15th European Conference on Perfusion Education and Training

Saturday, 3rd October 2015
0900 - 1730
Amsterdam, The Netherlands

Forum Room, ground level
RAI Conference Centre

Strategies in Adult & Pediatric Perfusion
The European Board of Cardiovascular Perfusion

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EBCP Delegate
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"The Proper Delivery Pressure for Cardioplegic Solution in Neonatal Cardiac Surgery- An Investigation of Biochemical and Structural Properties in Neonatal and Adult Coronary Arteries"

N. Sikora¹,³, A. Lacis¹, E. Ligere¹, V. Ozolins¹, L. Smits¹, V. Kasyanov²
¹Children’s University Hospital, Clinic for Pediatric Cardiology & Cardiac Surgery
²Biochemical Laboratory of Riga Stradins University, Riga, Latvia
³Department of Surgery, Riga Stradins University, Riga, Latvia

Introduction: One of the most important issues in pediatric cardiac surgery is myocardial protection. When cardioplegic solution is injected into coronary arteries with a pump in order to ensure myocardial protection, it is necessary to determine the correct delivery pressure to avoid damage of the heart. Neonates have many structural, functional, biomechanic and metabolic differences from adults, therefore it is crucial to give cardioplegic solution with an adequate delivery pressure. If it is too low or too high, it can lead to severe damage of the coronary artery wall and immature myocardium.

Methods: To assess the right delivery pressure of cardioplegic solution, we investigated twelve coronary artery specimens without cardiac pathology retrieved from autopsies of neonates 9.3 ± 9.7 days old and weight 3.99 ± 0.7 kg, and compared them to seven adult specimens with no detected atherosclerosis. Specimens were pressurized from 0 to 200 mmHg with the step of 20 mmHg, while maintaining the length of the sample in situ. Structural damages were investigated afterwards with light microscopy and immunohistochemistry.

Results: There was a rapid increase of strain until the inner pressure reached 80 – 100 mmHg whilst the increase of stress in the wall of neonatal coronary arteries was less rapid. When the internal pressure exceeds 100 mmHg, the strain of the arterial wall increases much slower but at the same time the wall stress and modulus of elasticity begin to increase rapidly. It means that the structural elements of the arterial wall have been straightened and possible damage in the wall of coronary arteries of neonates may appear. These results were compared with biomechanical properties of arterial wall of adults and differences had been found. Morphologic examination of tensile properties revealed prominent affection of the vascular wall of neonates with accentuated redistribution (loosening) of medial myocytes and adventitial vasa vasorum. There appear to be damage in the wall of neonatal coronary artery after being pressurized with the inner pressure of over than 100 mmHg.

Conclusions: Our experimental results show that the delivery pressure of the cardioplegic solution in neonatal coronary arteries should not exceed 100 mmHg. A raised inner pressure applied to cardioplegic solution injected into coronary arteries of neonates may increase the risk of structural damage of the vascular wall leading to the injury of
myocardium.

References
«Efficacy of Minimized Circuits on Cardiopulmonary bypass in Pediatric Cardiac Surgery»

Kivanç Metin, Baran Ugurlu, Nuran Ay Dereli, Tugra Gençpinar, Fikret Maltepe
Mustafa Kir, Nurettin Ünal

1Department of Cardiovascular Surgery
2Department of Anesthesiology
3Department of Pediatric Cardiology

Objective:
Excessive hemodilution during cardiopulmonary bypass is associated with higher mortality rates in cardiac surgery. Lowering of priming volume of the pump circuit can limit the extent of hemodilution and prevents homologous blood usage. There is an inequality between the blood volume of pediatric patients and priming volume of the commonly used pump circuits. Additional blood is almost always necessary in many infant cases. Infusions from the anesthetic site are another important issue, which is mostly beyond the control of the surgical team. All those and other factors are predicting homologous blood transfusion during pediatric cardiac surgery, which is an independent risk factor for multiorgan failure, sepsis and immunodilution. Disadvantages of transfusion have to be balanced with the concerns of hemodilution.

Methods:
We have compared the results of standard CPB patients and cases operated with the modified circuits. We have shortened our standard pump circuits (1/4 tubings) to limit blood usage during CPB and lowered the pump volume. The second stage was to use smaller diameter tubings (3/16). Results (both laboratory and clinical findings) of those modified circuits were collected and analyzed.

Results:
Our policy for bloodless priming has resulted in lesser homologous blood usage without compromising the surgical results (statistically significant). Its effects on peroperative and postoperative data were superior to standard technique.

Conclusion:
Bloodless priming is an effective tool for lesser homologous blood usage in priming of the CPB circuits. Our modification did not compromise the safety of standard surgical procedure and have limited blood usage.
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Objective: To evaluate the benefits and safety of miniaturized circuits on blood transfusion in < 10 kg pediatric patients.

Method: CPB was performed with a heart-lung machine dedicated to pediatric perfusion. The prime volume, including priming of the microplegia circuit, was 100 mL for bypass flow up to 600 mL.min\(^{-1}\), 125 mL for bypass flow between 600 and 1000 mL.min\(^{-1}\) and 155 mL between 1000 and 1500 mL.min\(^{-1}\). Venous drainage was optimized by vacuum-assisted venous drainage and pulsatile normothermic perfusion was associated with intermittent warm blood microplegia in all patients. Data recorded were blood volume transfused, age, weight, hemoglobin level measured during induction, cardiopulmonary bypass, on ICU admission, and on the morning of day1, inotropic agent score, time to extubation and length of ICU and hospital stay.

Results: The study included 172 patients with a median age of 3.0 months, (1 day to 20 months). Two patients died during their hospital stay but death was not related to anemia. Patients were discharged from ICU after a median period of 48 hours (20-380) and from the hospital in good condition after a median length of stay of 9 days (7-30). Blood volume transfused in OR and ICU was 60 ± 33 mL.kg\(^{-1}\) (median 51, 13-266), assuming a patient blood volume of 80 mL.kg\(^{-1}\), it varies from 16% to 332% (median 63%) of the patient’s blood volume. Postoperative hemoglobin was constantly above 12g/dL. Only one patient had platelet infusion.

Conclusion: Miniaturized circuits are safe and efficient in decreasing blood transfusion in pediatric patients.
Objective:
Despite perceived clinical advantages, penetration of MiECC technology in clinical practice is hampered by concerns regarding air handling as well as blood and volume management. We sought to overcome these concerns by designing a MiECC circuit that could be used in all types of cardiac procedures offering enhanced safety features.

Methods:
We designed a prototype hybrid (modular type IV) MiECC circuit (Medtronic AHEPA circuit) bearing a second standing-by open component with a venous reservoir and cardiotomy suction integrated to a type III MiECC (closed) system. This enabled us to perform complex cardiac surgical procedures pertaining a high possibility of unexpected perfusion scenarios. We challenged this modular configuration in a series of 90 consecutive high-risk patients operated in our department.

Results:
Surgical case mix consisted of coronary, valvular, aortic and intra-cardiac procedures, including emergency cases and reoperations (all-comers). The majority of patients were considered high-risk for surgery with a mean Log. EuroSCORE of 5.7. All operations were conducted successfully (technical success rate: 100%). The standard (type III MiECC) circuit was used in 86/90 patients (96%). In four patients the circuit was converted to open (conversion rate: 4%), due to air handling and blood management. Overall mortality rate in this series was considerably low (4.4%). Further analysis confirmed that the modular configuration retained all favorable perfusion and clinical characteristics attributed to MiECC.

Conclusions:
Modular MiECC systems represent a “state-of-the-art” technique and may become the standard practice for performing cardiac surgery. This pilot study applies to the real world and prompts for further evaluation through multicentre trials.
« Feasibility of utilization of Miniaturized Extracorporeal Circulation during Aortic Valve Surgery including Minimally Invasive Approach »

Valerio Mazzei MD, Domenico Benvenuto MD, Ruggero Rociola CCP, Antonio Rubini CCP, Nicola De Ninno CCP, Adriana Schena CCP, Giuseppe Chiarella MD, Domenico Paparella MD

Objective
Miniaturized extracorporeal circulation (MIECC) has been developed to reduce the standard cardiopulmonary bypass (CPB) negative effects associated with large priming volumes, air-blood contact and cardiotomy suction. MIECC has been predominantly used during CABG operations with documented potential benefit. MIECC utilization in valve surgery has been limited because of concern of air entrance in the venous line and left side vent management. We present a double centre experience of MIECC during aortic valve surgery, including combined procedures and minimally invasive approaches.

Methods
Aortic valve surgery was associated with CABG in 4 cases and ascending aorta replacement in 1. A J mini-sternotomy at the 3rd right intercostal space was used in 5 cases. Distal ascending aorta cannulation was always used. Percutaneous femoral vein cannulation was utilized in 4 mini-sternotomy cases, atrio-caval cannulation was used for the remaining. The pulmonary artery was cannulated for venting and blood drained into venous line. A closed heparin coated MIECC with centrifugal pump, without venous reservoir was used. Direct cardiotomy suction was avoided, a cell saver was used instead. Myocardial protection was achieved by means of intermittent warm blood cardioplegia.

Results
Twenty-seven patients (age 67±12) were operated in 2 cardiac surgery sites. Pre-operative haematocrit was 38.6%. Mean priming volume was 330±100 ml. Mean cross clamp time and CPB time were 57±22 and 88±31 minutes respectively. There were no hospital death, nor neurologic complications. ICU arrival haematocrit was 35.7%. Incidence of postoperative atrial fibrillation, red-blood cells transfusion and AKI were 25.9%, 22.2% and 11.1% respectively.

Conclusion
MIECC can be safely utilized in aortic valve surgery, including combined procedures and mini-sternotomy approach.
10:50-11:20
Coffee break
Objective:
The interaction of preoperative anaemia and transfusion has been reported to be associated with an increased hazard of late mortality in a single centre study. Using multi-centre perfusion registry data, this study examined the relationship of anaemia and red blood cell transfusion on in-hospital mortality in patients undergoing cardiac surgery with cardiopulmonary bypass (CPB).

Methods:
13,853 adult patients undergoing isolated coronary artery bypass graft (CABG), valve repair/replacement and valve/CABG procedures, between February 2007 and February 2014, were collected using the Perfusion Downunder Collaborative Database. 1508 patients on preoperative dialysis or with chronic kidney disease were excluded. A propensity score predicting the likelihood of receiving a transfusion was calculated in a logistic regression model, including 30 variables with univariate association with transfusion. The interaction of anaemia and transfusion on mortality was evaluated in the entire cohort and the 8739 propensity matched patients using mixed effect logistic regression model panelled by centre.

Results:
Mortality for the study cohort was 1.6%, for anaemic patients transfused or not, 5.0% and 0.5% respectively, and non-anaemic patients 2.9% and 0.3% respectively. The odds ratio (OR) for transfusion with anaemia was 16.4 (confidence interval (CI) 5.86-45.99; p <0.001), OR for transfusion without anaemia 12.1 (CI) 4.57-32.26; p <0.001. In the propensity matched analysis the association with anemia was lost, whilst transfusion ([OR] 4.8 [(CI) 2.0-11.4]; P <0.001) remained a significant predictor of mortality.

Conclusions:
Transfusion was an independent predictor of in-hospital mortality. These findings support blood conservation directed at reducing red cell transfusion in all patients.
“Technical Strategies to reduce Hemodilution”

Objective:
To reduce the harmful effects of hemodilution caused by the CPB it is necessary to study a technical strategy for each individual patient and to provide for the use of devices for the small CPB and the realization of low priming. By reducing the length of the tubes and choosing the oxygenator as needed according to the BSA, the perfusionist will get a safe practice, be capable of controlling hemodilution, the complications associated with it and obtain better outcomes.

Methods:
Between May 2013 and May 2015, 250 patients were treated with the CPB oxygenator FX15-40I30 all of which had pre-operative assessment by the perfusionist. The oxygenator has been chosen with the BSA and the flow of perfusion of 2.5l / min / m2. The circuit pre-assembled PVC Class VI and sizes 3/8-1/2. In all cases the total priming was 900ml colloid. The arterial and venous cannulation were central and in some cases peripheral femoral / axillary; systemic heparinisation was 3 IU / kg with ACT of 480 sec. The cardioplegic solution used was Custodiol. The systemic rewarming occurred until the esophageal temperature of 36 ° C was reached; weaning from CPB was uneventful.

Results:
Data are reported as mean ± standard deviation. The hematocrit on CPB was 27.3 ± 2.07. The arterial blood gases during CPB were normal with pH 7.38 ± 0.06, 1.52 ± 0.43 lactate, glucose 104.79 ± 16.01. There were no post-operative complications such as bleeding, renal failure (creatinine 0.64 ± 0.18) and complications linked to CPB.

Conclusions:
The use of a technique of CPB studied for patients with adequate choice of the oxygenator reduces hemodilution, complications associated therewith and improves patient outcome.
Transfusion is harmful for cardiac surgery patients

The Capiox FX15 Oxygenator:

- Reduces blood transfusion
- Improves patient outcome
- Reduces hospital cost

References
1) Murphy et al. Circulation 2007; 116: 2544
2) Lahanas et al. Perfusion 2013; 28: 541
3) Bronson et al. JECT 2013; 45: 187

For more information on Capiox FX15 Oxygenator, please visit us at EACTS booth #3.21

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cardiovascular.systems@terumo-europe.com
“The Role of Simulation in Perfusion”

Objectives
Increasingly complex operations are being undertaken on sicker patients whilst at the same time accountability, scrutiny and expectations have risen. There is a parallel need to improve safety, decrease costs and maximise efficiency. Such changes have improved patient outcome but they do not create an optimal training environment. We have to look for alternative educational methods.

Methods and results
Simulation refers to an artificial representation of a real world process to provide education and training via experiential learning. The educational benefits are well established and mandatory in other high risk, task focused environments such as aviation, nuclear power and armed forces.

Depending upon the level of realism and dynamic feedback the simulation maybe ‘low fidelity’ or often static (oxygenator change out on a dry circuit), ‘medium fidelity’ with some physiological feedback (emergency de-airing a water primed circuit) or ‘high fidelity’ with real time, interactive, physiological feedback (scenario or problem solving using a computer based or hydraulic simulator). With increasing fidelity complex tasks and procedures can be learnt and practiced in a safe environment with the learner developing their skills and understanding.

Approximate 1 – 5% of all hospital deaths are attributable to technical or human errors and in surgery 40% are due to problems with communication or non-technical skills. High fidelity simulators can be used to maintain skills and rehearse emergency procedures. Scenario based simulation can be used to understand and practice techniques of good communication, situational awareness, leadership and decision making to improve team working and error prevention.

Summary
Perfusion is a high risk practice reliant on technical skills, multitasking and problem solving in a team environment. Such skills are difficult to gain and maintain. Simulation provides a safe and standardised learning environment for the trainee, the experienced practitioner and the multidisciplinary operating team. Its use should become a standard in perfusion education.
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Integrated pressure sensor (IPS):
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“vv-ECMO: the ‘LANDING Monitor real time contribution’ for adequate patient’s respiratory function”

Objective:
Continuous respiratory monitoring during a vvECMO support for lung failure

Methods:
Applying the new monitor “Landing” at a vvECMO and describing the measured parameters and the calculated parameters in order to understand the inter-dependency between the patients and the machine ECMO

Results:
ECMO veno-venous can totally or partially substitute the lung gas exchange function. During VV ECMO, the interpretation of parameters, usually employed to monitor respiratory function, such as arterial partial pressure of oxygen (PaO$_2$) and carbon dioxide (PaCO$_2$), must take into account the contribution of extracorporeal gas exchange. To understand the respiratory function of the natural lung (NL), we need to evaluate continuously the role of VV ECMO, by calculating the oxygen added to the blood by the NL (V’O$_2$ NL) and by the membrane lung (ML) (V’O$_2$ ML), the carbon dioxide removed by the NL (V’CO$_2$ NL) and by the ML (V’CO$_2$ ML), and the intrapulmonary shunt fraction (shunt NL). It is also recommended to estimate the extracorporeal blood flow recirculation fraction (R/ BF) and other useful parameters to monitor the ML function as the ML dead space and the ML shunt. A daily Patient’s evaluation on VV ECMO can be adequately performed with blood gas analysis: arterial, mixed venous (by arterial pulmonary catheter), ECMO inlet, and ECMO outlet and assessment of hemodynamic, ventilator, and ECMO parameters. Moreover, daily monitoring of the ECMO pressure (drainage pressure, oxygenator inlet and outlet pressures) can provide important information about resistance through the oxygenator, the risk of hemolysis due to the suction forces and aging of the ML. When critical parameters are monitored continuously, clear trends can be identified that can be used to follow the natural lung recovery or the membrane lung performance. In normal practice however, Patients (and ECMO) are monitored discontinuously or on a tailored-base through a sampling regime, thus, deterioration to the natural lung and ECMO membrane can occur in a relatively short period. It is recommended to monitor parameters continuously and in a real time.

The LANDING monitor, manufactured by Eurosets S.r.l., Medolla (MO) Italy, provides the capability to continuously measure and calculate a number of critical parameters e.g. Hb value, saturation of the blood pre- and post-oxygenator, ECMO blood flow, inlet and outlet pressure of the oxygenator, drainage pressure, blood venous temperature. All these parameters are measured non-invasively without any blood sampling need neither from the ECMO system nor from the Patient. Moreover the Landing monitor software can calculate the amount of oxygen delivered to the Patient’s blood.
**Conclusion:** the gold standard, for monitoring Patients in vvECMO, is the Real Time Monitoring. The LANDING monitor can contribute to the adequate Patient’s respiratory function.
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“Medtronic Fusion Oxygenator Edinburgh Retrospective Investigation in routine Clinical use”

Objective
This presentation will retrospectively look at the clinical performance of the Medtronic Fusion Oxygenator since its introduction into the marketplace and as a standard clinical use oxygenator.

Methods
Edinburgh was one of the first clinical centers to adopt the production version of the new Medtronic Fusion Oxygenator into routine clinical use upon introduction in September 2013. Since its introduction at our clinic, over 900 have been used routinely as the standard adult oxygenator. The retrospective investigation looked at the performance of the oxygenator on routine adult cases with some of the extreme ends of the patient spectrum, specifically considering patient size, duration on bypass/complexity, adoption to emergency use, and other select case studies which will be presented in the course of the lecture.

Results
The Fusion has a 0% failure rate at the moment with very good performance statistics, even at the extreme ends of its manufacturers quoted ranges. Some aspects of use needed to be considered by the perfusion staff in regards to patient use; however none of these detracted from generally excellent performance.

Conclusion
The Medtronic fusion Oxygenator was a fairly radical departure in design from the norm, integrating a 38umfilter as part of the oxygenator bundle, and incorporating a venous bubble trap rather than using a separate screen, filter or other technical improvements. This design has been borne out by routine clinical use in Edinburgh. The oxygenator performs well even at the extreme ends of its performance range and has proven 100% reliable and efficacious for routine clinical use.
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13:00-14:00
LUNCH

1400 – 14.30  Poster powerpoint presentations
Objective:
Compare Del Nido and Custodiol cardioplegias as a myocardial protection in adult patients undergoing cardiac surgery.

Methods:
Historical cohort of convenience sample of 128 adult patients undergoing CABG, mitral valve repair / replacement, double valve replacement, ASD, aortic valve replacement with extracorporeal circulation. Secondary source: medical records. Qualitative variables were analyzed with absolute and relative frequencies. Quantitative variables were presented with central tendency, dispersion and position. Normality was testing by Shapiro Wilks. Difference of proportion and U The Mann Whitney test was used to compare the groups. Statistical significance p<0.05 was assumed.

Results:
There was no significance difference between groups in: pump time (p=0.455), clamp time (0.406), lactate in surgery (p=0.881) and ICU (p=0.256); RBC transfusion in CPB (p=0.055) and Length stay (0.610); length of stay in ICU (p=0.520), vasoactive-inotropic score (VIS) as myocardial protection at the end of surgery (p=0.285) and after 24 hours in ICU (p=0.752). Del Nido presented lower proportion of ventricular fibrillation compared to Custodiol (p=0.001), lower cost (p=0.001) and lower use of milrinone (p=0.048). In subgroups analysis of intervention by MICS in valve surgery there is no differences in clamp time (p=0.591), transfusion (p=0.425), pump time (p=0.652), as well as VIS at the end of surgery (p=0.330) and after 24 hours in ICU (p=0.995).

Conclusion:
In this study Del Nido did not present statistical differences compared with Custodiol cardioplegia and it showed that, with a low cost of cardiplegia, we obtain similar result in adult cardiac surgery and valve surgery by MICS, offering appropriate myocardial protection.
**Objective:**
As part of the development of our Minimal Incision Cardiac Surgery (MICS) program we have introduced the use of an intra-aortic occlusion device as a substitute external aortic clamp. This required a number of changes to our normal perfusion practise. This is a review of our first cohort of patients to assess whether this new technique was safe and efficacious in our institution.

**Methods:**
With the introduction of the new device a Specialist Registry was commenced to record relevant data. A retrospective audit of three groups of patients undergoing mitral valve repair or replacement was then undertaken. These groups were MICS with intra-aortic occlusive device, MICS with external aortic clamp and the third group undergoing conventional median sternotomy. Data for bypass and cross clamp time, discharge time, in-patient mortality, neurological events and infections were evaluated. Post-operative mitral valve function was also recorded. With the introduction of the new device a number of adaptations to perfusion practise were made. These include administration of adenosine immediately prior to cardioplegia, changes to the strength and temperature of cardioplegia and amending the pump prime to include colloids and mannitol.

**Results:**
The numbers were too small to be statistically evaluated. However, there was no in-hospital mortality or any significant neurological events. Infection rates were comparable within the groups and bypass and cross clamp times were comparable to published data.

**Conclusions:**
This audit has not raised concerns with the safety of this technique. Whilst this technology is challenging, it is as safe and effective as our other methods for mitral valve surgery.
Objective:
Postoperative delirium (POD) is a common and serious complication after cardiac surgery and numerous studies have confirmed this in occurrence from 10% to 60%. The aim of study was to identify the incidence and risk factors of postoperative delirium (POD) after cardiac surgery and to evaluate clinical outcome.

Methods:
The data of 292 patients after elective cardiac surgery with CPB were prospectively analyzed. The patients were assessed and monitored preoperatively, during surgery and in the early postoperative period.

Results:
The incidence of POD was 28%, average age of delirious patients was significantly higher than non-delirious patients 69.84(±10.01) vs. 65.83(±10.61) yr, p=0.003, average duration of CPB 111.29(±41.05) vs. 100.8(±36.87) min, p=0.003. The analysis showed that POD prolonged the length of the ICU stay 5.8(±2.89) vs. 3.86(±1.91) days, p<0.001 and length of stay in the hospital after ICU 14.51(±11.67) vs. 11.10(±9.07) days, p=0.016; patients after POD more frequent was required re-intubation (OR: 13.169, CI 1.456-119.087, p=0.022). Multivariate analysis remained as an independent predictors for POD: age > 70 yr (OR: 2.227; 95% CI 1.325-3.742, p=0.003), ejection fraction < 42% (OR: 2.398; 95% CI 1.397-4.117, p=0.002), combined valve repair and CABG surgery (OR: 2.083; 95% CI 1.153-3.761, p=0.015) and duration of CPB > 86 min (OR: 2.068; 95% CI 1.182-3.618, p=0.009).

Conclusions:
Our data suggest that early POD is a common complication and worsen patient outcome following cardiac surgery. POD may affect the many reasons and a multifactorial risk model should be applied to identify patients at an increased risk of developing POD.
**The comparison of the gold standard blood gas to the real-time Spectrum Non-Invasive blood gas monitoring system for maintaining the patients physiological parameters during cardiopulmonary bypass**

During cardiopulmonary bypass procedures several parameters are measured to ensure that the patient’s physiological state are maintained. The monitoring of these parameters has changed significantly over the last 25 years. The advancements in these monitoring devices have provided real-time monitoring into the Perfusionists clinical practice. The increased use of these devices has been documented in numerous surveys published since 2000. The implementation of these devices into clinical practice has been successful due to a relatively low cost for disposable cells.

**Methods:**
The study consisted of 22 patients in the control (Group I) which utilized arterial blood gases (ABG) to maintain physiological parameters and 22 patients in study group (Group II) which utilized the Spectrum Non-invasive blood gas monitoring to maintain physiological parameters during cardiopulmonary bypass. Maintenance of blood gas variables was set at: pH 7.40 ± 0.05, PaCO\(_2\) 40 ±5 mmHg, PaO\(_2\) 200 ± 50 mmHg.

**Results:**
The Spectrum Non-invasive blood gas monitoring system was with in 10% to our current method of utilizing the Abbott I-stat blood gas machine for blood gas analysis.

**Conclusion:**
This Spectrum Non-invasive blood gas monitor allowed for more accurate control blood gas physiological parameters on a second to second time frame compared to our current practice of every thirty minutes with an I-Stat blood gas. This study did not investigate the effects of tighter control of the patient physiological parameter outcomes but this has been shown be several other authors.
Objective:
Over the years new methods were introduced to optimize CPB circuits, aimed to decrease hemodilution, inflammatory response and hemolysis. Our study aims to evaluate if outcome can be improved by the separation and centrifugation of extracavitary blood during CPB.

Methods:
From November 2011 to October 2014 we retrospectively analyzed data related to 50 consecutive patients undergoing routine CABG with CPB. Patients were divided into 2 groups, each of 25 units: Group A without extracavitary blood suction separation and Group B with extracavitary blood suction separation and subsequent centrifugation with a cell saving system. Red blood cells were reinfused during or after CPB, as necessary.

Results:
The 2 groups were similar referring to sex (98% male, 2% female in both groups), median age (p=0.29), BSA (p=0.14), pre-op Hb (p=0.51), mean CPB time (p=0.75), mean aortic cross-clamp time (p=0.75) and priming volume (p=0.66).
Laboratory results showed a significant reduction on systemic inflammatory response in group B: interleukines IL-6 (p=0.0002); IL-8 (p=0.0019) and TNF α (p=0.0043) and on hemolysis, measured as gap of haptoglobin(p=0.041).
Transfusions were less frequent in group B (-24%) and number of units/patients transfused were inferior at all (p=0.01), during intra-operative (p=0.004) and post-operative (p=0.03) period.
This had a positive impact on outcome markers: mechanical ventilation time (p=0.24) and ICU stay length (p=0.0057).
No patient of group B had bleeding-related complications.
No variation of mortality at discharge and after 6 months.

Conclusion:
Our data suggest that extracavitary blood separation may reduce the inflammatory response mediators, hemolysis, need of transfusions, to have better outcomes.
Objective:
The assessment of oxygen delivery and consumption during CPB is the main way to control its safety and efficacy. This can be difficultly evaluated by common used parameters.

Methods:
The data of 68 adult patients (more than 70,000 rSO₂ values) were analyzed. The patients underwent on-pump CABG (67.6%), valve repair (23.5%) or combined (8.9%). The end-points were organ disorders occurred on 1-6th days post-op. INVOS oxymetry used with somatic sensors position at lumbar area of the body with cerebral monitoring at the same time.

Results:
The significant differences were found between groups with and without post-op organs disorders in time length of rSO₂ decrease from baseline more than 15%; the value of rSO₂ decrease from baseline; DO₂ (oxygen delivery index at the 30th minute of CPB) hemoglobin and hematocrit levels. The incidence of somatic rSO₂ values at 51-60% with time length more than 20 minutes was found to be strongly associated with poor outcome. The associations between cerebral and somatic rSO₂ and other parameters were analyzed also.

Conclusions:
The changes in somatic rSO₂ during CPB may reflect the adequacy of perfusion and possibly can be used as post-op complications predictors.
"Aortic Valve Surgery using only Blood for Cardioprotection"

A. Temelkovska, N. Hristov, T. Anguseva, I. Kajevski, Z. Mitrev

Objective:
The aim of this study was to analyze the patients with aortic valve surgery using only blood cardioprotection.

Methods:
40 patients undergoing surgical treatment of aortic valve between January and August 2014 were selected. 20 pts were operated using only blood cardioprotection and 20 pts were operated with retrograde and antegrade selective cardioplegia. In both groups moderate hypothermia (30-32°C) was used on extracorporeal circulation (ECC). Surgery in the patients with blood cardioprotection was performed on beating heart. In the first group we made AVR mechanical prosthesis 4pts, bioprosthesis 3pts, with pericardial patch 11pts and AVR with decalcification 2pts; and in the second group AVR mechanical prosthesis 9pts, bioprosthesis 3pts, with pericardial patch 7pts and AVR with decalcification 1pts. Laboratory analyses of AST/ALT were performed preoperatively and postoperatively.

Results:
The mean time of ECC in the group with retrograde and antegrade selective cardioplegia was 75.5min., aortic clamp 55.1min. and reperfusion 14.3min. In the second group with only blood cardioprotection the mean time of ECC was 68.9min., aortic clamp 52.5min. and reperfusion 11.9min. Patients with cardioplegia were extubated with mean time 10.8h.; whereas the patients without cardioplegia for 7.8h. The mean values of preoperative AST/ALT in the first group were 23.2/22.6, and in the second group 21.55/34.5. The postoperative mean results were 48.5/54.45 in the first group and 53.05/27.3 in the second group.

Conclusion:
Patients with only blood cardioprotection without cardiac arrest have shorter ECC, aortic clamp and reperfusion times. They also have earlier extubation, rehabilitation and hospital stay.
“Use of Modified Del Nido Blood Microplegia Technique in Adult Patients undergoing Coronary Revascularization and Heart Valvular Surgery; An Audit of 200 Consecutive Cases”
Faisal Shehzad CCP (PAK), Maj. General Asif Ali Khan (PAK), M.A.K. Nuri MD (USA), M.Mubashir Mumtaz MD (USA), M.A.Mumtaz MD (USA), Ijazullah Khan (SPAIN), A.U.Manan MS (PAK)

Background:
Myocardial protection is of paramount concern during coronary revascularization. The use of systemic hypothermia, ventricular unloading and the use of cardioplegia can reduce basal metabolic consumption during electromechanical arrest by ninety percent. The composition, temperature, route of administration of cardioplegia is subject to considerable variation. Since the classical description of Buckberg, cold blood cardioplegia in a 4:1 dilution has become the standard in the United States. Theoretically, combination of tepid cardioplegia and minimal dilution cardioplegia (mini cardioplegia as described by Calafiore et al) offers minimal dilution and maximal oxygen delivery. Microplegia technique is in our use from the last 5 years at Tahir Heart Institute. This is a unique 45.25ml volume of blood with 1ml volume of arresting agents.

Methods:
A total of 200 consecutive patients undergoing coronary revascularization and heart valvular surgeries at Tahir Heart Institute, Chenab Nagar (Rabwah) were studied from January 2012 to June 2014. All patients received minimally diluted Del Nido blood cardioplegia with temp.04-20 C using antegrade and retrograde administration, with selective graft perfusion. It is generally used in a single dose fashion.

Results:
The early mortality (hospital discharge) was 2% and IABP was required in 3% of patient with prolonged ionotropic support. There were significantly low incidences of ventricular fibrillation after aortic unclamping and new postoperative atrial fibrillation with no incidence of any neurological event or renal insufficiency requiring dialysis.

Conclusions:
These results demonstrate that the use of modified Del Nido blood microplegia is safe in adult patients who are undergoing coronary revascularization and significantly reduces the incidence of ventricular fibrillation after aortic unclamping and results in good in-hospital morbidity and mortality.
Continuous quality improvement is recognised as being an important contributor to improving the outcome for patients and in the setting of cardiopulmonary bypass electronic perfusion data provides a gateway to allowing the development of quality control systems for perfusion. In 2006 Newland et al\(^3\) reported the development of an automated data collection methodology using the Data Management System (DMS; Sorin, Munich, Germany) and a SQL database to firstly calculate quality indicators for perfusion, then generate and distribute the quality report. This pathway allowed the development of a feedback process that underpins our local perfusion practice. Quality indicators can then be used to help monitor changes in practice and in quality improvement programs\(^4\).

Having an impact on the process of care at the local level is important, however within our region the development of the Perfusion Downunder Collaboration (PDUC) and related Database Project has allowed multiple sites the benefit of being able to use electronic data from a variety of platforms (DMS, CONNECT (Sorin, Munich, Germany), and JOCAP XL (MAQUET, Rastatt, Germany)) to extend the value of electronic data beyond the perfusion record\(^5\). This has led to the development of benchmarking projects\(^6\) and a Collaboration wide Blood Management Quality Improvement Project within the PDUC.
The development of perfusion registries will help us continue to develop the evidence base for perfusion practice through both retrospective and prospective study designs, additionally allowing us to compare contemporary practice to published guidelines.

In 2005 we wrote

“Its potential (sic electronic data) at this time seems limitless, with one major application being the development of “real time” feedback for the perfusionist during the case”

We have seen major improvements in the latest versions of data management software, however we are still short of a decision support platform for cardiopulmonary bypass.

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Introduction:
Traditionally, ½” venous lines have been used in adult cardiac surgery to attain a good venous return without the use of vacuum. In order to save system priming volume, the use of 3/8” venous lines has been restricted to smaller patients, or by institutions that use vacuum or pump assisted venous modalities as in the minimal invasive extracorporeal circuits (MiECC).
In October of 2012, we started using the Medtronic Fusion cardiotomy reservoir and oxygenator system with integrated filter. With this system, we often noted venous line chattering, so instead of partially clamping the venous line, we decided to use 3/8” venous lines in place of our normal ½”.

Materials and Methods:
Retrospective study looking at two patient groups with a BSA ranging between 1.65 to 2.2m$^2$ using a 1.6 meter long ½” or 3/8” venous line. All cases were performed without vacuum using the Medtronic Fusion system and a 2-stage venous cannula. The height of the venous reservoir outlet was placed 40cm above the floor which, depending on the height of the operating table (or surgeon) averaged from 40-70 cm below the level of the heart.

Results:
A total of 504 patients were documented with 249 in the ½” group and 255 in the 3/8” group with an average BSA of 2.06m$^2$ and 1.91m$^2$ respectively.
½” group: Priming volume was 1050 ml. Average Blood flow ranged from 4.7 Lpm to 5.7 with an average cardiac index of 2.33 to 2.82 Lpm/m$^2$.
3/8” group: Priming volume was 960 ml. Average Blood flow ranged from 4.4 Lpm to 5.4 with an average cardiac index of 2.3 to 3.0 Lpm/m$^2$.

Conclusion:
The Medtronic Fusion venous reservoir has a very low resistance to venous flow as blood does not pass thorough the venous defoamer unless needed and the outlet tube widens from ½” to 5/8” at the bottom. Blood flows of over 5 Lpm are easily attained and so today, we are using this system in patients up to 100kg or 2.2m$^2$. 
Objective:
There is an increasing interest in the phenomenon of mechanical blood cell trauma in patients supported on ECLS as well as a greater awareness of the impact of hemolysis in terms of patient morbidity and mortality. There are an increasing number of reports investigating the role of centrifugal pumps in this iatrogenic complication and there seems to be a relation between choice of blood pump and degree of hemolysis. Current generation centrifugal pumps are considered to be non hemolytical in vitro, so there must be another factor to why these pumps are not performing as expected when they are being used clinically in an ECLS circuit.

Methods:
All recently published articles reporting hemolysis in ECLS patients were reviewed, inhouse experience was analyzed and the ELSO data Registry was queried in order to further understand the role of centrifugal pump use in blood cell trauma.

Results:
The incidence of hemolysis in adults is overall relatively low, however there is a high number of neonates on ECLS experiencing hemolysis. In this population, there is a big difference in hemolysis incidence depending on the type of blood pump being used, but interestingly also a big difference between the reported incidence of hemolysis in the European and worldwide ELSO Data Registry. This observation can either be attributed to a delay in applying new technology outside Europe or to a recent switch from roller pump technology which requires different circuit management. The results also suggest that certain types of centrifugal pumps don’t seem to be designed to be used in low flow/high shear conditions as seen in small patients.

Conclusions:
It is important that blood pumps for prolonged extracorporeal support are chosen in function of their hemolytic character for the required blood flows and pressure heads. It has become clear that in low flows and high shear conditions, different pumps configurations are required in other to minimize blood cell trauma.
Objective:
Extracorporeal circulation with deep hypothermia and total circulatory arrest is used in neurosurgery to perform the clipping of giant cerebral aneurysms; we present 6 cases in which the ECMO intra-operative system of intervention was used, showing that is a safe practice, reduces hemodilution, bleeding and improves the outcome.

Methods:
The ECMO circuit was modified from standards for the intervention in the 6 reported cases of clipping giant cerebral aneurysms in deep hypothermia. Arterial and venous cannulation was femoral.; systemic heparinization was 1.5 U.I/Kg. Esophageal and bladder temperature achieved was 18°C. Stopping time was on average 20 minutes. Systemic heating of the esophageal temperature arrived at 36°C; cessation of the ECMO was regular.

Results:
Data was reported as an average ± deviation standard. Patients did not receive a sternotomy. The hematocrit in CPB resulted 27,3 ± 2,07, two patients received a transfusion of 1 unit of erythrocytes. Blood gas values during CPB were in the norm, pH 7,38 ± 0,06, lactate 1,52 ± 0,43, glycemia 104,79 ± 16,01. Two patients were woken on the third day post-operative and four on the first day. There were no signs of post-operative complications such as bleeding or renal insufficiency (creatinine 0,64 ± 0,18) nor were there complications due to the CPB or the operation.

Conclusions:
The use of an extra-corporeal circulation technique with a closed system and miniaturized circuits for example ECMO, reduces hemodilution, perioperative bleeding and therefore improves the outcome of the neurosurgery patient.
15:45-16:15
Coffee Break
Objective:
Cardiac surgery may be complicated by acute kidney injury (AKI). Cardiotomy suction during cardiopulmonary bypass (CPB) is deleterious. A few studies have demonstrated that shed mediastinal blood (SMB) suction during cardiopulmonary bypass (CPB) can increase inflammatory response and lipids emboli. These 2 factors contribute to the development of postoperative AKI.

The RemoweLL (RemoweLeucoLipids, Eurosets™, Italy) filter is a recent designed cardiotomy with a multilayer filter for activated leucocytes filtration and a syphon for lipid particles sequestration. The SMB can be collected and filtered in this supplementary cardiotomy added to CPB circuit.

The aim of this monocentric prospective study was to compare the specific RemoweLL cardiotomy filtration for suction blood during CPB and a conventional 40 µm filter (Admiral, Eurosets™, Italy). The primary goal was to evaluate the AKI within 48 hours after surgery using the Acute Kidney Injury Network classification (AKIN classification) but also measuring early specific biomarkers of AKI: serum Cystatine C and urinary neutrophil gelatinase-associated lipocalin (NGAL).

Methods:
Sixty patients scheduled for elective cardiac surgery (aortic or mitral valvular combined or not with coronary bypass grafting) with a glomerular filtration rate (GFR) > 45mL/min. were randomly into 2 groups for SMB filtration:
- Groupe 1 (n=30) with RemoweLL cardiotomy (Leucocytes and lipids filter);
- Groupe 2 (n=30) with Admiral cardiotomy (conventional 40 µm filter).

All components: venous reservoir, oxygenator and surface treatment were similar in both groups.

Results:
Objective: To evaluate CPB circuits set up of two parallel oxygenators on a patient with a BSA of 2.93m$^2$ seamlessly while considering patients oxygen delivery, heat exchange and trans-membrane pressure at high flow rates.

Methods: A patient with a height of 182cm, weighing 170kg, and BSA of 2.93m$^2$ was presented to us for CABG. The patients BMI was calculated at 52%, therefore the patient was not muscular. We used two Medtronic -Fusion oxygenators, Orbit holder; Biomedicus 560 Pump with an AP40 (centrifugal pump head), Terumo system I-HLM and CDI 500. Our main concern was whether one oxygenator would handle the metabolic demands of a large patient. We utilized two-oxygenator arms, which were placed in a 45$^0$ angle, so the oxygenators sat right next to each other without any tape or additional holders. We also utilized two 3/8 Y connectors, one each on pre and post oxygenators. Also, a Y connector was placed on the oxygen line to blend in gas for two oxygenators. Both blood and gas inlet to one oxygenator were clamped out during the procedure and were ready to open if needed.

Results: The circuit adapted well because of the design of the oxygenator and the holder. A single oxygenator delivered adequate oxygen, heat transfer requirements as well as acceptable trans-membrane pressures. The Hemoglobin averaged at 10.5g/dl. The average VO2 calculated was 101mlO2/min/m2. The average DaO2 was 841. The patients PaO2 ranged from 310mmHg to 319mmHg throughout the case as we kept the FiO2 from 0.80% to 0.85%. The SvO2 ranged from 78% to 82%. The PcO2 averaged at 43mmHg with gas flow at 4.4L/min. Our blood flow averaged from 5.7L/min to 6.5L/min. The temperature did not go below 33 degrees of Celsius with cooling and rewarmed to 36.5 degrees.

Conclusion: The use of two parallel-connected oxygenators is very effective, safe and easy in very large patients. The use of only one Oxygenator was required for such a large patient. Fusion Oxygenator with an Orbit holder design makes it seamless.
Despite technical achievements in manufacturing medical equipment and expansion of the knowledge base in the application of medical devices, Cardiopulmonary bypass (CPB) is still a complex technology with inherent risks. Risk management processes aim at minimizing risks by identifying and analyzing potential hazards, preventing incidents, and learning from mistakes.

An extensive literature research to identify risks and risk management strategies associated with CPB has been conducted. Furthermore, a review of institutional standard operating procedures has complemented data acquisition.

Risks associated with cardiac operations with the use of CPB may be allocated to technical failures, patient-related risk factors and co-morbidities, surgical techniques, and human factors. Successful risk management strategies include choice and application of appropriate CPB technology, choice of appropriate surgical procedures, choice of adjunct therapies, close teamwork of all perioperative departments, and a focus on human factors.

Risks associated with the use of CPB in cardiac patients may be managed effectively when technical limitations of the CPB devices, patient co-morbidities and teamwork are considered.
Notes, Phone Numbers and Email Addresses
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