Dynamic cardiomyoplasty using latissimus dorsi muscle was previously used to compensate for congestive heart failure. Now however this method is not acceptable because the long term result was not as expected due to fatigue of the skeletal muscle. BioMetal fiber developed by TORK Corporation is one of the artificial muscles moving with electric equipment. This fiber behavior is similar to organic muscle. We made an artificial muscle like latissimus dorsi using BioMetal fiber and tested whether we could use this new muscle as a cardiac supporting device.

Testing one Biometal fiber showed the following performance: practical use maximal generative force was 30gf, exercise variation was 200%, and the standard driving current was 220mA. We made 4cm×12cm tabular artificial muscle using 8 BioMetal fibers as a cardiac support device. We also made a simulation circuit composed of a 6cm×8cm soft bag with unidirectional valves, reservoir and connecting tube. Simulation circuit was filled with water and the soft bag was wrapped by artificial muscle device. After powering the device electrically at 6V with a current of 220mA for each fiber, we measured the inside pressure and observed the movement of the artificial device. The artificial muscle shrank in 0.5 second for peak time and squeezed the soft bag. The peak inside pressure was 10 mmHg.

Although further work will be needed to enhance the speed of deformability and movement simulating contraction, we conclude that artificial muscle may be potentially useful as a cardiac assistance device that can be developed for dynamic cardiomyoplasty.

For clarify the Japanese needs for DT, we analyzed 108 cases of VAD implantation at Saitama medical university. 38 cases (35.2%) were performed VAD treatment longer than 6 months (379.7 ± 203.6 days). 7 cases were bridged to transplantation (BT) or for ABF treatment. Because of severe donor shortage, the duration of BT is getting longer and the recent waiting period is more than 2 years. This duration is nearly reached to Western DT duration. A term “DT” should have different meaning in Japan.

AIM. We investigated hemodynamic effects of intraaortic balloon pumping (IABP) upon graft flow in coronary surgery, especially in comparison between in-situ and aortocoronary grafts.

METHODS. One hundred sixty-seven patent grafts, including 83 internal thoracic arteries (LITAs), were examined intra-operatively with a transit-time flowmeter in 84 patients who underwent CABG with assist of prophylactic IABP. The following parameters were obtained for each graft during off-IABP and on-IABP; mean flow (Qm), maximal flow (Max), pulsatility index (PI), insufficiency rate (%INS), and diastolic filling index (DFI=100/Qd/[1/|Qs|+1/|Qd|]). Coronary angiograms were performed 14±3 days after CABG to verify the patency of the grafts.

RESULTS. All parameters significantly changed according to off-IABP and on-IABP. Qm 46±27→51±29 ml/min, Max: 87±52→121±69 ml/min, PI: 2.2±1.4→5.1±1.4, %INS: 17±3.9→3.5±4.5%, DFI: 64±8→71±9%. Among them, the parameters which were significantly different between the in-situ LITAs and aortocoronary grafts were Qm, Qs, Qd, %INS and DFI (p<0.05).

CONCLUSIONS. IABP assist increased flows of the in-situ LITA onto the left anterior descending artery significantly more than those of the aortocoronary grafts anastomosed with other coronary arteries. Not only for usual DT cases, but also for BT cases, we should be better to treat as our patient with high QOL using implantable VAD.
Microembolic signals (MES) by transtracral doppler have been reported to reflect microemboli in the cerebral artery. During left ventricular assist devices (LVAD) supporting, in order to prevent cerebral and the other organs' complications, the evaluation of MES by transtracral doppler can be useful and important. We performed the frequency analysis in MES, depending upon whether the frequency is no less than or less than 400 Hz and tried to examine the concern about function of organs. MES were recorded at 7 points (14 points before and during oxygen inspiration) in 3 cases with LVAD-Toyobo LVAS, Japan. The high frequency counts in MES were greater than the low frequency counts (n = 7 vs. 7, p = 0.025), and declined further with oxygen delivery. In the high frequency, the counts were greater after 1 postoperative month (POM) than before 1 POM (n = 3 vs. 4, p < 0.001). During this study, postoperative states were uneventful and laboratory findings were almost unchanged in the cases. In conclusion, the main MES in LVAD cases may be the high frequency signals and reveal air microemboli originated from LVAD, the counts might increase with time and which might imply non-symptomatic injury.

**Objective**

To evaluate the clinical outcomes of Toyobo LVAS and to elucidate the reason for recent improvement.

**Patients and methods**

Fifty-five patients who received LVAS treatment with Toyobo system in our institute were divided into 2 groups by the date of implantation; Group1, 1992-2001 (n = 26), Group 2, 2002-2007 (n = 29). Clinical outcomes were compared.

**Results**

In Group 1, only 2 patients survived to heart transplantation. The longest duration of the Toyobo LVAS support was 465 days. In Group 2, 1 patient underwent heart transplantation, 6 patients underwent LVAS removal, and 7 patients are now on going. The longest duration of the LVAS support was 1506 days and the patient is still waiting for heart transplantation on LVAS.

**Conclusion**

There was no increase in the number of patients who received heart transplantation. However, recovery of heart function, which was never achieved in Group 1, was achieved and LVAS was removed in 6 patients in Group 2. The reason for improvement in patient survival may be, in addition to improvements in surgical techniques and postoperative management, the recent application of strategies of "bridge to recovery".
P2-016  Simplified selective cerebral perfusion and systemic circulation with one pump in aortic arch surgery

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Background: In aortic arch surgery, two pumps are generally used for systemic perfusion and selective cerebral perfusion (SCP). We developed a new simplified technique with one centrifugal pump for systemic perfusion and SCP.

Materials: Consecutive 13 patients with true aneurysm (7 patients) or aortic dissection (6 patients) underwent total arch replacement from January 2006 to April 2007.

Methods: CPB was established by cannulating the ascending aorta or the right auxiliary artery. Distal anastomosis was performed using elephant trunk with blader temperature of 25-26°C. The cerebral perfusion lines were branched from the main perfusion line, and the brain was perfused through all the arch vessels. Bilateral noninvasive cerebral oxygen saturations (rSO2) (INVOS100), right radial arterial pressure (RAP), left common carotid arterial pressure (CAP), and femoral arterial pressure (FAP) were monitored.

Results: CPB time was 203 ± 42 min, aortic cross-clamp time was 126 ± 43 min, SCP time was 142 ± 37 min, and circulatory arrest time for lower body was 67 ± 19 min. At the beginning of SCP, flow rate was 0.58 ± 0.22 l/min, RAP was 46 ± 14 mmHg, CAP was 58 ± 12 mmHg, and rSO2 was 64 ± 13%. At the beginning of rewarming during SCP, flow rate was 2.38 ± 0.26 l/min, RAP was 47 ± 16 mmHg, CAP was 58 ± 10 mmHg, FAP was 71 ± 12 mmHg, and rSO2 was 59 ± 13%. There were two operative deaths (15%) due to pneumonia and bleeding from the left lung. Stroke occurred in 1 patient (8%).

Conclusions: This simple circuit system can be easily and safely applied to aortic arch surgery.

P2-017  DELAYED RECOVERY FROM LYMPHOCYTOPENIA AFTER VALVULAR SURGERY IN HEMODIALYSIS PATIENTS

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Background: Cardiac surgeries with cardiopulmonary bypass (CPB) suppress cell-mediated immunity and it may be amplified in hemodialysis (HD) patients. Apoptosis of the circulatory lymphocytes are induced by cardiac surgery and decreases in circulatory lymphocytes correlate with greater degrees of surgical damage. In this study, the pattern of recovery from lymphocytopenia in HD patients undergoing valvular surgery was retrospectively evaluated in comparison with non-HD patients.

Methods: To compare the recovery pattern from lymphocytopenia between HD and non-HD patients, we reviewed 6 HD and 60 non-HD patients undergoing cardiac surgery. Blood samples were obtained before surgery, end surgery, 6 and 12 hrs after surgery, on 1, 5, 10 days after surgery.

Results: Agarose gel electrophoresis in peripheral lymphocyte indicated the DNA ladder fragmentations, CD4+ T cells were induced by cardiac surgery and decreases in circulatory lymphocytes correlate with greater degrees of surgical damage. Two-color flow cytometry (CD4+, CD6+) showed that CD4+ lymphocytes, which indicate helper T cells, demonstrately decrease after surgery.

Conclusions: These results suggest that cell-mediated immunity is severely impaired resulting in decreased lymphocytes in HD patients. These conditions are at a greater risk such as infection. Careful pre- and post-operative care is mandatory.

P2-018  SUCCESSFUL USE OF THE ADULT-SIZED LEFT VENTRICULAR ASSIST DEVICE IN 5 CHILDREN

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In Japan, although pediatric heart transplantation (HTx) has not been legal, left ventricular assist device designed for pediatric patients are not clinically available. Between 2004 and 2007, we managed 5 cases of end-stage heart failure under 15-years-old children who received implantation with an adult-sized Toshiba-NCC LVAS in our institution. Case1: 10-years-old boy, BW 24kg: After implantation of LVAS, multiple organ failure were rapidly improved. Device-related brain stroke during waiting period determined this case out of indication for HTx. He survived 697 days after implantation of LVAS(Case 2:4-years-old girl, BW 38.6kg(BSA1.31m²)): After implantation, clinical course was uneventful with almost same LVAS setting as adult. HTx was revealed 7 months after transportation to United States. Case 3: 6-years-old girl, BW 16.4kg(BSA1.72 m²): After implantation, initial LVAS pump rate was set for 105 bpm without full-filling of mechanical chamber. Device-related brain stroke were observed 10 days after implantation. LVAS pump rate was reduced to 50 bpm with full-filling full-empty mode with large dose vasodilators. HTx was revealed in United States(Case 4: 11-years-old boy, BW 35kg(BSA1.48 m²)): LVAS was implanted after cardiac arrest due to critical myocarditis. HTx was revealed 11 month after transportation to United States. Case 5: 3-years-old girl, BW 16.2kg(BSA0.66 m²): After implantation, initial LVAS pump rate was set for 46 bpm with full-filling full-empty mode with vasodilators. HTx was revealed 8 month after transportation to Germany without device-related stroke.

Conclusions: In all of 5 cases overseas transportation after implantation of LVAS was possible, and 4 cases were revealed HTx. All of children over BW 20kg were successfully treated. We also succeeded clinical use of adult-sized LVAS for children under BW 20kg, with low pump rate and full-filling full-empty mode with vasodilators. However, use of adult-sized LVAS for small children associates non-physiological bradycardia and hypertension. We expect regal permission for clinical use of the LVAS designed for pediatric patients, in Japan.

P2-019  PERFORMANCE OF A PARACORPOREAL PULSATILE VAD FOR PEDIATRIC PATIENTS

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Background: Recent clinical results obtained with the use of pulsatile ventricular assist devices in pediatric patients suggest their usefulness for moderate to long-term circulatory support. We present the dynamic performance and particle image velocimetry studies performed on a pulsatile VAD designed for paracorporeal implantation in pediatric patients.

Methods: The VAD pump is designed to yield an ejection volume of 30 ml using a flexible pneumatic chamber, flow-cycling or full-to-empty modes. Pump operation was evaluated on a mock circulatory loop in full-to-empty mode at pre-loads varying from zero to 18 mm Hg and 100 mm Hg after-load. Phase-locked particle image velocity (PIV) with high resolution (0.08 mm/vecor) was used to visualize the flow within the pump operating at frequencies of 80, 100 and 120 bpm.

Results: The pump flow obtained varied from 1.6 l/min up to 3.4 l/min at 80 bpm. The pump's blood flow was found to be turbulent in the bulk flow and cycle-to-cycle variability in the instantaneous velocity distributions in the filling phase. These results suggest that the pediatric VAD has adequate hydrodynamic characteristics. Further PIV studies may help in the implementation of design modifications and improve performance.