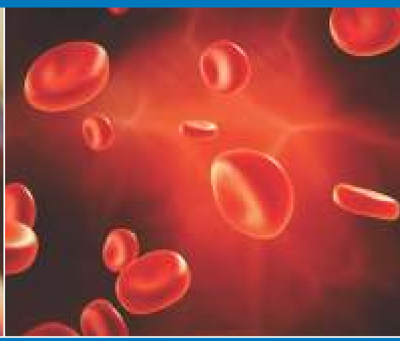
Issue 12

PRIME

Perfusion-Related Insights – Management and Evidence



Review Articles

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Self-Assessment

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PRIME Newsletter invites new authors for their contribution to the perfusion community. If you are interested in volunteering your time writing an article or a topic of your expertise and willing to share your knowledge with our readers, we certainly encourage you to do so. We invite everyone interested in joining our team, and you can contact us at the email given below. Any amount of time that you can volunteer in adding to our quality of publication will be greatly appreciated. Thank you for your interest in PRIME Newsletter. What are you waiting for?

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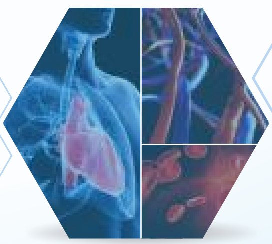

Editorial Letter

Dear Readers,

We are glad to present to you yet another engaging issue of PRIME newsletter.

“Perfusion-Related Insights - Management and Evidence” or "PRIME" is a scientific newsletter, which is published every quarter with the help of our editorial board members. It includes latest reviews, guidelines, and expert experiences associated with perfusion strategies.

In this twelfth issue of PRIME newsletter, we have focused on five interesting articles under the section “Review Articles.” The first article evaluates the benefits of using conventional versus minimized cardiopulmonary bypass support during coronary artery bypass grafting. The second article gives an overview of the efficacy of normothermic versus hypothermic cardiopulmonary bypass method in low-risk pediatric heart surgery. The third article determines the effectiveness of zero-balance ultrafiltration of priming blood on the procalcitonin level and respiratory function in infants after cardiopulmonary bypass. The benefits of direct innominate artery cannulation as a systemic and cerebral perfusion technique in aortic surgery are highlighted in the fourth article. The final article evaluates the impact of lung protection strategies during cardiopulmonary bypass on the composition of the bronchoalveolar fluid and lung tissue in patients undergoing cardiac surgery.

The section "Expert Experiences" presents two articles; the first article deals with blood conservation management in cardiac surgery, and another article talks about perfusion strategies for aortic arch surgeries.

The "Guidelines" section offers recommendations made by the American Society of ExtraCorporeal Technology regarding the management of blood flow and blood pressure during cardiopulmonary bypass.

The section "Latest News" shares recent insights on two articles, which include the effect of vasogenic shock or cardiogenic shock following cardiac surgery on gait speed and length of stay in a hospital, and the association between perioperative point-of-care platelet function testing and postoperative blood loss in patients undergoing high-risk cardiac surgery.

The final section "Self-assessment" is a fun section, which will allow you to evaluate your knowledge of cardiology.

We hope that perfusionists will find these articles interesting and helpful. We look forward to receiving your valuable feedback, comments, and suggestions to help us work better on future issues.

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Conventional versus Minimized Cardiopulmonary Bypass Support during Coronary Artery Bypass Grafting

Introduction

There exists a lack of clarity on the use of minimized cardiopulmonary bypass (MCPB) support in reducing the side effects associated with extracorporeal circulation. Several studies that compared conventional and minimized bypass circuits for coronary artery bypass grafting (CABG) focused on factors, such as stroke, mortality, myocardial damage, need for perioperative blood component transfusion, atrial fibrillation, renal failure, and inflammatory response activated by the extracorporeal circuit. The following study aimed to evaluate differences between conventional cardiopulmonary bypass (CCPB) and MCPB systems with the help of perfusion parameters and their course during CABG.

Methods

The study conducted by Provaznik Z *et al.* included the data of 5,164 patients who had undergone stand-alone CABG.

The following factors were used to assess tissue perfusion during cardiopulmonary bypass support and cardiac arrest:

- Body mass index (BMI)
- Hemodilution
- Blood pressure with corresponding pump flow and venous oxygen saturation
- Serum lactate
- Serum pH

Results

The study elicited the following results:

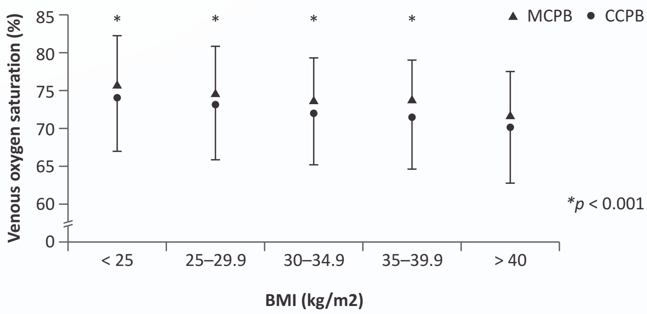
- The BMI, which was comparable between the two cohorts, was 29 ± 4.7 kg/m² for the CCPB group and 28 ± 3.9 kg/m² for the MCPB group.
- Hemodilution was more prominent after CCPB compared with MCPB. The hemoglobin level had dropped to 4.47 ± 0.142 g/dL and 2.77 ± 0.148 g/dL ($p = 0.0022$) after CCPB and MCPB, respectively.

"Minimized bypass systems can be considered as a favorable alternative to reduce adverse effects associated with cardiopulmonary bypass support."

- The mean BP was lower in the CCPB group than in the MCPB group during aortic clamping (53 ± 10 vs. 56 ± 13 mmHg, $p < 0.0001$), at 34 °C (57 ± 9 vs. 61 ± 12 mmHg, $p < 0.0001$), and during aortic clamp removal (55 ± 9 vs. 59 ± 11 mmHg, $p < 0.0001$) at all time points.
- Both CCPB and MCPB groups demonstrated comparable levels of venous oxygen saturation, which were greater than 70% (Figure 1).
- The increase in serum lactate was more prominent in the CCPB group (8.98 ± 1.28 mg/dL, $p = 0.0079$) than in the MCPB group (3.66 ± 1.25 mg/dL, $p = 0.0079$).
- The serum pH level decreased to the acidotic range during support with CCPB (7.33 ± 0.06, $p < 0.0001$), whereas it was maintained at the physiological level during support with MCPB (7.35 ± 0.06, $p < 0.0001$).

All BMI ranges showed evidence of the above-mentioned results.

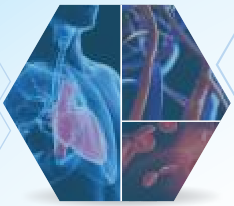
Figure 1: Venous oxygen saturation during support with MCPB and CCPB across BMI subgroups



CONCLUSION

Minimized cardiopulmonary bypass support is equivalent to CCPB, because MCPB provides efficient perfusion in all BMI ranges.

Reference: Provaznik Z, Unterbuchner C, Philipp A, Foltan M, Creutzenberg M, Schopka S, *et al.* Conventional or minimized cardiopulmonary bypass support during coronary artery bypass grafting? - An analysis by means of perfusion and body mass index. *Artif Organs.* 2018 Nov 9.



Efficacy of Normothermic versus Hypothermic Cardiopulmonary Bypass in Low-Risk Pediatric Heart Surgery

Introduction

An absence of shivering, hemodynamic stability, minimal need for use of inotropes, and early extubation were observed when patients underwent normothermic systemic perfusion. A study was conducted to evaluate normothermic (35 °C–36 °C) versus hypothermic (28 °C) cardiopulmonary bypass (CPB) in pediatric patients undergoing open heart surgery and to test the hypothesis that normothermic CPB perfusion preserves the functional integrity of the major organ systems leading to rapid recovery.

Methods

Caputo M *et al.* conducted two single-center, randomized controlled trials (also known as Thermic-1 and Thermic-2 studies, respectively) to evaluate the effectiveness and acceptability of normothermic CPB versus hypothermic CPB in children with congenital heart disease undergoing open heart surgery.

A total of 200 patients (aged ≤ 18 years) participated in the study. Of them, 59 were recruited to the Thermic-1 study and 141 patients were recruited to the Thermic-2 study. Of the 200 patients, normothermic CPB was induced in 98 patients and hypothermic CPB was induced in 102 patients. The researchers selected factors, such as duration of inotropic support, intubation time, and postoperative hospital stay, as the coprimary clinical outcomes in both trials.

> **"Significant differences in renal function, which were in favor of normothermic CPB, were seen across several markers of renal damage."**

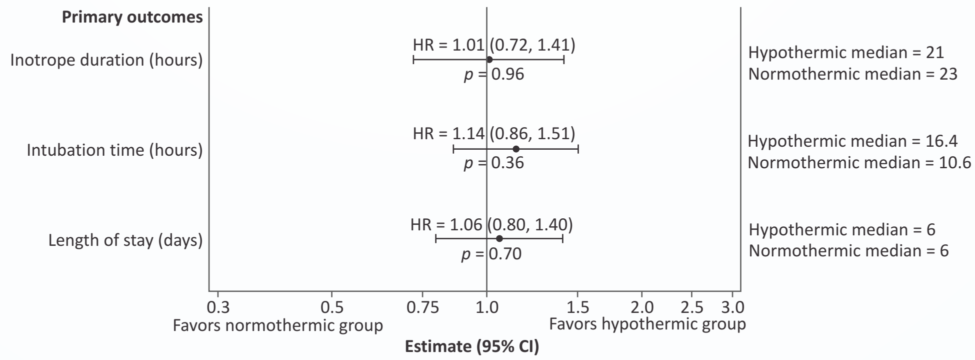
Results

The researchers found no significant difference between the treatment groups for any of the co-primary outcomes: Duration of inotropic support (hazard ratio [HR] = 1.01, 95% CI = 0.72–1.41), intubation time (HR = 1.14, 95% CI = 0.86–1.51), or postoperative hospital stay (HR = 1.06, 95% CI = 0.80–1.40) [Figure 1].

Differences that favored normothermia were found in the following parameters at the specified time points:

- Neutrophil gelatinase-associated lipocalin at 4 hours: Geometric mean ratio (GMR) = 0.47 (95% CI = 0.22–1.02)
- Urinary albumin at 48 hours: GMR = 0.32 (95% CI = 0.14–0.74)
- Urea nitrogen at 2 days: GMR = 0.86 (95% CI = 0.77–0.97)
- Serum creatinine at 3 days: GMR = 0.89 (95% CI = 0.81–0.98)

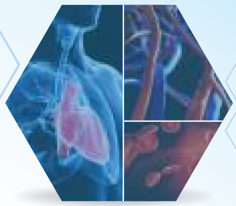
Figure 1: Primary outcomes associated with the normothermic and hypothermic CPB groups



CONCLUSION

The safety and efficacy of normothermic CPB are comparable to the findings seen with hypothermic CPB. Thus, normothermic CPB can be accepted as a perfusion strategy in low-risk infants and children undergoing open heart surgery.

Reference: Caputo M, Pike K, Baos S, Sheehan K, Selway K, Ellis L, *et al.* Normothermic versus hypothermic cardiopulmonary bypass in low-risk paediatric heart surgery: A randomised controlled trial. *Heart.* 2018 Oct 15.



Effect of Zero-Balance Ultrafiltration of Priming Blood on the Procalcitonin Level and Respiratory Function in Infants after Cardiopulmonary Bypass

Introduction

Blood priming is essential for cardiopulmonary bypass (CPB) in neonates and infants to avoid excessive hemodilution; however, transfusion-related inflammation has been shown to affect post-CPB outcomes in open heart surgery of infants. Procalcitonin, which is a newly identified inflammatory moderator and a sensitive parameter for forecasting pulmonary dysfunction secondary to CPB, rises after CPB. Dehaki MG *et al.* conducted a randomized trial to assess the effects of hemofiltration of priming blood before CPB on the procalcitonin concentration and postoperative pulmonary function among infants following CPB.

Methods

The researchers chose 60 infants with weight < 10 kg and divided them randomly into two equal groups; one group undergoing CPB with the zero-balance ultrafiltration (Z-BUF) of priming blood and another group undergoing CPB without Z-BUF. The researchers measured the procalcitonin level before anesthesia, after admission to the intensive care unit (ICU), and 24 h later. They also measured the respiratory index and pulmonary compliance (PC) after anesthesia, after CPB, and 2 h after admission to the ICU. Moreover, they recorded the time to extubation.

Results

The researchers observed the following results:

- The procalcitonin concentration in the Z-BUF group and non–Z-BUF group demonstrated a postoperative increase compared with baseline. The Z-BUF group demonstrated a smaller rise in the peak procalcitonin concentration than that seen in the non–Z-BUF group at 24 h after the operation, and the difference between the two groups constituted a statistical significance ($P = 0.05$) [Table 1].
- A positive correlation was seen between the peak procalcitonin concentration and the time to extubation directly ($P = 0.001$). A positive correlation was witnessed between the peak procalcitonin concentration and PC reversely ($P = 0.003$) [Table 2].
- The Z-BUF group demonstrated a significantly lower postoperative mechanical ventilation time than the non–Z-BUF group did ($P = 0.03$).

Table 1: Mean serum procalcitonin level (ng/mL) in the study groups at various time points

	Baseline	At ICU admission	24 h postoperatively
Z-BUF	0.2 ± 0.26	1.2 ± 1.4	2.1 ± 1.6
Non–Z-BUF	0.3 ± 0.37	1.9 ± 1.3	3.3 ± 2.7
P	0.2	0.8	0.05*

Data are reported as mean ± SD.
*$P < 0.05$ compared with the non–Z-BUF group; *P* for the main effect of time = 0.001; *P* for interaction = 0.12.

Table 2: Correlations between the peak procalcitonin concentration and time to extubation as well as PC

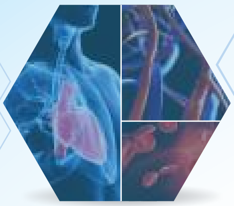
	Peak procalcitonin level	
	Correlation coefficient	*P*
Time to extubation	0.44	0.001
PC (mL/cmH2O) at ICU	-0.38	0.003

$P < 0.05$ indicates a positive correlation between the peak procalcitonin level and the time to extubation directly and PC reversely.

CONCLUSION

The Z-BUF of priming blood may lead to favorable clinical effects in the form of improved respiratory function and attenuated procalcitonin.

Reference: Gholampour Dehaki M, Niknam S, Azarfarin R, Bakhshandeh H, Mahdavi M. Zero-balance ultrafiltration of priming blood attenuates procalcitonin and improves the respiratory function in infants after cardiopulmonary bypass: A randomized controlled trial. *Artif Organs.* 2018 Oct 5.



Role of Direct Innominate Artery Cannulation as a Systemic and Cerebral Perfusion Technique in Aortic Surgery

Introduction

Surgeons often find the arterial cannulation procedure used in thoracic aortic surgery very challenging due to the site of the surgery and need for cerebral protection during periods of circulatory arrest. The use of cannulation sites that comprise the ascending and descending aorta along with the axillary, carotid, and femoral arteries has limitations and is associated with complications due to their closeness to surrounding structures. Therefore, surgeons use the innominate artery by either direct cannulation or indirect cannulation through a graft as an alternative site. The following article presents a retrospective review of the outcomes obtained when the artery cannulation technique which involved the sole direct innominate artery was used to perform aortic surgery.

Methods

The new innominate artery cannulation technique was used to perform surgery that involved the ascending aorta in 14 patients between 2011 and 2015.

From the group of 14 patients:

- Replacement of the aortic valve, aortic root, and ascending aorta with a valved conduit was performed in six patients.
- Replacement of the aortic valve and ascending aorta was performed in four patients.
- Replacement of only the ascending aorta was performed in two patients.
- Replacement of the ascending aorta and hemiarch was performed in one patient.
- Replacement of the concurrent mitral valve was performed in one patient.

"Innominate artery dissection or damage during the procedure was not seen even in a single patient."

Results

The postoperative outcomes of the new innominate artery cannulation technique in aortic surgery are mentioned in Table 1.

Table 1: Postoperative outcomes of the new innominate artery cannulation technique in aortic surgery

Parameters	Values
Survival	14 (100%)
Neurological deficit	
CVA	1 (7%)
Prolonged delirium	1 (7%)
ICU LOS (days)*	4.62 ± 3.77 (2–13)
Hospital LOS (days)**	13.07 ± 6.61 (5–26)
Acute renal failure	3 (21%)
Creatinine	101.69 ± 38.74 (50–191)[§]
Atrial fibrillation	8 (57%)
New	6 (43%)
Pre-existing	2 (14%)
CHB	1 (7%)
Permanent pacemaker	1 (7%)
Reoperation for bleeding	1 (7%)
Deep sternal infection	0 (0%)
DVT	1 (7%)
HIT	1 (7%)

Abbreviations: CVA, cerebrovascular accident; *ICU LOS, intensive care length of stay (days); **Hospital LOS, hospital length of stay (days); CHB, complete heart block; DVT, deep vein thrombosis; HIT, heparin-induced thrombocytopenia.

[§]Absolute creatinine value (mg/L)

CONCLUSION

Innominate artery cannulation technique is safe, convenient, and able to provide both systemic and selective cerebral perfusion promptly during aortic surgery.

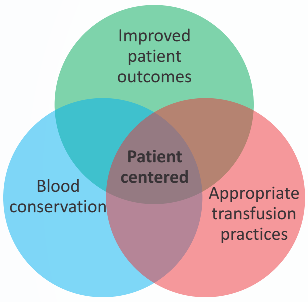
Reference: Kashani A, Doyle M, Horton M. Direct innominate artery cannulation as a sole systemic and cerebral perfusion technique in aortic surgery. *Heart Lung Circ*. 2018 Aug 28.

Blood Conservation Management in Cardiac Surgery Patients Undergoing Cardiopulmonary Bypass

Contributed by: Alok Kumar, Perfusionist, All India Institute of Medical Sciences, New Delhi

Blood conservation and importance of blood

Cardiac surgery is associated with excessive bleeding when compared with noncardiovascular surgery. Regional blood centers find it increasingly difficult to collect sufficient blood to meet patient needs in many areas of the country. In the next 15–20 years, the number of patients > 65 years will be more than double, but the number of blood donors will only increase marginally.



Blood management

Methods to reduce blood use in surgery

Preoperative

Preoperative conservation of blood is accomplished by hemoglobin optimization; correction of nutritional anemia with iron therapy via dietary advice, supplementation with vitamin B_{12}, as well as folate and erythropoietin therapies; and by stopping drugs that interfere with hemostasis.

Intraoperative

Meticulous hemostasis and operative techniques can play an essential role in reducing blood loss.

Postoperative

Blood can be salvaged from drains into collection devices that permit reinfusion through cell salvage techniques and the use of blood substitutes, such as volume expanders, human albumin, and perfluorocarbon emulsions.

- **Plasmapheresis and plateletpheresis**

  Plasmapheresis and plateletpheresis are terms used to describe the removal of fresh plasma and platelets from whole blood, respectively, while separating the red blood cells and giving them back to the patient after bypass surgery.

- **Hemoconcentrators**

  Excess fluid can be removed from patients' vascular system with a hemoconcentrator. The hematocrit of the patient increases as the fluid is removed. During cardiopulmonary bypass (CPB), these devices may be connected to the pump circuit and are a great asset for fluid management. The residual blood left in the pump circuit can be salvaged and concentrated with the hemoconcentrator after CPB is completed.

- **Isovolemic hemodilution**

  During this technique, one to two units of the patients' blood are withdrawn at the beginning of a procedure, and the blood volume is restored with the crystalloid/colloid solution. The surgical procedure is accomplished with patients' blood (thin blood) during the procedure, and patients get blood back at the end of the surgery.

- **Cardiopulmonary bypass circuit modifications**

  An open reservoir membrane oxygenator system during CPB may reduce blood utilization and improve safety. Similarly, activated clotting time (ACT)-guided heparin dosing during prolonged CPB reduces blood transfusion, hemostatic system activation, platelets, and protein consumption compared with fixed-dose heparin supplements.

- **Autologous blood transfusion**

  It involves collection and reinfusion (transfusion) of the patients' blood or blood components after completion of surgery. This procedure is beneficial as the blood is fully compatible and there is no risk of transfusion - transmitted diseases.

CONCLUSION

The use of management options, such as controlled hypotensive anesthesia, regional anesthesia and tranexamic acid, autologous hemotransfusion, normovolemic hemodilution, modification in the CPB circuit, cell-savaging procedures, plasmapheresis, and ultrafiltration, offers multidimensional alternatives for blood conservation in cardiac surgery patients undergoing CPB.

Perfusion Strategies for Aortic Arch Surgeries

Contributed by: Sam Immanuel, P. V. S. Prakash, Selva Kumar Rajamani, and Dr. Devi Shetty, Narayana Health, Bengaluru

Cerebral protection

1. Cerebral protection remains crucial. Current trends are hinting toward selective antegrade cerebral perfusion (ACP) at moderate temperature (24 ˚C nasal and 26 ˚C rectal).
2. Cerebral metabolism can be estimated and monitored indirectly by the oxygen metabolic rate equation (cerebral metabolic rate of oxygen = cerebral blood flow × cerebral arteriovenous oxygen content difference/100).
3. Total circulatory arrest is established at a core temperature of less than 20 ˚C.
4. Near-infrared spectroscopy (NIRS), bispectral index, electroencephalogram, and mixed venous oxygen saturation (SvO_2) tests are routinely conducted and monitored for aortic arch reconstructive procedures.
5. Cerebrospinal fluid is drained, and somatosensory evoked potentials are stimulated periodically. These measures help keep the intracranial pressure within the desirable range and avoid paraplegia.
6. Monitor the differential flow of blood between the upper and lower body by incorporating a noninvasive ultrasonic flow sensor.
7. The pH-stat is used during the cooling phase, and the alpha-stat is used during the rewarming phase. Employ mild hypercapnia during the cooling phase for deep hypothermic circulatory arrest (DHCA) and alpha-stat normocapnia during the rewarming phase.
8. Steroids are routinely administered as per the protocol.
9. Hypoperfusion may result in central nervous system ischemia, whereas hyperperfusion leads to cerebral edema.

Myocardial protection

1. Venting of the right superior pulmonary vein and left ventricular apex is routinely performed to avoid myocardial rewarming and distension.
2. During profound hypothermia (< 18 ˚C), cardioplegia is administered just before DHCA.
3. STS solution (4 ˚C) is administered through both coronary ostia. If coronary ostia are small and calcified, retrograde cardioplegia is preferred.
4. At lower temperature (< 20 ˚C), STS cardioplegia is repeated once in 30–40 min, even during the ACP period.
5. After implantation/repair of the aortic valve with the coronary buttons, antegrade cardioplegia is performed using a modified Foley's catheter in the neo-root (graft).

Visceral organ protection

1. Once ACP time exceeds 40 min, re-establish the femoral flow to the visceral organs. This is performed when an endoclamp catheter is deployed just after the left subclavian artery.
2. Monitor the difference between the upper and lower body perfusions by incorporating a noninvasive ultrasonic flow sensor.
3. Aim to achieve urine output 0.5–1 mL/kg/h during the cardiopulmonary bypass (CPB) run.
4. Frusemide 20 mg stat is administered during the rewarming phase.
5. Conventional ultrafiltration is performed during the rewarming phase, and modified ultrafiltration is done for 10–15 minutes.
6. Cerebrospinal fluid pressure increases during clamping, further decreasing the perfusion pressure of the spinal cord.

Perfusion strategies

1. Double arterial cannulation is performed with the right axillary/innominate and femoral arteries using an 8-mm graft with an elongated one-piece arterial cannula. Venous circulation is accessed with regular bicaval cannulation.
2. Plasmalyte A solution is the most preferred prime with additives of mannitol 50 mL and sodium bicarbonate 25 mL.
3. Cooling is commenced soon after ongoing bypass maintaining the difference between nasal and rectal temperatures around 3–4 ˚C.
4. If DHCA is indicated, the patient is cooled to 18 ˚C core temperature, and if ACP is indicated, the patient is cooled to 24 ˚C.

5. All neuroprotective agents are administered 5 min before DHCA/ACP.
6. During hypothermia, FiO_2 levels are titrated with response to SvO_2.
7. Activated clotting time is maintained in the range of 480–600 sec.
8. Arterial blood gas is monitored every half hourly.
9. Fresh frozen plasma is given as an infusion 50 mL/h in the CPB circuit.
10. During profound hypothermia, accept hematocrit up to 20%, and come off bypass at a hematocrit percentage that is not less than 28%.
11. Serum lactate is maintained at 4–6 mmol/L and serum glucose level has to be maintained at 150–200 mg/dL during the CPB run.

Strategies for ascending and arch aortic aneurysm

1. Initiate CPB with bicaval venous and double arterial cannulation (axillary and femoral arteries with an 8-mm graft).
2. Invasive ambulatory blood pressure monitoring is conducted via right radial access and left femoral access.
3. Near-infrared spectroscopy monitoring is mandatory for all cases of aneurysmal dissection involving the aortic arch.
4. Safer DHCA lasts for less than 30 min at 18 ˚C core temperature.
5. During DHCA, cerebral reperfusion is re-established once the NIRS value reaches 20% less than the baseline index.
6. The neurological outcome is better in DHCA with ACP versus DHCA without ACP.
7. Antegrade cerebral perfusion flows 10%–20% of total cardiac output which varies with NIRS and right radial pressure 40–50 mmHg.
8. The left common carotid artery requires additional cannulation if left NIRS is less than the baseline during ACP.
9. The recommended ACP duration should not exceed 90 min with the temperature difference of the nasal (18 ˚C) and rectal (22 ˚C).
10. Myocardial protection with STS cardioplegia is repeated at 25–40 min with respect to the patient's core temperature.
11. Once the ACP time exceeds 40 min, femoral arterial flow is re-established after introducing an endoaortic clamp just distal to the left subclavian artery.
12. During ACP, SVC saturation is measured and kept in a range of 70%–80% with FiO_2 adjustment in the perfusate.
13. Employ mild hypercapnia (pH-stat) during the cooling phase for DHCA and normocapnia (alpha-stat) during the rewarming phase.
14. Sodium thiopental (stat 10–15 mg/kg) and propofol infusion (7–10 mg/kg/h) are routinely used for aortic arch reconstructive procedures.
15. Cerebrospinal fluid is drained to decrease the intracranial pressure which helps avoid cerebral hypoperfusion.
16. Tranexamic acid (stat 10 mg/kg) is administered, and an infusion of tranexamic acid at 1 mg/kg/h is kept on flow.
17. Effective deairing is accomplished by placing the patient in the Trendelenburg position and compressing the bilateral carotid arteries under transesophageal echocardiography guidance.
18. Serum lactate is maintained at 4–6 mmol/L and serum glucose level has to be maintained at 150–200 mg/dL during the CPB run.

The American Society of ExtraCorporeal Technology Standards and Guidelines for Perfusion Practice (2017) Recommendations on the Management of Blood Flow and Blood Pressure during Cardiopulmonary Bypass Surgery

Blood flow

The perfusionist should:

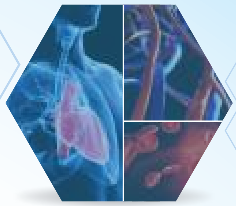
- Determine the target blood flow rates prior to cardiopulmonary bypass (CPB) according to the protocol
- Work in tandem with the surgical care team to maintain the targeted blood flow rate during CPB
- Report and communicate about the variance between the intended and targeted blood flow to the physician-in-charge
- Determine the appropriate blood flow rate by evaluation of factors, such as acid–base balance, anesthetic level, arterial blood pressure, cerebral oximetry, lactate burden, oxygen delivery and consumption, systemic vascular resistance, temperature, and venous oxygen saturation

Blood pressure

The perfusionist should:

- Work in close collaboration with the physician-in-charge to define and communicate the intended treatment algorithm for the management of blood pressure before CPB
- Work in tandem with the surgical team to maintain blood pressure according to protocol during CPB
- Report and communicate about the variance between the intended and targeted blood pressure to the physician-in-charge so that requisite changes can be made in the blood pressure management plan

Reference: American Society of ExtraCorporeal Technology Standards and Guidelines for Perfusion Practice [Internet]. Available at: http://www.amsect.org/p/cm/ld/fid=1617. Accessed on Jan 3, 2018.



Effect of Vasogenic Shock or Cardiogenic Shock following Cardiac Surgery on Gait Speed and Length of Stay in Hospital

Introduction

Frailty is a syndrome characterized by increased vulnerability to stressors owing to multiple impairments in the functioning of organs and diminishment of physiological reserves. Frailty has been demonstrated as a prognostic indicator of poor outcomes after cardiac surgery. One crucial factor that has been validated as a reliable marker of frailty is gait speed. Slow gait speed has been linked to mortality after cardiac surgery. Clark *et al.* conducted a retrospective analysis to investigate the etiology of poor outcomes after cardiac surgery with regards to gait speed.

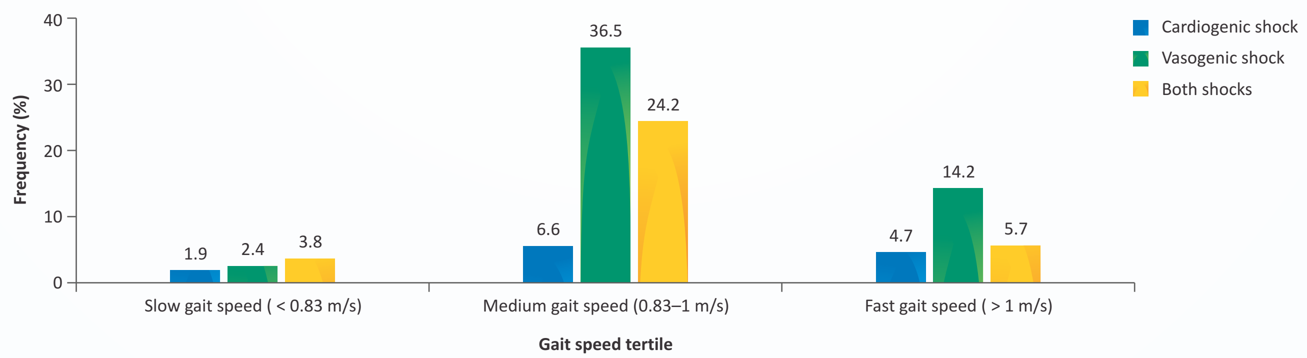
Methods

The study analyzed patients who were about to undergo cardiac surgery and who had a 5-meter walk test performed preoperatively (n = 333).

Results

- The tertiles that were used to stratify gait speeds were categorized as < 0.83 m/s, 0.83–1 m/s, and > 1 m/s.
- No difference was seen in the incidence of cardiogenic or vasogenic shock on a comparison of the gait speed groups.
- Postoperative vasogenic shock was seen in 183 (55%) patients, cardiogenic shock was seen in 99 (29.7%) patients, and both shocks were seen in 71 (21.3%) patients.
- The percentage of patients with vasogenic, cardiogenic, and both shocks within each gait speed tertile is represented in Figure 1.
- The researchers also found that the total length of stay in the hospital was significantly different among the gait speed groups ($p = 0.005$).
- The patients in the slowest gait speed tertile demonstrated a significant association with the need for a postoperative permanent pacemaker ($p = 0.0298$) compared with those present in the other gait speed tertiles.

Figure 1: Percentage of patients with vasogenic, cardiogenic, or both shocks



CONCLUSION

No significant association exists between gait speed and the incidence of cardiogenic or vasogenic shock after cardiac surgery. Gait speed is related to an increased length of stay in the hospital and a need for a permanent pacemaker after cardiac surgery.

Reference: Clark K, Leathers T, Rotich D, He J, Wirtz K, Daon E, *et al.* Gait speed is not associated with vasogenic shock or cardiogenic shock following cardiac surgery, but is associated with increased hospital length of stay. *Crit Care Res Pract.* 2018 Oct 23;2018:1538587.

Association between Perioperative Point-of-Care Platelet Function Testing and Postoperative Blood Loss in Patients Undergoing High-Risk Cardiac Surgery

Introduction

Hemostatic impairment is very common after cardiac surgery and is associated with increased morbidity and mortality. During cardiac surgery, function of platelets is influenced by several factors that include patient and procedural characteristics. Platelet dysfunction can be rapidly detected and quantified by point-of-care (POC) platelet function testing with whole blood multiple electrode aggregometry (MEA). This test can contribute to optimal patient blood management. Vlot EA *et al.* conducted a study to explore the possible association between the POC platelet function testing during the perioperative period and postoperative blood loss occurring in patients undergoing high-risk cardiac surgery.

> “Neonatal and infant cardiac surgery has been catapulted into the mainstream standard of care through the development of CPB and perfusion techniques.”

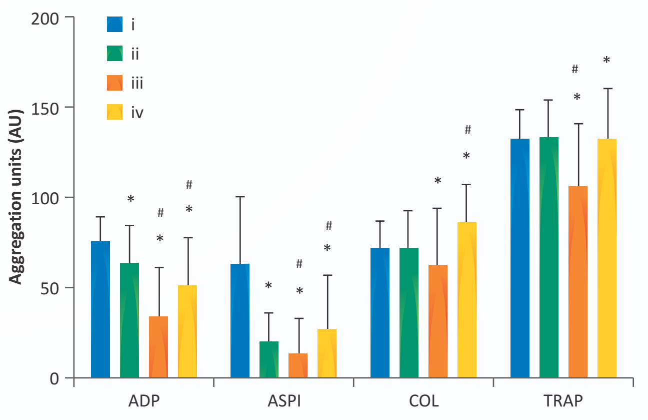
Methods

The study included 99 patients undergoing CABG and heart valve surgery, of which 59 (60%) patients were on antiplatelet therapy at the time of surgery. The platelet function was evaluated using POC MEA at four different perioperative time points in response to stimulation with four specific receptor agonist reagents, namely adenosine diphosphate (ADP) [ADP test], arachidonic acid (AA) [ASPI test], collagen (COL) [COL test], and thrombin receptor activating peptide-6 (TRAP) [TRAP test]. The recording of postoperative bleeding was done 24 h after the surgery. The researchers used regression analyses to establish associations between platelet function during the perioperative period and postoperative blood loss.

Results

- Platelet aggregation induced by ADP and AA declined during cardiopulmonary bypass (CPB) and after decannulation from CPB. The ADP test showed a maximum decrease of 55% (35 vs. 77 AU at baseline; $P < 0.001$), and the ASPI test showed a maximum decrease of 78% (14 vs. 64 AU at baseline; $P < 0.001$) [Figure 1].
- The ADP-induced platelet aggregometry at baseline and postoperative blood loss ($r = -0.249$; $P = 0.015$) demonstrated a linear relationship between them.
- The maximum decrease in platelet function between baseline and CPB decannulation was associated with postoperative blood loss ($r = 0.308$; $P = 0.037$) in aspirin users.
- The multivariate analysis elicited a finding that a reduced ADP platelet function before cardiac surgery was linked to postoperative blood loss ($r = -0.239$; $P = 0.012$).

Figure 1: Perioperative platelet function



(*) Significant change compared with previous time point ($P < 0.05$). (#) Significant change compared with baseline ($P < 0.05$). Baseline (i), during CPB (ii), after CPB decannulation and protamine (iii), and arrival at the ICU (iv). Values are median [interquartile range].

CONCLUSION

Reduced platelet aggregation induced by the ADP reagent at baseline is related to increased postoperative blood loss in patients undergoing high-risk cardiac surgery.

Reference: Vlot EA, Willemsen LM, Van Dongen EPA, Janssen PW, Hackeng CM, Kloppenburg GTL, *et al.* Perioperative point of care platelet function testing and postoperative blood loss in high-risk cardiac surgery patients. *Platelets.* 2018 Nov 9:1–7.

SELF-ASSESSMENT

SECTION 5

1. Which of the following statements is true in case of cardiopulmonary bypass?

a. Venous cannulation is normally into the inferior vena cava for closed procedures.
b. The optimal perfusion pressure is 120 mmHg.
c. The femoral artery is a recognized site for inserting the arterial cannula.
d. The arterial cannula is usually inserted in the descending aorta.
e. The patient is cooled to 25 ^{o}C if circulatory arrest is necessary.

2. Which of the following outcomes is commonly seen after coronary artery bypass grafting?

a. Basal lung collapse
b. Atrial arrhythmia
c. Diffuse cerebral injury resulting in an alteration in short-term memory
d. New Q waves on electrocardiogram
e. Blood loss of approximately 250 mL in the first hour after surgery

3. Which of the following options is an indicator of poor peripheral perfusion?

a. Oliguria
b. Hyperthermia
c. Confusion
d. Central cyanosis
e. Metabolic alkalosis

4. Which of the following statements is true for the transfusion process?

a. Transfusion-related acute lung injury manifests itself classically by severe dyspnea.
b. Graft versus host disease usually occurs within 24 hours.
c. Management of WBC-mediated transfusion reactions includes immediate cessation of transfusion.
d. Leukodepletion reduces the risk of febrile reactions.
e. Massive transfusion is defined as the transfusion of more than half of the blood volume in 24 hours.

5. Which of the following factors is associated with monitoring of the central venous pressure (CVP)?

a. It allows assessment of preload/filling pressure of the left heart.
b. It carries a higher risk of pneumothorax by the subclavian approach compared with the internal jugular approach.
c. It carries a higher risk of hemothorax by the subclavian approach compared with the internal jugular approach.
d. It indicates hypovolemia when the CVP is low.
e. It may not reflect the left heart filling pressure in patients with chronic obstructive pulmonary disease.

Reference: Ashford RU, Evans TN, Archbold RA. Key questions in surgical critical care. London, United Kingdom: Cambridge University Press; 2003. Section 1: MCQs. Cardiovascular system - Questions; p.3–11.

Issue 11 Answered: 1 - c, 2 - d, 3 - b, 4 - b, 5 - a, 6 - a

For the use of a registered medical practitioner or a hospital or a laboratory only

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