pocket of pump except one. The new Z system functioned exactly and estimated Op was linearly related to Op measured with an electromagnetic flowmeter. The full-fill to full-empty drive was achieved satisfactory by this Z system.

In conclusion, the new Z system is practical and useful for monitoring and control of an implantable pump and this LVAS with the new Z system is promising for clinical use.