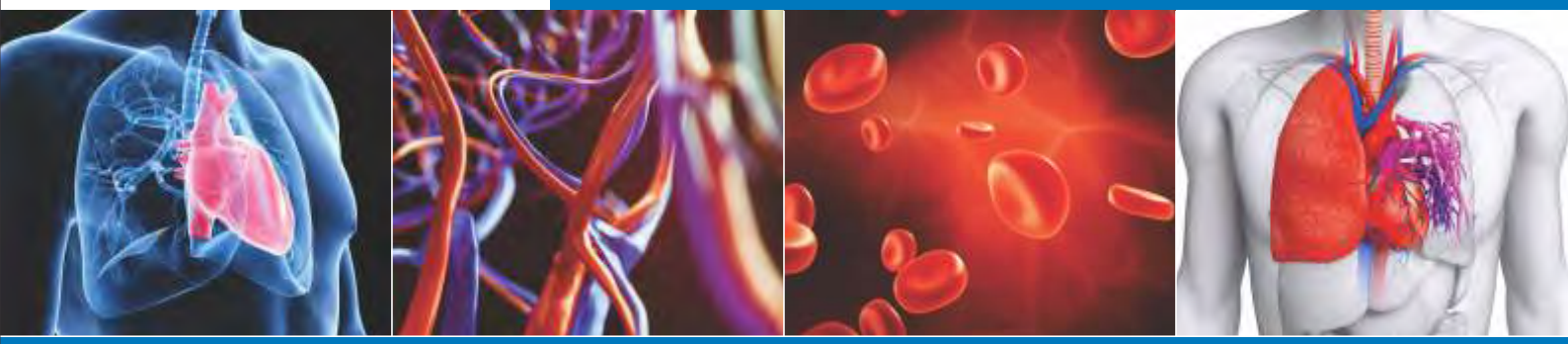
Issue 9

PRIME

Perfusion Related Insights – Management and Evidence



Review Articles

Expert Experiences

Guidelines

Latest News

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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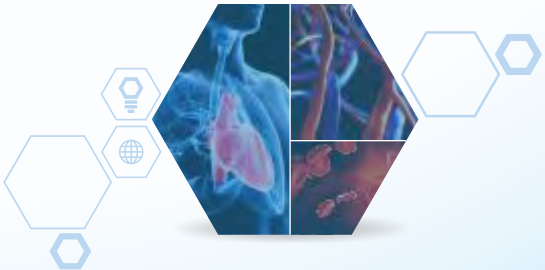

Editorial Letter

Dear Readers,

We are pleased to present the ninth issue of PRIME Newsletter to you. PRIME, or “Perfusion-Related Insights - Management and Evidence," is a scientific newsletter published every quarter with the help of our editorial board members and includes latest reviews, guidelines, and expert experiences in relation to perfusion strategies.

In this ninth issue, we are happy to present five articles under the section “Review Articles.” The first article examines the impact of a blood conservation protocol on transfusion rates and outcome after cardiac surgery and on stability of transfusion. The second study determines the impact of lowering the extracorporeal life support circuit volume by reducing the tubing length and changing components on blood product use in neonatal and pediatric patients. The third study focuses on the effectiveness of implementing the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines in preventing cardiac surgery-associated acute kidney injury in high-risk patients defined by renal biomarkers. The fourth study evaluates the link between perioperative white blood cell response and postoperative new-onset atrial fibrillation in a larger study cohort. The fifth study focuses on transfusion-related immunomodulation in renal allograft survival and postoperative mortality in cardiac surgery.

The "Expert Experiences" section covers two interesting topics by the experts: an assessment of risk factors for a sustainable “on-table extubation” program in pediatric congenital cardiac surgery: 5-year experience, and blood conservation during cardiopulmonary bypass.

The "Guidelines" section highlights the standards and guidelines for qualification, competency, and support staff. The “Latest News” section explains how desensitization of patient antibodies can reduce the risk of heart transplant rejection and describes a recently developed faster and cheaper cardiac imaging test for use in developing countries.

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

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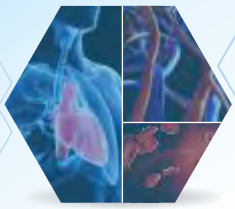

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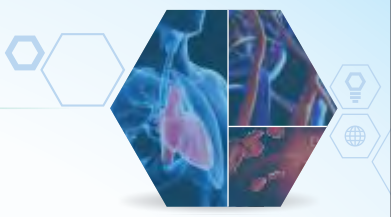


REVIEW ARTICLES

SECTION 1

Effect of a Multidisciplinary Blood Conservation Protocol on Patient Outcome and Cost after Cardiac Surgery

There is an absence of blood transfusion standardization in cardiac surgery. A multidisciplinary criterion-driven algorithm for transfusion management was implemented at the Inova Heart and Vascular Institute in the United States. The present study assessed the impact of the blood conservation protocol on transfusion rates and outcome after cardiac surgery, and on stability of transfusion.

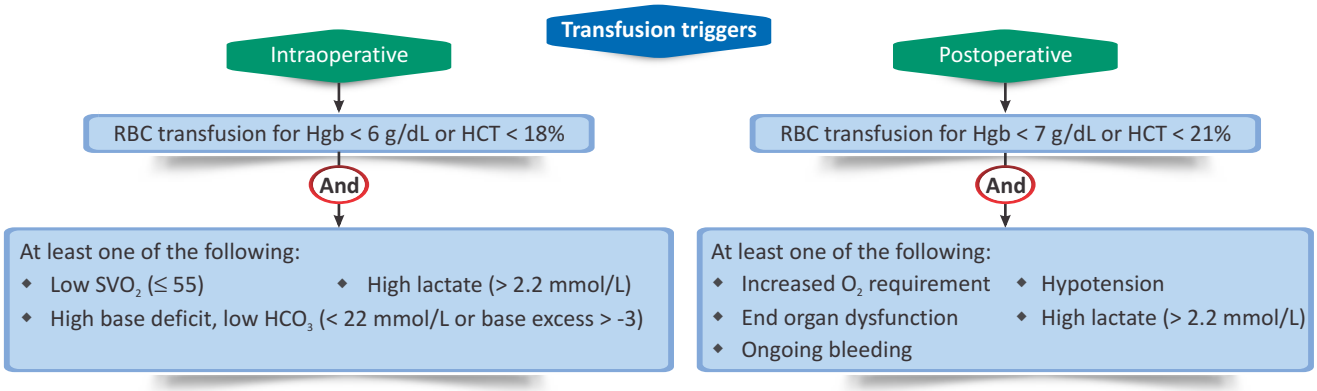
Materials and methods

Patients who underwent first-time cardiac surgery in 2006 (a complete year before protocol) were compared with those who underwent first-time cardiac surgery in 2009 (after protocol), and propensity scores were matched to improve balance. Stability of transfusion incidence was also compared (2005–2006 vs. 2008–2014). The Inova Heart and Vascular Institute developed and implemented a multifarious blood conservation methodology to achieve a reduction in blood use. The treatment algorithm was depicted in conjugation with the Society of Thoracic Surgeons guidelines of 2007 (Figure 1).

Results

The study consisted of 890 patients. There was a reduction in the use of blood products from 54% in 2006 to 25% in 2009 ($P < 0.001$). In 2009, the patients had fewer occurrences of postoperative renal failure (2.6% vs. 4%; $P = 0.04$), reoperations for bleeding (2% vs. 4%; $P = 0.004$), and readmissions at less than 30 days (6% vs. 12%; $P < 0.001$). The physical ($P = 0.001$) and mental ($P = 0.02$) quality of life of patients showed a greater improvement in 2009 than in 2006. A decrease in the blood product use reduced the need of packed erythrocytes ($P < 0.001$) and platelets (PLT) [$P < 0.001$], thereby leading to marked cost savings. After implementation of the protocol, transfusion incidence was ≤ 30%, with < 28% in most years.

Figure 1: Blood conservation protocol



Abbreviations: RBC, red blood cell; Hgb, hemoglobin; HCT, hematocrit; SVO_2, venous blood oxygen saturation; HCO_3, bicarbonate.

CONCLUSION

A multidisciplinary blood conservation program can remarkably enhance outcomes, control blood transfusion rates, and be sustained over time.

Source: Ad N, Holmes SD, Patel J, Shuman DJ, Massimiano PS, Choi E, *et al.* The impact of a multidisciplinary blood conservation protocol on patient outcomes and cost after cardiac surgery. *J Thorac Cardiovasc Surg.* 2017 Mar;153(3):597–605.

Reduced Use of Blood Product with Decreased Circuit Volumes during Extracorporeal Life Support

When blood contacts the extracorporeal life support (ECLS) circuit and its components, activation and consumption of PLT and clotting factors, along with hemolysis, can occur. The aim of this study was to determine the impact of decreasing the ECLS circuit volume by reducing the tubing length and changing components on the blood product use in neonatal and pediatric patients.

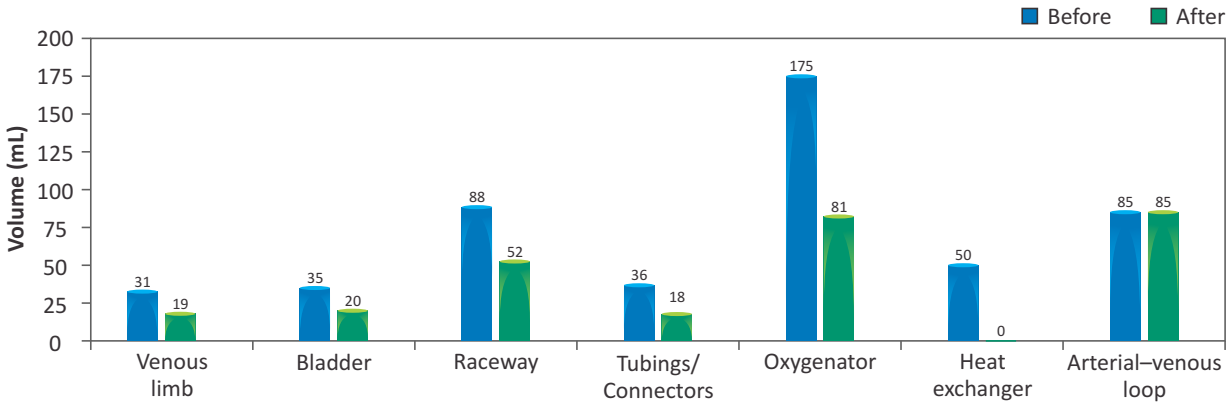
Methods

Blood product administration was assessed in 40 patients who required ECLS for cardiac or respiratory failure before (PRE) and after (POST) changes in the circuit designs and components. The patients were also grouped based on diagnosis, those with respiratory failure or underlying cardiac disease, and those requiring ECLS following surgery.

Results

The traditional ECLS circuit before volume reduction had a total priming volume of 500 mL. It consisted of 1/4 × 3/32-inch tubing, a silicone bladder, a silicone oxygenator, and a heater/cooler. The newer circuits had a total priming volume of 275 mL. They consisted of 1/4 × 3/32-inch tubing, a bladder, and a polymethylpentene oxygenator. All circuits had a roller pump. Figure 1 compares the volume of all individual circuit components in the old and new circuits. The total blood product volume use was 58% lower in the POST group versus the PRE group (81 mL/kg/day vs. 191 mL/kg/day; $P = 0.003$), fresh-frozen plasma (FFP) was 65% lower (15 mL/kg/day vs. 43 mL/kg/day; $P = 0.001$), and the PLT volume was lower. There was a 55% decrease in total blood product replacement (61 mL/kg/day vs. 136 mL/kg/day; $P = 0.008$), a 61% reduction in RBCs (28 mL/kg/day vs. 71 mL/kg/day; $P < 0.049$), and a 73% decrease in FFP use (11 mL/kg/day vs. 41 mL/kg/day; $P < 0.001$) in the subgroup of infants with respiratory or cardiac failure. There was a 25% reduction in RBC use (86 mL/kg/day vs. 115 mL/kg/day; $P = 0.03$) in the postoperative infants subgroup.

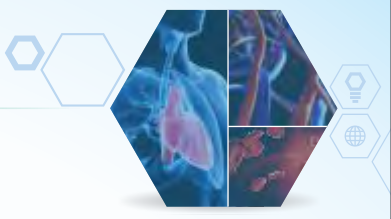
Figure 1: Volume of different components before and after changes in the circuit design



CONCLUSION

A marked decrease in blood product use was linked to the reduction in ECLS circuit volume by decreasing the tubing length and changing the components.

Source: Addison SD, Buck ML, Fang GY, Gangemi JJ, Kaufman DA. Decreased blood product usage during extracorporeal life support with reduced circuit volumes. *Transfusion.* 2017 Jun;57(6):1391–5.



Implementation of the Kidney Disease: Improving Global Outcomes Guidelines to Prevent Surgery-Associated Acute Kidney Injury in High-Risk Patients Identified by Biomarkers: The PrevAKI Randomized Controlled Trial

Introduction

Even though care bundles have not been shown to improve outcomes, they are recommended in patients at a high risk of acute kidney injury (AKI). The study aimed to evaluate the effectiveness of implementing the Kidney Disease: Improving Global Outcomes (KDIGO) guidelines in preventing cardiac surgery-associated AKI in high-risk patients defined by renal biomarkers.

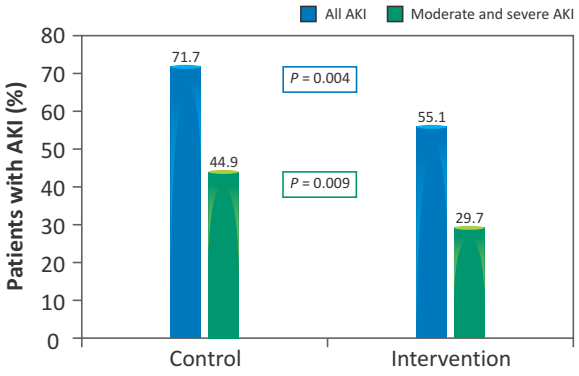
Methods

A single-center study evaluated the impact of a KDIGO bundle. The KDIGO bundle consisted of optimization of the volume status and hemodynamics, avoidance of nephrotoxic drugs, and prevention of high blood glucose in high-risk patients defined as urinary (tissue inhibitor of metalloproteinases-2)·(insulin-like growth factor-binding protein 7) > 0.3 undergoing cardiac surgery. The primary endpoint of the study was the occurrence of AKI within the first 72 h following cardiac surgery. The secondary endpoints included AKI severity, need for dialysis, length of stay, and major adverse kidney events at 30, 60, and 90 days.

Results

The intervention caused a significant reduction in AKI versus controls (55.1% vs. 71.7%; absolute risk reduction of 16.6%; 95 confidence interval [CI] 5.5%–27.9%; P = 0.004) [Figure 1]. The use of the bundle caused an improvement in hemodynamic parameters at different time points ($P < 0.05$), less hyperglycemia ($P < 0.001$), and use of angiotensin-converting enzyme inhibitors/angiotensin II receptor blockers ($P < 0.001$) versus controls. Additionally, the intervention caused a reduction in the rates of moderate-to-severe AKI versus controls. There was no marked impact on other secondary outcomes.

Figure 1: Prevalence of cardiac surgery-associated AKI in the intervention and control groups



CONCLUSION

Compared with standard care, implementation of the KDIGO guidelines caused a reduction in the frequency and severity of AKI after cardiac surgery in high-risk patients.

Source: Meersch M, Schmidt C, Hoffmeier A, Van Aken H, Wempe C, Gerss J, *et al.* Prevention of cardiac surgery-associated AKI by implementing the KDIGO guidelines in high risk patients identified by biomarkers: The PrevAKI randomized controlled trial. *Intensive Care Med.* 2017 Jan 21.

New-Onset Atrial Fibrillation and White Blood Cell Count after Cardiac Surgery

The most common complication of cardiac surgery is postoperative new-onset atrial fibrillation (PNAF). The inflammatory response has been studied as a potential underlying mechanism. In small studies, only white blood cell (WBC) count has been identified as a consistent inflammatory marker linked to PNAF. The present study aimed to evaluate the link between perioperative WBC response and PNAF in a larger study cohort.

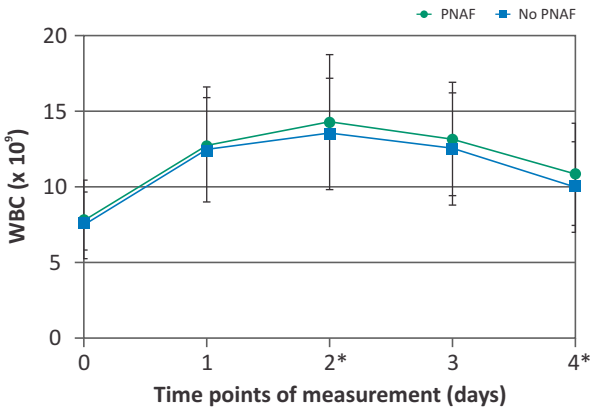
Methods

The study consisted of patients aged ≥ 18 years who would undergo elective cardiac surgery with a preoperative sinus rhythm. White blood cells were measured preoperatively and daily during the first 4 postoperative days. The main outcomes were the difference between peak postoperative WBC and the neutrophil/lymphocyte ratio (N/L ratio) and preoperative WBC and N/L ratio (ΔWBC and ΔN/L ratios, respectively). A continuous 12-lead ECG monitoring was used to evaluate the development of PNAF.

Results

Of the 657 patients included in the study, 277 (42%) developed PNAF. A detailed course of postoperative WBC is shown in Figure 1. As per the univariate analysis, there was a statistically significant relationship between ΔWBC (P = 0.030) and ΔN/L ratio (P = 0.002), and PNAF. Per the multivariate analysis, there was no significant relationship between ΔWBC ratio (odds ratio [OR] 1.14 per 1 × 10^9/L increase; 95% CI 0.65–2.03; P = 0.645), ΔN/L ratio ((OR 1.65 per 1 × 10^9/L increase; 95% CI 0.94–2.90; P = 0.089), and PNAF. The factors associated with PNAF were increasing age (OR 1.08 per year; 95% CI 1.01–1.16; P = 0.022) and (additional) valve surgery (versus coronary artery bypass grafting) [OR 4.96; 95% CI 2.07–6.91; $P \leq 0.001$].

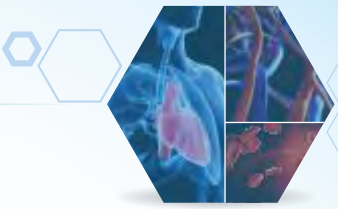
Figure 1: Postoperative WBC count at baseline and during the 4 consecutive postoperative days in patients with or without PNAF (*$P < 0.05$)



CONCLUSION

The development of PNAF was not linked to perioperative WBC response or its components.

Source: Jacob KA, Buijsrogge MP, Frencken JF, Ten Berg MJ, Suyker WJ, van Dijk D, *et al.* White blood cell count and new-onset atrial fibrillation after cardiac surgery. *Int J Cardiol.* 2017 Feb 1;228:971–6.



Transfusion-Related Immunomodulation in Renal Allograft Survival and Postoperative Mortality in Cardiac Surgery

Transfusion-related immunomodulation includes the documented laboratory immune alterations after allogenic blood transfusion (ABT), as well as established or claimed, beneficial or harmful clinical effects that may be attributed to immunosuppression caused by ABT.

Link between non-white-cell-reduced allogeneic blood transfusion and postoperative mortality

The benefits reported in an analysis of studies transfusing buffy-coat-reduced versus prestorage filtered RBCs were due to overrepresentation of cardiac surgery in that analysis. Three of the six randomized controlled trials (RCTs) included in the analysis were conducted in open-heart surgery. Among the five RCTs conducted in open-heart surgery, a 72% increase in mortality in association with non-WBC-reduced ABT was observed (OR 1.72; 95% CI 1.05–2.81; $P < 0.05$). No ABT effect was observed in six RCTs conducted in other surgical settings (OR 0.99; 95% CI 0.73–1.33; $P > 0.05$).

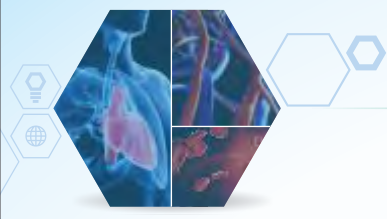
Systemic inflammatory response syndrome (SIRS) presents with leukocytosis, capillary leakage, and organ dysfunction. The multiple organ dysfunction syndrome (MODS) is caused by overwhelming SIRS. The compensatory anti-inflammatory response syndrome (CARS) has an immune-paralyzing effect manifested by anti-inflammatory cytokines, such as transforming growth factor-β1, interleukin-4 (IL-4), and IL-10. The postperfusion SIRS of cardiac surgery generally resolves with the intervention of CARS. Any intervention by biologic response modifiers, when an inflammatory cascade is present, can move the SIRS/CARS equilibrium toward the SIRS, causing the MODS, multiorgan failure syndrome, and death. White blood cell-containing ABT given during cardiac surgery may cause the second hit, worsen the SIRS, and can lead to patient's death. In completed cardiac surgery RCTs, non-WBC-reduced ABT was not linked to a particular cause of death, but the aggregate mortality was higher in the non-WBC-reduced arm than in the WBC-reduced arm.

A study analyzed the pro- and anti-inflammatory cytokine profiles of patients participating in an RCT that compared buffy-coat-reduced recipients versus WBC-reduced allogenic RBCs. Among the subgroups of patients who received more than three non-WBC-reduced RBC units, the patients who developed postoperative infection had higher IL-6 levels and those who developed MODS had higher IL-12 levels. This finding supports the hypothesis that non-WBC-reduced ABT amplifies an inflammatory response, which is a second hit superimposed upon the ongoing SIRS caused by cardiac surgery. The second hit inflammatory response may cause profound CARS, which can cause transfusion-induced immunosuppression predisposing to enhanced vulnerability to postoperative infection.

CONCLUSION

Transfusion-related immunomodulation enhances the survival of renal allografts in patients who receive pretransplant ABT. In cardiac surgery patients, the use of non-WBC-reduced ABT is linked to increased mortality.

Source: Lee J, Donahoe M. Hematologic abnormalities and acute lung syndromes. Switzerland: Springer International Publishing AG Switzerland; 2017. Chapter 13, Transfusion-related immunomodulation (TRIM): From renal allograft survival to postoperative mortality in cardiac surgery; p.241–60.



EXPERT EXPERIENCES

SECTION 2

A 5-Year Evaluation of Risk Factors for a Sustainable "On-Table Extubation" Program in Pediatric Congenital Cardiac Surgery

Contributed by: Radhakrishnan R. Nair, Reena Khantwal Joshi, Neeraj Aggarwal, Mridul Agarwal, Veronique Dinand, and Raja Joshi

Early extubation in pediatric patients after cardiac surgery is cumbersome due to unpredictable organ system responses to cardiopulmonary bypass (CPB), immature vital organ systems, and reduced respiratory reserve. Supporters of early extubation in pediatric cardiac surgery state that early initiation of feeding, early parental interaction, and decreased occurrence of ventilator-acquired pneumonia cause a shorter intensive care unit stay and minimal psychological trauma. The aim of the present study was to describe the risk factors for the failure of extubation in the operating room among pediatric patients undergoing cardiac surgery.

Methods

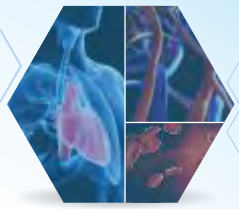
The prospective, observational study consisted of patients undergoing congenital heart surgery between July, 2010 and January, 2015. Initially, 448 patients were included in the study for extubatation in the operating room. The patients included in the study were > 3 months of age. Patients were excluded from the study if they were mechanically ventilated preoperatively; clinical evaluation showed anatomical upper airway compromise, audible stridor, apneic spells, hypotonia, and mottling on crying; airway anomaly was observed on bronchoscopy or tomography; they had experienced preoperative cardiovascular shock; there were frequent arrhythmias; or there were complex repair procedures with risk-adjusted congenital heart surgery (RACHS). Patients whose airways were successfully extubated in the operating room were represented as successful extubation in the operating room (SEOR), and patients whose extubations were deferred were represented as deferred extubation in the operating room (DEOR).

Results

Of the 448 patients, 292 (65%) were men and 156 (35%) were women; the airways of 412 patients (92%) were extubated in the operating room. The occurrence of reintubation in the SEOR patients was 2.4%. There were four mortalities in the whole group, and none of them had a direct causal relationship with fast-tracking. The airways of all patients undergoing RACHS category 1 surgery (n = 73), redosternotomies for various indications (n = 43), and patients aged > 18 years with adult congenital heart disease repairs (n = 39) were successfully extubated in the operating room. In the SEOR patients, the median length of stay in the pediatric cardiac intensive care unit and hospital was 3 days (interquartile range [IQR] 2–4 days) and 6 days (IQR 5–7days), respectively.

CONCLUSION

In most of the patients undergoing cardiac surgery, extubation in the operating room was successful. As per the multivatiate analysis, weight < 5 kg, age < 1 year, and significant noncardiac structural anomalies were identified as factors that affect extubation in the operating room, with an adjusted OR (95% CI) of 10 (2.7–37), 7.2 (2–22), 5.5 (1.7–17.7), and 3.3 (1.2–9.3), respectively.



Blood Conservation during Cardiopulmonary Bypass

Contributed by: Alok Kumar, AIIMS Hospital, New Delhi

As opposed to noncardiovascular surgery, cardiac surgery is linked to excessive bleeding. Regional blood centers find it difficult to maintain a balance between collection of sufficient blood and patient needs in many areas across the country.

Strategies to reduce blood use in surgery

1. **Preoperatively:** Preoperative blood conservation can be accomplished by optimizing hemoglobin levels; correcting nutritional anemia with iron therapy through dietary advice, vitamin B_{12}, folate, and erythropoietin therapy; and not using drugs that interfere with hemostasis.
2. **Intraoperatively:** Blood loss can be reduced with hemostasis and operative technique.
3. **Postoperatively:** Blood can be saved by using drains into collection devices which allow reinfusion through cell salvage techniques and the use of blood substitutes, such as volume expanders, human albumin, and perflurocarbon emulsions.
    - Plasmapheresis and plateletpheresis refer to the removal of plasma and PLT, respectively, from whole blood while separating the RBCs and transfusing them back to the patient. The product may then be transfused to the patient after bypass.
    - Hemoconcentrators: A hemoconcentrator can be used to remove excess fluid from the patient's vascular system. During CPB, the device can be connected to a pump circuit, which can help in fluid management. After CPB is completed, the residual blood present in the pump circuit can be preserved and concentrated with the hemoconcentrator.
    - Isovolemic hemodilution: During this procedure, 1–2 units of blood is withdrawn from the patient at the start of the procedure and crystalloid/colloid solution is used to restore the blood volume. While performing the surgical procedure, the patient bleeds thin blood and gets own blood back at the end of surgery.
    - Cardiopulmonary bypass circuit modifications: Blood utilization can be reduced and safety can be enhanced by using the open reservoir membrane oxygenator system during CPB. The activated clotting time-guided heparin dosing during prolonged CPB reduces blood transfusion, hemostatic system activation, PLT, and proteins consumption compared with fixed-dose heparin supplements.
    - Autologous blood transfusion: It implies collection and reinfusion of patient's own blood or blood components following a surgical procedure. This procedure is beneficial as the blood is fully compatible and there is no risk of transfusion-transmitted diseases.

CONCLUSION

In cardiac surgery patients undergoing CPB, controlled hypotensive anesthesia and the use of regional anesthesia and tranexamic acid, autologus hemotransfusion, normovolemic hemodilution, modification in the CPB circuit, cell-savaging procedures, plasmapheresis, and the use of ultrafiltration offer multidimensional management techniques for blood conservation.

GUIDELINES

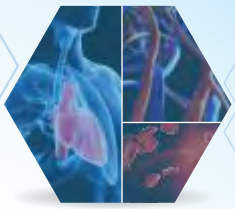
SECTION 3

The American Society of ExtraCorporeal Technology Standards and Guidelines for Perfusion Practice (2013)

Standards and guidelines for qualification, competency, and support staff

- Cardiopulmonary bypass can be performed by a perfusionist who is board certified by the American Board of Cardiovascular Perfusion or who has equivalent qualifications and competency.
- To assess compliance with departmental protocols, competency of a perfusionist should be evaluated annually.
- The perfusionist should engage, attend, and participate in perfusion-related continuing education courses annually.
- During CPB procedures, a support staff should be present on-site to assist the primary perfusionist.
    - Within 3 years of graduation, a person graduating from an accredited perfusion education program should complete all the requirements for the American Board of Cardiovascular Perfusion certification.
    - To ensure that the support staff has general knowledge of the duties performed by the perfusionist, operation flow, and location of primary and ancillary items necessary during CPB, a standardized protocol should be developed and followed to identify, orient, and educate.

Source: Baker RA, Bronson SL, Dickinson TA, Fitzgerald DC, Likosky DS, Mellas NB, *et al*; International Consortium for Evidence-Based Perfusion for the American Society of ExtraCorporeal Technology. Report from AmSECT's International Consortium for Evidence-Based Perfusion: American Society of Extracorporeal Technology Standards and Guidelines for Perfusion Practice: 2013. *J Extra Corpor Technol.* 2013 Sep;45(3):156–66.



LATEST NEWS

SECTION 4

Desensitization of Patient Antibodies can Reduce the Risk of Heart Transplant Rejection

According to a research study presented at the Heart Failure 2017 and the 4th World Congress on Acute Heart Failure, desensitization of patient antibodies can reduce the risk of heart transplant rejection. A virtual crossmatch is conducted at the time of transplantation to check whether the antihuman leukocyte antigen (anti-HLA) antibodies of the patient are specific to donor's specific HLA antigen. If they are specific, they are termed "donor-specific anti-HLA antibodies" (DSA).

Heart transplantation is not conducted in patients with high DSA levels at several centers, because this population presents with a high risk of antibody-mediated rejection, particularly hyperacute rejection. These patients need to wait for donors with different HLA antigens.

To reduce the possibility of rejection in patients having a high immunological risk, a desensitization program was initiated at Pitié-Salpêtrière Hospital in 2009. The present study assessed the effect of the program on the survival after heart transplantations that were performed between 2009 and 2015.

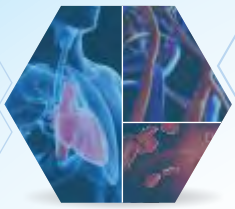
The DSA level determines the type of desensitization treatment a patient undergoes. Patients received antithymocyte globulins and conventional immunosuppressive therapy (calcineurin inhibitors, mycophenolate mofetil, and corticosteroids). Patients with low DSA levels received IV immunoglobulins. Patients with high DSA levels received plasmapheresis before and after transplantation, whereas after the complete cycle of plasmapheresis, IV immunoglobulins were given.

The study consisted of 523 patients with a mean age of 50 years; 77% of them were men. No DSA, low DSA, and high DSA levels were observed in 46%, 17%, and 37% of the patients, respectively. Among the three groups, the length of survival after transplantation was same even after adjustment for age, sex, and the presence of a ventricular assist device before transplantation. Survival at 1 year and at the end of follow-up was 79% and 73%, respectively, in the no DSA group; 80% and 72%, respectively, in the low DSA group; and 84% and 76%, respectively, in the high DSA group ($P = 0.85$).

Antibody-mediated rejections were more frequent in patients with high DSA levels than in those with no DSA (27% vs. 6%). These rejections occurred early in patients with high DSA levels but had no impact on survival and could be treated. Bleeding complications due to perioperative plasmapheresis were more common in patients with high DSA levels.

After desensitization of antibodies, survival was similar in patients at a high immunological risk and in those without DSA. Regardless of the treatment regimen, antibody-mediated rejections were common but were not linked to a poor outcome. An early identification of rejection with repetitive biopsies, aggressive treatment of rejections with plasmapheresis, and the use of IV immunoglobulins in subclinical rejections were the factors responsible for good results. The desensitization program can reduce the waiting time and improve the access to transplantation in patients with a high immunological risk.

Source: Risk of heart transplant rejection reduced by desensitising patient antibodies [Internet] [Updated May 1, 2017]. Available at: https://www.escardio.org/The-ESC/Press-Office/Press-releases/risk-of-heart-transplant-rejection-reduced-by-desensitising-patient-antibodies. Accessed on Jun 15, 2017.



Development of a Faster and Cheaper Cardiac Imaging Test for Developing Countries

A faster and cheaper cardiac imaging test has been developed by the investigators in the United Kingdom and Peru; the test can also be used in developing countries. The scan is three times faster and costs less than 20% of the available techniques. Presently, cardiovascular magnetic resonance (CMR) is the gold standard for the diagnosis of cardiovascular diseases. It is used for measuring the structure and function of the heart, determining the heart muscle scarring after a heart attack, and predicting the occurrence of a subsequent heart attack.

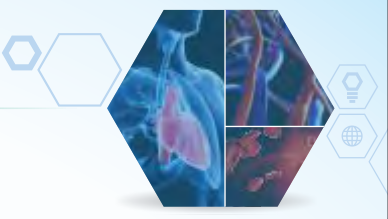
In Peru, only two public hospitals offer CMR and five private hospitals charge USD 600–800 for each scan. The aim of the Non-invasive CMR Assessment (INCA)-Peru study was to develop and test an ultrafast CMR procedure for wider application in Peru. The initial protocol was developed at University College London (UCL), and the mean scan time was reduced to 10 minutes from the initial 60 minutes. It was successfully implemented in Thailand where it was used for the assessment of cardiac and liver iron overload in patients with thalassemia major.

The procedure was adapted for the INCA-Peru study by adding gadolinium, a contrast agent. The procedure was tested in a pilot study in 50 patients at UCL, and every scan took 15–20 minutes. The ultrafast CMR procedure was tested using the contrast over 2 days at two hospitals in Peru along with training for local radiologists, cardiologists, and technicians. The study consisted of 100 patients with suspected cardiomyopathy and 11 healthy controls. No scan-related complications were observed. All scans were diagnostic in nature, and a repeat scan was necessary in two patients. Ninety-five percent of the patients received gadolinium-based contrast agents.

On an average, every ultrafast CMR scan took 18 minutes and cost USD 150. Hypertrophic cardiomyopathy (21%), nonischemic dilated cardiomyopathy (17%), and ischemic cardiomyopathy (11%) were the most common underlying diagnoses. In addition, there were 20 other diagnoses, including tumors, congenital heart disease, myocardial iron overload, amyloidosis, vasculitis, and apical thrombus.

The clinical management of 33% of the patients was affected by CMR. In 20% of the patients, CMR identified a new, unsuspected diagnosis that caused a complete change in treatment management. No other cardiac testing was necessary in 30% of the patients. To assess the effect of diagnosis with ultrafast CMR on long-term morbidity and mortality, the researchers of the INCA-Peru study will follow up the patients for 2 years. The use of CMR has provided accurate diagnoses and reduced morbidity and mortality in Europe, and the researchers hope to find similar results in Peru.

Source: Researchers develop faster and cheaper cardiac imaging test for developing countries [Internet] [Updated May 26, 2017]. Available at: https://www.escardio.org/The-ESC/Press-Office/Press-releases/researchers-develop-faster-and-cheaper-cardiac-imaging-test-for-developing-countries. Accessed on Jun 19, 2017.



SELF ASSESSMENT

SECTION 5

1. Cardiopulmonary bypass is associated with an intense inflammatory response because of:

a. No positive pressure ventilation ☐
b. Normothermia ☐
c. No anesthetic from peripheral line or inhalational anesthetic ☐
d. Heart arrest with cardioplegia ☐

2. "Fast tracking" in the postoperative period of CPB surgery is early tracheal extubation within _____.

a. 4–8 h ☐
b. 10–12 h ☐
c. 14–20 h ☐
d. 24–36 h ☐

3. Bovine serum albumin (BSA) is used in extracorporeal to calculate:

a. Cardiac output ☐
b. Gas-to-blood flow ratio ☐
c. Cardiac index ☐
d. Cardiac ejection fraction ☐
e. Cardiac time tension index ☐

4. Increasing the velocity of blood flow through a blood oxygenator:

a. Increases blood path membrane boundary layers ☐
b. Causes less "secondary flow" ☐
c. Decrease blood path membrane boundary layers ☐
d. Does not affect blood path membrane boundary layers ☐
e. Does not affect "secondary flow" ☐

5. When walking the raceway of a patient with venovenous extracorporeal membrane oxygenation (VV-ECMO), you are not required to clamp off above the bridge, because the blood pressure at both ends of the circuit is the same.

a. True ☐
b. False ☐

6. Most likely indications for ECMO include: ☐

a. Bridge to heart or lung transplantation ☐
b. Hemodynamic support in patients with severe aortic regurgitation ☐
c. Pulmonary embolism caused by a tumor ☐
d. Pneumonia-associated acute respiratory distress syndrome (ARDS) refractory to conventional therapy ☐
e. ECMO-assisted cardiopulmonary resuscitation (CPR)

Answers: 1–b; 2–a; 3–c; 4–c; 5–a; 6–a.

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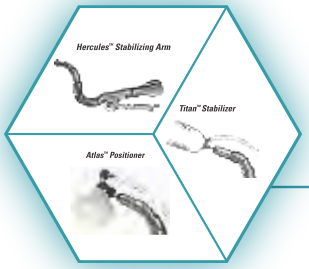

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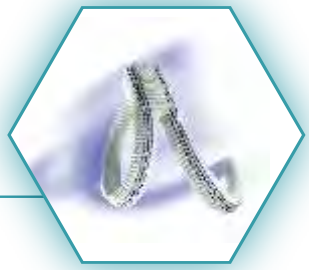

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