



Selected Abstracts

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A PILOT STUDY ON THE EFFECT OF TREATMENT OF CARDIOTOMY BLOOD ON SYSTEMIC VASCULAR RESISTANCE DURING CARDIOPULMONARY BYPASS.

Background: Cardiotomy suction is seen by some as the weak link in blood handling during Cardiopulmonary Bypass and is known for its deleterious effects on formed and unformed blood components. A fall in systemic vascular resistance (SVR) was noted when a bolus of blood aspirated from the aortic root was collected into a cardiotomy reservoir, and added to the systemic circulation. This effect was investigated and quantified. Furthermore the effect of treatment of this blood on the fall in SVR was also examined.

Methods: In 10 patients, blood aspirated from the aortic root vent, was collected and added to the systemic circulation in the normal manner or processed with one of the following, cell washer, haemoconcentrator, leucodepleting filter and cell washer and leucodepleting filter and then returned to the circulation.

Results: Mean fall in SVR associated with the routine method was 134 dyne.s.cm-5 (12%, $p < 0.0001$). Treatment with the haemoconcentrator reduced the fall to 42 (4.7%, $p < 0.05$). The fall associated with treatment of the aspirated blood with the cell washer (181 dyne.s.cm-5, 16.5%, $p < 0.1$), cell washer and leucodepletion (275 dyne.s.cm-5, 25%, $p < 0.001$), and leucodepletion (363 dyne.s.cm-5, 30%, $p < 0.0001$) all exacerbated the response.

Conclusions: There is a mean reduction in SVR of 12% associated with the bolus addition of cardiotomy blood. The processing of the blood with a cell washer does not blunt the response seen. The response is greater when the blood is processed with a leucodepleting filter, (with or without the concurrent use of a cell washer). The routine use of the cell washer to process cardiotomy blood is questionable though further investigation is necessary. The action of the RS1 on blood also needs further investigation.

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PUMP INDUCED HAEMOLYSIS: A COMPARISON OF SHORT TERM VENTRICULAR ASSIST DEVICES.

The Royal Children’s Hospital have utilised the centrifugal pump as a short term Ventricular assist Device (VAD) for 75 procedures since May 1989. During this period the average duration of support has been 79 hours. The majority of these procedures were performed using the Biomedicus (BP) BP50 and BP80 constrained vortex centrifugal pump but recently we have also used the Jostra Rota Flow (JRF) shrouded impeller centrifugal pump.

To assess the suitability of the JRF for our VAD program we performed an invitro evaluation of the JRF and compared it to the BP50 and a standard Cobe roller pump (RP). The chosen indicator of pump performance was changes in Plasma Free Haemoglobin (Fhb) levels. We constructed similar circuits for each of the three pumps simulating VAD conditions with respect to pressure, flow and duration of support, and then subjected each circuit to a predetermined set of stress conditions. Fresh human blood was recirculated through the circuit and blood samples to measure Fhb taken at regular intervals. At the end of each trial period a new circuit was constructed for each of the three pumps and new stress conditions set. In the first trial heparinised blood was used with circuit inlet pressure set at -15mmHg and outlet pressure at +110mmHg over a 66 hour trial time. In the second trial heparinised blood was used with pressure conditions of -40mmHg and +150mmHg over a 93 hour period. In the third trial citrated blood was used with pressure conditions of -40mmHg and +150mmHg over a 159 hour period. Results for the Normalised Index of Haemolysis (grams of free Hb per 100 litres of blood pumped) for each of the three trials are summarised as follows. Data is presented as Median (lower and upper 95% confidence interval)

	RotaFlow	Biomedicus	Roller Pump	P Value
Trial 1	0.0112 (0.0053–0.0662)	0.0216 (0.0054–0.0654)	0.0161 (0.0084–0.0746)	0.8251
Trial 2	0.0099 (0.0085–0.013)	0.011 (0.0060–0.0213)	0.0114 (0.0081–0.0163)	0.8431
Trial 3	0.0036 (0.0024–0.0051)	0.0044 (0.0037–0.0010)	0.021 (0.0091–0.0307)	0.0001

In this preliminary study we have found the JRF to be equal or superior to the BP and RP under each of the three trail conditions in terms of blood handling as indicated by changes in Fhb and Normalised Indices of Haemolysis.

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CORRELATION BETWEEN BLOOD HEPARIN CONCENTRATION AND THE ACT DURING CPB

Blood heparin levels during cardiopulmonary bypass (CPB) have been traditionally measured indirectly via the activated clotting time (ACT) in our institution. The aim of this study was to determine whether the ACT (Medtronic HemoTec, MN, USA) correlated to actual measured blood heparin concentration levels during CPB, using the protamine titration method (Medtronic Hepcon HMS, MN, USA).

Only patients (N=9) undergoing primary coronary artery bypass surgery and who had normal haematological and biochemical parameters were selected for the study. All patients received an initial loading dose of 3 mg/kg of porcine mucous heparin prior to the initialisation of CPB plus 50 mg in the prime.

The blood heparin concentration as measured by the Hepcon was as follows: 2.8 mg/kg at 5 min post heparin administration, 2.1 mg/kg at 20 min of CPB and 1.9 mg/kg at 90 min of CPB.

The respective ACT as measured by the kaolin HemoTec was as follows: 598 s at 5 min post heparin administration, 662 s at 20 min of CPB and 523 s at 90 min of CPB. Three patients required extra heparin during CPB to maintain an ACT above 480 s.

The correlation coefficient (Spearman Rank) between blood heparin concentration and the ACT was 0.613.

The results of this study suggest that there is only a reasonable agreement between blood heparin concentration and the ACT.

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DYNAMIC TESTING OF VENOUS PERFUSION CANNULAE FOR PAEDIATRICS

Adequate venous drainage has been a continuous problem for paediatric perfusionists and surgeons over the last few decades. Although cannula manufacturers give impressive graphs of blood flow versus venous pressure, most are reluctant to suggest the maximum flow characteristics of individual cannula, suggesting that it is the perfusionist's decision. Manufacturers' flow data is difficult to interpret as the test methods vary from one company to another.

This study sets explicit guidelines for choosing the correct cannula size by using the potential height between the patient and the oxygenator and the length and diameter of the venous return line.

Flow studies were carried out using both single and dual cannulae using blood with a haematocrit of approximately 25% at 25°Celsius temperature on 1/4" and 3/8" venous tubing. The initial tests were simple "drop tests" to measure the maximum flow that could be obtained by the combination of siphon and gravity drainage.

The extrapolation of test results shows the expected flow rates of each size of cannula. This test result is more realistic because of the similarity of the bypass conditions used and a good reference for accurate cannulae size selection.

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PULSATILE PERFUSION AND OTHER STRATEGIES FOR CPB IN PREGNANCY: A CASE REPORT

A 25 yr old female weighing 54.5 Kg (BSA 1.58 m²) was urgently transferred from a regional hospital with critical mitral stenosis (valve area 0.75cm² on echo) in the context of 17 weeks pregnancy. She was in pulmonary oedema and treated with intravenous diuretic and required open mitral commissurotomy.

The additional physiological stress of pregnancy on the cardiovascular system causes significant maternal mortality in the presence of cardiovascular disease. Cardiopulmonary bypass in the gravid patient carries variable risk to both mother and foetus. There is an absence of controlled studies into the effects of CPB on foetal physiology and outcome most likely due to the small numbers of such procedures in any given institution. Recent reviews of maternal and foetal outcome since the first reported use of CPB in a pregnant patient demonstrate a maternal mortality suggested being similar for a particular operation to that for nonpregnant women. However foetal mortality remains a significant risk following CPB and foetal outcome does not appear to be dependent on particular factor (e.g. temperature) of complex perioperative management. Foetal mortality was highest in aortic and mitral valve replacement and delivery by caesarean section pre CPB has been advocated after the middle of the 3rd trimester.

Strategies for CPB during pregnancy are based on the principles for such patients requiring any type of surgery namely maternal safety, avoidance of teratogenic drugs, avoiding intrauterine asphyxia and prevention of pre-term labour. Of importance is patient positioning, maternal and foetal monitoring, CPB blood flow, temperature and management of blood pressure, oxygen delivery and anaesthetic and cardiovascular drugs. The relationship of maternal mean arterial blood pressure (MAP) to uterine blood flow (UBF) uterine vascular resistance (UVR) and the absence carbon dioxide effect, oxygen gas tension effect and autoregulation of UBF increase the necessity for thoughtful management of MAP during CPB. Hypotension associated with commencement of bypass will additionally influence circuit prime and technique of instituting CPB. Vasopressor drugs should be used sparingly and not impede UBF and as most vasodilators cross the placental barrier, short acting titratable vasodilators are preferred.

Decrement in FHR has been noted following commencement of CPB and after aortic cross clamping and then normalises immediately after cessation of CPB. Flattened nonpulsatile blood velocity waveform patterns in the main uterine artery during CPB have been demonstrated to be associated with a dramatic decrease in FHR from 120 to as low as 37 bpm, both of which were only restored in the post CPB period. The use of pulsatile perfusion has been shown to attenuate prostoglandin-mediated increase in placental vascular resistance in sheep and was successfully used in an 11 week pregnant 25 year old requiring complex aortic valve and ascending aortic replacement.

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3½ HOURS AT 18 DEGREES CELSIUS WITH CIRCULATORY ARREST: A CASE REPORT

A man with several known, as well as several unknown, heart abnormalities presented for surgery. Deep hypothermic circulatory arrest was anticipated. Due to anomalies found intra-operatively, the patient spent 3½ hours at 18 degrees Celsius and we changed venous cannulation twice during CPB. Circulatory arrest time was a relatively short 31 minutes.

Our techniques included very slow cooling with a small gradient, High-dose Aprotinin, high dose Heparin, retrograde cerebral perfusion, cerebral oxygen saturation monitoring, slow rewarming with a small gradient, extended warm time on CPB and a cocktail of drugs including mannitol and protein in the prime.

The patient bled a total 801mls, was discharged from ICU inside of 24 hours and was discharged from hospital on day six. The patient suffered no detected cerebral deficit.

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HYPOXIC HYPERTHERMIC ISOLATED LIMB PERFUSION

Traditional isolated limb perfusion protocols have been streamlined and the oxygenator eliminated from the circuit resulting in a hypoxic hyperthermic isolated limb perfusion therapy for recurrent malignant melanoma. By using percutaneously inserted perfusion catheters vascular surgery is avoided and the melphalan hydrochloride can be administered almost directly to the tumour site. Melphalan has been shown to be most effective at mild hyperthermia, and it has improved action on hypoxic tumour tissue. Regional anaesthesia can be utilised and blood transfusion is not required for this procedure. This approach has reduced the complexity, expense, and time requirements of traditional isolated limb perfusion while providing comparable clinical outcomes.

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NEUROPSYCHOLOGICAL AND BIOCHEMICAL OUTCOMES IN OFF PUMP CORONARY ARTERY BYPASS SURGERY.

The recent advent of new technologies for the performance of beating heart surgery has revitalised the interest in performing coronary artery bypass graft surgery without the use of cardiopulmonary bypass (CPB). The aim of this study was to determine in a prospective randomised patient group, whether coronary artery bypass graft (CABG) surgery performed utilising the Octopus II™ stabilising system provides myocardial and cerebral protection comparable to traditional CABG surgery utilising cardiopulmonary bypass (CPB).

Thirty-one elective patients, requiring surgery for double or triple vessel disease were randomised to receive either conventional CABG with CPB (n=17) or OPCAB using the Octopus II™ stabilising system (n=14), after receiving institutional approval and written consent. Exclusion criteria included previous cardiac surgery, recent myocardial infarction, and previous cerebrovascular disease. Troponin T (TnT) was measured preoperatively, and at 2, 4, 6, 8, 10, 12, 24, and 72 hours after initiation of grafting. Neuropsychological assessments (10 measures) were performed in the week prior to surgery, one week, and 6 months after surgery.

Troponin T release was reduced in the OPCAB patients at all time points (repeated measures ANOVA $p=0.05$). Other factors (composite clinical end point (prolonged LOS or ICU stay or 30d mortality), infarction, and intubation time) did not show any significant differences between the two groups. The incidence of neuropsychological deficits was not different between the two groups at both 7 day and 6 month follow-up assessments.

In conclusion OPCAB surgery utilising the Octopus II™ system clearly provides a myocardial benefit as assessed by TnT release. A neuropsychological benefit can not be demonstrated at this time.

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