

Successful Restoration of Function of Frozen/Thawed Isolated Rat Hearts

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Introduction Long-term organ preservation for transplantation may allow optimal donor-recipient matching with potential reduction in the incidence and severity of rejection. Complete cessation of metabolism may be obtained by freezing. Previous attempts to freeze intact mammalian hearts were limited to -3.6°C , restricting tissue ice content to 34%. We hypothesized that our freezing method will allow recovery of function of the intact rat heart after freezing to -8°C , a temperature at which most of the tissue water is frozen. **Methods** Isolated rat hearts were attached to a Langendorff apparatus. After normothermic perfusion, cold cardioplegia was induced followed by perfusion with a cryoprotecting agent. Hearts were then frozen to -8°C ; thawed, and reperfused for 1hr. Recovery was tested by means of haemodynamic parameters, ATP and phosphocreatine content and electron microscopy scanning. **Results** All frozen/thawed hearts regained normal electric activity. At -8°C , ice content was over 64%. The hearts maintained over 80% viability although energy stores, as represented by ATP and phosphocreatine were depleted compared to the control hearts. Integrity of muscle fibers and intracellular organelles after thawing and reperfusion, as demonstrated by electron microscopy, was maintained. **Conclusion** We demonstrate for the first time, the feasibility of functional recovery following freezing and thawing of the isolated rat heart while maintaining structural integrity and viability.

Repair of Ischemic Mitral Regurgitation: Comparison Between Flexible and Rigid Annuloplasty Rings

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Introduction: The surgical treatment of ischemic mitral valve regurgitation (IMR) usually involves implantation of an annuloplasty ring. We compared results of mitral valve repair using a flexible or a rigid annuloplasty ring in patients with IMR undergoing coronary artery bypass grafting (CABG) and mitral valve repair.

Methods: One hundred and seventy patients underwent CABG with mitral valve annuloplasty. A flexible ring was implanted in 118 and a rigid ring in 52. Age and clinical profile, degree of left ventricular dysfunction and degree of MR (mean 3.2) were similar between both groups.

Results: Operative mortality was 9% in each group. Late follow-up (58+30 months for flexible and 14+7 months for rigid groups) was available in 88%. For the flexible and rigid ring group respectively: mean NYHA class was 1.9 and 1.6, with 33% and 14% in NYHA class III-IV (p=0.03). There was no difference in LV function or dimensions. Mean MR grade was 1.3 and 0.7 respectively for flexible and rigid ring groups (p=0.006). At late follow-up, 29 patients (34%) in the flexible group had residual MR of moderate degree or greater compared with 6 (15%) in the rigid group (p=0.03). TI gradient was 39 and 34 mmHg (p=ns), however the degree of reduction was greater in the rigid group (p<0.001). Late mortality was observed in 33 patients, all in the flexible group.

Conclusions: Clinical and hemodynamic results are better with rigid mitral annuloplasty rings compared to flexible rings. This may be due to ring design which dictates not only the annular diameter, but also annular configuration. Longer follow-up is needed to determine differences in survival.

Multiple Arterial Revascularization Using the Tangential K-Graft Technique

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BACKGROUND: Complete arterial revascularization of the left ventricle with two conduits can be achieved even in triple vessel disease, using a T-configuration. However, kinks, tension and technical errors in constructing this end-to-side anastomosis can jeopardize the entire revascularization. Hypoperfusion and ignored diagonal branches are also troublesome. The tangential K-graft composite technique attempts to resolve these issues. We present our new surgical technique - Tangential (K-graft) and its intermediate clinical and physiological outcome.

METHODS: From July 2002 to September 2007, 194 consecutive patients underwent multiple arterial grafting using the Tangential K-graft technique. One end of the free graft is anastomosed end-to-side, the other sequential side-to-side anastomoses are constructed parallel to the coronary artery, and the other end of the free arterial conduit is anastomosed end-to-side to a diagonal or intermediate branch. After the left internal thoracic artery (LITA) is attached to the left anterior descending artery (LAD), a wide-open side-to-side free right ITA or radial artery (RA) to LITA anastomosis - resembling the letter "K" - is constructed.

RESULTS: Mean age was 66 (range 31 to 81). 74 patients (38%) were older than 70, 70 patients (36%) suffered from diabetes mellitus. 17 (8.8%) cases were emergent. Left ventricle ejection fraction (EF) ranged from 18% to 72% (mean $52 \pm 13\%$). The number of distal anastomoses of the left ventricle per patient was averaged 3.9(mean). In 167patients (86 %) both IMA's and in 27 patients (17%) any IMA and RA were used. 15 patients (7.7%) were undergoing first-time reoperation. Eighteen patients (8.7%) were operated on by off-pump coronary arteries bypass (OPCAB) technique. Cross-clamp was 79 ± 13 minutes, and bypass time was 98 ± 16 minutes. Operative mortality was 1.55% (n=3). There was 1.55% (n=3) perioperative myocardial infarction, and one patient (0.79%) sustained permanent stroke. Deep sternal wound infection occurred in 4 patients (2 %) and six (3%) had superficial wound infections. During the follow-up in 27 arbitrary patients studied early postoperatively no of them had recurrent angina or intervention. Newly released 64-slice multidetector CT scanner verified patency in all 27 patients.

CONCLUSIONS: The K-grafting technique was found to be safe, and has the potential of increasing the ease and versatility with which the surgeon can perform total grafting to the left system using only two arterial conduits.

Neontal Brain Protection Using Innominate Artery Cannulation for Continuous Brain Perfusion in Complex Aortic Arch Repairs

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Introduction: Traditionally, deep hypothermic circulatory arrest has been used when complex neonatal arch surgery was performed. Recently, the use of antegrade cerebral perfusion (ACP) has been advocated as means of brain protection. Two basic techniques have been used; either suturing a gortex shunt to the innominate artery, or direct cannulation of the ascending aorta with sliding of the cannula to the innominate artery when ACP is performed. Both techniques require additional surgical maneuvers to complete. For the last year we have been using direct innominate artery cannulation when ACP is performed.

Materials and Methods: During 2007, 6 neonates [Norwood (3), IAA VSD (2), severe coarctation (1)], and 1 child [intracardiac Willms tumor] underwent complex arch surgery using innominate artery cannulation and ACP. Median age was 1 week (range- 1week-3.5yrs), median weight was 3 kg (range 2.4-12kg). Innominate artery cannulation was accomplished using 8 french modified cannula inserted 3 mm into the innominate artery and directed into the ascending aorta enabling 200cc/kg flow. CPB times: mean 176±66 min, median 221 and ranges were 104-268 minutes. ACP times: mean 49±27 minutes, median 40 minutes, range 26-84 minutes.

Results: All patients survived the operation without neurologic damage, there were no clinical seizures. Innominate artery cannulation accommodated appropriate flows and de-cannulation was performed without complications.

Conclusion: Innominate artery cannulation and ACP is a safe and effective technique for brain protection in neonates and infants undergoing complex arch surgery.

Phrenic Nerve Paralysis after Pediatric Cardiac Surgery: Role of Diaphragmatic Plication

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Background: Diaphragmatic paralysis complicating cardiac surgery in children continues to occur with significant impact on morbidity.

Methods: From 2003 to 2007 our institution screened pediatric patients for phrenic nerve paralysis (PNP) following cardiac surgery. The diagnosis was suspected if difficulty was experienced in weaning the patient from the ventilator with respiratory failure. PNP was established by ultrasound screening of the diaphragm together with chest x-ray. Indications for placcation were reintubation, failure to wean from ventilator, recurrent lung infection and persistent respiratory distress. Abnormal elevation of the hemidiaphragm was present in eight patients and a modified technique of transthoracic diaphragmatic plication was performed. Echocardiography was used to assess subsequent return of diaphragmatic function.

Results: Median age at diaphragmatic placcation was 10.6 months. Median time from cardiac surgery to surgical placcation was 12 days. Incidences of PNP were observed after Blalock-Taussig shunt, Fontan procedure, repair of coarctation and arterial switch. There were no deaths. All patients after placcation were weaned from ventilation. Position of plicated diaphragm was normal in all patients.

Conclusion: Our method of transthoracic diaphragmatic placcation is a simple and effective means of treatment for PNP and effectively reduced the duration of ventilation, morbidity and ICU stay.

Ligation of Patent Ductus Arteriosus for Premature Infants in the Intensive Care Units in the North of Israel

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Purpose: Patent ductus arteriosus (PDA) is common in preterm babies and persists in 15% to 80% of infants, depending on the gestational age and birth weight. The purpose was to review the results of ligation of patent ductus arteriosus in premature babies in an intensive care unit in the North of Israel.

Method: Retrospective review of premature babies who underwent ligation of patent ductus arteriosus in the intensive care units (Carmel Hospital, Bnai Zion Hospital, Ha'emek Medical Center, Western Galilee Hospital) during the period from December, 1984 to August, 2006.

Results: A total of 72 premature babies were recruited. 44 male and 28 female babies with a mean gestation of 25.7 weeks (ranged from 24 to 30 weeks) and a mean birth weight of 835 grams (ranged from 625 to 2650 gram) underwent ligation of patent ductus arteriosus via a left thoracotomy in the intensive units. The mean body weight at the time of operation was 1154 grams with a range of 570 to 3010 grams. The indications were respiratory failure and congestive heart failure. The babies were from 4 different hospitals. All except 18 babies had a trial of indomethacin induction for closure of patent ductus arteriosus (18 infants were operated before era of indomethacin treatment). The mean ductal size was 3 mm with a range of 2 to 5 mm. Until 1991 in-hospital-mortality in premature infants that underwent PDA closure was very high and reached 85% because lack of experience and technologies in treatment of this kind of patients. After 1991 only one patient died. There was no operative-mortality. Blood loss was minimal and there was no empyema or wound dehiscence. In two patients the operation was discontinued after exposure and recognition of additional congenital pathology.

Conclusion: Ligation of patent ductus arteriosus in the intensive units is safe and effective procedure. Risks, including hypothermia, encountered during transfer of preterm infants to the operating theatre can be avoided when patent ductus arteriosus is ligated in the intensive unit.