Gazette Issue 6/16

The AUSTRALIAN AND NEW ZEALAND COLLEGE of PERFUSIONISTS GAZETTE

JUNE 2016

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This edition of the Gazette has been proudly supported by Cellplex.

A MESSAGE FROM THE EDITOR

by Molly Oldeen, *CCP.*

Welcome to my 5th edition as Editor. As usual I'm impressed by the number of people that come through, even at the last minute, to help with submitting articles. It might result in the occasional delay in publication but it is well worth it, so thank you to everyone for your efforts.

In this edition, we have the abstracts from the 2015 Annual Scientific Meeting as well as a great variety of case reports, techniques, and other interesting pieces. I hope you enjoy! I look forward to choosing two awards ($250 cash) for the best articles again to be presented at the next ASM.

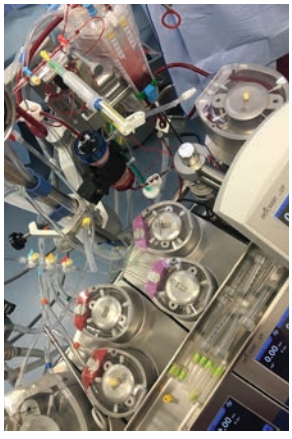
I'm going to keep this letter short as I have been quite busy.

As some of you know, I am currently in Saint Petersburg, Florida at Johns Hopkins All Children's Hospital. This October I will be attending my third trip to Cambodia with Open Heart International. It's wonderful to continue contributions to such a great organization and team!! I enjoy keeping up with my Australian colleagues and hope to make it to one of the excellent conferences this year.

Thank you again!

Kind regards,
Molly Oldeen
The Gazette Editor



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A MESSAGE FROM THE PRESIDENT

by Jon Van den Berg, *CCP.*

In my first six months as President I have come to appreciate the commitment members have to their profession. Recently there have been a number of experienced members pass on existing roles to newcomers as they move to emerging new roles. This is very positive for our organisation.

Website

My first report outlined a planned overhaul of the College website. Thank you to Andrew Sanderson for his years of service to the site and facilitating the transition to our new provider. Jack Bhana has stepped into the role as webmaster. (See report in this issue)

Perfusion Staff Survey

The survey has now progressed to draft form. After review it will be sent to Chief Perfusionists in early August. There will be two sets of questions. The unit specific questions directed to Chief Perfusionists, a second set of questions for Staff/ Trainee Perfusionists. The survey will also seek volunteers to participate in a more in depth study aimed to identify key attributes of the successful Perfusionist.

New Zealand Regulation

Progress toward regulating Perfusion in New Zealand was placed on hold in October 2015 awaiting Cabinet approval for a number of amendments to the Act mainly around disciplinary procedures. On the 27thof May the NZ Ministry of Health Published amendments to the Health Practitioners Assurance Act. The Minister of Health can now review applications and regulate other professions.

Australasian Simulation and Perfusion Meeting (ASaP)

I was privileged to be a participant at the inaugural Simulation Meeting held at the Royal North Shore Hospital in May. Congratulations to Darryl McMillan, Jane Ottens and Arthur Preovolus for putting together a very good training programme. I`m sure everyone who enrolled for the course had some apprehension being placed in front of equipment destined to go wrong in front of our peers. However this was quickly put to rest as instructors ensured a safe environment and peers remained supportive. The sharing of ideas and solutions flowed magically in the sessions. Seventeen participants including six local Trainees along and four Vietnamese Perfusionists attended. In line with overseas practice it is perhaps near time the Board allocate a higher number of education points to simulation attendance over other meetings. Perfusionists at all levels of experience should be encouraged to attend the 2018 meeting.

Education Board Planning Meeting.

On the 18th of June the ANZCP Board will meet in Melbourne for a Planning Day. Board members are scattered throughout Australia and seldom have the opportunity to meet as a working group. There are a number of issues planned for discussion including restructuring of the course, new content and allocation of the workload. I look forward to being part of this meeting.

In closing thankyou to Molly Oldeen and contributors to the December gazette for an exceptional edition.

Jon Van den Berg

President ANZCP
jon.vandenberg@waikatodhb.health.nz

The Journal of EXTRACORPOREAL Technology

Official Journal of:
American Society of Extra Corporeal Technology
Australian and New Zealand College of Perfusion

AUSTRALASIAN BOARD OF CARDIOVASCULAR PERFUSION

by Mark Mennen, *Chairman ABCP*

After almost four years since the recommencement of ABCP run Diploma course, it's been noted that the presentation format and some content has become a little stale. This will be the focus of the Board with the aim of setting goals for the immediate future. We will be holding a planning day at the Alfred Hospital in Melbourne on the 18th June to discuss the course as well as the where the Board's focus should be and setting goals for the next few years. All input is welcome at the meeting and beyond so please feel free to contact the board with suggestions, particularly current supervisors and students.

Four candidates successfully completed the Diploma of Perfusion programme and/or certification exams in February including our first two graduates from Hong Kong. There will not be a midyear exam this year but beginning next year we will again be conducting two sets of exams each year to tie in with individuals completing their studies in August now that we are taking enrolments in September.

The Autotransfusion course is now well established and has taken over 200 enrolments since commencing in 2013 and continues to take strong enrolments.

Most of our group continue to recertify each time around although each cycle loses two or three to non-return. Should lapsed members wish to recertify at any stage, please feel free to contact the board and we should be able to accommodate.

I would also like to take this opportunity to thank the rest of the Board, including past members who continue to contribute over many years, for their continued effort.

ASAP THROUGH THE EYES OF A TRAINEE

By Nicole Shrimpton,
Lady Cilento Children's Hospital

What a fantastic experience! I've just returned from the inaugural Australian Simulation and Perfusion meeting held at Royal North Shore Hospital in St Leonards and my mind is abuzz with new concepts and skills.

The meeting took place over two days, covering topics including the do's and don'ts of vacuum assisted venous drainage, trouble shooting of VA and VV ECMO, management of anticoagulation, prime reduction techniques and the applications of cerebral oximetry.

Seven trainees from Australia and New Zealand had the opportunity to attend and broaden their perfusion experience. I'm sure I speak for all trainees in saying that the meeting was an invaluable experience and we were warmly welcomed by fellow participants and instructors alike, all whom were keen to ensure we left with a wealth of knowledge and skills.

We were all stretched safely beyond our comfort zone which is a fantastic advantage of simulation perfusion. Whether it be by having to adapt to a L>R setup configuration, roller vs. centrifugal pump operation, use a hard vs. soft shell reservoir, or by the simulations themselves, we were all challenged in a safe environment where help and advice were forthcoming.

As the saying goes, there certainly is more than one way to skin a cat. I left the meeting thankful to return to the comfort and familiarity of the setup at Lady Cilento Children's Hospital, but excited to have discovered a world of perfusion now at my fingertips.

Many thanks to Jane Ottens and Darryl McMillan and all others who put in the hard yards to make the meeting such a success. I encourage you all to take the opportunity to attend when the next ASaP rolls around. I know my name will be on the attendees list!

Australian and New Zealand College of Perfusionists

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AROUND THE PUMP ROOM

Emerson Sgammotta, *Perfusion Services, Melbourne*

As the latest graduate of the Perfusion diploma course and the newest member of the College, I thought I would give a snap shot of the people and places that have aided my journey in the last 3 years at Perfusion Services in this edition of around the pump room.

As a company, we recently celebrated completing 25 000 cardiac cases across 2 hospitals, Cabrini Hospital in Malvern, and Monash Medical Centre in Clayton. Last year, we completed 932 bypass cases across the two hospitals, including CABG, valve replacement and repairs, aorta and arch replacements, minimally invasive surgery, adult congenital surgeries, and 3 renal cell carcinoma cases. We are also involved in Intra Aortic Balloon Pump insertions and transfers from other hospitals, auto transfusion cases across Melbourne, HIPEC at the Peter MacCallum Cancer Centre, and ECLS; of which we had 16 cases in the last year. An increasing number of TAVIs and Trans Apical Mitral Valve Replacements have seen us spend some time in our hybrid theatres and cath labs over the past few years.

Our pump room can be quite a vibrant place, usually with music playing, a discussion about an interesting article in the latest journal, or someone taking a coffee order (which I have learnt is very essential to being a Perfusionist). Being quite a large and diverse group of Perfusionists allows some lively and spirited discussions! Our current team consists of James McMillan (managing director), Michael McDonald (Director) and four qualified Perfusionists: Kyriakos Angus-Anagnostou, Kamala Priyadarshini, Vanessa Perafan, and myself. We also have two trainees currently in their last year of their studies, Mitchell Bago and Jane Ennor, who will be qualified by the beginning of next year.

There's always a topic of research that is taking place within our company. The recent heater cooler water quality issues have given us an opportunity to determine whether the latest cleaning protocol released by the company are proving to be effective, and comparing this to our previous methods of water tank cleaning, with a paper being produced soon. We are also currently testing out some essential point of care machines, such as the TEG 6s, iStat blood gas and act analysers, and the Coaguchek by Roche. Our aim is to determine whether the results from these devices produce similar accuracies as our current gold standard devices.

One of the benefits of having a large team is the fact that we're able to send a representative to many domestic and international perfusion conferences and workshops. ANZCP AGM, ANSCPR, CREF, EuroELSO and simulation meetings have been some of the events we have attended over the past year, with an interesting round table discussion upon the return of the representative to discuss any interesting issues that may arise from the conference. I am lucky enough to be attending my first international meeting in October at the Canadian Society of Clinical Perfusion AGM and hope to gain some worthy knowledge, and possibly run into some of you!

AUCKLAND CITY HOSPITAL DOUBLE TROUBLE

By Kate Rawlings & Camilla Hand

Auckland City Hospital Double Trouble: Introducing Auckland City Hospital's newest trainees Kate and Camilla

We started training at the end of 2015/beginning of January of this year from back grounds of physiology and exercise physiology, specialising in cardiac rehabilitation. Before this we had never set foot in a cardiac theatre and were excited to begin our career as perfusionists, which none of our friends and families had ever heard of before.

We are both very similar and are constantly confused by multiple staff members gaining the nicknames Kate Middleton and Camilla Parker Bowles or the staff favourite Katmilla. By training together we are able to share and understand each other's experiences and have become a good team.

Despite our similarities we are trained in very different ways, we have our main mentors Alex Peterson, Shuja Zahidani, Tim Willcox and Jake Wojdyla as well as the rest of the perfusion department who all play a role in our training. This means our perfusion techniques are considerably different and have accepted that there are multiple ways to get to the same end point. We have each combined multiple perfusion concepts to create our own personal methods.

The perfusion course has been challenging as both of us have had to adjust from University study. This includes having to get used to working full time while juggling study and not getting regular lectures. Luckily we have been given an afternoon a week to study which reduces the work load and allows us to seek advice from the rest of the perfusion team.

As we get further into our training we are both becoming more confident in our own abilities and being more comfortable in a range of scenarios. We are looking forward to being exposed to more challenging surgeries and growing as perfusionists.

NEW HEART LUNG MACHINES FOR THE PRINCE CHARLES HOSPITAL

Nicole Tysoe

The Prince Charles Hospital (TPCH) is situated within the Metro North District of Brisbane. We are comprised of 6 full time experienced Clinical Perfusionists and one trainee. We perform approximately 1200 open heart surgeries (on adults) and 800 other types of cases per year. These other cases include heart and lung transplants, ECMO (VV and VA), VAD implants (Heartware), IABP and Transapical Valve Insertions (TAVI's).

TPCH is home to the Heart Failure Unit (HFU) so we are exposed to a large number of patients from across Queensland and northern NSW that fall into this category and require some kind of intervention by Cardiac Staff. We have had 128 ECMO (VA & VV) cases since 2009 with the longest patient being supported on ECMO for 85 days (2016).

The only Ex-Vivo Lung Reconditioning machine in the Southern Hemisphere is also located at TPCH. This machine reconditions donor lungs for transplant. It is set up and operated by Perfusionists. 19 sets of lungs have been placed on the Ex-Vivo machine since its acquisition with a total of 16 sets of these lungs being transplanted into a recipient. Research is currently underway at TPCH with assistance from one of our Perfusionists into a similar reconditioning machine for the Heart.

Excitingly, we recently acquired a new fleet of 5 Heart Lung Machines. The new S5 Sorin HLM's are replacing our old HL20 Jostra Machines that were in the vicinity of 15 years old. These new machines are a welcome addition to the Prince Charles Team. See photos below.

Now retired HL20 HLM's

5 new S5 Sorin HLM's ready to be set up

Setting up the S5 HLM's ready for theatre

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**Seyfried et al., Transfusion. August 2015 (average value using 225 ml bowl on 10% and 25% inlet hematocrit)*

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CLINICAL PERFUSIONISTS IN THE MEDIA

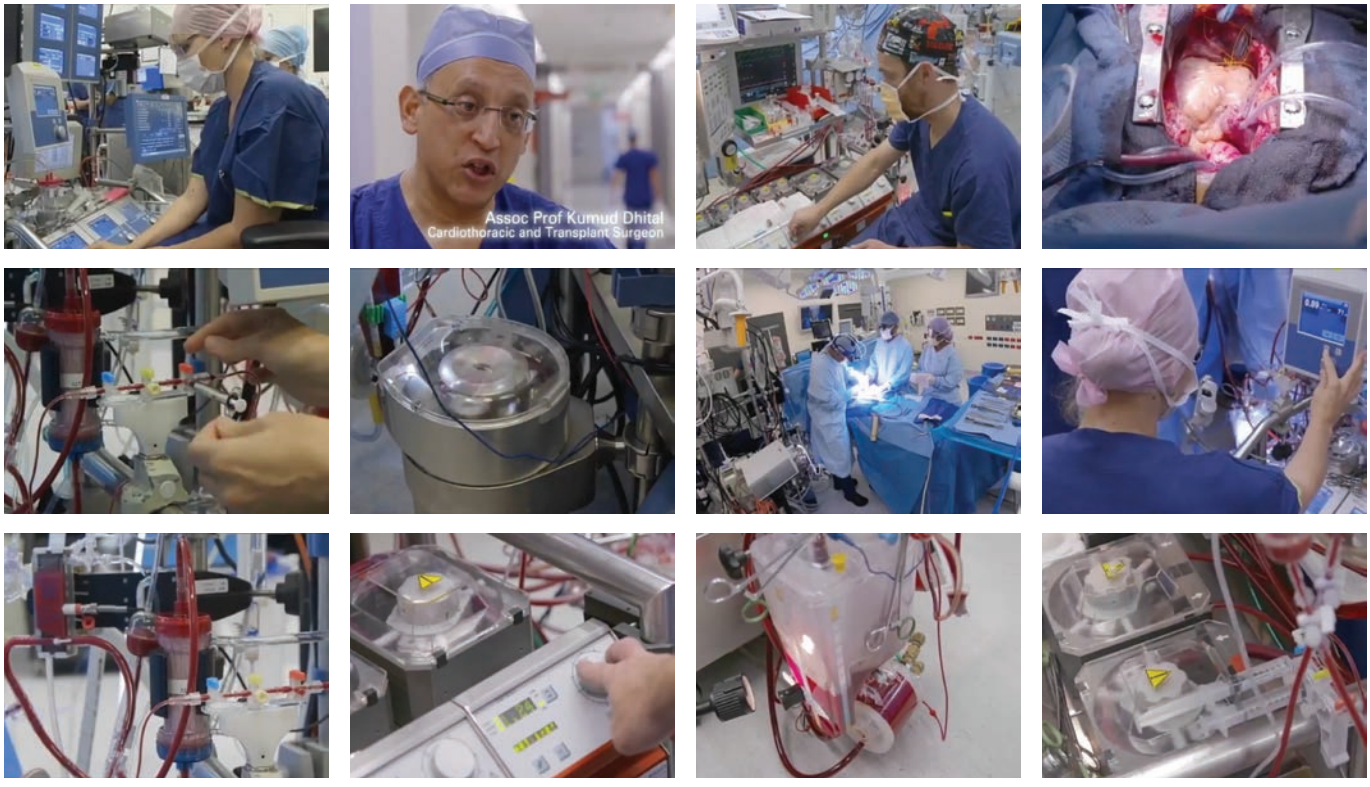
Molly Oldeen

Keeping Australia Alive is a recent documentary series aired on ABC, that films snapshots into the world of the Australian health system, focused on sharing the stories behind the patients, the families, and the healthcare workers. It was all filmed on Wednesday, October 28th, 2015, utilizing "100 cameras, 350 researchers, producers, camera operators, sound recordists and editors, examining 80 hospitals, clinics, surgeries and homes all over Australia and generating 600 hours of video that turned into seven episodes of a documentary series". Executive producer, Karen Dunaway, focused on covering hospitals across the entire country, as well as a broad range of some of the top ten causes of death.

Two of the episodes featured cardiac/thoracic surgical patients and mentioned the important role of clinical perfusionists.

Pediatric perfusionists were aired in episode 4, 'Love and Sacrifice' which was filmed at the Lady Cilento Children's Hospital in Brisbane. In addition, adult perfusionists were shown in episode 7, 'The Costs, The Challenges and the Future' filmed at Saint Vincent's Hospital in Sydney.

Episode 4 follows nine month old Ariana through her open heart surgery to repair her diagnosis of Tetralogy of Fallot. They film cardiac surgeon, Nelson Alphonso, as he describes the process of the repair including steps specifically related to the heart lung machine. He describes how the perfusionist, Carla Zazulak, is 'doing all the work right now', and the processes of stopping the heart to create a bloodless and motionless field.



Episode 7 features a woman, Kerry, who she needs surgery to remove clots in her lungs, as they are leading to right heart failure and increased shortness of breath. Associate Professor Kumad Dhital, a cardiothoracic and transplant surgeon, describes how he will need to support her on the heart lung machine in order to perform the operation. He also describes the process of cooling the patient to 20 degrees C so that they are able to stop the heart, turn off the pump and safely remove the clots.

Jonathan Cropper, the perfusionist in the episode, is filmed running the heart lung machine through all steps of the procedure. His significantly important role is exemplified throughout the procedure, especially during a short period of instability post CPB, where bypass was nearly reinitiated.

Well done to the Perfusionists and hospitals involved! Not only is it great to see our profession in the media, but one can appreciate the surgical experience from the family's perspective as well.

ANZCPR

Australian & New Zealand Collaborative Perfusion Registry

Quality Perfusion through reporting

Last year, the Perfusion Downunder Collaboration underwent a name change to the Australian and New Zealand Collaborative Perfusion Registry (ANZCPR). Recently we completed the 9th annual data harvest, and have now collected data for nearly 25,000 procedures from 9 centres throughout Australia and New Zealand since 2007. This data provides us with an opportunity to meet the objectives of the collaboration; to understand our clinical practice of cardiopulmonary bypass (CPB), provide a foundation for research, and to facilitate quality improvement.

One of the ways in which we can utilise the data to understand clinical practice, is to be able to determine whether existing published studies of observational data can be reproduced. Since these publications are commonly from single centres with relatively small patient cohorts, often from other parts of the world, it leads us to question how applicable these studies might be to our own patients.. The ANZCPR provides us with the opportunity to determine whether these observations can be observed in our regional multicentre practice, or in other words; our patients! This is an important aspect of contributing to clinical science that is often overlooked.

An example that we have recently been looking at relates to the data published by Marco Ranucci and co-workers that describes determinants of hyperlactatemia during CPB and its impact on postoperative outcome (1). In this paper, Ranucci hypothesises that certain perfusion related parameters may contribute to the hyperlactatemia associated with postoperative morbidity and mortality, with specific respect to hemodilution and oxygen delivery. The premise that these factors are related to lactate production is based on the concept of a critical value of oxygen delivery, the assumption being that below this critical value, oxygen consumption becomes limited by oxygen delivery and energy production is partially supplied by anaerobic glycolysis. As a result, lactate production increases. So does our data support this assumption?

Figure 1 shows the relationship between peak CPB arterial blood lactate values and CPB duration, lowest oxygen delivery (figure 2), and the peak blood glucose concentration (figure 3) in 20,938 patients from the ANZCPR dataset.

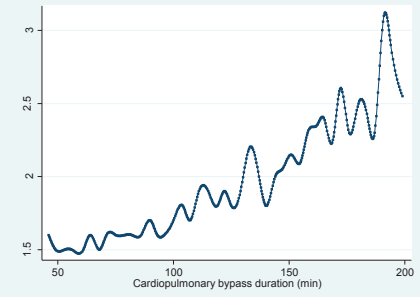


Figure 1

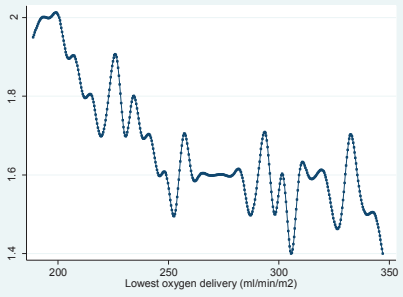


Figure 2

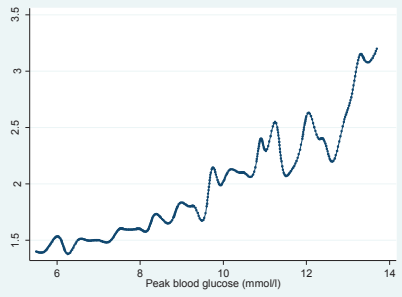


Figure 3

Figure 1-3. Peak arterial blood lactate during cardiopulmonary bypass relative to the duration of bypass, lowest oxygen delivery, and peak blood glucose.. Data are represented as a median spline by using cross medians as knots to fit a cubic spline.

If you compare the ANZCPR results with those published by Ranucci (http://ccforum.com/content/10/6/R167) the results are strikingly similar. Ranuccis' work indicated that the value of oxygen delivery below which the blood lactate starts increasing was approximately 260 ml/min/m2, similar to the cut-off values identified in other studies looking at the relationship between lowest oxygen delivery and acute kidney injury (262 ml/min/m2 (2) and 262 ml/min/m2 (3)). Our corresponding plot, derived from multicentre data supports these findings. Furthermore, similar observations for the data for CPB duration and blood glucose levels and lactate concentration are evident. The ANZCPR data provides compelling support for the assumption of a critical value of oxygen delivery, given a sample size of 20,938 patients – compared with 500 in the published study. This is just one example of how ANZCPR data can be utilised to confirm (or dispute) existing published studies. The next step in this work will be to evaluate the relationship between lactate levels and morbidity and mortality, so watch this space, or even better, become involved in the collaboration.

Recent example of using the registry data for research is the collaboration's publication in the Annals of Thoracic Surgery "Rewarming Temperature During Cardiopulmonary Bypass and Acute Kidney Injury: A Multicenter Analysis" (http://www.annalsthoracicsurgery.org/article/S0003-4975(16)00099-0/fulltext). This study was able to use the power of our multicentre registry to generalise the findings from a single centre study looking at the influence of hyperthermia on acute kidney injury. In our most recent paper we were able to demonstrate that in patients propensity matched based on the likelihood of being exposed to hyperthermic perfusion (rewarming temperature greater than 37oC) that the duration of hyperthermic perfusion was an independent predictor of acute kidney injury (4). Such a relationship was not observed for rewarming temperature duration above 36 or 36.5oC, with the implication being that avoidance of hyperthermic perfusion may be more beneficial in reducing AKI than avoidance of rewarming per se.

Although this data has been only recently published, we have been able to share this knowledge within the Australasian perfusion community for some time. The avoidance of hyperthermic perfusion has been a focus for quality improvement initiatives within the collaboration since 2011 when we introduced benchmarking as a tool for leveraging the data for this purpose. If we track the compliance with this quality indicator over this period, we can see the impact of embracing the ethos of data collection, reporting and feedback on clinical practice (figure 4, figure 5).

Since the introduction of benchmarking, we have seen a reduction in the overall requirement for postoperative dialysis (figure 5.)

We look forward to sharing more of the knowledge gained from participation in the ANZCPR at the upcoming Australian and New Zealand College of Perfusionists Annual Scientific Meeting in Townsville, and the Perfusion Downunder Meeting in Queenstown this year. We really are very privileged to have access to this unique dataset, as it is the only perfusion registry in the world to have incorporated data collected electronically from the heart lung machine software. Please visit our new website ANZCPR.org for more details about how you can get involved.

Richard Newland and Rob Baker on behalf of the ANZCPR.

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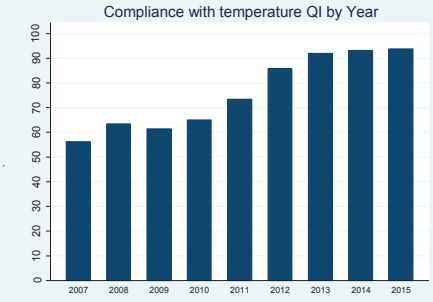

Figure 4. Incidence of avoidance of oxygenator arterial outlet temperature >37°C by year. Overall incidence for the ANZCPR is currently maintained >90% compliance.

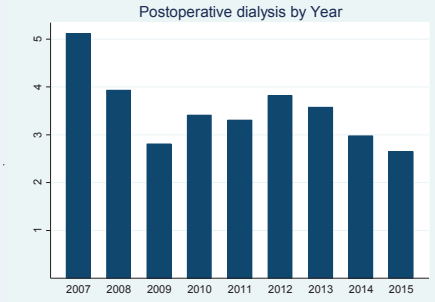

Figure 5. Incidence of avoidance of oxygenator arterial outlet temperature >37°C by year. Overall incidence for the ANZCPR is currently maintained >90% compliance.

UPDATE: MYCOBACTERIAL INFECTIONS ASSOCIATED WITH HEATER COOLER UNITS USED IN CARDIAC SURGERY

June 2016

Background

There is a risk that heater cooler perfusion units used in cardiac surgery may be contaminated with Mycobacterium chimaera, and that exposure of patients to the aerosolised exhaust from these units in the operating theatre may lead to the development of a serious infection up to several years post-surgery. There are no known cases in Victoria to date.

There have been reports of infections and deaths in the US and Europe, although the actual risk of infection appears extremely low. Infections appear to be generally confined to patients who have had a valve insertion or repair or a prosthetic graft.

The Victorian public health laboratory, Microbiological Diagnostic Unit (MDU), has developed an assay for testing water samples from heater cooler units. The turnaround time for the test is six to eight weeks. If a positive result is returned, the Australian sponsor company for the Sorin heater cooler units will decontaminate the unit, provided that it is less than eight years old.

The Therapeutic Goods Administration (TGA) has provided advice for health services and staff in a recent Medical Devices Safety Update (see References). The TGA is continuing to investigate the risk of contamination with heater cooler unit manufacturers.

In Victoria, on Friday 13 May 2016, the Department of Health and Human Services (the department) held a meeting for health services who undertake cardiac surgery for the purpose of sharing information and providing a forum for discussion. Following this meeting, the department has revised and reissued its list of recommended actions for health services (see below).

Recommended actions for health services

Testing

1. Undertake testing of heater cooler units as a matter of urgency to determine if the unit is contaminated.
2. Inform the department of all microbiological test results from heater cooler units until further notice.
3. Ensure maintenance records and any microbiological sampling results are kept for all heater cooler units.
4. Report any confirmed Mycobacterium chimaera infections suspected to be associated with heater cooler unit use to the department, the TGA and to the manufacturer of the unit.

Maintenance

5. Provide the department with the contact details of a designated person from your health service who has been allocated the responsibility of responding to this issue.
6. Advise the department of the brand, model, serial number and age of all heater cooler units in use at your health service.
7. Strictly adhere to the manufacturer' s instructions for cleaning, disinfection and maintenance of the heater cooler unit. Seek clarification from the manufacturer if the instructions are unclear.

Patient Care

8. Ensure the heater cooler unit is positioned as far away from the patient as possible in the operating theatre and ensure that the fan exhaust is directed away from the patient and is close to the suction exhaust outlet of the operating theatre. Seek assistance from the manufacturer if required in order to accomplish this safely and effectively.
9. Ensure patient records include a reference to the individual heater cooler unit used for their procedure to facilitate tracing if required.
10. Consider amending patient consent information to include the (low risk, <1%) possibility of developing serious infections postoperatively up to several years after cardiac surgery.
11. Consider the possibility of Mycobacterium chimaera infection for cardiac surgery patients presenting postoperatively with symptoms of unexplained infection; seek infectious diseases specialist advice to assist diagnosis and management.

Contingency plans

12. Undertake local contingency planning for the ongoing provision of cardiac surgery in the event of a positive test result for Mycobacterium chimaera.

Sampling and testing

If your health service is yet to do so, contact MDU as soon as possible to arrange testing of units.

Labelling

Ensure that samples are correctly labelled, including date, hospital name, heater cooler unit serial number, sample site (ie, which circuit) and details of a designated point of contact for results.

Sampling procedure

The two tests undertaken on heater cooler unit water samples are a heterotrophic plate count (surrogate measure of cleanliness/ overall water quality, results available in 3-5 days) and mycobacteria cultures (results available in 6-8 weeks).

The sampling procedure recommended is that described by Public Health England (see References), with key points as follows:

- Units should be connected and running for at least five minutes before water samples are taken
- Ideally sampling should take place just prior to the machine undergoing its disinfection cycle
- Water should be sampled from both the 'patient' circuit and the 'cardioplegia' circuit
- Sample volume of 100 mL (ie, 100 mL from each circuit)
- If not processed immediately, water should be stored between 2°C and 8°C for up to 24 hours.

Frequency of sampling

There is no consensus around departmental requirements for frequency of sampling at this time – guidance on this issue will be provided as soon as possible.

Responding to test results

If the results test positive for mycobacteria:

- do not use the heater cooler unit
- report positive results to the department, the TGA and the manufacturer as soon as possible
- contact the manufacturer to discuss decontamination. LivaNova Australia Pty Ltd provides a decontamination service for Sorin heater cooler units that are less than 8 years old. Note that this may be a lengthy process depending on the manufacturer' s workload constraints. Follow up testing of samples from decontaminated heater cooler units are currently subject to an 8 week wait for confirmation of negative mycobacterial cultures
- access backup or loan heater cooler unit if possible.

If the results are negative for mycobacteria but the heterotrophic plate count is high:

- disinfect the heater cooler unit prior to further use and re-test as per the manufacturer' s instructions for use
- seek advice from the manufacturer on how to deal with persistently high heterotrophic plate count results.

All microbiological test results from MDU (ie, for Mycobacterium chimaera and heterotrophic plate count) are to be reported to the department until further notice, regardless of whether these are positive or negative. At this time, the department does not require results of any additional heterotrophic plate count tests undertaken by local health service laboratories.

It is advised that health services develop a local contingency plan for the ongoing provision of cardiac surgery in the event of a positive test result for Mycobacterium chimaera. This may include sourcing a back-up or loan heater cooler unit and/or working with other health services. If you think the provision of cardiac surgery at your health service will be affected, please contact the department. Once initial test results are known, the department will provide further information on system level contingency plans if required.

Record keeping

As per the recommendations for health services above, records must now be kept for all heater cooler units if this is not already done. Records must include as a minimum:

- Heater cooler unit details including make, model, serial number, date of manufacture and date of commencement of use at health service
- Dates and sufficient detail of all maintenance and disinfection procedures
- All microbiological test results
- Patient medical records including details of the individual heater cooler unit used in the procedure

Note that record keeping is the responsibility of the health service. While the department will also monitor and record microbiological test data from Victorian health service heater cooler units over the next 1-2 years, this does not take the place of health service records.

Costs

The cost of testing by MDU is anticipated to be $230 per sample. LivaNova Australia Pty Ltd is currently charging health services $6,400 to decontaminate affected Sorin heater cooler units.

Contacts

Department of Health and Human Services
(for submission of test results)

Glenda Gorrie, Assistant Director, Quality and Safety

Ph: (03) 9096 7553, email: glenda.gorrie@dhhs.vic.gov.au

Sampling and testing inquiries

Microbiological Diagnostic Unit Public Health Laboratory, University of Melbourne, Parkville VIC

Ph: (03) 8344 5701

Reporting of a suspected adverse event relating to a medical device

Therapeutic Goods Administration Medical Devices Branch Ph: 1800 809 361, email: iris@tga.gov.au

Further information and references

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CARDIAC MORPHOLOGY AT THE CHILDREN'S HOSPITAL AT WESTMEAD

By Martin Gill

Morph - meaning "form"

- Ology meaning "the study of"

As a trainee perfusionist at the Children's Hospital at Westmead one of the highlights for me was Dr Richard Hawkers Morphology/ Pathology days. These infamous sessions saw a group of people huddled around a table whilst Dr Hawker removed sealed plastic bags from a white bucket, sliced them open with a somewhat rusty scalpel blade, thus permitting the contents to spill out onto a conveniently placed tray.

The smell of Formalin was close to overpowering, resulting in every eye in the room watering. Occasionally one or two medical students would leave the room retching. Those that managed to remain were in for a real treat. The cardiac specimens available for analysis were approximately 20-30 years old with conditions ranging from ventricular septal defects, right through Tetralogy of Fallot to Truncus Arteriosus and Hypoplastic Left heart Syndrome. Some of the conditions had had corrective surgery, some not, and one had most likely passed away in the cath lab. as evidenced by the rather large hole in the side of the RV to PA conduit.

People in the room would have the opportunity to handle the specimens and hopefully, under the experienced eye of Dr Hawker, correctly diagnose the cardiac abnormality. The atmosphere in the room was always non-threatening and surprisingly fun despite the slightly macabre undertones.

The educational value of an extensive understanding of cardiac morphology cannot be overestimated. Such an understanding is essential if one is to understand surgical correction and treatment. For the perfusionist this results in better being able to predict what is happening or going to happen within the surgical field, thus being able to take measures to ensure safe practice or to optimise the flow of the procedure.

Unfortunately, as Dr Hawker wound down towards retirement so did the morphology sessions. For a time they were occasionally discussed with fondness, but after a while became all but forgotten…….

Fast forward to 2015 and the Children's Hospital has employed several new cardiologists and was about to host a 'Hands-on Cardiac Morphology' course ran by Dr Andrew Cook. Dr Cook is Senior Lecturer and heads the Cardiovascular Morphology and Education Unit at the UCL Institute of Cardiovascular Science / Great Ormond Street Hospital, London, UK.

The two day course was primarily geared to improving knowledge of cardiac anatomy, in particular congenital heart malformations from fetal life to adulthood. Information was imparted through didactic lectures and of course hands-on!!!

Now, I am sure you can imagine the Australian Customs and Border Protection service is not going to waive someone through Kingsford-Smith with a suitcase full of preserved hearts. What was needed was a ready supply of preserved hearts demonstrating an array of congenital cardiac malformations…..which brings us full circle to Dr Hawkers samples from my trainee days.

Dr Hawkers cardiac samples had not seen the light of day for some 5 years. Each sample HAD been individually sealed in a plastic bag filled with Formalin then placed in a bucket with other specimens of a similar ilk. Unfortunately many of the specimens were completely decimated due to leakage or evaporation of the preservation solution. Out of 300 specimens approximately half were completely useless and many more were significantly damaged. Luckily, enough had survived, and of sufficient variability to be used.

The two day course was fantastic with just the right mixture of lecture and hands-on components. Under expert guidance, course participants had the opportunity to handle, analyse, and attempt to diagnose some of the wide array of congenital malformations on offer.

Each specimen used throughout the course had been previously cut by a pathologist thus permitting ready access to all chambers and associated structures of the heart. Dr Cook subscribes to 'Sequential Segmental Analysis' as a means of determining and categorising cardiac malformations. Sequential Segmental Analysis of

the congenitally malformed heart is based on the premise that the heart possesses three component parts, namely the atriums, the ventricular mass, and the arterial trunks. These parts are known as "segments", and each of the segments in the normal heart contains two parts, the right and left atriums and ventricles, and the aorta and the pulmonary trunk. When a heart is abnormal, there are limited ways in which these components can be deranged. Describing the derangements is the essence of sequential analysis.

Following any conference I attend I usually have a period of feeling completely reinvigorated academically speaking. I do, of course, struggle with prolonging this feeling for any significant period of time. Fortunately I was not the only one who felt this way after this particular course. Approximately six months after the course one of our cardiologists approached me for help in restarting Dr Hawkers Morphology/ Pathology sessions.

The cardiologist in question had already catalogued all the surviving cardiac specimens and, after speaking to the head of the Pathology laboratory had decided to place the samples in a 10% honey solution. The thought being that after approximately 30 years in Formalin the specimens had been sufficiently stabilised, we now just needed to preserve them. Such a strategy had the added bonus of avoiding the rather confronting odour of the former preservation solution.

So the date was set for the first in a new series of morphology/ pathology sessions. The chosen topic was to be Tetralogy of Fallot. Three buckets of samples were available containing approximately fifteen hearts.

I must admit to being fairly excited as I made my way down to the pathology laboratory to retrieve and prepare the samples about an hour or so before the session commenced. This excitement soon dissipated when I opened the first specimen bucket to a smell of alcohol and a nice growth of yeast on top of the hearts; a situation that was repeated in the second and third buckets.

The growth was easily washed off, but clearly the 10% honey was not a long term solution to the preservation of the cardiac specimens.

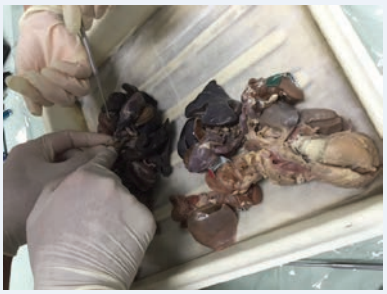
The session went ahead and was a great success. As I had experienced during Dr Cooks two day course, the participants attending this hour long session all immensely enjoyed the opportunity to handle and, again under tutelage, systematically work their way through the heart in such a way that maximised the educational impact of the session. Participants included cardiac surgeons, cardiologists, perfusionists, nursing staff and medical students; with each bringing a unique and different perspective to the session.

Once the session was finished the next task was returning the specimens to their buckets and preservation solution….. Obviously this was not going to be possible in the honey solution. We once again spoke to the pathology laboratory manager who suggested adding copper to the honey to kill the yeast. This may well be a long term solution to our solution problems but we were not willing to take any chances with the specimens.

So, it was back to the old tried and tested Formalin. This required the opening and washing of some 150 samples. A mixture of aerobic and anaerobic fungus was found in many of the buckets containing the 10% honey. This situation most certainly will not occur with Formalin…. Just smell, lots of smell.

I am pleased to report that we are going to continue to run the sessions. I can certainly recommend attending any such sessions if you have the opportunity at your institution. If not, I can recommend Dr Cooks morphology course if and when it returns to Australia.

In the meantime you can visit **http://www.cardiacmorphology.com** and register for free to obtain access to a truly great online resource containing videoed morphology examinations of cardiac specimens… Enjoy!!!



DEL NIDO EXPERIENCE

By Carla Zazulak - *Lady Cilento Children's Hospital - South Brisbane*

Approximately 8 months ago at the Head surgeons request we investigated the possibility of adding 'del Nido' Cardioplegia 1:4 ratio of blood to crystalloid to our Perfusion imprest alongside our current 'Paediatric Buckberg' Cardioplegia 4:1 blood to crystalloid - which has been used here for the past 8 years and that we have found to provide good myocardial protection.

The perceived benefits were that the surgeon could continue operating with less time spent in delivering cardioplegia doses on long complex cases and that perhaps we would see a longer period before return of activity.

The first issue encountered was around del Nido not being available commercially in Australia or New Zealand.

We liaised closely with our in-house Pharmacy staff, providing literature reviews and the current recipe that existed from Boston Children's Hospital in the USA.

Pharmacy conducted their own research as well as surveying colleagues around Australia to gauge the interest in del Nido use and the possibility of it being produced commercially in the future.

Our Pharmacy was then able to offer us del Nido cardioplegia made by them and prescribed/labelled for each individual patient that required it. This proved to be challenging at times when there were last minute changes to the list.

Our next step was to then find a way to use our current Cardioplegia set in a way that allowed us to be able to use either of the Cardioplegia solutions as well as continue to be able to use it for Modified Ultrafiltration.

A review of our circuit allowed us to make a small change and add one 1/4x1/4 luer lock connector pre cardioplegia pump to give us the ability to deliver the del Nido at that connector without drastically changing our design.

When the del Nido is attached to the tap on the connector a clamp is placed proximal to the connector allowing the del Nido crystalloid to flow in to the 1/4 " tubing rather than blood from the oxygenator. We then bag off some patient blood after going on bypass and connect this to the 1/8 " line that would normally have the Buckberg CP connected to it - and this gives us the 1 part blood needed for del Nido delivery.

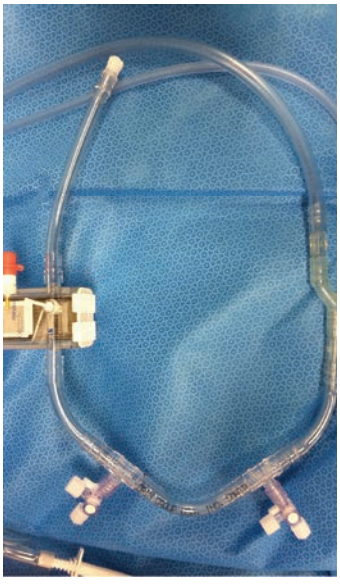
Once the cross clamp is off we simply clamp off the del Nido bag, turn the tap off on the 1/4x1/4 Luer Lock connector and remove the proximal clamp on the tubing. This then allows us to convert our cardioplegia circuit to our normal MUF configuration in preparation for Modified Ultrafiltration post bypass.

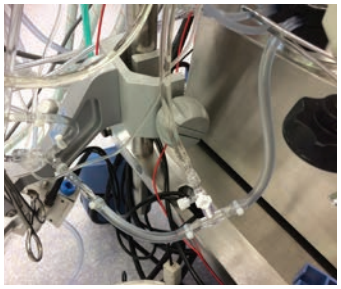
To date we have used del Nido in over 60 patients. The average time between doses is around 80 -90 minutes. We currently select del Nido for any patient where we expect the cross clamp time to be over 60 minutes or at the surgeons specific request.

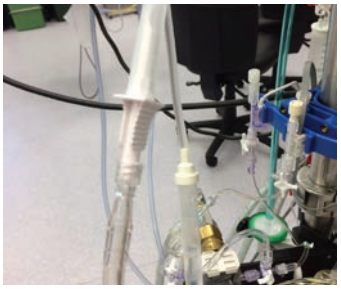
We are still getting to grips with how best to utilise it and how often we should be re-dosing with del Nido - especially in cases where we are keeping the patient normothermic or only cooling slightly. I would be interested in hearing about other units experiences with del Nido and their protocols for use.

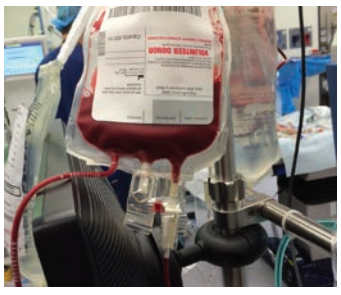
Our Pharmacy currently copes with the demand of making this solution in-house and are prepared for us to increase our usage in the future if need be.

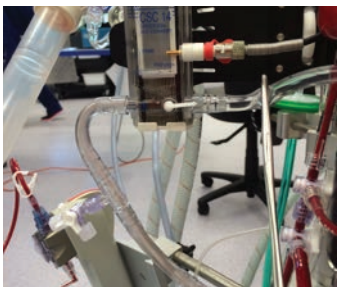
Carla Zazulak
Lady Cilento Children's Hospital - South Brisbane











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PERFUSING A HEMOPHILIAC AT THE CANBERRA HOSPITAL

Casey Edwards

Introduction

Hemophilia patients in the Western world now have higher life expectancies than ever before. It is suggested that children born today with hemophilia will have an equivalent life expectancy to unaffected persons (Mejia-Carvajal et al., 2006). As healthcare professionals we will be increasingly faced with the prospect of treating age-related disorders in hemophiliacs. Cardiac surgery in particular poses a significant hemostatic challenge because of the need for a sternotomy, heparinization, extracorporeal circulation, hypothermia and cardiac arrest (Tang et al., 2009). On the 3rd of November 2015, we were presented with this particular challenge at the Canberra Hospital.

Hemophilia – details and mechanism

Hemophilia is a hereditary clotting disorder with a X-chromosomal inheritance pattern. It manifests as a deficiency of either clotting factor VIII (hemophilia A), or factor IX (hemophilia B). There are a number of genetic mutations that result in hemophilia, with different mutations resulting in different levels and morphologies of the affected clotting factor production. Consequently the disease has a spectrum of severity. A patient with less than 1% active factor VIII or IX is classified a severe hemophiliac, 1–5% active factor a moderate hemophiliac and 5–40% a mild hemophiliac (Butenas et al., 2002).

Patient parameters

The patient to be discussed is a 72-year-old male with hemophila A. His average factor VIII levels were 36% of normal production. Therefore, he is considered a mild hemophiliac. He was otherwise fit and well at the time of surgery, measuring 171cm tall, weighing 84kg and with a body surface area of 1.98cm2. He suffered from severe triple vessel disease and was admitted to the Canberra Hospital consenting to 3 coronary artery bypass grafts.

Preoperative care

A specialized hemophiliac nurse managed the patient's preoperative care. Thirty minutes prior to surgery, he received a 2500IU bolus of Advate (recombinant factor VIII concentrate). A continuous factor VIII infusion (CFI) of 130IU/hour was instituted from then on, with the intent to titrate this infusion post-operatively in response to factor VIII levels observed.

Cardiopulmonary bypass

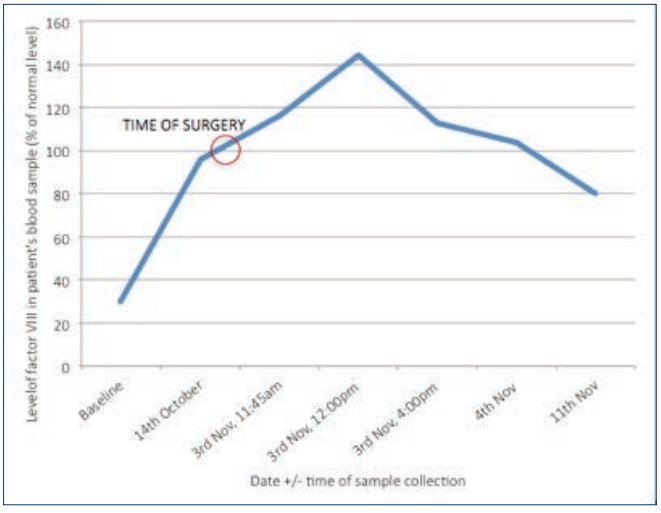
The Stockert SIII heart lung machine was set up as per routine with a Medtronic Fusion oxygenator and patented bonded circuit. It was then primed with 1500mL of Plasmalyte, 250mL of 4% Albumex and 15,000U of heparin sodium. After the induction of anaesthesia, a baseline blood gas and activated clotting time (ACT) was obtained, returning a reading of 133 seconds. After administering 35,000IU of heparin sodium, the ACT elevated to 756 seconds. The lowest ACT recorded during bypass was 603 seconds and no additional heparin was given on pump, aside from the 15,000 units added to the priming solution.

The case was uneventful. The bypass time was 64 minutes, the cross clamp time was 53 minutes and the patient spontaneously converted to sinus rhythm. In the immediate postoperative period following heparin reversal with protamine sulfate, the patient's ACT returned to 130 seconds. Minimal postoperative blood loss was observed thus the patient was transferred smoothly to the intensive care unit for ongoing treatment and monitoring.

Postoperative outcome

In addition to routine post-cardiac surgical care, the patient's factor VIII levels were checked at non-specific time intervals during his intensive care stay. His factor VIII levels are depicted in the following graph:

A hemophiliac patient's factor VIII levels pre and post cardiac surgery:



It is evident from the above graph that the patient's factor VIII levels significantly exceeded 100% of normal, peaking at 144%.

Shortly after extubation and the patient returning to consciousness, it was noted by ICU staff that he had suffered a cerebral event. He exhibited dysphasia and muscle weakness. At four months post surgery, his difficulty speaking and impaired comprehension were persistent as a result of his stroke. There we no other complications of note with regard to his recovery from surgery.

Discussion and conclusion

It is well understood that strokes are a risk of cardiac surgery with cardiopulmonary bypass. It is also understood that such events may result from a variety of causes (Hogue et al., 1999), therefore, it may not be possible to delineate the specific causative agent of a stroke following bypass. It has been speculated that in our case, excessive factor VII rendered the patient hypercoagulable thus resulting in clot formation and stroke. This hypothesis cannot be confirmed nor rejected but from experience, we can suggest that maintaining postoperative factor VII less than or equaled to 100% may be prudent to ameliorate the risk of cerebral events. The case outlined above highlights that being overzealous with blood management may be just as dangerous as being lax.

Perhaps more frequent monitoring of factor VIII levels at fixed time intervals post-bypass may have enabled the patient's hemophilia coordinator to titrate his factor VIII infusion more accurately and identify excessive factor VIII levels more quickly in the immediate postoperative period. This would have minimized time the patient spent in a potentially hypercoagulable state. Additionally, no factor VIII level tests were completed between the preoperative bolus and the commencement of surgery. Perhaps the effect of the bolus could have been evaluated before progressing to surgery, which may have affected the rate of infusion that was subsequently commenced.

Our first experience perfusing a hemophiliac was both eventful and informative. No firm conclusions can be drawn about the cause of our patient's stroke, however our management of hemophiliacs in the future is likely to be different as a result of his experience. Since the life expectancy of those with the disease continues to improve, we do anticipate facing similar cases in future. In such circumstances, as a team we would endeavor to monitor factor VIII levels more closely and adjust infusion doses with greater vigilance to ensure factor levels do not exceed 100% of normal. In doing so, we would hope to avoid one of the many risk factors for post cardiac-surgical stroke.

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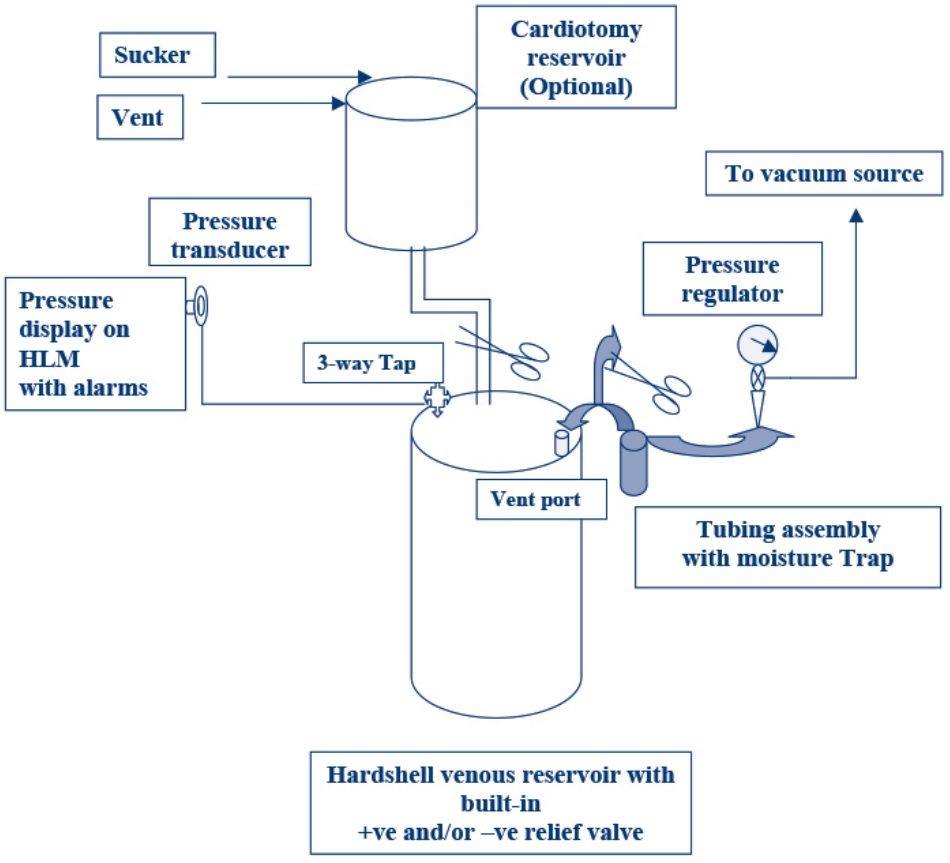
VACUUM ASSISTED VENOUS DRAINAGE (VAVD): PITFALLS AND SUGGESTIONS

Monique Brouwer and Ray Miraziz, *Westmead Hospital, Sydney*



The Inaugural Australasian Simulation and Perfusion (ASaP) meeting was held in May this year, at Royal North Shore hospital. One of the simulation sessions included in this meeting featured VAVD. An overview of the technique was provided whilst the safety issues were demonstrated and strategies to prevent inadvertent pressurisation/implosion were discussed and practiced.

As minimally invasive surgical procedures become more prevalent it is likely that there will be an increase in the need for VAVD.

As with many safety practises it is easy to become complacent in their use. It is important to review safety measures periodically and refine or expand on how we approach a technique. Caution will lead to safer outcomes.

We have compiled a summary of the safety features for VAVD as reviewed at the ASaP meeting.

The do's and don'ts of VAVD

The do's

1. Ensure the use of a functioning/calibrated vacuum regulator with built in positive relief valve (or a regulator with both +/- relief valves if available).
2. Ensure your hard shell reservoir has a positive and negative pressure relief valve (or add via a leur port).
3. Include a moisture trap, when using a Y connector, to protect the patient's circulation from contamination (condensation leaking back from the vacuum line into the patient reservoir).
4. Pressure displays must have **audible** alarms to alert the perfusionist of any positive pressure at all and negative pressures beyond acceptable ranges. Remembering that the effective negative pressures are the sum of the

vacuum (as per your regulator) + the siphon contribution (depending on the height of the table above the reservoir). We choose a positive pressure alarm setting of + 7mmHg (allowing for some inaccuracies) and a – 60mmHg (a sum total of -75 to -90 mmHg depending on table height).

5. In difficult cases, with the use of multiple suckers/vents, consider the use of a separate cardiotomy reservoir in order to overcome the effects of free air flow. Air pumped directly into the reservoir by the sucker or vent:

- May reduce the –ve pressure applied and interfere with venous drainage
- May produce excessive +ve pressures and overcome the -ve pressures (especially if only using low levels of –ve pressures).

6. Consider the use of an empty prime bag connected to the reservoir as a visual sign that the reservoir is pressurised. This may however delay the audible alarm from alerting the perfusionist of an urgent problem.

7. Apply safe levels of vacuum. Normally -20 to -40 mmHg to augment venous drainage after commencing bypass.

8. Always **stop the vacuum** before you come down on arterial blood flow or as the first step in weaning the patient off bypass. Excessive -ve pressures in the reservoir can pull air across the microporous membrane oxygenator and allow air to enter the patient's circulation. The main arterial pump pressurises the oxygenator however this positive pressure is lost when the flow is reduced and the negative pressure in the reservoir is then transmitted to the oxygenator.

9. Maintain adequate blood level in the reservoir to protect the patient from GME.

10. What you should **do** when you hear an audible VAVD alarm:

- **Any VAVD alarm = get rid of vacuum!** then assess the situation
- Stop suckers and/or vent pumps immediately (unless using a separate cardiotomy).

11. Include VAVD in your pre-bypass checklist. Checks should include:

- Positive and negative pressure relief valves are insitu
- Alarm limits are set and audible alarms are functioning
- There are no leaks in the system (caps tightly on all ports)
- Wall suction is connected and working well.

The don'ts

1. Do not leave syringes with drugs attached to the manifold. Syringes can be aspirated into the reservoir if ports are not fully closed or accidently forgotten.

2. Do not apply –ve pressures more than -60mmHg as this may:

3. De-prime the oxygenator when pump flows are low

- Decrease the efficiency of the arterial pump (negative pressure effect on the raceway tubing).
- Decompress the reservoir providing false assurance that adequate blood levels are present
- Increase gases coming out of solution in the blood leading to GME.

4. Do not fully clamp the side line if using a Y connector as this can provide an escape for air when vacuum is discontinued.

5. Watch your vacuum line carefully ensuring it is not kinked or inadvertently clamped trapping pressures within the reservoir.

6. What you should **not** do when you hear an audible VAVD alarm:

- Reduce pump flow without first releasing vacuum
- Clamp venous line to protect the patient from a pressurised reservoir before releasing vacuum

Remember you must release the vacuum first.

Reducing pump flows when your -ve pressures are too high may result in air being pulled across the membrane

Clamping the venous line if you have a pressurised reservoir may lead to a reservoir exploding something that is hard to recover from.

7. Do not increase your vacuum when there is a significant amount of air entrained in the venous line.

Increasing the vacuum increases the GME delivered to the patient. Air in the venous line needs surgical intervention. The venous cannula needs to be sitting in a pool of blood in order for an increase in vacuum to effectively increase venous drainage and facilitate the emptying of the heart. If vacuum is increased when the caval cannulae are poorly snared or if there is a hole in the atrium then you are only increasing the GME delivered to the patient (accelerating venous air entrainment - sucking in more air!)

The ASaP meeting was terrific opportunity to practice VAVD and simulate many of its pitfalls. We look forward to future simulation meetings and congratulate Darryl, Jane and Arthur on this initiative.

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CEREBRAL PROTECTION MANAGEMENT DURING DHCA: A REVIEW OF CURRENT METHODS

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Abstract

The idea of Deep Hypothermic Circulatory Arrest (DHCA) regarding cerebral protection has been around since 1975. First performed by Greipp and colleagues, DHCA aims to provide a decrease in the brains metabolic rate and oxygen requirement with the reduction of temperature, allowing a bloodless field for the surgeon. Its use is commonly used for surgical correction of paediatric cardiac anomalies, but routinely used for complex aortic surgery in adults. DHCA has its disadvantages, such as coagulopathy, extended bypass time, elevated inflammatory response, and end-organ dysfunction, with neurologic injury being of the highest concern. Continuing development of cerebral monitoring and pharmacologic advancements, have caused a great discussion in optimal cerebral protection during DHCA. This review aims to provide an update of practices and methods of the last decade, concerning cerebral protection with focus on pharmacologic protection, cannulation techniques and the discussion of use of antegrade cerebral perfusion. The purpose of this review is to determine the most effective method of which cerebral protection can be achieved when under hypothermic circulatory arrest.

Introduction

The idea of Deep Hypothermic Circulatory Arrest (DHCA) regarding cerebral protection has been around since 1975. First performed by Greipp and colleagues, [1] the use of hypothermia aims to provide a decrease in the brains metabolic rate and oxygen requirements of hypoxic tissues. It is said that the cerebral metabolic rate decreases by 50% for every 6°c drop in brain (core) temperature, permitting a longer period of interrupted blood flow to the brain. [2]Initially used for the replacement of the aortic arch, DHCA is today used in surgery concerning complex cerebral aneurysms, complex paediatric cardiac anomalies, throacoabdominal aneurysms and renal carcinomas extending to the right atrium.

As little as 10 years after DHCA was being implemented in arch surgeries, cooling to deep and profound temperatures during circulatory arrest caused concern for the patients physiologic consequences. Concerns such as hypothermia-induced bleeding complications, and prolonged perfusion times causing an increase in systemic inflammatory response led researchers to support lesser degrees of hypothermia. [3]Optimal circulatory arrest temperature during arch surgery remains under great debate and strategies for HCA very greatly between centers around the world. In recent times, there have been concerns over the neurocognitive deficits potentially being caused by hypothermic neuronal injury, Permanent and Temporary Neurological Dysfunction.[4]

This review aims to provide an update of practices and methods of the last decade, concerning cerebral protection with focus on pharmacologic protection, cannulation techniques and the discussion of moderate vs deep hypothermia. The goal of this review is to determine the gold standard for temperature and techniques, whilst undergoing circulatory arrest, in achieving optimal cerebral protection.

Pharmacologic management

Pharmacologic interventions regarding DHCA and organ protection, namely cerebral protection, have been under constant debate, and a standardization of treatment is non-existent. Hypothermia itself is able to protect against cerebral ischemic injury by reducing $CMRO_2$, attenuating Ca^{2+} accumulation and other mechanisms. [5]Pharmacological agents aim to reduce the basal metabolism of the brain, about 20%, of which hypothermia does not affect. The beneficial use of barbiturates, steroids, lidocaine and calcium channel blockers have all been demonstrated in animal trails, however, further have stopped short of concluding beneficial evidence in clinical trials.

Barbiturates, in particular thiopental, are the most commonly used pharmacologic agent for cerebral protection (59% of respondents), according to a survey of the Association of Cardiothoracic Anesthetists in the UK in 2002[6]. The use and protocols of administration of barbiturates vary from hospital to hospital. They are used in addition to hypothermia to increase the tolerance of cerebral tissues to ischemia that may be caused temporarily from circulatory arrest. Used for its ability to reduce $CMRO_2$, cerebral edema and free radicals, it was first reported by Nussmeier et al in 1986 that the use of thiopental prevented neuropsychiatric complications 10 days after cardiac surgery[7]. Zaidan et al. then found that there was no significant difference of the action of thiopental on the postoperative neurocognitive dysfunction of the patient. [8]It is still used today, as the drugs' ability to reduce cerebral oxygen demands as well as intracranial pressure. A study by Schwer et al. in 2013 showed molecular evidence that thiopental inhibits global protein synthesis in neurons, reducing the ATP consumption as well as cellular damage in oxygen deprived cells[9]. This energy balance in hypoxic cells is crucial in maintaining cerebral protection, especially under rewarming. As Hirotani et al. in 1999 showed, decreased oxygen delivery calculated through jugular venous saturation upon rewarming can be avoided with the use of thiopental, as oxygen consumption is decreased[10].

As thiopental will lower the energy state of the brain, the timing and dosage being administered is also quite crucial. If thiopental is administered too early before being cooled, the vasoconstriction effect of the barbiturate will reduce cerebral blood flow, and impair cerebral cooling. [11]The inhibition of glycolysis would prove detrimental to the energy state of the brain if administered to early[12]. Hirotani et al showed that thiopental being administered 5 mins prior to circulatory arrest, at a dose of $30mgkg^{-1}$, resulted in lower cerebral oxygen consumption, when compared with a lower dose, combined with no neurologic complications[8].

Steroids are used in conjunction with thiopental, namely dexamethasone and methylprednisolone, to offset the systemic inflammatory response of cardiopulmonary bypass. It is known to reduce proinflammatory cytokines and cerebral edema with the optimal timing and dosage relatively unclear. The effect of cerebral response to ischemia was first shown by Langley et al. [13]when high dose methylprednisolone was given to piglets prior to induction of anesthesia, resulting in a significant recovery of cerebral blood flow and cerebral metabolism in the steroid-treated animals. Further research by Shum-Tim et al. [14]and Lodge et al. [15]both showed that steroid treatment given systemically pre-operatively showed a significantly reduced inflammatory response, reduced body oedema as well as improved immunohistochemical markers of neuroprotection. Based on studies concerning positive results of large doses of methylprednisolone given to patients after spinal cord injuries, there is continued support for the use of corticosteroids during DHCA for neuroprotection. At a dose of 30 mg/kg either preoperatively or as early as possible would be beneficial to the patient, with a close monitoring of hyperglycemia caused by the corticosteroid.

Mannitol is another commonly administered drug by the perfusionist during DHCA, as not only does it protect the kidneys by decreasing the renal vascular resistance, reduces endothelial oedema and preserving tubular integrity as an osmotic diuretic, and can also reduce cerebral edema and scavenge free radicals, leading to a decrease in tissue damage. [16]Its effect on improving blood rheology and the osmotic potency is treatment for cerebral edema. [17]Since 1981, it has also been shown by Hanley and Davidson [18] that the combination of furosemide and mannitol being administered preserves renal function in ischemic conditions. Standard dose of 0.5g/kg for administering mannitol, with Appoo et al. [19]suggesting 0.25g/kg 10 to 15 minutes prior to exsanguination, and a further 0.25g/kg upon the restart of CPB.

Lidocaine is also used as a cerebral protective agent as it reduces cerebral metabolism and has membrane stabilizing properties by selectively blocking Na+ channels in neuronal membranes. [20]These properties were initially shown in dogs to prolong the safe duration of DHCA by inducing an isoelectric EEG, reducing the $CMRO_2$ by an additional 15-20%[21]. In a more recent study on humans, doses of greater than 42.6mg/kg in non-diabetic patients were shown to improve cognitive outcome 1 year after surgery, however in diabetic patients, high doses showed an increased postoperative neurocognitive decline[22].

Moderate vs deep hypothermia

The role of temperature control and adjunctive perfusion in hypothermic circulatory arrest is of vital importance, with the debate over ideal hypothermic temperature a contentious issue. Ever since Griepp and his associates first described performing aortic arch surgery with hypothermic circulatory arrest 40 years ago, the ideas and techniques of arch surgery have continued to change and cerebral perfusion has evolved into a standard method of cerebral protection during arch surgery. They initially reported on 4 patients undergoing aortic arch surgery using profound hypothermic circulatory arrest. With one patient dying 4 days in the post-operative period, they concluded that their experience of using this total body hypothermia and circulatory arrest can be carried out with an acceptable mortality rate1. The outcome of this study was a huge development in surgery of the aortic arch. As time progressed, moderate hypothermic circulatory arrest with adjunctive cerebral perfusion, was proposed to negate potential hypothermia-related comorbidities whilst still maintaining adequate cerebral protection.

With the aim to prevent ischaemic cerebral injuries during arch surgery, Temporary and Permanent Neurological Dysfunction have become indicators in assessing cerebral injury post bypass.

The incidence of Temporary Neurological Dysfunction after arch surgery using DHCA alone is quite significant. A study by Ergin et al. [23] in 1999 was conducted to determine the correlation of the incidence and severity of TND post DHCA. The study found that in a patient group of 71, 28.1% of all patients who underwent DHCA acquired a TND – resulting in deficits in memory and motor functions at 6 weeks of testing. It was concluded that the temporary exclusion of cerebral circulation may attribute to this result; however, further research is needed to determine the contributing cause of this complication.

Studies were then performed to determine whether the addition of Antegrade Selective Cerebral Perfusion (ASCP) to patients undergoing DHCA would help resolve the incidence of this complication. A multicentre study by Di Eusanio et al. in 2003 [24] evaluated the results of ASCP as a method of brain protection whilst under DHCA and its effectiveness in reducing TND. Their results showed that in 588 patients across the 3 centres, there was a reported TND rate of 5.6%. They successfully showed a lower result of TND when ASCP was used in conjunction with DHCA.

In recent times, there have been several studies performed around the world trying to evaluate the use of moderate hypothermia with routine ASCP and its effect on TND when compared to deep hypothermic circulatory arrest. In 2007, the Bologna group performed a study of 205 aortic arch operations employing the cooling protocol of either moderate or deep hypothermic circulatory arrest [25]. With no significant difference in ASCP time or CPB time, they found that there were no differences between the groups with regard to 30 day mortality, and permanent or temporary neurological dysfunction.

In 2010, Leshnower and his colleagues presented a retrospective review of 5 years of data for arch cases involving were able to show very low neurological complications in more than 400 patients undergoing moderate hypothermic circulatory arrest.[26]By using selective antegrade cerebral perfusion at an average of 26 degrees, they were able to achieve a TND rate of 5.1%, with other morbidity outcomes being very low as well. They effectively showed that MHCA in combination with SACP provides and effective cerebral protective method in patients requiring arch reconstruction.

Cannulation Site

The idea of providing continuous perfusion to the brain at a moderate temperature has reasonably been shown by the literature to be a viable and safe practice for surgeries on the aortic arch. However, it is the location of the cannulas to perfusion the brain which has also caused some debate. When referring to permanent neurological dysfunction, incidences have been shown to be directly related to the site of arterial cannulation after arch reconstruction, mainly due to embolization from atheroma of the cannulated vessels and possible further aortic dissection

The cannulation of the right axillary was initially described in 1995 by the Cleveland Clinic group, as these arteries are usually free from atheroma, are rarely involved in aortic dissection in cases of Type A dissections. It was a more advantageous location in which to provide antegrade systemic perfusion during the rewarming phase. Auxillary cannulation can provide unilateral or bilateral cerebral perfusion. The

choice between these techniques has also been a highly published issue.

In determining which method of cerebral perfusion should be chosen, a pre-operative assessment of the cerebral circulation is recommended, as an incomplete circle of willis can occur in 6 to 17% of cases[17]. It has been controversially hypothesized by Urbanski that the Circle of Willis is not the only pathway for cerebral cross-perfusion, and that extracranial collateral circulation most likely plays a meaningful role during unilateral SCP in patients with incomplete Circle of Willis[27] . However, the use of Near Infrared Spectroscopy is said to be able determine if bilateral cerebral perfusion is necessary if there is an incomplete circle of Willis and no extracranial collateral circulation.

In a large study by Zierer et al in 2012, they reported on 1002 patients who underwent partial or total aortic arch repair. They compared the results of patients receiving uni- and bi-lateral cerebral perfusion under mild HCA. Their results showed that unilateral ACP offers as much brain and visceral organ protection as bilateral ACP, and could be advantageous, as it avoids the manipulation of the arch vessels and possible embolization. They noticed a trend towards a reduced PND (p=0.06) after unilateral ACP, and no difference in the occurrence of transient neurologic deficits.(p=0.6)[28].

There are quite a few studies that back up this claim, such as a recent single centre study by Preventza et al in 2015 on 157 patients undergoing proximal aortic dissection. With a mean ACP time of 34 mins, the study found no significant difference between unilateral and bilateral ACP in many variable outcomes. As one of the largest single centre studies of the efficacy of unilateral and bilateral cerebral perfusion in patients with type a dissection they concluded that unilateral cerebral perfusion is a reasonably justified for most operations, with circulatory arrest times of greater than 40 minutes being recommended to use bilateral antegrade perfusion. [29]

This conclusion of the appropriate time for cerebral perfusion in relation to cannulation site was assessed by Malvindi and associates. They performed a meta-analysis of 2949 patients receiving bilateral cerebral perfusion and almost 600 receiving unilateral perfusion. Their findings showed that when unilateral antegrade perfusion was performed for a period of 30 to up to 50 mins, they produced similar neurological injury rates when compared to bilateral antegrade perfusion periods of over 86 mins, at 5%. [30]

This article, like many in the past, has shown that there is still no definitive answer to the question of which optimal temperature should be universally applied to hypothermic circulatory arrest whilst performing arch operations. However, it does show that the following protocol, in terms of anesthetic management, cannulation position, and temperature, provides optimal cerebral protection in patients requiring hypothermic circulatory arrest.

- Administration of steroids (dexamethasone at 30 mg/kg) as early as possible to reduce proinflammatory cytokines and cerebral oedema.
- Barbiturates (thiopental, 30mg/kg) to reduce $CMRO_2$, cerebral edema and free radicals, and given 5 minutes before arrest, to avoid cerebral vasoconstriction and limit uniform cerebral cooling.
- Mannitol to decrease the renal vascular resistance, reduce endothelial oedema and preserving tubular integrity as an osmotic diuretic, and can also reduce cerebral edema and scavenge free radicals, 0.25mg/kg 10-15 mins prior to arrest, 0.25mg/kg upon reperfusion.
- Lidocaine to reduce cerebral metabolism, 42mg/kg in non-diabetic patients.
- If possible, a pre-operative CT scan to determine the communication of the Circle of Willis.
- Cannulation of the right auxillary artery at moderate (28-32°c) hypothermia
- Unilateral cerebral perfusion for periods of 30-50 mins, with bilateral perfusion for periods above 86 minutes.

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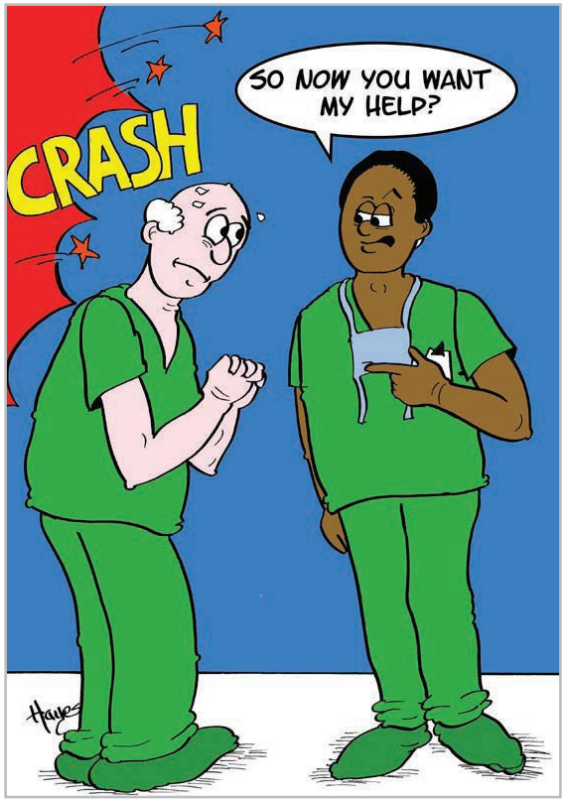

Perfusionist Occupational Hazards

The following pages contain the abstracts from the 32nd Annual Scientific Meeting Australian and New Zealand College of Perfusionists.

LOW PRIME AND AUTOLOGOUS PRIME ABSTRACT

James Ferguson

Blood Conservation remains an ongoing quest since the early times of cardiac surgery. Many improvements occurred during the last decades and have allowed a move to bloodless cardiac surgery. Moreover, blood transfusions have been associated with increased mortality rate and remains unclear if blood transfusion improves survival. In adults, low hematocrits during CPB have been shown as an independent predictor of operative mortality, prolonged ICU stay, postoperative hospital stay and worse 0 to 6 year survival.

Blood conservation usually utilizes methods to limit Hemodilution and to limit blood loss during surgery.

1. Methods to limit Hemodilution include low prime circuits, remote pump head systems, ultrafiltration, antegrade and retrograde autologous priming of the circuit, and red cell salvage.

2. Methods to limit blood loss include surface modifying additives, accuracy of heparin therapy during CPB, pharmacologic modulation of the coagulation system.

This presentation will discuss designs of Minimally Invasive Extracorporeal Circulation Technology (MiECT) systems and associated literature with the use of MiECT systems. Also, the use of antegrade and retrograde autologous priming will be discussed with regards to its benefits on blood conservation.

SETTING ABOUT CHANGE IN FLUID MANAGEMENT

Jon Van Den Berg,
Waikato Hospital, New Zealand.

In 2004 we invited The New Zealand Blood Service to present transfusion data from five major Cardiac Centres at our National Cardiac Surgery meeting. The results were blinded and clearly one unit had a much lower transfusion rate than others. We were quite clear our unit was one of the remaining four. Given the significant number of delegates attending from our unit the drive for blood management change had begun.

Initiating blood cellsaving and reducing circuit prime are two easy strategies reaping instant benefit. However what more can be done?

Reviewing the circuit prime composition and fluid replacement strategy promoted stability and improved outcomes from bypass. What more can be done?

A Team approach to fluid management resulted in further benefits. The Perfusion and Anaesthetic Teams now combine strategies to manage blood conservation and fluid replacement. Furthermore intra-operative fluid management strategies have now begun to influence post-operative intensive care management.

WATER QUALITY OF HEATER-COOLER UNITS
WOULD YOU DRINK IT?

Darryl McMillan *CCP; Dip Perf,* Kieron C. Potger, *BSc, CCP, Dip Perf;*
Joanne Southwell, *BSc.*
Cardiopulmonary Perfusion & Autotransfusion Unit, Royal North Shore Hospital, Sydney.

In the operating theatre (OT) resides the heater-cooler unit (HCU) containing a reservoir of water which is used to control the temperature of our patients on cardiopulmonary bypass (CPB). A reservoir of water that may be used any number of times, over days to weeks and longer – without being cleaned or changed.

The water quality issue of HCUs was noted in 2001 by Weitkemper and colleagues who were able to culture Pseudomonas and Legionella in six Jostra HCU-20s, noting a mass of particles and vegetation in the inner tank (1).

After a spate of cardiac surgical site infections in the USA between 2008 and 2011, a self-contained overhead water reservoir for CPB heat regulation was implicated in growing M. wolinski (a rapidly growing nontuberculous mycobacterium [NTM] commonly present in water). Frequent dripping and atomization of the grossly discolored and particulate contaminated water was noted; associated with the connection and disconnection of the heat exchanger to the water supply. Hoping to resolve the problem, the system was replaced by portable HCUs (2).

However, as already seen, portable HCUs are not infallible – as was reported in Swizerland last year (3). Invasive M. chimaera infections (a slow growing NTM) were initially found in two cardiac surgery patients, launching a systematic investigation to identify the source and extent of the potential outbreak and to implement preventive measures. Water and air samples were collected from operating theaters and elsewhere within the hospital. Cases were also identified retrospectively on archived histopathology samples and prospectively on patients considered at risk. Consequently, six adult male patients were identified with prosthetic valve endocarditis or vascular graft infection due to M. chimaera – of which two died due to the infection. M. chimaera was found in the tap water filled Sorin 3T HCUs and in the air samples collected when these units were in use – both sites yielding identical M. chimaera strains. However, these environmental samples did not exactly match the patient samples. Nevertheless, the authors concluded that there was evidence for the airborne transmission of M. chimaera from contaminated water tanks to patients during open-heart surgery presumably due to airborne transmission of microbes sprayed from the ventilation outlets of the HCUs (3).

In a follow up article, a further four cases of M. chimaera infections subsequent to valvular or aortic surgery purportedly (but not conclusively) originating from airborne contamination associated with the HCU were identified (of which 2 died): 1 from Germany, and 3 (including one child) from the Netherlands. The authors estimated the rate of infections being approximately 1-2 per 1000 patients undergoing open heart surgery (4).

Alerted by the events in Europe, the UK's Department of Public Health identified 13 probable cases of M. chimaera infections subsequent to valve surgery from all cardiac cases in the NHS, but did not confirm them as being linked to the HCU. However, M. chimaera had been identified in the HCU water and they confirmed the feasibility of the HCU generating a microbial aerosol by experimental testing (5).

Mycobacterium chimaera is commonly found in soil and drinking water and is not harmful to most healthy people; however, it causes respiratory infections and disseminated infections in immunocompromised patients, and post cardiac surgery – after a lag time of months to years – has been associated with endocarditis or septicaemia. Here, the outcome is very poor despite surgical reintervention and long term antimicrobial therapy (4). The M. chimaera found in the HCU may reflect a diffuse contamination from local water sources or represent a single, identifiable point source contamination (6).

Measures to reduce possible contamination and improve the water quality include filtering the tap water used to fill the HCU, frequent HCU water changes, hose changes, in-line water filtering and use of cleaning solutions. However, measures to clean and decontaminate the HCU according to manufacturer's recommendations in Switzerland were followed by recontamination (3). Also, contamination of a Jostra HCU-30 with M. chimaera was also recently reported in the USA despite weekly cleaning and maintenance as per the manufacturer's instructions (7). An issue is that after contamination, a biofilm may form within the HCU tanks and hoses. This would limit the effectiveness of any ongoing cleaning maintenance as biofilms are resistant to standard disinfection procedures. If, for example, the hoses are not change, there may be a reinfection of the HCU from the colonisation formed within the biofilm of the water circuit (8). Further measures may include the removal of the heart-lung machine from the surgical area prior to disconnecting the heat-exchanger hoses, positioning the HCU condensing fan away from the patient, or positioning the HCU as far from the patient in the operating room as possible. As M. chimaera has only been detected in units that locate their HCUs within the OT, Kohler et al., recommends that either the HCUs should be placed outside the OT with independent air flow, or that the water reservoir and tubing are air-tight (4). Indeed, in Holland, several elective heart cases were postponed until measures such as placing the HCU outside the OT was taken. In one Swiss hospital, customized cabinets were built to house the HCU within the OT (9).

What should be the quality of the water used in the heater-coolers? The answer may simply be 'drinking water'. As recommended to minimize the risk of infection, Sorin reiterates that the water in their 3T HCU should meet microbiological requirements for drinking water and testing should include Coliform bacteria and Pseudomonas aerginosa (10). Although, recommended drinking water testing entails using the heterotrophic plate count (a test used to detect a number of micro-organisms present in water), no Australian guideline has yet been set for heterotrophic plate counts in drinking water for NTM. A positive result of a heterotrophic plate count test does not represent a health risk but provides

useful information on the general microbiological content of the water and hence a measure of the effectiveness of disinfection (11).

Concerned European agencies have stated that it is not conclusive that the HCU is the cause of the infections but recommend following manufacturers' guidelines on disinfecting and cleaning the HCU and ensuring that departmental protocols include these practices. At this stage, it would be inefficient for each perfusion unit in Australia and New Zealand to independently identify the problems and formulate protocols to deal with something that affects us all. It may be better to have a unified strategy to approach the Australian and New Zealand health authorities – in conjunction with the manufactures – to formulate and establish an appropriate decontamination protocol. This will be an ongoing issue as new, yet unidentified microbes, may begin to haunt us into the future.

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THE ORIGINS OF CLINICAL GOVERNANCE

Steve Bolsin

In July 1998 on the 50th Anniversary of the NHS an article entitled Clinical governance and the drive for quality improvement in the new NHS in England was published in the BMJ. Prior to this there had been <20 articles linking Quality Improvement to Governance of Clinical processes in healthcare. Since this article there have been >2500. The failure of clinical accountability that led to this proposal for Clinical Governance arose directly from the stark failings in a UK Cardiac Surgical unit at the Bristol Royal Infirmary. These events led directly to the unnecessary deaths of 171 children in the unit despite the knowledge of the Surgical Director, the Hospital Medical Director, the Chief Executive, the Royal College of Surgeons, the Royal College of Anaesthetists, the Department of Health and the Health Minister.

Several inquiries were held including an external review, a GMC Disciplinary Inquiry and finally a Royal Commission. Eventually 3 doctors were found guilty of Serious Professional Misconduct and two doctors were "struck off" the Medical Register; these were the Medical Director and the Chief Executive of the hospital.

This talk will illuminate the events that led to Clinical Governance as we know it.

AMSECT'S STANDARDS & GUIDELINES: COMPLEMENT OR CONTRADICTION?

Steve Bolsin

In 2013 the American Society of Extracorporeal Technology (AmSECT) revised their Standards & Guidelines for the management of adult cardiopulmonary bypass. Over the last 2 years, the Perfusion community has expressed concern that some of the Standards & Guidelines contradict current practice. In this presentation delegates will be engaged in a discussion regarding the Standards & Guidelines and some of the challenges to implementation.

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THE PRESENT STATE OF EVIDENCE BASED PERFUSION

Robert A Baker, *PhD, CCP(Aust), Cardiac Surgery Research and Perfusion, Cardiac and Thoracic Surgery Unit, Flinders Medical Centre and Flinders University, Adelaide, Australia.*

Traditionally the pyramid of our knowledge base is capped with meta-analyses and multiple randomised controlled trials, however in our field of cardiopulmonary bypass (CPB) there is a lack of this high level evidence for many of the activities that we perform. Bartel and colleagues, in 2002, highlighted this in their paper "Cardiopulmonary bypass: evidence or experience based?", concluding that "For most CPB principles, the scientific background is not conclusive enough to allow general recommendations. Therefore, recommendations should be based on a consensus of numerous expert opinions on CPB in combination with a review of the literature." The authors went on to highlight the responsibility of the profession towards developing improved clinical outcomes using evidence based medicine principles and developing a culture of creating quality scientific research.

Have we progressed since 1992, has the knowledge base grown sufficiently or have we worked towards developing consensus based guidelines since that time? A number of publications and initiatives have evolved to help develop perfusion practices by providing guidelines and recommendations for practice, these include guidelines looking at glucose management and blood management developed under the auspices of the Society of Thoracic Surgeons (refs). In 2006 the International Consortium for Evidence Based Perfusion was initiated to help provide inertia in this area and in 2010 the Perfusion Task Force was formed combining surgical, anesthesia and perfusion disciplines in a multidisciplinary attempt to promote the development of guidelines in CPB. This initiative has resulted in temperature management guidelines (finalized) and anticoagulation, renal and neuro-protection guidelines in development.

These initiatives help provide some direction to how our clinical practices can be shaped. In parallel multi-centre perfusion registries have developed in Australia and New Zealand (Perfusion Downunder Collaboration), USA (PERFform Registry, Northern New England (NNE) Registry), Japan and Europe allowing an understanding of current practices to be developed. These registries now have over 50,000 patient records and help us understand our current practices and demonstrate areas where practices vary and those that may need dedicated research. One current focus of these registries has been to look at blood management and the role of perfusion in patient blood management practices, a second to look at factors influencing acute kidney injury following CPB. Collectively the use of registry in cardiac surgery offers enormous opportunity for us to learn from our experience and develop improved practices as we develop. The nestling of the PERFform and NNE perfusion registries within large quality improvement collaboratives highlights this.

The paradigm of evidence based medicine has been in vogue for over 20 years, it's application in the field of CPB has been limited. This provides us with a unique opportunity to learn from the experiences of EBM in other disciplines and to develop a balance rather than a reliance on standardization of practice and recognition of the value that can be gained from variation's in practice when evidence, ethics, the individual and judgment combine to deliver real evidence based medicine.

QUALITY, SAFETY & ETHICS

Stephen Bolsin

Medical ethics are continually evolving to accommodate changes in medical knowledge and the expectation of society and patients. Some changes in medical ethics occur in response to the failure of the medical profession to practice according to the standards society expects.

This presentation will trace the history of changes in medical ethics brought about by the failure of the medical profession to adhere to the standards expected by civilised society. The impact of human experimentation in the 2nd World War and the Tuskegee Experiment illustrate the reassertion of the Hippocratic Oath and the introduction of the 'Four Pillars' of Beneficence, Non-malificence, Autonomy and Justice. However have the 4 Pillars worked or is the burden of healthcare error something that should be addressed by a change in ethical principles?

This question will be answered and some alternative ethical reasoning offered to improve outcomes and reduce error rates in complex healthcare environments.

SEVEN TEAM TASKS APPROACH

Stephanie O'Regan, *Sydney Clinical Skills and Simulation Centre*

When errors occur in medicine it can be devastating for both the patient and their family and for the health professionals involved in the case. Clinical competence is often not the reason for these errors; rather they are often related to a combination of human factors, environmental factors and organisational issues. The World Health Organisation refers to human factors as "environmental, organizational and job factors, and human and individual characteristics which influence behavior at work in a way which can affect health and safety. A simple way to view human factors is to think about three aspects: the job, the individual and the organization and how they impact people's health and safety-related behavior". (www.who.int/patientsafety/research/methods_measures/human_factors/en/)

Decision-making is complex and frequent. Estimates suggest we make more than 35,000 decisions per day or nearly 2000 per awake hour. It stands to reason that some of these decisions will be less than optimal. During stress our ability to think broadly is reduced so finding solutions is impaired and again poor decision-making may ensue. The Seven Team Tasks Approach, using a human factors focus, provides one strategy to reduce, mediate and prevent errors.

The Seven Team Tasks are:

1. Assemble the Right Team
2. Plan and Prepare
3. Manage Resources
4. Manage People
5. Communicate Effectively
6. Monitor and Evaluate
7. Support Each Other

TEAMWORK - CORPORATE SECTOR AND PERFUSION IT'S ALL ABOUT THE PATIENT

Arthur Preovolos *CCP(Aus)*
Perfusionist – Technical Product Specialist Medtronic Australasia

At the core of the relationship between Perfusionists and the corporate sector it's all about providing what is best for the patient.

The teamwork that exits between the corporate sector and perfusionists extends beyond providing quality products in a timely manner for clinical use.

There has been a long history of cooperation between clinicians and the corporate sector. This cooperation over the years has led to the development of innovative products and techniques that improve patient care.

A newer area of cooperation is in the sphere of education. The corporate sector when asked can and does provide clinical support and training and education in the use of their products.

This clinical support of education and training of perfusionists has been extended to include simulation training. Basic perfusion training, crisis management and teamwork simulations are taught to groups, the aim of these courses is to improve clinical patient management and patient outcome.

SIMULATION: A FOCUS ON TEAMWORK

Kenneth G Shann, *CCP*

This interactive session will promote the long term interaction in simulation of all the disciplines involved in cardiac surgery (surgical, anaesthesia, nursing, perfusion and industry).

To gain an understanding of the complex environment of the cardiac theatre through the lens of different members of the cardiac team.

The concept of simulation and team work will be presented utilizing video scenarios.

TEG®6S EVALUATION: DEFYING THE ODDS

R. Miraziz, *Chief Perfusionist, Westmead Public Hospital, Sydney*

Point of Care Haemostatic Assessment Devices, utilising emerging cartridge-based technology (TEG®6s and ROTEM®sigma), are increasingly being evaluated and used in Cardiac Surgery.

The benefit of such analysers in cardiac theatres relates to their convenience, speed and their precise and reproducible assessment of haemostatic alterations.

The alterations in haemostasis are influenced by a number of parameters that contribute to postoperative bleeding and the necessity for transfusion of blood products.

The transfusion of blood products can be life-saving during surgery, however with each blood product transfused carries a small risk of an acute or late adverse effect. Alternative strategies towards restrictive transfusion practices have shown to be equivalent or better than liberal practices.

Westmead Hospital evaluated the TEG®6s predominantly for the management of cardiac patients post cardiopulmonary bypass in order to reduce the transfusion of blood products.

The evaluation of the intraoperative coagulation and platelet function with the use of appropriate cartridges (Citrated Multichannel and PlateletMapping Cartridges) optimised the transfusion therapy and the administration of pharmacological drugs by achieving a targeted haemostasis.

The use of TEG®6s analyser has led to change of practice at Westmead Hospital and now guides the transfusion practice following cardiac surgery.

A review of a series of cardiopulmonary bypass cases defied the odds by using the TEG®6s analyser including, redo procedures, aortic dissection and DHCA cases with > 4hr bypass time requiring the transfusion of nil or minimal blood products.

PRESERVE BLOOD - EVERY DROP COUNTS

Rona Steel, A.Prof Peter Klineberg, Ray Miraziz, Monique Brouwer, Grace Agbulos, Dr Hugh Playford, Dr Kate Harris, Pauline Hinks, Dr Adam Eslic

There is overwhelming evidence that RBC transfusion is associated with increased mortality and morbidity (2,3,4,7). The incidence of RBC transfusion has been associated with an increase in risk of bacterial infections (1,9), low-output failure (6), arrhythmias (10), acute kidney injury (11), longer ICU and hospital stays (3) and poorer quality of life post operatively (8).

In 2013 a comparison of 9 cardiac surgical units in Australia and New Zealand found that Westmead's transfusion rates far exceeded its peers. A collaborative project was formed at Westmead Hospital comprising 14 representatives from key disciplines impacting blood usage. This collaboration enabled the project to drive change in practice across these key disciplines resulting in a significant reduction in transfusion rates for cardiac surgical patients at Westmead Hospital.

The methodology applied was transferred from the US (5) and is expected to be readily transferable to other units. It is simple, cost effective and easily reproducible and supported by evidence based guidelines.

A noteworthy inclusion to our practise changes was the adoption of a venous 'RAP' technique. This technique removes a large volume of prime from our circuits at the initiation of bypass quickly and without delay and is fully controlled by the perfusionist. This technique has resulted in an impressive reduction to our patients hemodilution during bypass. A video demonstration of this technique will be presented.

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THE ROLE OF TRANSFUSION IN POST-OPERATIVE MORBIDITY AND MORTALITY: EMERGING SCIENCE AND CLINICAL REGISTRIES

Robert A. Baker

TOPIC OBJECTIVES:

1. Review and discuss randomised controlled trial data evaluating transfusion as it contributes to the evidence base for post-operative morbidity and mortality
2. Review and discuss registry data evaluating transfusion as it contributes to the evidence base for post-operative morbidity and mortality

Understanding clinical practice allows the clinician the opportunity to treat every patient appropriately; however what do we do when the science behind our clinical practice does not clearly define the optimal pathway forward. Our current literature has many publications that have evaluated the role of preoperative anaemia and the effect of blood transfusion on patient's morbidity and mortality. In the realm of cardiac surgery the question of causation rather than association is widely discussed with advocates suggesting preoperative anaemia and the patients co-morbidities provide the most significant driver of poor outcome (eg Kulier et al 20071), while others are firmly entrenched with the view that red blood cell transfusion is central to poor outcome (eg Koch et al 20062). Layered upon this is the question of when should transfusion occur. The Society of Thoracic Surgeons and the Society of Cardiovascular Anesthesiologists has made the following recommendations in relation to transfusion3:

- "During cardiopulmonary bypass (CPB) with moderate hypothermia, transfusion of red cells for hemoglobin <=6 g/dL is reasonable except in patients at risk for decreased cerebral oxygen delivery (ie, history of cerebrovascular attack, diabetes, cerebrovascular disease, carotid stenosis) where higher hemoglobin levels may be justified. (IIa, Level of evidence C)"
- In the setting of hemoglobin values exceeding 6 g/dL while on CPB, it is reasonable to transfuse red cells based on the patient's clinical situation, and this should be considered as the most important component of the decision making process. Indications for transfusion of red blood cells in this setting are multifactorial and should be guided by patient-related factors (ie, age, severity of illness, cardiac function, or risk for critical end-organ ischemia), the clinical setting (massive or active blood loss), and laboratory or clinical parameters (eg, hematocrit, SVO2, electrocardiogram, or echocardiographic evidence of myocardial ischemia etc.). (IIa, Level of evidence C)
- "With hemoglobin levels below 6 g/dL, red blood cell transfusion is reasonable since this can be life-saving. Transfusion is reasonable in most postoperative patients whose hemoglobin is less than 7 g/dL but no high level evidence supports this recommendation. (IIa, Level of evidence C).

Whilst these recommendations are actionable, the level of evidence supporting them is not high.

The difficulty in applying these recommendations is reflected in data demonstrating variation in transfusion practices in United States Cardiac Surgery Units in an analysis of data from the STS database which was performed after the initial publication of the guidelines in 2007. There was large variability among hospitals in the rate of red blood cell transfusion, ranging from 7.8% to more than 92.8% among coronary-artery bypass graft surgery patients, with this variation only partly explained by case mix (20%) and geographic location/academic status and volume (11%)4. Contemporary data from the PERForm registry (2010-2014) has shown red blood cell transfusion rates to vary from 16.8% to 57.6% in the perioperative setting for coronary artery bypass grafting in contributing centres.

Given the STS recommendations and the paucity of evidence are current randomised controlled trials (RCT) and registry data helping improve the level of evidence for clinical practice. Much of the RCT evidence base for cardiac surgery is limited, as has been reported in both the most recent Cochrane review5 and the recent meta-analysis6, or is taken from the critical care or other surgical specialty literature.

The most recent RCT was published by Murphy7 in March this year aimed at determining if a restrictive threshold for red cell transfusion (Hb <7.5 g/dl) as compared with a liberal threshold (Hb < 9.0 g/dl) in an postoperatively anaemic patients (Hb <9.0 g/dl) would reduce morbidity and health related costs found that the restrictive transfusion threshold after cardiac surgery was not superior to the liberal threshold with respect to morbidity (primary outcome occurred in 35.1% of the patients in the restrictive-threshold group and 33.0% of the patients in the liberal-threshold group (odds ratio, 1.11; 95% confidence interval [CI], 0.91 to 1.34; P=0.30) or health care costs. They reported a secondary outcome suggesting more deaths in the restrictive-threshold group than in the liberal-threshold group (4.2% vs. 2.6%; hazard ratio, 1.64; 95% CI, 1.00 to 2.67; P=0.045).

This study has been met by much commentary in relation to non adherence to the transfusion thresholds, the exclusion of the role of oxygen consumption and delivery, the question as to how restrictive the restrictive threshold actually was (63.7% transfusion versus 94.9%), transfusion was controlled only in post operative period, ignoring the intraoperative period, and the role of a patient blood management focussed approach8. However it is consistent with other RCT's such as the FOCUS

trial in hip fracture patients9, that showed liberal blood transfusion did not affect mortality compared with a restrictive transfusion strategy in a high-risk group of elderly patients with underlying cardiovascular disease or risk factors no benefit on long-term mortality or affects cause of death. Findings that do not support the hypothesis that blood transfusion leads to long-term immunosuppression that is severe enough to affect the long-term mortality rate by more than 20–25% or cause of death.

These results challenge the current practices promoting restrictive transfusion which have been supported by the Cochrane review5, whilst the 2014 meta-analysis6 recommended further studies were necessary to determine the optimal strategy. A number of trials are underway including the TRICS III study evaluating restrictive versus liberal transfusion protocols. Interestingly the TRICS III trial will include intraoperative interventions and is not restricted to the postoperative period.

Observational studies and registry data has suggested that transfusion is harmful after cardiac surgery, with associations reported between transfusion and mortality and morbidity including infection, low cardiac output and acute kidney injury2,10. These earlier studies are complimented by more recent studies which have similarly been able to demonstrate under a number of different conditions that the association between mortality and transfusion remains strong. For example, Engoren et al11 in 2014 in a small single institution study, examined the interaction between anaemia and red blood cell transfusion with respect to late mortality, finding anaemia and transfusion were associated with increased risk of late mortality in CABG patients (4 years). Whilst most recently we have evaluated the interaction of transfusion and anemia in the PDU registry in both a mixed and CABG only cohort. We have, using a propensity model, designed to predict the likelihood of transfusion, looked at the association of transfusion and anemia (standardise WHO criteria). Propensity matching allowed us to incorporate many of the factors previously identified to limit observational and registry studies, for example the influence of oxygen delivery during bypass7,12, and postoperative blood loss13. We have shown that after propensity matching, anaemia without transfusion was not found to be a predictor of mortality or morbidity. Transfusion was found to be an independent predictor of mortality with or without anaemia (An+Tx+ OR, 5.62; 95% CI, 1.59-19.82; P=0.007, An-Tx+ OR, 6.66; 95% CI, 2.08-21.29; P=0.001). Transfusion was also found to be an independent predictor of morbidity with or without anaemia (An+Tx+ OR, 2.24; 95% CI, 1.68-2.99; P<0.001, An-Tx+ OR, 3.53; 95% CI, 2.71-4.52; P<0.001).

The issues associated with RCT's and registry studies are well reported. Perhaps the answer may lie in the methodology proposed by Lauer and D'Agostino14 who noted "the "intellectual trap" between randomized trials that lack external validity (generalizability) and observational studies that lack internal validity owing to unmeasured confounders". They proposed registry-based randomized trials to achieve both internal and external validity. Perfusion, with robust clinical registries, such as the PERForm and the PDUC Registries, may be well positioned to undertake these important studies.

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FIFTY YEARS OF HIGH POTASSIUM CARDIOPLEGIA: IS IT TIME FOR CHANGE?

Geoffrey P.Dobson *PhD FAHA*
Professor, Personal Chair, Heart, Trauma & Sepsis Research Laboratory,
Australian Institute of Tropical Health and Medicine, College of Medicine and Dentistry,
James Cook University

Cardiothoracic surgeons, anesthetists and perfusionists are confronted with unprecedented challenges in myocardial protection from an aging population and more complex pediatric surgeries. Notwithstanding the multi-factorial etiology of myocardial injury, one area identified as a potential contributor leading to sub-optimal protection is high potassium (K+) in surgical cardioplegia. As extracellular K+ is raised above 10 mM, the voltage-dependent Na+ fast channel availability and Na+ conductances are dramatically reduced, and the heart arrests in diastole at depolarized potentials.

Prolonged K+ depolarization can lead to: 1) intracellular Na+ and Ca2+ loading and mitochondrial dysfunction; 2) coronary vasoconstriction and spasm; 3) endothelial activation; 4) arrhythmias and conduction disturbances; and 5) low cardiac output and ventricular stunning. While moderate hypothermia may partially offset some of these negative effects, the most vulnerable period for the depolarized heart may not be during surgical ischemia but during rewarming, reperfusion and arousal. We will discuss these potential limitations and possible alternatives.

THE SO-COOL STUDY

Tim Willcox

THE AVOIDANCE OF HYPEROXAEMIA DURING CARDIOPULMONARY BYPASS – A DUAL-CENTRE PHASE IIB RANDOMISED CONTROLLED TRIAL - PRELIMINARY RESULTS

PRESENTED AT PDU 2015 ADELAIDE

Auckland City Hospital, Auckland, New Zealand; Shay McGuinness, Rachael Parke, Cornelius Kruger, Tim Willcox, Megan Baker, Keri-Anne Cowdrey, Eileen Gilder, Lianne McCarthy.

Calvary Wakefield Hospital, Adelaide, South Australia; Kate Drummond, Tom Painter.

BACKGROUND

Cardiac surgery utilising cardiopulmonary bypass (CPB) is one of the most common forms of major surgery, with more than 1 million patients undergoing this surgery worldwide each year, including around 2500 in New Zealand. Despite recent improvements to both surgical techniques and the equipment used for CPB mortality and significant morbidity remains high. During CPB it is common practice to oxygenate the arterial return blood to supra-normal levels, in part because monitoring of the blood oxygen levels, and thus the function of the oxygenator, is only done intermittently using blood gas sampling.

Cardiac surgery associated multi-organ dysfunction (CSA-MOD) is well recognised and includes cardiac surgery associated Acute Kidney Injury (CSA-AKI),[1] acute hepatic impairment, myocardial damage and post-operative neurological deficit. The pathophysiology of CSA-MOD involves numerous injurious pathways linked to the use of CPB[2]. Although there is considerable overlap between them, the principle processes include the exposure of circulating blood to the non-biocompatible surfaces of the HLM and red-cell damage and haemolysis caused by mechanical stress from the blood circulating pumps and suction equipment. The subsequent activation of inflammatory pathways, ischaemia-reperfusion injury, decreased end-organ perfusion and haemolysis are contributors to CSA-MOD.[1] These complications result in significant morbidity and mortality as well as increased intensive care and hospital length of stay and a consequential increase in healthcare costs.[3]

Although the deleterious effects of CPB affect all body systems they are most marked on the kidney, with renal damage occurring in up to 30% of patients[1]. Oxidative stress, the creation of oxygen free radicals and haem or iron containing reactive oxygen species, is recognised as an important factor in the development of CSA-AKI.[4, 5]. The production of these toxic molecules is in part dependent on arterial oxygen levels. There is also evidence suggesting that high levels of arterial oxygenation may exacerbate ischaemic-reperfusion injuries and this effect is attenuated by avoiding hyperoxaemia.[6, 7] Hyperoxaemia has also been shown to have significant adverse haemodynamic effects after coronary artery bypass surgery.[8]

As mentioned above, current standard practice is to use supra-normal arterial blood oxygen tensions during CPB, however the recent commercial availability of real-time continuous in-line blood gas analysis now provides the opportunity to safely use lower, more physiological arterial oxygen tensions.

AIM

The aim of this study was to determine a negative impact of arterial hyperoxia during cardiac surgery with the hypothesis that avoidance of perioperative arterial hyperoxia decreases the degree of oxidative stress and thus reduces the severity of the multi-organ dysfunction that is common following cardiac surgery utilising cardiopulmonary bypass.

Primary endpoint was the difference between groups (hyperoxaemia v normoxaemia) in CSA-AKI as demonstrated by KDIGO classification during hospital admission. Secondary Outcomes included: changes in a range of serum biomarkers known to correlate with specific end organ damage, including Troponin T, AST and Amylase.

STUDY DESIGN AND METHODOLOGY

This study conducted in two hospitals (Auckland City Hospital, Auckland New Zealand and Calvary Wakefield Hospital, Adelaide, South Australia) was parallel group, Phase IIb RCT of the use of an arterial oxygenation strategy that avoids hyperoxaemia vs. standard care to reduce CSA-MOD in patients undergoing cardiac surgery using cardiopulmonary bypass.

Following approval from the Northern X regional ethics committee, patients scheduled for elective cardiac surgery at the study centre and who met the inclusion criteria (adult patient (≥16 yrs) scheduled to have cardiac surgery using cardiopulmonary bypass) were approached for consent and enrolled in the study pre-operatively. Exclusion criteria included; pre-operative acute renal failure within 6 weeks (acute rise in serum creatinine >50% from baseline) or; Pre-operative end stage renal disease (serum creatinine >300 µmol/L) present or; receiving any form of renal replacement therapy or pre-operative hepatic dysfunction (AST> 2* upper limit of normal) or Recent (< 6 weeks) cerebrovascular event, (Including CVA, TIA or intracerebral bleed) or; pregnant; planned hypothermic circulatory arrest; pre-operative IABP.

STUDY DESIGN

Patients were randomised 1:1 to the intervention or standard care. Subjects were stratified into "high risk of AKI" and "low risk of AKI" using well recognised criteria[9] (We know from previous studies that approximately 45% of patients in our unit will be in the high risk group).

The intervention groups were protocoled to receive control of arterial oxygenation from induction of anaesthesia until the end of surgery to maintain arterial oxygen tensions of 10 - 12 kPa. It was recognised that not all anaesthetists would be happy with this approach and may wish to administer 100% FiO2 (as opposed to the recommended target SpO2 of 92 - 95%) during part or all of the pre and post CPB period. During CPB the oxygen tension of the arterial return blood flow target was 10 - 12 kPa using continuous in-line real-time blood gas monitoring (Terumo CDI 500, Terumo Corporation and Spectrum M4, Spectrum Medical, Gloucester, UK), providing arterial saturation was ≥ 97% (If it is less than 97% then the PaO2 to be increased beyond 12 kPa).

Control group were to receive standard care, including selection of appropriate supplemental oxygen by the treating anaesthetist and clinical perfusionist.

A total of 286 patients were required to enter this two-treatment parallel-design study such that the probability was` 80 percent that the study would detect a treatment difference at a two-sided 0.05 significance level, if the true difference between treatments is 0.333 times the standard deviation. The same power existed for the secondary biomarker endpoints. In our experience loss to follow up is extremely low for this sort of study, however 298 patients were enrolled to account for this.

The randomisation sequence was generated by an independent statistician using computer-generated random numbers and participants were randomised to treatment just prior to surgery.

Troponin T, AST and Amylase and C Reactive protein and serum selenium were measured at baseline (immediately prior to induction of anaesthesia), immediately prior to commencement of bypass, 6 hrs and 24 hrs post commencement of bypass. Other secondary outcomes measured were; length of ICU and hospital stay; duration of mechanical ventilation; development of AKI as defined by RIFLE and acute kidney injury network (AKIN) criteria

STATISTICS/DATA ANALYSIS

Data from the trial was entered into an excel spreadsheet, and then extracted into STATA for analysis. All data analyses were carried out on an intention-to-treat basis. Incidence rates and absolute differences (with corresponding NNTs) and 95% CIs were obtained for binary variables in the first instance with subsequent multiple logistic regression adjusted for stratification factors. Time to event data was analysed using Cox regression modelling thereby taking into account known covariates and the varying times since randomisation. Continuous data was analysed using the appropriate parametric or non-parametric analysis after testing for normality.

RESULTS

Between December 2012 and May 2014 298 patients were randomized to either the avoidance of hyperoxaemia or standard care at two hospitals in New Zealand and Australia. All patients were followed to day 90.

There were no significant differences in baseline characteristics and excellent treatment separation was achieved between the two groups (Table 1).

	CONTROL	INTERVENTION
	n=148	n=150
Age (years)	65.25	65.8
Sex (% Male)	74	72
Isolated CABG (%)	43	48
CPB time (mins mean)	106	109

Table 1 Demographics

There was excellent treatment separation during CPB however there was significant hyperoxaemia in the intervention group in the pre and post CPB period. (Fig 1)

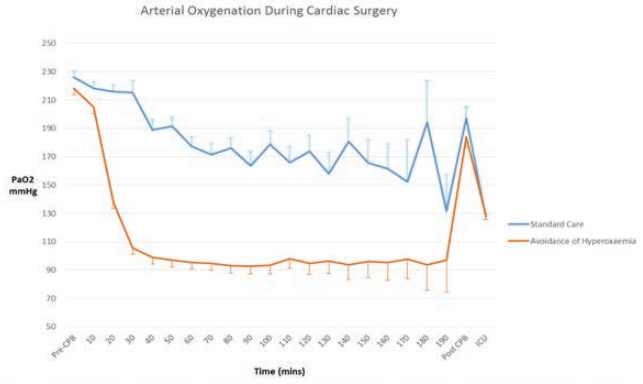

Figure 1 : Figure shows the arterial oxygen partial pressure for oxygen (mmHg). The pre-CPB value was measured immediately before the commencement of CPB. The post-CPB value is an average of the values recorded every 10 mins from the end of CPB to the completion of surgery. The ICU value is the average of values recorded hourly for 6 hours from admission to ICU.
Values are means and error bars are standard error of the mean

Figure 1 Perioperative PaO2 for the standard care and intervention groups.

There was no difference between the intervention arm and the control arm in the development of any AKI (72% vs. 66%; p=0.28) or more severe AKI (KDIGO 2 or 3; 27% vs. 30%; p=0.56). (Table 2)

CSA-AKI	CONTROL n=148	INTERVENTION n=150	p
KDIGO - Any	72%	66%	0.28
KDIGO Stage 1	36%	45%	0.12
KDIGO Stage 2	29%	24%	0.32
KDIGO Stage 3	1%	3%	0.26

Table 2 CSA-AKI

There was also no difference in the multiple markers of other organ damage measured (fig2) or in ICU and hospital length of stay. (Fig 3).

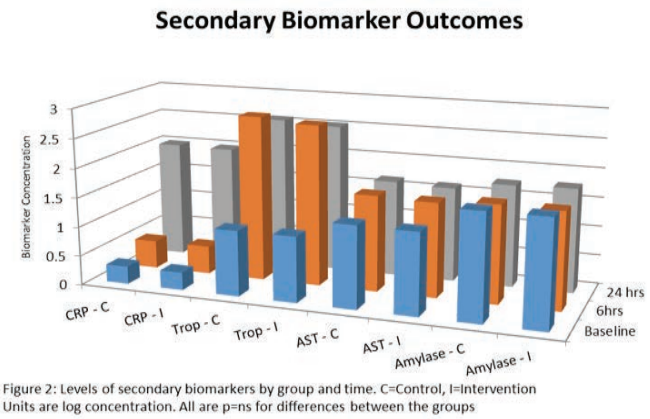

Figure 2: Levels of secondary biomarkers by group and time. C=Control, I=Intervention
Units are log concentration. All are p=ns for differences between the groups

Figure 2 Secondary Biomarker Outcomes

	CONTROL	INTERVENTION	P
Ventilation time (hrs median)	7.2	7.2	0.35
ICU length of stay (hours median)	23.3	22.8	0.75
Hospital length of stay (days median)	8.95	9	0.65

Table 3 Secondary outcomes - LOS and ventilation time

There was no difference in serum selenium between groups at any of the time points.(Fig 3)

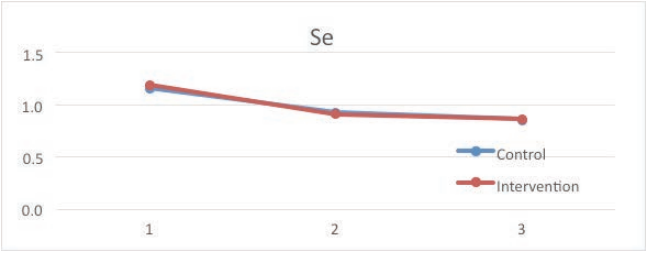

Figure 3.Serum selenium. 1=baseline 2= 6hrs 3 = 24hrs post start CPB

DISCUSSION

We conducted a phase IIb study of the avoidance of hyperoxaemia in adult patients undergoing cardiac surgery using cardiopulmonary bypass (CPB).

In the 298 patients included we achieved excellent treatment separation but failed to demonstrate any significant difference in either the incidence of acute kidney injury or in any of the other secondary endpoints. A limitation of the study is that the intervention only occurred during CPB and thus there was significant hyperoxaemia both pre and post CPB. It is possible that these times represent "at risk" periods for hyperoxaemia mediated cellular damage.

CONCLUSION

This study did not demonstrate any benefits from avoiding hyperoxaemia during CPB however it did show that maintaining normal physiological PaO2 was feasible. Further studies extending the intervention in to the pre and post CPB period are warranted.

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PLASMA LEAKAGE THROUGH A POLYMETHYLPENTENE OXYGENATOR

K O'Shaughnessy, *CCP,* J Dittmer, *CCP,* Martin Gill, *CCP*

Prior to the advent of Polymethylpentene (PMP) oxygenators, plasma leakage was an unwelcome occurrence that complicated many ECMO runs. The introduction of PMP fibres into ECMO oxygenators is widely regarded to have eradicated plasma leakage from ECMO. We describe a paediatric ECMO case during which plasma leakage occurred and oxygenator function gradually deteriorated, ultimately necessitating device replacement. To our knowledge this is the first case of plasma leakage described using a PMP device during paediatric ECMO. Subsequent detailed investigation is described demonstrating the relative porous nature of this fibre and how a protein coating reduces the free passage of solution across the PMP membrane. Discussion of possible patient specific contributing factors will also be given. Whilst PMP oxygenators offer resistance to plasma leakage, they remain a 'microporous' device. Whilst PMP fibres may improve the long term capabilities of such devices, plasma leakage should not be disregarded as a possible clinical occurrence.

A NOVEL APPROACH TO ECMO TRAINING FOR NURSES IN A HIGH FIDELITY SIMULATED ENVIRONMENT

Andrew Lahanas, *Prince of Wales Hospital / Sydney Children's Hospital, Barker Street, Randwick, N.S.W. 2031, Australia.*

Extracorporeal membrane oxygenation (ECMO) is a modality of treatment offering cardiac and/or respiratory support in critically ill patients1. Our institution has an active education program for ECMO nurses, relying predominantly on didactic sessions with wet lab drills to ensure the skills are maintained at a high standard. The inauguration of a new high fidelity simulation centre has provided the opportunity to modify our ECMO training program within the more realistic setting. Although wet lab drills are frequently used to simulate catastrophic events, the presence of props and personnel required to manipulate the circuit detracts from the fidelity of the simulation, one of the key purposes of team based exercises and learning2.

Our aim was to design a simulation program with an appropriately high level of clinical authenticity to enable the application of wet-lab drills in a realistic patient setting. The simulation space was replicated to match the Children's Intensive Care Unit (CICU) environment. The ECMO circuit was connected to a reservoir bag placed inside the manikin, also accessible via central/peripheral intravenous access lines. Subsequently, any volume shifts produced real fluctuations to circuit dynamics. A novel method for remotely inflating intraluminal balloons positioned inside the circuit tubing allowed us to simulate complete arterial or venous line obstruction from the control room via concealed tubing fed through a specifically designed sub-floor conduit in the simulation centre. In addition, simulation of hypovolaemia and massive venous air entrainment was also possible from the control room. The ECMO console continuously displayed flow rates, revolutions per minute, venous inlet and arterial outlet pressures and pre-programmed alarms which the participants used for troubleshooting. A very high level of authenticity was achieved with the simulation co-ordinator working in tandem with the perfusionist to vary physiological parameters.

CONCLUSION

Techniques for remote control of the ECMO circuit have been described. Changes to circuit volume, introduction of venous air and remote inflation of intraluminal balloons positioned inside the circuit tubing via a subfloor conduit allows manipulation of circuit physiology and the creation of various emergencies. We believe this system which has yet to be described in the literature offers a very high degree of realism in duplicating real life situations.

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ALM POLARSHOT CARDIOPLEGIA: LESSONS FROM NATURAL HIBERNATORS

Geoffrey Dobson

Natural hibernators do not flood their hearts with high K+ during hibernation, as is standard practice in cardiac surgery today. Could the human heart be pharmacologically manipulated to operate like the heart of a natural hibernator? The overall objective was to arrest the heart at its natural or 'polarised' resting membrane potential (-80 mV) by: 1) inhibiting the voltage-dependent Na+ fast channels responsible for the phase O upstroke of the cardiac action potential (lidocaine), and 2) simultaneously decreasing the action potential duration by opening K+ATP channels (adenosine). Magnesium was included to reduce Ca2+ entry and protect the heart from ischemia-reperfusion injury and post-operative arrhythmias. Early proof-of-concept studies in the isolated working rat heart at James Cook University, and the canine cardiopulmonary bypass model at Emory University, showed superiority of ALM cardioplegia compared to high K+ solutions. More recently, two prospective randomized human trials have been completed showing that whole blood ALM microplegia is superior to modified Buckberg solution in high risk and low risk patients. Superiority was based on significantly lower coronary sinus Troponin-1 and lactate levels at 10 min reperfusion, improved cardiac performance, improved left ventricular-arterial coupling, reduced need for blood transfusions and one-day less in the ICU. Further multi-centered trials are required, and future studies are planned to compliment the new 'polarising' cardioplegia with a low volume ALM IV 'drip' administered after anaesthesia but before the first incision to reduce the patient's stress response against the trauma of surgery.

OPTIONS FOR CORRECTING SEVERE ACID-BASE AND ELECTROLYTE DISTURBANCES DURING CARDIOPULMONARY BYPASS

Melissa Donnellan. *Department of Perfusion and Autotransfusion, Department of Anaesthesia and Pain Management, Royal North Shore Hospital, Sydney.*

Increasingly complex cardiac surgery performed while on cardiopulmonary bypass presents a number of challenges to the metabolic management of the patient. This discussion has been prompted by a small proportion of cases at our institution. These cases had in common long duration of bypass, hypothermia and a degree of perioperative vasoplegia. We decided to reinvestigate possible options for correcting severe acid-base and electrolyte disturbances as flagged by extreme blood gas results routinely obtained during bypass.

In general cardiopulmonary bypass associated physiological disturbances result from haemodilution, hypoperfusion, hyperkalemia and hypothermia. Some options for the tackling of these issues beyond alterations in main pump and gas flows may include pharmacological, fluid and blood management and the addition of haemoconcentration, ultrafiltration and dialysis. This discussion primarily focuses on the possibilities for filtration/dialysis available intraoperatively during elective cases and during emergency out of hours situations.

DUAL VOLATILE ANAESTHETIC AGENT USE IN CARDIAC SURGERY QUIRK OR CONCERN?

Mark Ambrose. *Department of Perfusion and Auto Transfusion, Department of Anaesthesia and Pain Management. Royal North Shore Hospital, Sydney.*

While much research has been conducted in Cardiac Anaesthesia regarding the use of volatile anaesthetic agents with cardiopulmonary bypass, there seems to be scant information about the use of simultaneous differing volatile anaesthetic agents. While perhaps an unintentional situation, differing volatile anaesthetic agents can be placed on the anaesthetic and Cardiopulmonary Bypass machines simultaneously.

This "Perfusion Concept" presentation will discuss the issue of different volatile anaesthetic agents being simultaneously used. Three time points in the intra-operative phase will be identified and pose the question "is there any harm?".

HYPOBARIC OXYGENATION: A NOVEL APPROACH TO DECREASING GASEOUS MICROEMBOLI

Mark Ambrose. *Department of Perfusion and Auto Transfusion, Department of Anaesthesia and Pain Management. Royal North Shore Hospital, Sydney.*

The existence of gaseous micro emboli (GME) leaving the arterial line of the heart lung machine has long been of concern to the perfusionist. Negative neurocognitive and neuropsychological changes associated with exposure to GME has influenced many perfusion management strategies (1). Efforts to reduce exposure of the patient to GME has also had a lasting clinical impact on circuit component evaluation and design (2).

One novel technique for the reduction of patient exposure to GME is the use of "Hypobaric Oxygenation". This involves ventilating the gaseous phase of the oxygenator with sub atmospheric pressures using 100% oxygen (3).

This "Perfusion Concept" presentation will outline the principle of Hypobaric Oxygenation. It will attempt to explain the etiology of GME minimization as a result of this technique. Advantages and concerns in using this novel approach to GME reduction will be discussed.

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SEIZURES POST CARDIOPULMONARY BYPASS

Monique Brouwer and William McMeniman,
Westmead Private Hospital, Mons Road and Darcy Roads, Westmead NSW 2145

Seizures following cardiopulmonary bypass are an immediate and alarming indication that a neurologic event has occurred. A case report is reviewed highlighting the possible causes of seizures following bypass in a 67 year old man undergoing aortic valve surgery.

CEREBRAL PROTECTION MANAGEMENT DURING DHCA: A REVIEW OF CURRENT METHODS

Emerson Sgammotta, *Perfusion Services, Melbourne*

The idea of Deep Hypothermic Circulatory Arrest (DHCA) regarding cerebral protection has been around since 1975. First performed by Greipp and colleagues, DHCA aims to provide a decrease in the brains metabolic rate and oxygen requirement with the reduction of temperature, allowing a bloodless field for the surgeon. Its use is commonly used for surgical correction of paediatric cardiac anomalies, but routinely used for complex aortic surgery in adults. DHCA has its disadvantages, such as coagulopathy, extended bypass time, elevated inflammatory response, and end-organ dysfunction, with neurologic injury being of the highest concern. Continuing development of cerebral monitoring and pharmacologic advancements, have caused a great discussion in optimal cerebral protection during DHCA. This review aims to provide an update of practices and methods of the last decade, concerning cerebral protection with focus on pharmacologic protection, cannulation techniques and the discussion of use of antegrade cerebral perfusion. The purpose of this review is to determine the most effective method of which DHCA should be carried out to achieve optimal cerebral protection.

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DOES RETROGRADE AUTOLOGOUS PRIMING FLUID BALANCE?

Keith Adkins, *Saint Vincent's hospital, Darlinghurst, Sydney, NSW 2010.*

The purpose of this study was to determine the effects of retrograde autologous (RAP) on fluid balance both during CPB and the total operating theatre fluid balance.

This was a retrospective analysis comparing the fluid balance of RAP patients versus non RAP patients. There were 50 consecutive patients each group. The inclusion criteria were; elective surgery, 1st time sternotomies, and single procedure only (i.e. single valve replacement or coronary artery bypass grafting only). All pre and post bypass fluids, all CPB fluids and urine output were accounted for. Peri-operative blood loss was not accounted for.

Pre bypass fluids were similar (595mls RAP, 703 non RAP, p=0.22), priming volume was also similar (2000 RAP, 2028 non RAP, p=0.22). A mean amount of 633mls was removed from the prime by retrograde autologous priming. On 78% of occasions some of the RAP volume was returned, and on 64% of occasions all the RAP volume was returned. The mean fluid balance at the end of CPB was 2375 mls in the RAP group, and 2903 mls in the non RAP group, p=0.001. The total operating theatre fluid balance was 2416 mls in the RAP group, and 3045 mls in the non RAP group, p=0.004.

The conclusion was that retrograde autologous priming does significantly reduce fluid balance both during CPB, and the total operative fluid balance.

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HYDRODYNAMIC EVALUATION OF AORTIC CARDIOPULMONARY BYPASS CANNULAE USING PARTICLE IMAGE VELOCIMETRY

Charles I. McDonald1, Eléonore Bolle2, Hansi F. Lang 2, Camille Ribolzi 2, Bruce Thomson2,3, Geoffrey D. Tansley 4, John F. Fraser 2,5 and Shaun D. Gregory 2,5

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2 The Innovative Cardiovascular Engineering and Technology Laboratory, Critical Care Research Group, The Prince Charles Hospital, Chermside, Australia

3 Department of Cardiothoracic Surgery, The Prince Charles Hospital, Brisbane, Qld, Australia

4 School of Engineering, Griffith University, Gold Coast, Qld, Australia

5 School of Medicine, University of Queensland, Brisbane, Qld, Australia

PURPOSE

Rotary blood pumps are often used during cardiopulmonary bypass (CPB), where the arterial cannula is inserted into the distal ascending aorta. Arterial cannula design and placement in an atherosclerotic aorta can contribute to neurologic deficits post-cardiac surgery, with stroke and other cognitive deficits occurring in up to 30% of patients after surgery. Therefore the aim of this study was to analyse the exit jet profile and velocity in various dispersion and non-dispersion cannulae to provide a clinical recommendation to reduce neurological deficits.

METHOD

Particle image velocimetry was used to assess 19 (7 dispersion and 12 non-dispersion) adult arterial CPB cannulae in a clear perspex chamber using a Levitronix CentriMag. Pump speed was set to achieve flow rates of 3.0 and 5.0 L/min with each cannula. The fluid (water/glycerol at 60/40% by mass) was seeded with tracer particles, which were tracked using 20 image pairs under continuous flow conditions. The maximum velocity of the exit jet was assessed at 20 and 40 mm from the cannula tip at both flow rates with each cannula.

RESULTS

Dispersion and non-dispersion cannulae were characterized by a fan shape and narrow velocity profile respectively. With the exception of one cannula, all dispersion cannulae had lower maximum velocities than non-dispersion cannulae. From the 19 cannulae, the respective highest and lowest velocities at 20 mm from the tip were 3.06 (non-dispersion) and 0.63 m/s (dispersion) at 5 L/min and 1.55 (non-dispersion) and 0.25 (dispersion) at 3 L/min.

CONCLUSION

Due to lower exit velocities and subsequent jet forces on the aortic wall, dispersion cannulae may cause less damage to endothelial tissue and should be used for atherosclerotic aortas. This study may assist the surgeon in choosing the best cannula for patient and operation type based on the hydrodynamic performance of the cannula.

AIR TRANSMISSION COMPARISON OF TWO ADULT ARTERIAL FILTERS - AF-100 VS. CB351: AN IN-VITRO STUDY

Kieron C Potger, Darryl Mcmillan, Mark Ambrose. *Cardiopulmonary Perfusion & Autotransfusion Unit, Royal North Shore Hospital, Sydney*

INTRODUCTION

Arterial filters are commonly incorporated within the extracorporeal circuit to minimise cerebral injury by capturing particulate matter and microbubbles. We clinically use the Affinity CB351 arterial filter. The new Affinity AF-100 (BB851) arterial filter has a smaller prime volume (100 mL vs. 212 mL) and smaller screen pore size (30 µm vs. 38 µm). Our aim was to determine if the AF-100 was as safe as the CB351 in terms of relative microbubble transmission of introduced air.

METHODS

A recirculating in-vitro circuit primed with warmed blood was used to compare both arterial filters. Microbubbles were detected using a GAMPT BC100 Doppler in the arterial filter inflow and outflow line. While at 3 L/min and 5 L/min pump flow rates, measurements were taken one minute prior and for three minutes after bolusing 30 mL air proximal to the venous reservoir.

RESULTS

Both arterial filters transmitted microbubbles during air injection. Both arterial filters' proportion of bubble volume transmitted increase with higher flows. Both arterial filters transmit a similar number of bubbles. However, the AF-100 transmits smaller sized bubbles and consequently less total bubble volume.

CONCLUSION

The results of this in-vitro study show that the transmission of introduced air by the AF-100 arterial filter is not more than the CB351 arterial filter over a range of flow rates suggesting that it is as safe in terms of air handling.

A COMPARISON OF 4 INTEGRATED ARTERIAL FILTER OXYGENATORS ABILITY TO HANDLE GME

Ferguson, James *CCP,*
Chief Perfusionist at Phoenix Perfusion Services Phoenix, Arizona

OVERVIEW

This presentation begins with a detailed review of the origins of GME and its effects on patients. Best practices to attenuate GME in the conventional extracorporeal circuit are discussed. Literature about integrated arterial filters prior to 2013 are referenced.

The presentation concludes with Mr. Ferguson's study, evaluating 4 oxygenators with integrated arterial filters and their ability to handle GME. The four commercially available oxygenators that were studied, were, Affinity Fusion from Medtronic, Synthesis from Sorin, Capiox FX15 from Terumo, and Quadrox-I from Maquet. Testing was conducted in vitro with bovine blood and GME was measured with an EDAC bubble detector. Data was collected for total embolic load, total volume, total emboli < 40 microns, total emboli > 40, and clearance time. The different oxygenators were listed as manufacturer 1…to manufacturer 4 (Affinity Fusion).

The results demonstrated that Affinity Fusion has the least amount of total embolic load, total volume, and total emobli > 40 microns; however was second to Quadrox in the amount of time it took to clear the air from the system.

KEY TAKEAWAYS

Affinity Fusion was ranked number one by the investigators for overall GME handling capabilities compared to the other 3 competitor devices.

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LEADERSHIP DEVELOPMENT: NEGOTIATING, IN AND OUT OF THE OR

Kieron C Potger, Darryl Mcmillan, Mark Ambrose.
Cardiopulmonary Perfusion & Autotransfusion Unit, Royal North Shore Hospital, Sydney

SESSION OBJECTIVES

To discuss leadership strategies with a focus on effective negotiating techniques to efficiently achieve goals and objectives. The delegates will be introduced to scenarios illustrating successful project management including the elements of planning, execution, monitoring, and closing.

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What are you talking about?	Giovanni Cecere CCP
How do I negotiate?	Kenneth G. Shann CCP

Simulated negotiation scenarios

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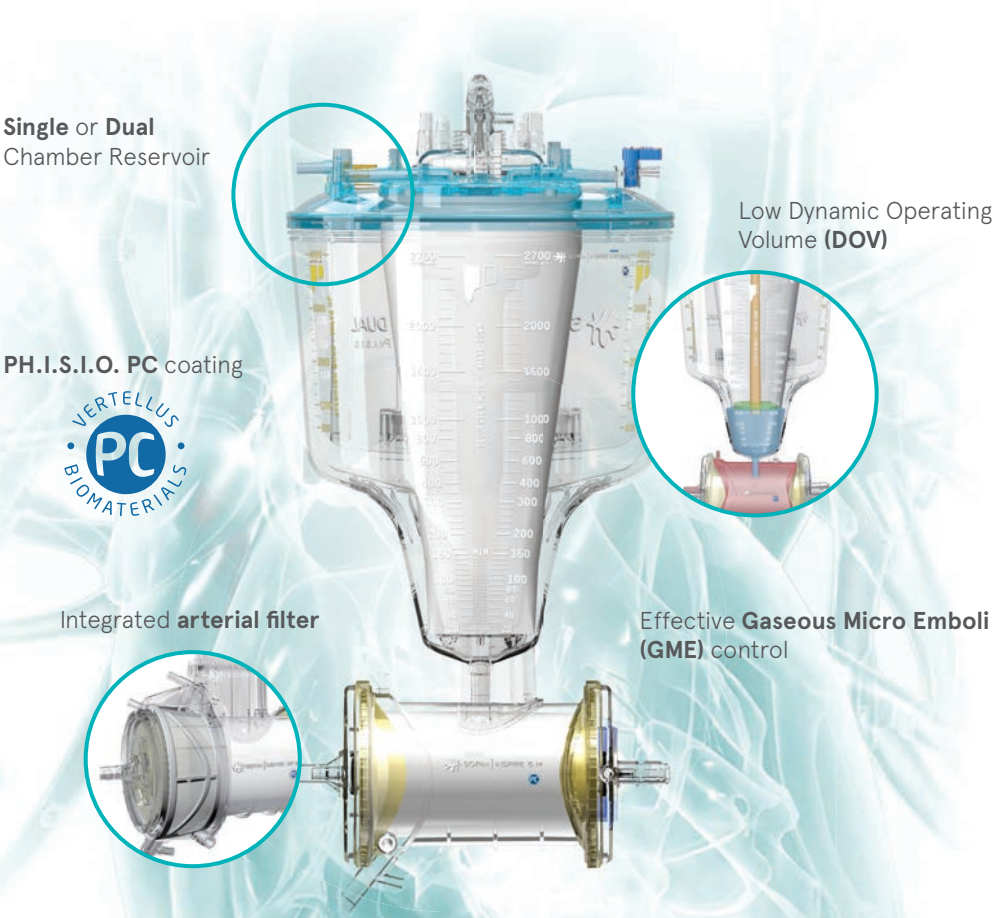
Because no two of your patients are the same.

INSPIRE™ is part of the integrated **HeartLink™ System** and offers a low (DOV) Dynamic Operating Volume to reduce hemodilution and (AKI) Acute Kidney Injury occurrence.



Superior handling of gaseous micro emboli (GME) lowers the risk of cognitive dysfunctions.

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