Patient Blood Management In Cardiac Surgery

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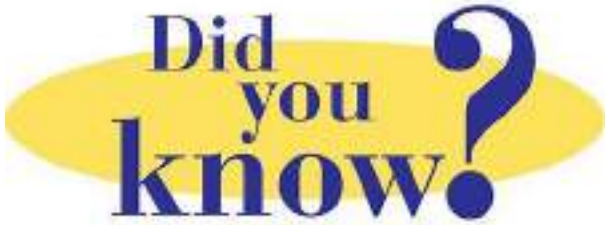
Nothing for declare


Did you know?


IMPORTANT


EVIDENCE

NIH Public Access
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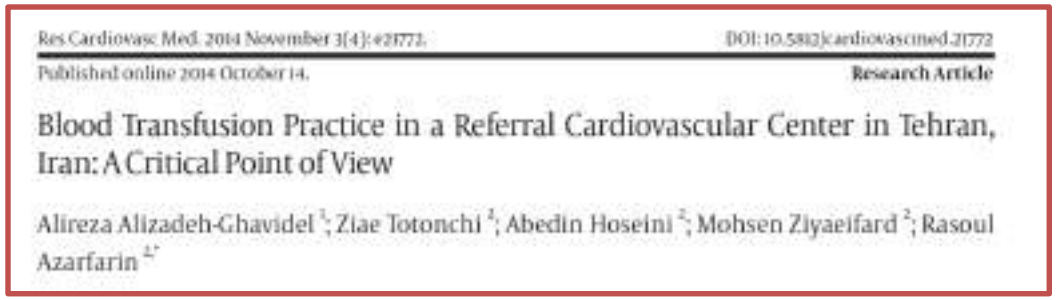
Published in final edited form as:

Blood Transfusion and Infection After Cardiac Surgery

Keith A. Horvath, MD[1], Michael A. Acker, MD[2], Helena Chang, MS[2], Emilia Bagiella, PhD[2], Peter K. Smith, MD[4], Alexander Iribarne, MD, MS[3], Irving L. Kron, MD[3], Pamela Lackner, BA[5], Michael Argenziano, MD[7], Deborah D. Ascheim, MD[3], Anneline C. Gelijns, PhD[3], Robert E. Michler, MD[8], Danielle Van Patten, BA[7], John D. Puskas, MD[9], Karen O'Sullivan, MPH[3], Dorothy Kliniewski, RN, BSN[2], Neal O. Jeffries, PhD[10], Patrick T. O'Gara, MD[11], Alan J. Moskowitz, MD[3], and Eugene Blackstone, MD[6]



Res Cardiovasc Med. 2014 November 3(4): e21772. DOI: 10.5812/cardiovascmed.21772
Published online 2014 October 14. Research Article

Blood Transfusion Practice in a Referral Cardiovascular Center in Tehran, Iran: A Critical Point of View

Alireza Alizadeh-Ghavidel [1]; Ziae Totonchi [2]; Abedin Hoseini [3]; Mohsen Ziyaeifard [2]; Rasoul Azarfarin [2,*]

Cardiac surgery has the largest consumption of blood products of any field in medicine (10% to 15% of the US blood supply),

Overall 48% patients received at least 1 unit of RBCs ranged from 33% to 74%,

Overall major infections (5.8%), Over 40% of major infections occurred after hospital discharge

More than 90 % of patients received PC and 54.9% transfused FFP during or after surgery.

Most of the transfusions were done after operation in intensive care unit (ICU).

Also, 20% and 17% of the patients underwent transfusion of more than 6 units of PC and FFP, respectively

Antifibrinolysis and Blood-Saving Techniques

Limiting Excessive Postoperative Blood Transfusion after Cardiac Procedures

A Review

Heart Inst J 1995;22:216-30)

Causes of Excessive Blood Transfusion

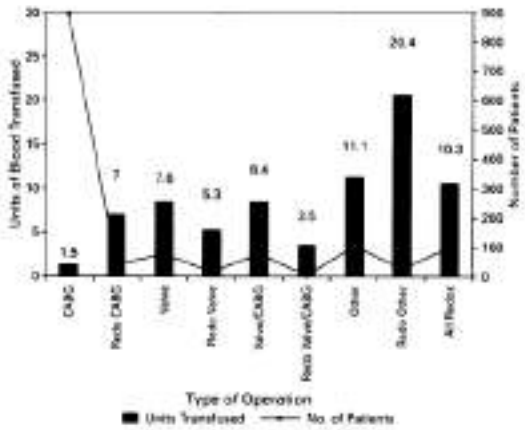


Fig. 3 *Blood transfusion by operation type in 1,252 patients at Albany Medical Center during 1993.*

Patient-Related Causes

Drug-Related Causes

Physician-Related Causes ("Transfusion Triggers")

REVIEW ARTICLE

Bleeding Complications Associated With Cardiopulmonary Bypass

By Richard C. Woodman and Laurence A. Harker

Blood, Vol 76, No 9 (November 1), 1990: pp 1680-1697

In some hospitals more than **25%** of all blood products are dedicated to **OH units**

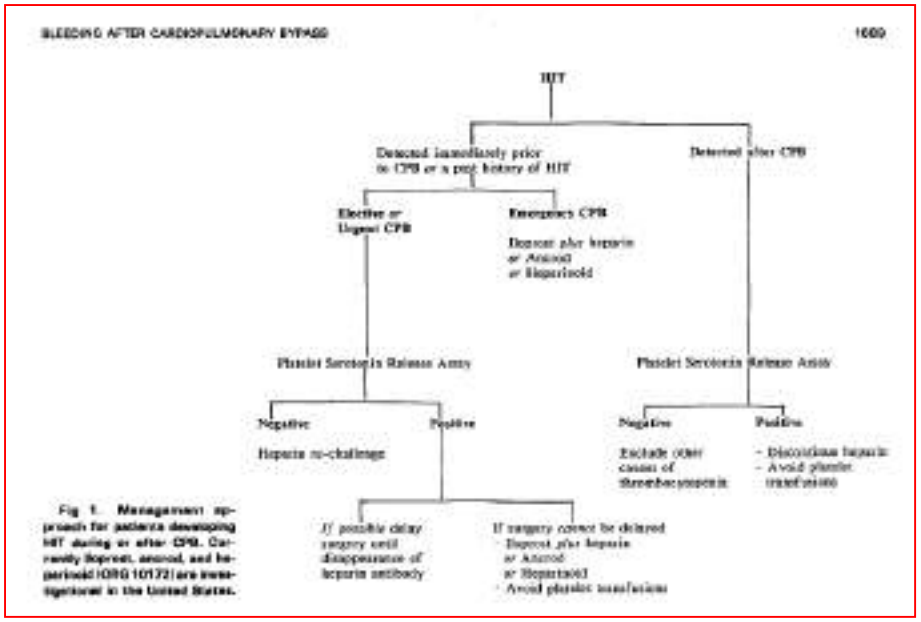


Fig 1. Management approach for patients developing HIT during or after CPB. Currently ilioprost, aprotinin, and hirudin (ORG 10172) are investigational in the United States.

Table 1. Various Causes of Bleeding After CPB

Common (95% to 99%)	
	Defective surgical hemostasis
	Acquired transient platelet dysfunction
Uncommon (1% to 5%)	
	Drug-induced platelet dysfunction (aspirin)
	Thrombocytopenia (drug-induced or heparin-induced antibodies, sepsis, posttransfusion purpura, fat emboli)
	Vitamin K-dependent factor deficiencies (warfarin, liver dysfunction)
	Consumptive coagulopathy (sepsis, cardiogenic shock)
	Inherited clotting factor deficiencies or platelet dysfunction
Doubtful significance	
	Primary fibrinolysis
	Heparin (inadequate neutralization, rebound)
	Protamine excess

Basic Information

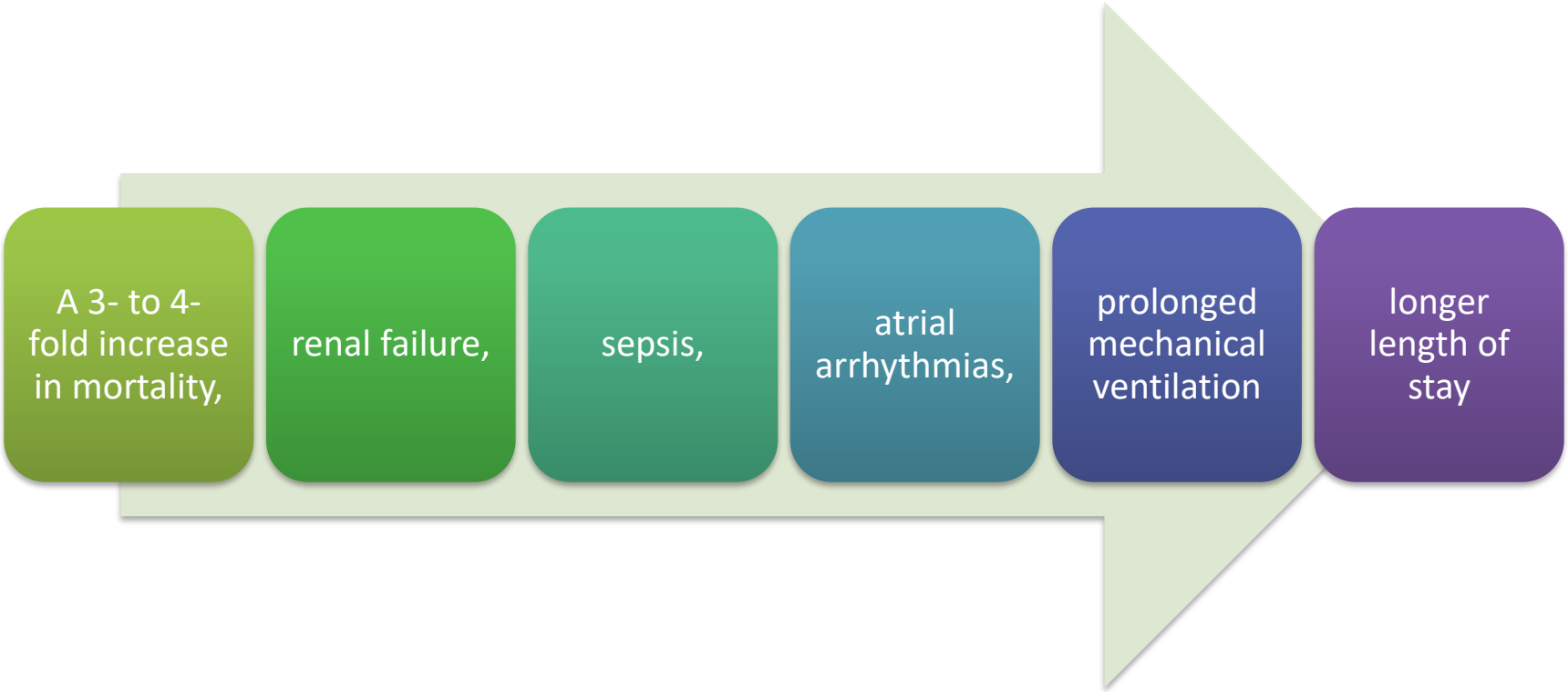
In some hospitals more than 25% of all blood products are dedicated to OH units	✓The incidence of reoperation for hemostasis varies in the literature, ranging from 3% to 14%,with an average of 6.2%	✓Approximately 5%to 7%of patients undergoing cardiac surgery lose more than 2 L of chest tube drainage during the first 24 hours postoperatively	✓Up to 5-10% require re-exploration for bleeding, resulting in an increased length of stay and higher mortality.


Prediction and management of bleeding in cardiac surgery

Why the PBM is Important?

Excessive bleeding after cardiac surgery can result in increased morbidity and mortality related to transfusion- and hypoperfusion-related injuries to critical organ systems

Excessive microvascular bleeding after cardiac surgery can result in re exploration, which has been shown to be associated with a variety of negative outcomes such as:



Stroke, short-term or long-term mortality

may be increased in cardiac surgical patients who receive transfusion

REVIEW

Blood conservation strategies to reduce the need for red blood cell transfusion in critically ill patients

Alan T. Tinmouth MD MSc, Lauralynn A. McIntyre MD MSc, Robert A. Fowler MDCM MS

Table 3: Incidence of adverse effects associated with allogeneic red blood cell transfusions[8]

Adverse effect	Incidence per transfused units
Infectious	
Viral infection	
Hepatitis A	1:2 000 000
Hepatitis B	1:31 000* to 1:81 000†
Hepatitis C	1:1 935 000 to 1:3 100 000
HIV	1:2 135 000 to 1:4 700 000
HTLV I/II	1:1 900 000
Bacterial contamination	1:14 000 to 1:28 000
Parasitic infection	1:4 000 000
Prion disease	Rare
Noninfectious	
Febrile nonhemolytic reaction	1:500
Urticarial reaction	1:50 to 1:100
Anaphylactic reaction	1:23 000
Hemolytic transfusion reaction	1:9 000
Transfusion-related acute lung injury (TRALI)	1:1 300 to 1:5 000
Transfusion-associated circulatory overload (TACO)	1:17 000
Post-transfusion purpura	1:143 000

The hemostatic system limits hemorrhage when vascular integrity is compromised and includes several major components:

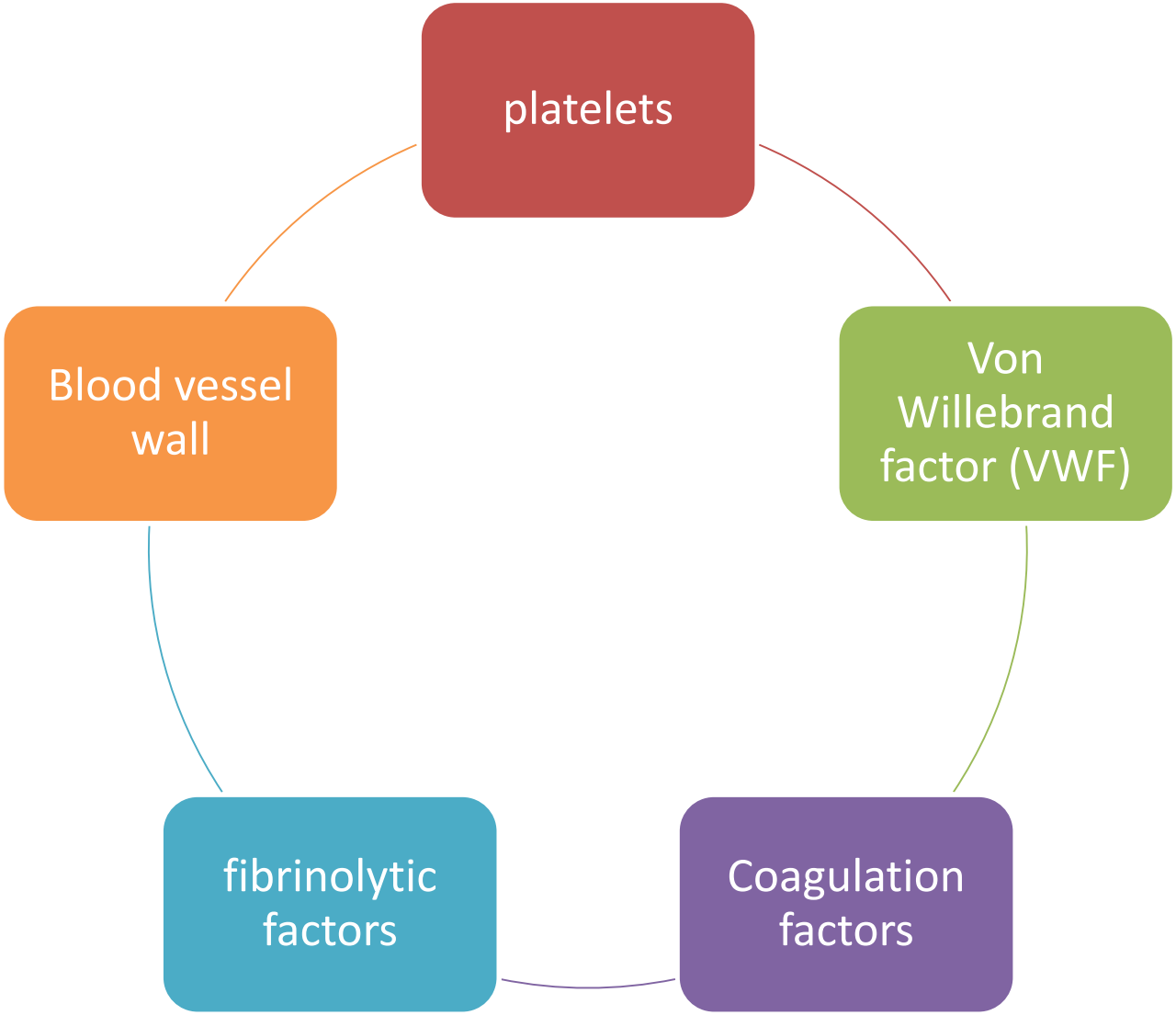
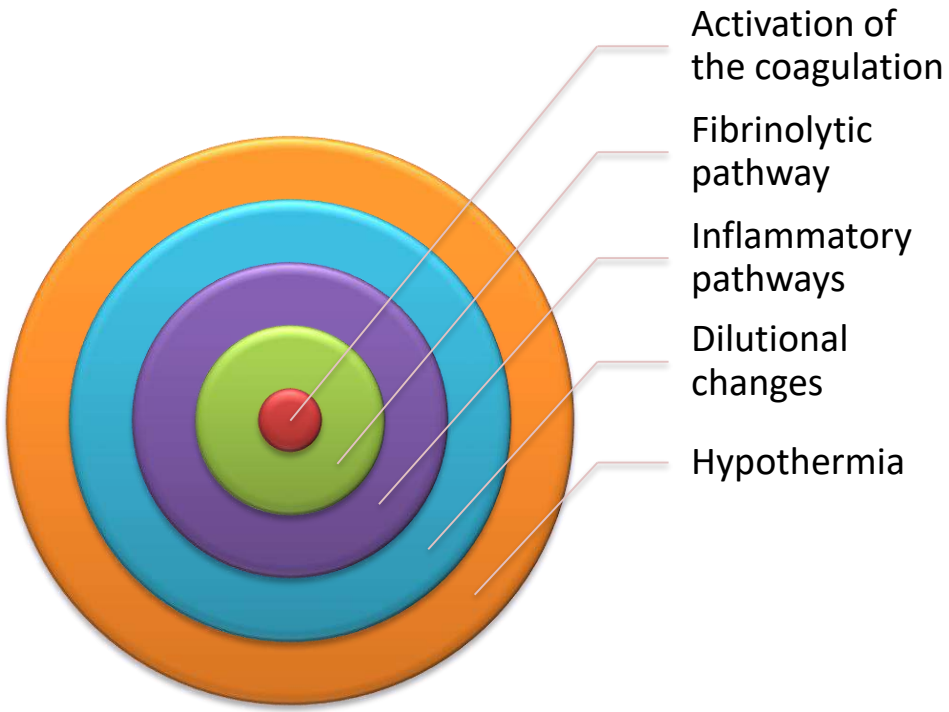


Table 1 Hereditary vs. acquired defects after cardiac surgery [2]

Source of hemostatic defect (S)	Prevalence/incidence
Hereditary	
Platelet disorders (e.g. abnormal adhesion or aggregation receptors, storage defects)	One hundred and thirty cases described in the literature 0.4% of general population and 8% of pts with history of bleeding/abnormal screening tests
Severe bleeding (i.e. as related to adhesion or aggregation defects)	<1:1 000 000
Mild bleeding (storage pool defects, signal transduction defects)	Incidence unknown, less common than von Willebrand disease
Coagulation factor deficiency	
Factor VIII	1:5000–10 000
Factor IX	1:30 000
Factor XI	1:1 000 000 or 1:50 (Ashkenazi Jewish births)
Factor VII	1:500 000
Factor V, X	1:1 000 000
Afibrinogenemia, Dysfibringenemia	1:1 000 000
Factor XIII	1:2 000 000
Factor II (prothrombin deficiency)	1:2 000 000
Acquired with Extracorporeal circulation	1.5% – 1:10 000
Thrombocytopenia	
$<50\ 000\ \mu L^{-1}$	6%
$<100\ 000\ \mu L^{-1}$	60%
Qualitative platelet abnormalities	
Reduced TRAP-mediated activation in PRP	10%
Reduced PAF-mediated activation in whole blood	33%
Coagulation factor deficiency (<20% activity)	30%
Hypofibrinogenemia (fibrinogen < 100 mg dL^{-1})	9%

TRAP, thrombin receptor agonist peptide; PRP, platelet-rich-plasma; PAF, platelet activating factor.



Perioperative use of various anticoagulants, and platelet inhibitors

Postopertaive needs

Original Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2017(10 Jul);31.37. https://doi.org/10.14196/mjiri.31.37

Perioperative changes in platelet count and function in patients undergoing cardiac surgery

Elham Khalaf Adeli[1], Seyed Mostafa Alavi[2], Alireza Alizadeh-Ghavidel[3], Hooman Bakhshandeh-Abkenar[2], Ali Akbar Pourfathollah[1,4*]

Received: 17 Nov 2016 Published: 10 Jul 2017

Table 2. Number and Percent of Patients with Abnormal Platelet Function

	Before CPB	After CPB	Post Operation
ADP-induced aggregation	28(70%)	34(85%)	32(80%)
AA-induced aggregation	23(58%)	32(80%)	31(78%)
COL-induced aggregation	25(63%)	28(74%)	34(85%)

Abbreviation: CPB, cardiopulmonary bypass; ADP, Adenosine diphosphate; AA, Acid arachidonic; Col, Collagen

Platelet count and platelet aggregation are reduced during CPB. Our results emphasized the effect of platelet dysfunction on increased postoperative bleeding and transfusion requirements.

Perioperative monitoring of platelet function can be considered as a bleeding management strategy for implantation of PBM programs

Mechanisms for excessive bleeding after cardiac surgery

- Disseminated intravascular coagulation (DIC)
- Excessive fibrinolysis because of either primary or secondary fibrinolysis

(i.e. as related to CPB-mediated DIC and/or reduced fibrinolysis inhibitors such as PAI1, a-2 antiplasmin)

- Decreased or denatured coagulation factors
- Platelet-related

Thrombocytopenia
Platelet activation/desensitization
Prolonged bleeding time
Decreased platelet reactivity to one or more platelet agonists
Loss of platelet glycoprotein receptors
Fibrinogen (Gp IIb/IIIa)
von Willebrand Factor receptor (Gp Ib)
Platelet Degranulation (i.e. as demonstrated by release of BTG, PF4, ADP)
Changes in platelet signaling/adhesion molecule expression
Hypothermia-related effects
Heparin-related inhibition
Heparin-related activation
Protamine-related platelet dysfunction

The universal definition of perioperative bleeding in cardiac surgery (UDPB).

0: insignificant, 1: mild, 2: moderate, 3: severe, 4: massive

Severe: when sternal closure is delayed (left open or packed for hemostatic issues), or five to ten units of RBC or fresh frozen plasma (FFP) have been transfused the patient after chest closure, to or the chest drains exceed 1,000 ml/12h or surgical re-exploration has already been applied.

Massive bleeding occurs when more than ten units of RBC or FFP have been transfused, or drains exceed 2,000 ml/12h or when the administration of recombinant activated factor VII (rFVIIa) was judged compulsory to stop bleeding

Patient blood management

British Journal of Anaesthesia 109 (1): 55–68 (2012)
Advance Access publication 24 May 2012 · doi:10.1093/bja/aes139

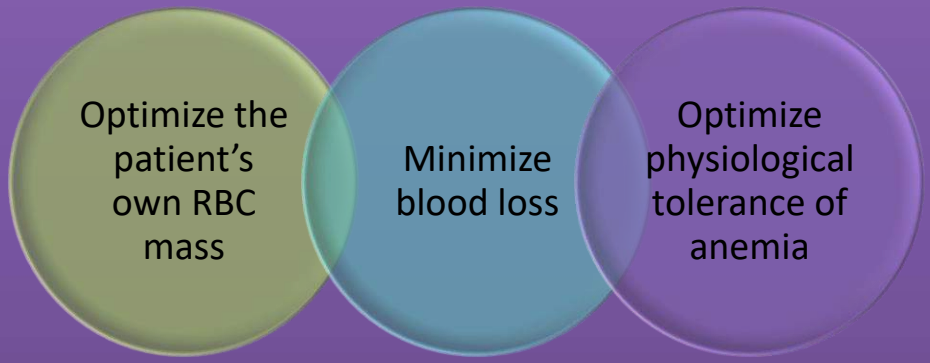
BJA

Patient blood management in Europe

A. Shander[1*], H. Van Aken[2], M. J. Colomina[3], H. Gombotz[4], A. Hofmann[5], R. Krauspe[6], S. Lasocki[7], T. Richards[8], R. Slappendel[9] and D. R. Spahn[10]

The concept has been developed with more emphasis on preventative measures and improving patient outcome.

PBM relies on three key strategies to achieve its goals:



Therefore, PBM requires a multidisciplinary, multimodal, individualized strategy for avoiding and controlling blood loss, and to systematically identify, evaluate, and manage anaemia

Journal of Cardiothoracic and Vascular Anesthesia 32 (2018) 88–120

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journal homepage: www.jcvaonline.com

2017 EACTS/EACTA Guidelines on patient blood management for adult cardiac surgery

The Task Force on Patient Blood Management for Adult Cardiac Surgery of the European Association for Cardio-Thoracic Surgery (EACTS) and the European Association of Cardiothoracic Anaesthesiology (EACTA)

Christa Boer (EACTA Chairperson)[*,1,2], Michael I. Meesters[1,2], Milan Milojevic[1], Umberto Benedetto[1], Daniel Bolliger[1,2], Christian von Heymann[1,2], Anders Jeppsson[1], Andreas Koster[1,2], Ruben L. Osnabrugge[1], Marco Ranucci[1,2], Hanne Berg Ravn[1,2], Alexander B.A. Vonk[1], Alexander Wahba[1], Domenico Pagano (EACTS Chairperson)[*,1]

Even the transfusion of 1 or 2 units of packed red blood cells (PRBCs) has been associated with a dramatic increase in morbidity, mortality and costs in patients undergoing coronary artery bypass grafting (CABG)

Predictors of bleeding, transfusion and reoperation in cardiac surgery

Advanced age

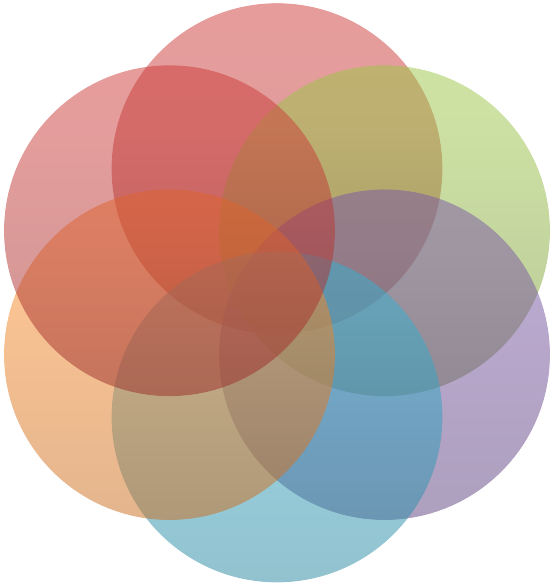
Preoperative dual antiplatelet therapy (DAPT) use

Poor platelet function

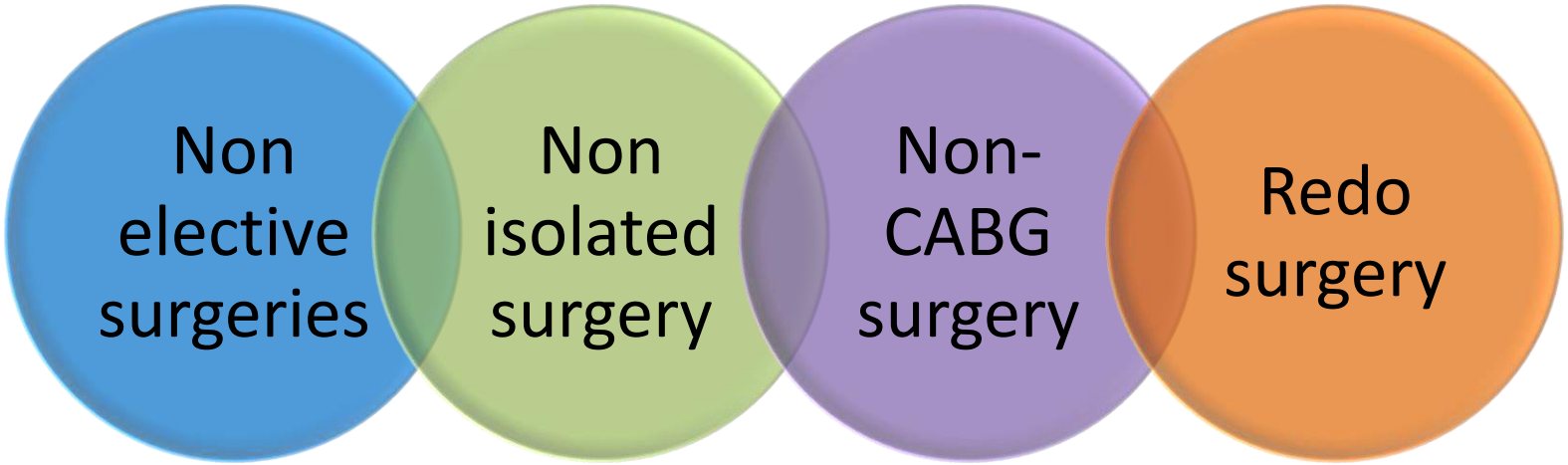
Preoperative anaemia

small body surface area

The female gender



Surgeries associated with an increased risk of bleeding, transfusion and reoperation



Patients blood management levels

Preoperative	✓Intraoperative	✓Post operative

PREOPERATIVE

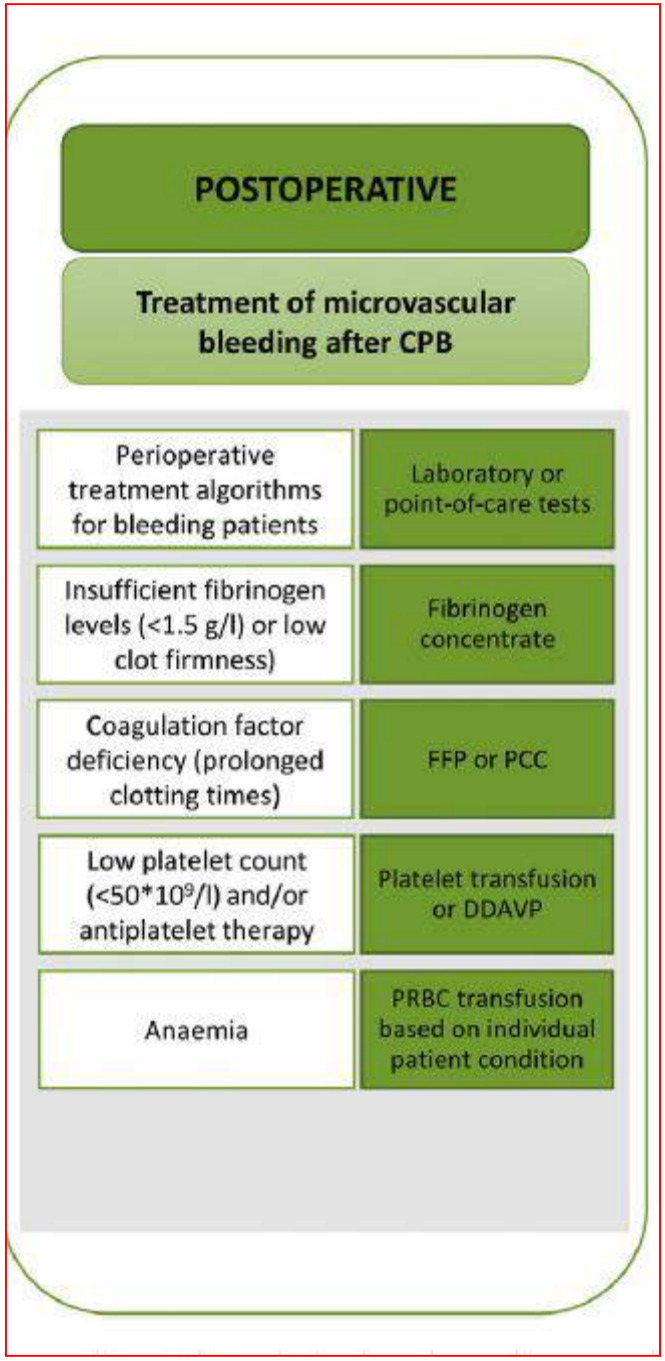
Identification of patients at high risk of bleeding

Iron deficiency anaemia	Oral or i.v. iron to improve erythropoiesis
Non-iron deficiency anaemia (e.g. vit D or folate deficiency)	EPO +/- iron
Fibrinogen level testing	
Platelet function testing in patients taking P2Y12 inhibitors or DAPT	

INTRAOPERATIVE

Maintenance of haemostasis and minimizing blood loss

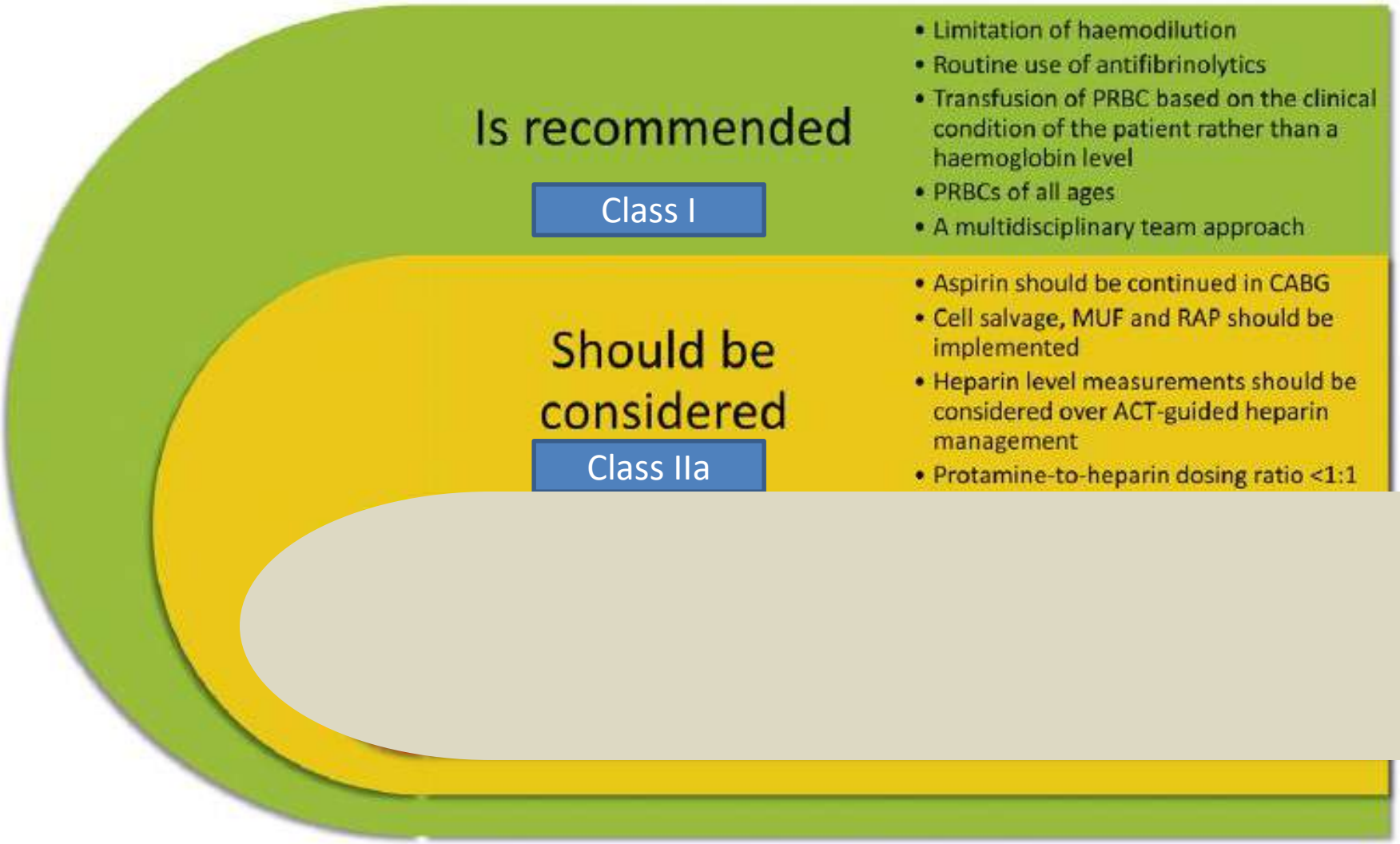
Meticulous surgical haemostasis	
Minimizing haemodilution, e.g. by MiECC	E.g. MiECC, retro- or antegrade autologous priming
Individual heparin and protamine titration	ACT, heparin or FXa measurements
Normothermia (>36^{0}C) and normal pH (7.35–7.45)	Patient warming, maintenance of tissue perfusion
Prevention of fibrinolysis	Tranexamic acid, aprotinin, EACA
Use of cell saver	


POSTOPERATIVE
Treatment of microvascular bleeding after CPB
Perioperative treatment algorithms for bleeding patients
Laboratory or point-of-care tests
Insufficient fibrinogen levels (<1.5 g/l) or low clot firmness)
Fibrinogen concentrate
Coagulation factor deficiency (prolonged clotting times)
FFP or PCC
Low platelet count (<50*10⁹/l) and/or antiplatelet therapy
Platelet transfusion or DDAVP
Anaemia
PRBC transfusion based on individual patient condition

Is recommended

Class I

- Limitation of haemodilution
- Routine use of antifibrinolytics
- Transfusion of PRBC based on the clinical condition of the patient rather than a haemoglobin level
- PRBCs of all ages
- A multidisciplinary team approach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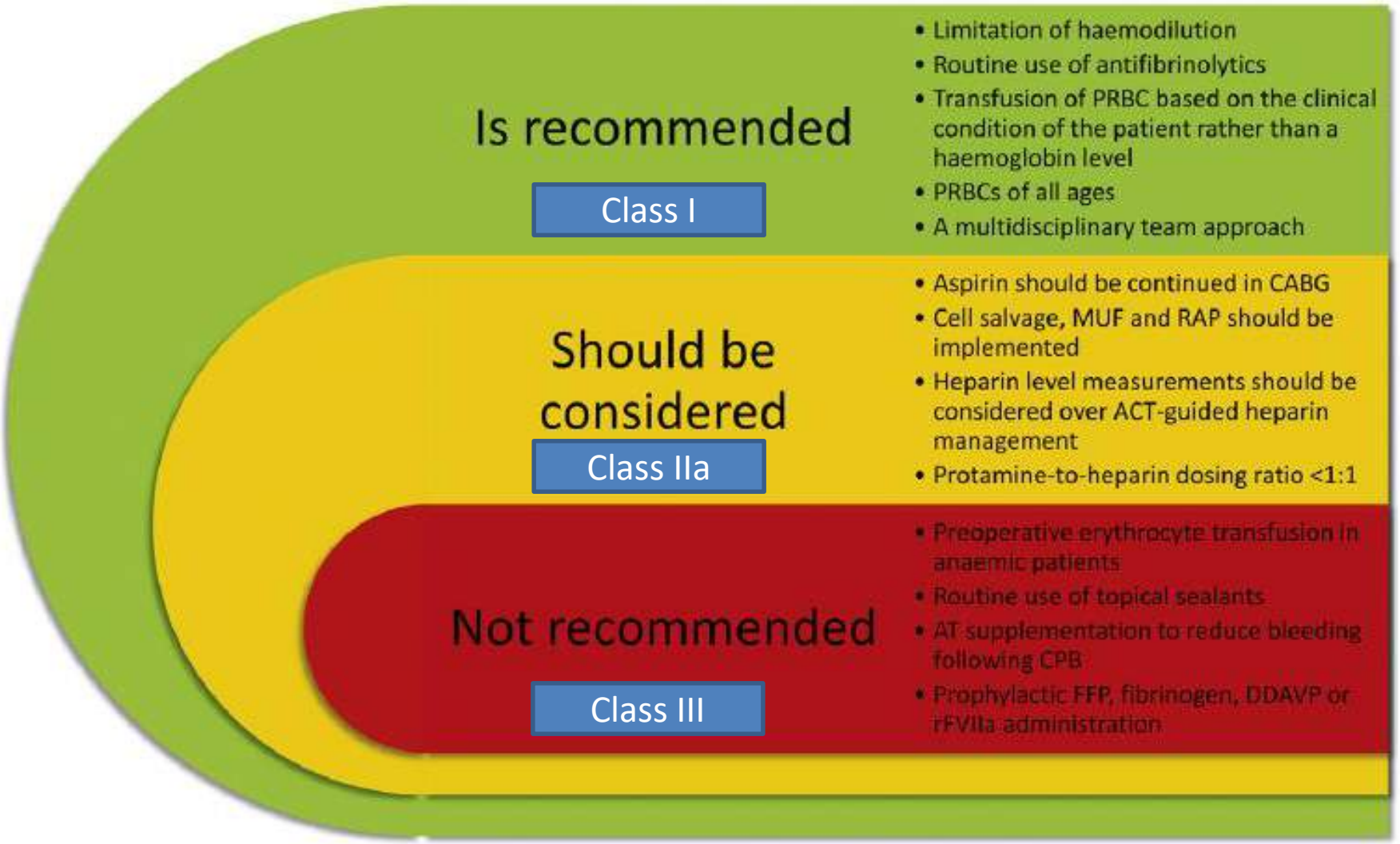
• Transfusion of PRBC based on the clinical condition of the patient rather than a haemoglobin level
• PRBCs of all ages
• A multidisciplinary team approach
Should be considered
Class IIa
• Aspirin should be continued in CABG
• Cell salvage, MUF and RAP should be implemented
• Heparin level measurements should be considered over ACT-guided heparin management
• Protamine-to-heparin dosing ratio <1:1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• Routine use of antifibrinolytics
• Transfusion of PRBC based on the clinical condition of the patient rather than a haemoglobin level
• PRBCs of all ages
• A multidisciplinary team approach
Should be considered
Class IIa
• Aspirin should be continued in CABG
• Cell salvage, MUF and RAP should be implemented
• Heparin level measurements should be considered over ACT-guided heparin management
• Protamine-to-heparin dosing ratio <1:1
Not recommended
Class III
• Preoperative erythrocyte transfusion in anaemic patients
• Routine use of topical sealants
• AT supplementation to reduce bleeding following CPB
• Prophylactic FFP, fibrinogen, DDAVP or rFVIIa administration

Massive Bleeding ?!

Severe or massive hemorrhage in cardiac surgery is an infrequent but clinically significant event. Estimations vary considerably (2-10 %)

Depending on the definition of massive hemorrhage but are nevertheless associated with high mortality

Failed or delayed treatment of a massive bleeding can result in irreversible end-organ damage and MACCE

Mortality and significantly increased costs

What is massive bleeding?

According to the Hemostasis Score,

Intraoperative massive hemorrhage is present when operating field blood loss exceeds 600 ml/h

The intermittent application of packing

When the chest drains poor out >300 mL/h of blood for two hours postoperatively

The PLASMACARD study defined

Excessive bleeding as abnormal diffuse or microvascular bleeding that cannot be controlled by compression and electrocoagulation, necessitates >two or three units of RBC transfusion or >400 or 600 mL of cell salvage blood depending on patient's weight

A postoperative drain output of >1.5 mL/kg/h for at least three hours or a need for surgical reexploration for hemostasis during the first 48 hours.

Basic strategies for PBM

1- Dx & Tx of underline disease

- Chronic Anemia
- Coagulopathies

2-Rreduce Blood loss

- Meticulous hemostasis
- Antifibrinolytic

3- Protocol based Transfusion

- Threshold of transfusion
- Point of care

4- Autologous blood saving

- Cell Saver
- ANH


surgery
preoperative
anesthesia
care
hospital
recovery
medical
healthcare
patient

REVIEW

Blood conservation strategies to reduce the need for red blood cell transfusion in critically ill patients

Alan T. Tinmouth MD MSc, Lauralynn A. McIntyre MD MSc, Robert A. Fowler MDCM MS

To prevent subacute anemia			
Reducing blood loss associated with diagnostic testing		• Increase in hemoglobin level	RCT
Closed blood sampling techniques	Reduction of iatrogenic blood loss from diagnostic testing	• Elimination of "discard" blood loss before testing in patients with in-dwelling central catheters	RCT
		• Reduced risk of bacterial contamination of catheter hubs and blood-stream infections	Expert opinion
Small-volume sample tubes	Reduction of iatrogenic blood loss from diagnostic testing	• Reduced blood loss	RCT
Point-of-care microanalysis	Reduction of iatrogenic blood loss from diagnostic testing	• Short turnaround time for test results • Reduced personnel time	Expert opinion
Erythropoietin	Increased production of red blood cells in bone marrow	• Increase in hemoglobin level and possible reduced need for transfusion	RCT; meta-analysis
		• Possible reduction in mortality among trauma patients†	RCT subgroup analysis
Restrictive red blood cell transfusion trigger*	Raised hemoglobin threshold for red blood cell transfusion	• Reduced need for blood transfusion without increase in morbidity or mortality in most critically ill patients	RCT

Review

Preoperative recombinant human erythropoietin in anemic surgical patients

Terri G Monk

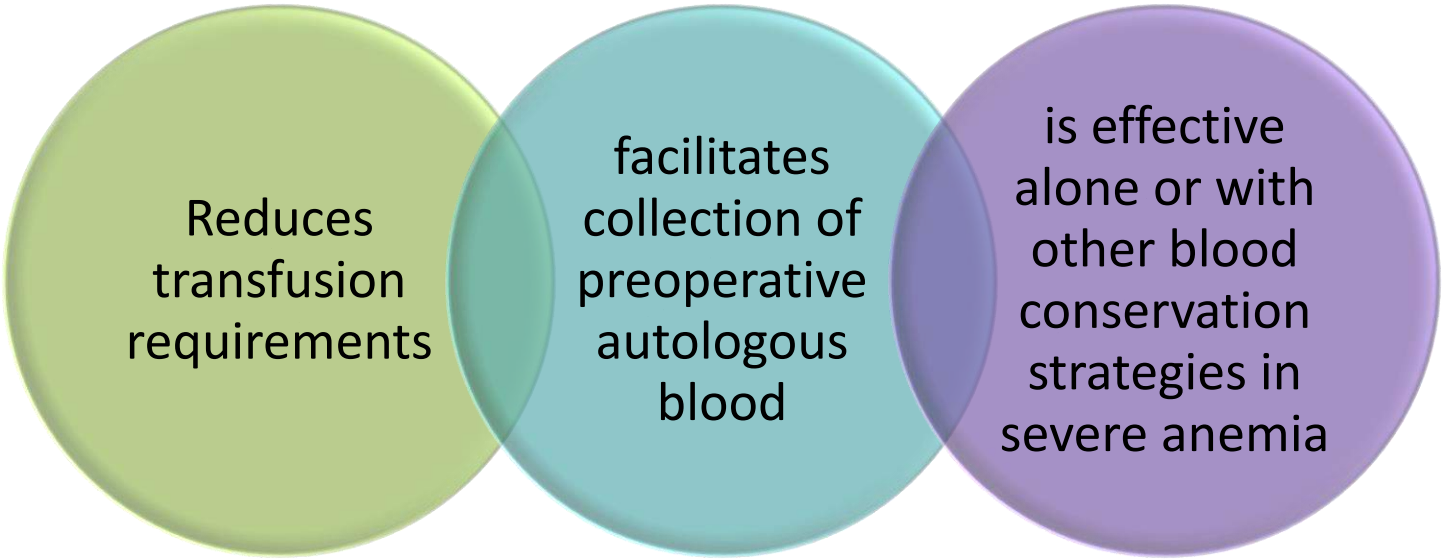
Professor, Department of Anesthesiology, Duke University Medical Center, Durham, North Carolina, USA

Correspondence: Terri G. Monk, Terri.Monk@duke.edu

Published online: 14 June 2004
This article is online at http://ccforum.com/content/8/S2/S45

Critical Care 2004, 8(Suppl 2):S45-S48 (DOI 10.1186/cc2824)

recombinant human erythropoietin (rHuEPO)



Surgeons should enthusiastically adopt available therapies that help to avoid transfusions and their accompanying risks, conserve blood, and treat preoperative anemia, with the goal of improving surgical outcomes.

JECT. 2005;37:15–22
The Journal of The American Society of Extra-Corporeal Technology

Cardiopulmonary Bypass in Patients With Pre-existing Coagulopathy

William DeBois, MBA, CCP; Junli Liu, PhD, CCP; Leonard Lee, MD; Leonard Girardi, MD; Wilson Ko, MD; Anthony Tortolani, MD; Karl Krieger, MD; O. Wayne Isom, MD

New York Presbyterian Hospital-Weill Cornell Medical Center, New York, New York

- FACTOR XII DEFICIENCY
- HEMOPHILIA
- IDIOPATHIC THROMBOCYTOPENIC
- PURPURA (ITP)
- PROTEIN S DEFICIENCY
- SICKLE CELL DISEASE
- PLATELET GLYCOPROTEIN (GP)IIB/
- IIIA INHIBITION
- ANTITHROMBIN III (AT III) DEFICIENCY
- HEPARIN-INDUCED
- THROMBOCYTOPENIA (HIT)
- CANCER

pre-existing coagulopathy in patients undergoing open-heart surgeries, if not recognized and appropriately managed, can cause serious complications.

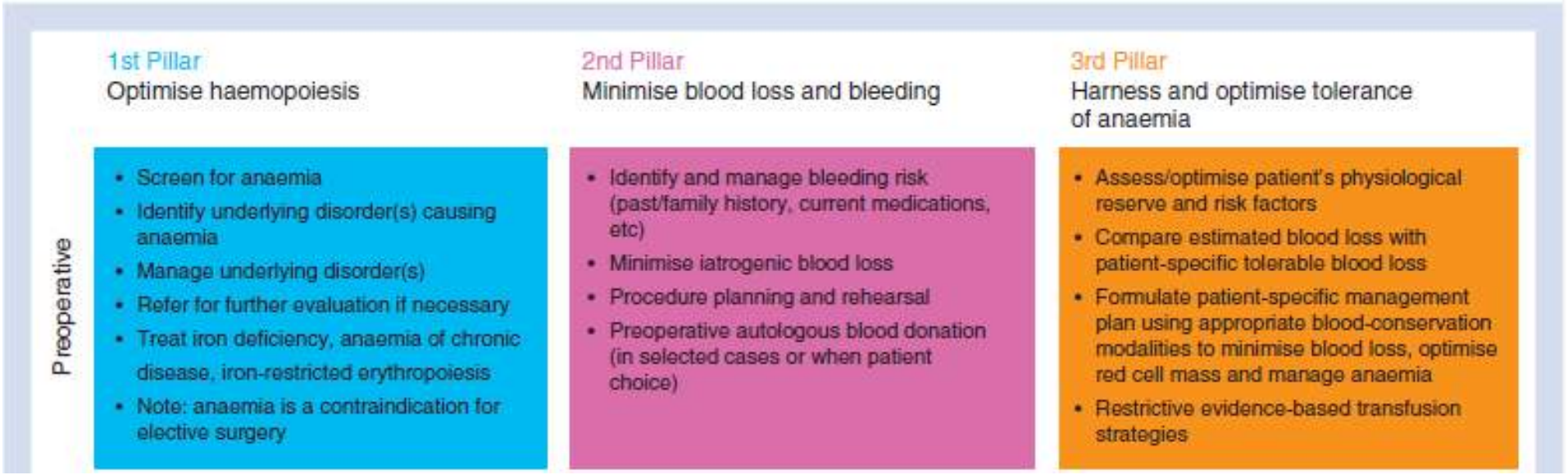
Management of patients undergoing cardiac procedures should include a routine coagulation work-up and a thorough past medical history examination. If any of the foregoing is abnormal, further evaluation is warranted.

British Journal of Anaesthesia **109** (1): 55–68 (2012)
Advance Access publication 24 May 2012 · doi:10.1093/bja/aes139

BJA

Patient blood management in Europe

A. Shander[1*], H. Van Aken[2], M. J. Colomina[3], H. Gombotz[4], A. Hofmann[5], R. Krauspe[6], S. Lasocki[7], T. Richards[8], R. Slappendel[9] and D. R. Spahn[10]



Intraoperative considerations

JECT 2011;43:P52–P57
The Journal of ExtraCorporeal Technology

Blood Management Issues: Getting Clots Together When You Want Them

Darryl McMillan, CCP; Kieron Potger, MClinN, CCP; Joanne Southwell, BSc

Cardiopulmonary Perfusion and Autotransfusion Unit, Department of Anaesthesia and Pain Management, Royal North Shore Hospital of Sydney, Sydney, Australia

Presented at Perfusion Downunder, Queenstown, New Zealand, August 5–8, 2010.

It is a team approach to “getting clots together” by all specialties who must be diligent in their tasks at all stages of the cardiac surgical patient’s care and recognize that hemodilution not only affects hemoglobin but also the factors, fibrinogen, and platelets of the coagulation system.

In patients where excessive hemodilution has occurred and the transfusion of homologous red cells are required to maintain the hemoglobin, should consideration be given to the effects the dilution has also had on the coagulation system?

REVIEW

Blood conservation strategies to reduce the need for red blood cell transfusion in critically ill patients

Alan T. Tinmouth MD MSc, Lauralynn A. McIntyre MD MSc, Robert A. Fowler MDCM MS

Table 1: Summary of clinical recommendations and evidence base for blood conservation strategies to reduce the need for blood transfusions in critically ill patients

Strategy	Mechanism of action	Potential benefits and advantages	Evidence base
To reduce acute blood loss			
Antifibrinolytic agents			
Tranexamic acid or epsilon aminocaproic acid	Improved hemostasis	• Reduced risk of recurrent bleeding and death associated with gastrointestinal bleeding†	Meta-analysis
		• Reduced risk of perioperative bleeding and need for reoperation in cardiac surgery patients	Meta-analysis
		• Under investigation for use in trauma patients	
Aprotinin	Improved hemostasis	• Reduced risk of perioperative bleeding and need for reoperation in cardiac surgery patients	Meta-analysis
Desmopressin	Improved hemostasis from increased factor VIII and von Willebrand levels	• Reduced risk of bleeding in patients with congenital coagulation defects (platelet dysfunction, von Willebrand's disease, mild hemophilia A) and those with renal failure	Observational studies
Recombinant activated factor VII	Improved hemostasis	• Possible benefit in selected cases refractory to standard surgical and medical treatment†	Case reports; expert opinion
Artificial oxygen carriers (modified hemoglobin substitutes, perfluorocarbons)	Increased oxygen transport without blood transfusion; increased ability to perform acute normovolemic hemodilution	• Possible reduction in need for transfusion†	RCT
		• Prolonged shelf-life	
		• Products can be stored at room temperature	
		• No risk of disease transmission	
		• No immunologic effects	
Postoperative blood recovery techniques (cell salvage)	Return of blood collected in surgical drains	• Reduced need for perioperative blood transfusion in orthopedic surgery but not in cardiac surgery	Meta-analysis

Table 2: Potential risks and disadvantages associated with blood conservation strategies

Strategy	Potential risks and disadvantages
Antifibrinolytic agents	• Thrombosis • Possible increased risk of death with use of aprotinin
Desmopressin	• Thrombosis
Recombinant activated factor VII	• Thrombosis • No benefit with routine use in cases of trauma or massive bleeding
Artificial oxygen carriers (modified hemoglobin substitutes, perfluorocarbons)	• Short half-life • Interference with laboratory measures with use of hemoglobin substitutes • Vasoreactivity with use of hemoglobin substitutes • Use of 100% oxygen to provide effective oxygenation with use of perfluorocarbons may cause lung injury
Postoperative blood recovery techniques (cell salvage)	• Limited applicability to most critical care patients • Reduced quality of reinfused blood (hemolyzed, diluted, cytokines [e.g., interleukins])
Reduction of blood loss associated with diagnostic testing	
Closed blood sampling techniques	• Retrograde arterial embolization
Small-volume sample tubes	• Potential for insufficient volume for diagnostic testing
Point-of-care microanalysis	• Variable accuracy and precision (need for ongoing quality assurance and calibration)
Erythropoietin	• Thrombosis
Restrictive blood transfusion trigger	• Possible risk of death among patients with active cardiac disease

A phase 2 prospective, randomized, double-blind trial comparing the effects of tranexamic acid with ecallantide on blood loss from high-risk cardiac surgery with cardiopulmonary bypass (CONSERV-2 Trial)

Paula M. Bokesch, MD,[a,b] Gabor Szabo, MD,[c] Ryszard Wojdyga, MD,[d] Hilary P. Grocott, MD, FRCPC,[e] Peter K. Smith, MD,[f] C. David Mazer, MD, FRCPC,[g] Santosh Vetticaden, MD, PhD,[a] Alistair Wheeler, MD,[a] and Jerrold H. Levy, MD, FAHA[h]

The Journal of Thoracic and Cardiovascular Surgery • May 2012

High-dose tranexamic acid was more effective than the low dose in reducing blood loss.

The high dose of tranexamic acid used in this trial was 30 mg/ kg/loading dose and continuous infusion at 16 mg/kg/h.

J Cardiovasc Thorac Res, 2014, 6(3), 197-202
doi: 10.15171/jcvtr.2014.011

Original Article

Safety and Efficacy of Caproamin Fides and Tranexamic Acid Versus Placebo in Patients Undergoing Coronary Artery Revascularization

Alireza Alizadeh Ghavidel[1], Ziae Totonchi[2], Mitra Chitsazan[2*], Maziar Gholampour Dehaki[1], Farshid Jalili[2], Fariborz Farsad[2], Maral Hejrati[3]

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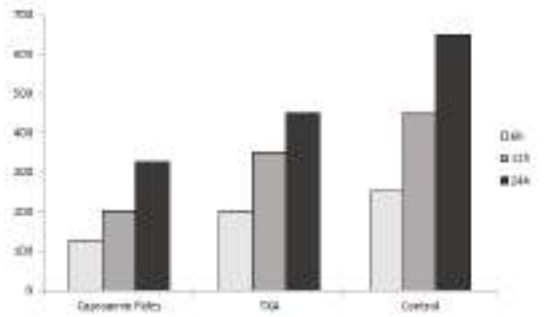


Figure 1. Post-operative mediastinal bleeding (mL) in the 3 study groups during the first 24 hours.

300 adult CABG patients.

Table 2. Allogeneic blood product transfusions.

		Caproamin Fides (n=100)	TXA (n=100)	Control (n=100)	Caproamin Fides vs. control		TXA vs. control		Caproamin Fides vs. TXA	
					Effect size	P	Effect size	P	Effect size	P
Transfusions During Operation	PRBCs (pts)	65 (65)	70 (70)	74 (74)	RR=0.49 (0.26-0.93)	0.02*	RR=0.62 (0.32-1.18)	0.14	RR=1.25 (0.69-2.27)	0.45
	FFP (pts)	5 (5)	7 (7)	11 (11)	RR=0.43 (0.14-1.27)	0.12	RR=0.66 (0.22-1.64)	0.32	RR=1.43 (0.43-4.66)	0.55
	Platelets (pts)	4 (4)	3 (3)	6 (6)	RR=0.65 (0.17-2.38)	0.51	RR=0.82 (0.24-2.79)	0.75	RR=1.26 (0.33-4.84)	0.73
	PRBCs (U)	1.13±1.09	1.38±1.88	1.68±1.37	MD=-0.55	0.001*	MD=-0.18	0.62*	MD=-0.17	0.31
	FFP (U)	0.21±0.99	0.24±0.52	0.45±0.99	MD=-0.25	0.14	MD=-0.23	0.18	MD=-0.02	0.89
	Platelets (U)	0.13±0.79	0.18±0.89	0.22±0.91	MD=-0.07	0.57	MD=-0.03	0.80	MD=-0.04	0.74
Transfusions During ICU Stay	PRBCs (pts)	53 (53)	60 (60)	74 (74)	RR=0.31 (0.17-0.56)	0.001*	RR=0.52 (0.28-0.96)	0.03*	RR=1.93 (0.96-2.96)	0.06
	FFP (pts)	19 (19)	23 (23)	38 (38)	RR=0.36 (0.20-0.72)	0.003*	RR=0.48 (0.26-0.90)	0.02*	RR=1.27 (0.64-2.52)	0.48
	Platelets (pts)	5 (5)	6 (6)	8 (8)	RR=0.60 (0.19-1.91)	0.39	RR=0.73 (0.24-2.19)	0.58	RR=1.21 (0.35-4.11)	0.75
	PRBCs (U)	0.76±0.08	1.25±0.53	1.85±0.55	MD=-0.87	<0.001*	MD=-0.40	0.04*	MD=-0.47	0.01*
	FFP (U)	0.57±0.28	0.84±0.83	1.30±0.92	MD=-0.75	0.002*	MD=-46	0.03*	MD=-0.27	0.24
	Platelets (U)	0.22±0.01	0.20±0.20	0.39±0.15	MD=-0.17	0.33	MD=-0.06	0.61	0.08	0.65

Table 3. Post-operative mediastinal bleeding in the 3 study groups.

Mediastinal Bleeding (mL)	Caproamin Fides (n=100)	TXA (n=100)	Control (n=100)	P	Caproamin Fides vs. control	TXA vs. control	Caproamin Fides vs. TXA
					P	P	P
6 hours	125 (50-250)	200 (100-400)	250(100-437.5)	0.002*	0.001*	0.29	0.009*
12 hours	200 (150-400)	350(200-600)	450(250-637.5)	<0.001*	<0.001*	0.10	0.003*
24 hours	325 (200-550)	450(312-800)	650(350-868.75)	<0.001*	<0.001*	0.10	<0.001*

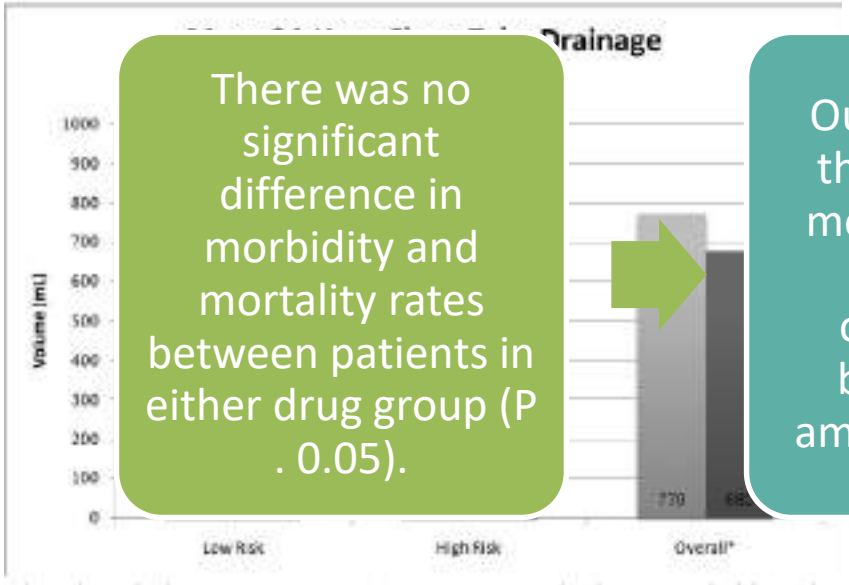
In conclusion, Caproamin Fides seems to be superior to TXA regarding the blood saving effects in patients undergoing coronary artery revascularization.

The Effect of Antifibrinolytic Prophylaxis on Postoperative Outcomes in Patients Undergoing Cardiac Operations

Abhinav Koul[1], Victor Ferraris[2], Daniel L. Davenport[3], Chandrashekhar Ramaiah[2]

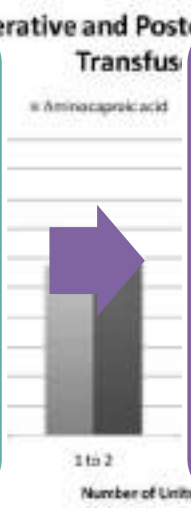
[1]University of Kentucky College of Medicine, Lexington, Kentucky, USA

Int Surg 2012;97:34–42



There was no significant difference in morbidity and mortality rates between patients in either drug group (P . 0.05).

Our study shows that aprotinin is more effective at controlling operative site bleeding than aminocaproic acid



Aminocaproic acid remains a safe and cost-effective option for antifibrinolytic prophylaxis because of unavailability of aprotinin

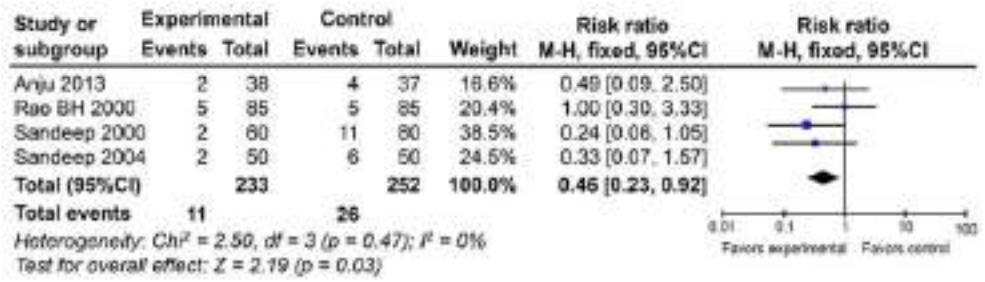
Int J Clin Exp Pathol 2015;8(7):7978-7987
www.ijcep.com /ISSN:1936-2625/IJCEP0009039

Original Article

Epsilon aminocaproic acid reduces blood transfusion and improves the coagulation test after pediatric open-heart surgery: a meta-analysis of 5 clinical trials

Jun Lu[1*], Haoyu Meng[2*], Zhaoyi Meng[3], Ying Sun[2], John P Pribis[4], Chunyan Zhu[4], Quan Li[1*]

5 RCT



Study or subgroup	Experimental Events	Experimental Total	Control Events	Control Total	Weight	Risk ratio M-H, fixed, 95%CI
Anju 2013	2	38	4	37	16.6%	0.49 [0.09, 2.50]
Rao BH 2000	5	85	5	85	20.4%	1.00 [0.30, 3.33]
Sandeep 2000	2	60	11	80	38.5%	0.24 [0.06, 1.05]
Sandeep 2004	2	50	6	50	24.5%	0.33 [0.07, 1.57]
Total (95%CI)		**233**		**252**	**100.0%**	**0.46 [0.23, 0.92]**
Total events	**11**		**26**			

Heterogeneity: Chi² = 2.50, df = 3 (p = 0.47); I² = 0%
Test for overall effect: Z = 2.19 (p = 0.03)

EACA is a good choice for the prevention of postoperative blood transfusion following pediatric cardiac surgery.

ANNALS OF SURGERY
Vol. 235, No. 1, 145–151

Autologous Versus Allogeneic Transfusion in Aortic Surgery

A Multicenter Randomized Clinical Trial

Julian C. L. Wong, FRCS, Francesco Torella, FRCS, Sarah L. Haynes, PhD, Kirsteen Dalrymple, BSc (Hons), Andrew J. Mortimer, FRCA, and Charles N. McCollum, FRCS on behalf of the ATIS Investigators

From the Academic Surgery Unit, Wythenshawe Hospital, Manchester, United Kingdom

To evaluate the efficacy of acute normovolemic hemodiliuton (ANH) and intraoperative cell salvage (ICS) in blood-conservation

Both ANH and ICS were safe and reduced the allogeneic blood requirement in patients undergoing elective infrarenal aortic surgery.

Shen et al. J Transl Med (2016) 14:228
DOI 10.1186/s12967-016-0986-6

Journal of
Translational Medicine

RESEARCH Open Access

Impact of intra-operative cell salvage on blood coagulation in high-bleeding-risk patients undergoing cardiac surgery with cardiopulmonary bypass: a prospective randomized and controlled trial

Sheliang Shen[1*†], Jun Zhang[2†], Wenyuan Wang[1], Jiayin Zheng[3] and Yihong Xie[4]

Conclusion

Our preliminary data support a proposal that intra-operative Cell Salvage could impair blood coagulation in the scenario of high-risk-bleeding cardiac surgery with CPB.

The Journal of Thoracic and Cardiovascular Surgery • July 2005

ACD

Safety, efficacy, and cost of intraoperative cell salvage and autotransfusion after off-pump coronary artery bypass surgery: A randomized trial

G. J. Murphy, MD, FRCS,[a] C. S. Rogers, PhD,[a] W. B. Lansdowne, BSc,[b] I. Channon, BSc,[b] H. Alwair, MRCS,[a] A. Cohen, FRCA,[c] M. Caputo, MD,[a] and G. D. Angelini, MD, FRCS[a]

Sixty-one patients undergoing OPCAB surgery were prospectively randomdize to autotransfusion (n 30; receiving autotransfused washed blood from intraoperative cell salvage) or control (n 31 receiving homologous blood only as blood-replacement therapy)

In conclusion, intraoperative cell salvage and autotransfusion in OPCAB surgery is associated with a modest clinical benefit, without increased risk to patients or significantly increased costs.

As homologous blood becomes more expensive, the relative cost-effectiveness of this technique will increase.

IVYSPRING INTERNATIONAL PUBLISHER

International Journal of Medical Sciences

2015; 12(4): 322-328. doi: 10.7150/ijms.11227

Research Paper

The Efficacy, Safety and Cost-Effectiveness of Intra-Operative Cell Salvage in High-Bleeding-Risk Cardiac Surgery with Cardiopulmonary Bypass: A Prospective Randomized and Controlled Trial

Yihong Xie[1], Shuliang Shen[2]✉, Jun Zhang[3], Wenyuan Wang[2], Jiayin Zheng[4]

Table 1: Patients' basal and operative characteristics

Variable	Group CS (n=72)	Group C (n=69)	*P* value
Age(years)	51.7(15.6)	53.1(15.[illegible])	0.548
>70years	17(23.6)	16(23.2)	0.682
Male	35(48.6)	29(42.0)	0.778
BSA	1.75(0.13)	1.72(0.1[illegible])	0.932
<1.6 m²	7(9.7)	7(10.1)	0.985
Surgery type			0.988
multiple valve	47(65.3)	46(66.7)	
Bentall	10(13.9)	8(11.6)	
reoperations	15(20.8)	15(21.7)	
Complication			
renal dysfunction	26(36.1)	24(34.8)	0.923
liver insufficiency	12(16.7)	13(18.8)	0.537
coagulation disorders	20(27.8)	18(26.1)	0.821
HB levels lower	30(41.7)	30(43.5)	0.687
PLT abnormal	20(27.8)	21(30.4)	0.752
intake of aspirin or clopidogrel	18(25.0)	15(21.7)	0.702
CPB time (min)	140.2(32.7)	124.5(2[illegible].9)	0.311
Surgical time (min)	280.4(31.7)	258.7(3[illegible].4)	0.204
Tracheal intubation time (hour)	12.5(11.2)	13.4(4.7)	0.274
ICU stay (hour)	20.3(3.7)	21.8(4.7)	0.253
Hospital stay (day)	23.1(7.8)	25.1(9.3)	0.263
Residual blood in CPB circuit	870.3(47.5)	858.7(8[illegible].2)	0.372
Intraoperative blood loss (ml)	1425.6(162.4)	1347.5([illegible]9.8)	0.105
MTD (ml), in 0hour	361.5(138.4)	294.2(1[illegible].7)	0.287
in 24hour	651.4 (287.6)	559.8(1[illegible].4)	0.0n7
Intraoperative heparin dose (mg)	240.5(47.7)	241.0(4[illegible].2)	0.791
Intraoperative protamine dose(mg)	422.2(90.6)	410.2(9[illegible].5)	0.507

Data are presented as mean (SD) or number (percentage). BSA= body surface area. MTD = mediastinal tube drainage. patients with resternotomy were not calculated.

Table 2: Perioperation allogeneic blood transfusion

Variable		Group CS (n=72)	Group C (n=69)	P value
RBC				
	proportion	27(37.5)	52(75.4)	0.0002
	quantity (U)	2.01(2.75)	5.39(3.28)	<0.0001
FFP				
	quantity (ml)	113.9(202.7)	133.3(220.6)	0.725
	proportion	14(19.4.)	14(20.3)	0.909
PLT				
	quantity (U)	1.97(3.57)	1.91(3.42)	0.879
	proportion	16(22.2)	13(18.8)	0.627

Data are presented as mean (SD) or number (percentage).

Table 3: Costs of transfusion- related

Variable	Group CS (n=72)	Group C (n=69)	P value
Autologous blood transfusion	243.9	0	
Allogeneic blood transfusion			
RBC	45.7(54.3)	122.7 (65.6)	<0.001
FFP	14.8 (37.5)	17.3 (32.4)	0.825
PLT	56.1 (51.5)	54.4 (42.7)	0.978
Total (RBC+ FFP+ PLT)	116.6 (140.8)	194.4 (152.4)	0.002
Total blood transfusion	360.5 (140.8)	194.4 (152.4)	0.001
Total hospital	16725.3 (2271.7)	16142.2 (2572.3)	0.211

Conclusion: Intra-operative CS in high-bleeding-risk cardiac surgery with CPB is effective, generally safe, and cost-effective in developed countries but not in China

JECT. 2007;39:66–70
The Journal of The American Society of Extra-Corporeal Technology

Original Articles

Autotransfusion Management During and After Cardiopulmonary Bypass Alters Fibrin Degradation and Transfusion Requirements

Alice E.C.M. Wiefferink, BSc, EKP;* Patrick W. Weerwind, PhD;† Waander van Heerde, PhD;‡ Steven Teerenstra, PhD;§ Luc Noyez, MD, PhD;† Ben E. de Pauw, MD, PhD;¶ René M.H.J. Brouwer, MD, PhD†

Table 2. Postoperative transfusion requirements in the control (A) and intervention (B) group.

	Group A (n = 15)	Group B (n = 15)
No transfusion	5 (33%)	7 (47%)
At least one PRC	10 (67%)	8 (54%)
At least two PRC	7 (47%)	2 (13%)*

Autotransfusion management during and after CPB suppresses early postoperative fibrin degradation

Journal of Cardiology 63 (2014) 391–396

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Journal of Cardiology

journal homepage: www.elsevier.com/locate/jjcc

Review

The "benefits" of the mini-extracorporeal circulation in the minimal invasive cardiac surgery era

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Mini-extracorporeal circulation (MECC) constitutes a novel miniaturized cardiopulmonary bypass (CPB) circuit, heparin-coated and primed with aprotinin. Its membrane oxygenation is similar to conventional cardio-pulmonary bypass (CCPB), but it is a completely closed-volume system due to the lack of the venous reservoir which has been removed.

In a mini circuit, the reservoir is the patient himself. Consequently, air entering the venous cannula is avoided. Nevertheless, the capabilities of MECC have been expanded either by the inclusion of a suction device that is only activated on direct contact with liquid in some circuits or by postoperative autotransfusion of the wrecked erythrocytes by a separate suction device with a cell-saver.

Although the tubing diameter is similar between the two systems, the tubing length of the MECC is around half that of the CCPB, resulting in the restriction of priming volume

MECC circuits, despite their accompanying risks, provide a safe procedure to perform CABG, decreasing the postoperative CPB-associated morbidity thanks to the restriction of SIRS, with potential improvement in clinical outcomes.

The endothelial damage, the granulocyte sequestration, and its activation are much lower since the artificial surface is smaller .

Furthermore, a miniaturized circuit leads to less hemodilution and less bloodloss than conventional CPB and as a result, less blood and blood products requirements .

Nevertheless, similar quantities of air in the MECC circuit, entering the venous line through suture holes at the venous cannulation point , are able to stop the function of the pump or induce embolization .

Original Article

This article is accompanied by an invited commentary by Dr. Deepak K. Tempe

Duration of deep hypothermia during aortic surgery and the risk of perioperative blood transfusion

Michael Mazzeffi[1], Michael Marotta, Hung-Mo Lin, Gregory Fischer

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Annals of Cardiac Anaesthesia • Vol. 15:4 • Oct-Dec-2012

The relationship between deep hypothermia duration and perioperative bleeding is dependent on CPB time.

For surgeries with short CPB times (120 to 180 minutes), prolonged deep hypothermia is associated with increased post-operative bleeding, as estimated by RBC transfusion.

For cases with longer CPB times (300 to 360 minutes), there appears to be no relationship.

J Cardiovasc Thorac Res, 2014, 6(2), 91-95
doi: 10.5681/jcvtr.2014.020
http://journals.tbzmed.ac.ir/jcvtr

Original Article

Haemostatic Role of TachoSil Surgical Patch in Cardiac Surgery

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[1]Heart Valve Disease Research Center, Rajaie Cardiovascular Medical & Research Center, Iran University of Medical Sciences, Tehran, Iran
[2]Rajaie Cardiovascular Medical & Research Center, Cardiac Surgery Department, Iran University of Medical Sciences, Tehran, Iran

Methods: Forty-two patients scheduled for open heart surgeries, were entered to this study from August 2010 to May 2011. After primary haemostatic measures, patients divided in two groups based on surgeon's judgment. Group A: 20 patients for whom TachoSil was applied and group B: 22 patients that conventional method using Surgicel (13 patients) or wait and see method (9 cases), were performed in order to control the bleeding. In group A, 10 patients were male with mean age of 56.95±15.67 years and in group B, 9 cases were male with mean age of 49.95±14.4 years. In case group 70% (14/20) of the surgeries were redo surgeries versus 100% (22/22) in control group.

Table 2. Intra-operative Characteristics

Intra Operation	Group A (n=20)	Group B (n=22)	P value
Transfusion Need (%)	75	90.90	0.03
No. PC (Mean±SD)	2±1.13	3.11±1.44	0.01
No. FFP (Mean ±SD)	2.78±1.98	1.70±2.02	0.09
No. PLT (Mean±SD)	1.50±2.09	2.26±2.05	0.20
Operation Time (Mean±SD)	217.40±70.33	213.33±88.96	0.88
CPB Time (Mean±SD)	105.12±54.18	114.90±57.05	0.59
AOX Time (Mean±SD)	54.88±25.04	62.16±31.76	0.45

PC: Packed Cell, FFP: Fresh Frozen Plasma, PLT: Platelet, CPB: Cardio pulmonary bypass, AOX: Aortic cross clamping

1- Aortic surgeries:

- In aortic root surgeries with no specific source but continuous oozing from suture lines
- In patients with aortic dissection to support suture lines
- In elderly patients to support the suture lines

2- CABG cases:

- In patients suffering from minor bleeding from distal graft anastomosis especially in cases with deep coronary arteries who need to get their fat tissue or myocard dissected in order to gain access to coronary arteries
- In cases with extensive coronary enderctomy with long segment anastomosis with oozing from suture lines which in these cases an extra suture is more harmful than useful in order to control the bleeding due to tissue inconsistency
- In some coronary patients with small or poor run-off coronary arteries especially in diabetic patients with minor bleeding from the head and/or the heal of anastomosis which additional sutures can lead to narrowed anastomosis

3-Valve surgeries:

- In patients with severe Tricuspid regurgitation (TR) and enlarged right atrium with thin wall especially in redo surgeries in which control of bleeding from suture lines with the aid of extra sutures is hardly possible
- In cases suffering from Tricuspid valve disease and concomitant liver dysfunction with bleeding from suture lines in spite of managing the coagulative disorders

4-Others:

- In patients undergoing redo cardiac surgeries with de-epithialized cardiac surface because of the decortication and punctuated bleeding through the surface of the heart
- In cases with constrictive pericarditis who are undergoing pericardectomy and experiencing punctuated bleeding due to adhesion and

	1st Pillar Optimise haemopoiesis	2nd Pillar Minimise blood loss and bleeding	3rd Pillar Harness and optimise tolerance of anaemia
Intraoperative	• Timing surgery with haematological optimisation	• Meticulous haemostasis and surgical techniques • Blood-sparing surgical techniques • Anaesthetic blood-conserving strategies • Autologous blood options • Pharmacological/haemostatic agents	• Optimise cardiac output • Optimise ventilation and oxygenation • Restrictive evidence-based transfusion strategies

Postoperative Care

British Journal of Anaesthesia **92** (2): 178–86 (2004)
DOI: 10.1093/bja/aeh037

BJA

Comparison of structured use of routine laboratory tests or near-patient assessment with clinical judgement in the management of bleeding after cardiac surgery

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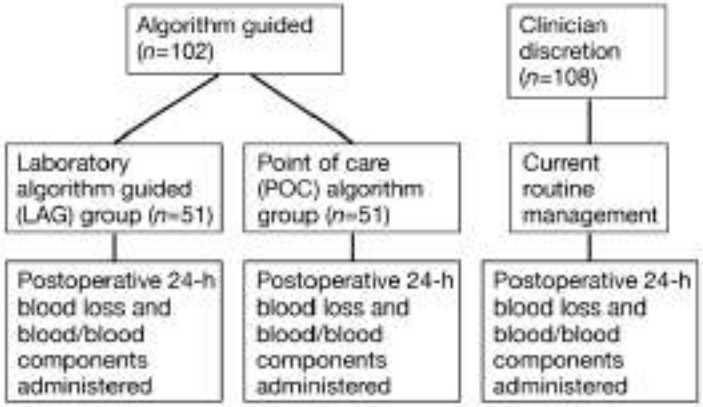

Fig 1 Study design.

Variable	LAG group (n=51)	POC group (n=51)	CD group (n=108)
Postoperative 24 h blood loss (ml)	850 (688–1095)	755 (606–975)	810 (550–1295)
Postoperative haemoglobin (g dl^{-1})	9.3 (8.5–9.7)	9.3 (8.4–10.3)	N/A
Postoperative 24 h haemoglobin (g dl^{-1})	9.9 (9–10.8)	10.1 (9–10.9)	10.1 (9.6–10.8)
Postoperative platelet count ($\times 10^9$ $litre^{-1}$)	140 (111–168)	131 (110–165)	N/A
Postoperative 24 h platelet count ($\times 10^9$ $litre^{-1}$)	159 (135–200)	149 (123–187)	144 (121–174)
Heparin loading dose ×100 (units)	310 (280–360)	250 (205–313)	230* (200–250)
Total heparin dose ×100 (units)	480 (420–560)	505 (421–553)	330* (300–350)
Total protamine dose (mg)	240 (210–280)	353† (292–403)	N/A
Intra-operative crystalloid (ml)	2000 (1550–2000)	2000 (1100–2000)	N/A
Intra-operative colloid (ml)	1000 (1000–1500)	1000 (1000–1250)	N/A
Postoperative 24 h crystalloid (ml)	2892 (2580–3244)	2845 (2478–3215)	N/A
Postoperative 24 h colloid (ml)	2500 (2000–2980)	2000 (2000–2500)	N/A
Postoperative 24 h urine (ml)	2792 (2297–3350)	2740 (2356–3259)	N/A
Time to extubation after surgery (min)	255 (180–355)	262 (181–370)	N/A

Table 3 Blood components received. The table shows the number of patients (%) in each group that received transfusions. LAG=laboratory-guided algorithm; POC=point of care; CD=clinician discretion

Blood component	LAG group (n=51)	POC group (n=51)	CD group (n=108)	P (χ^2 test)
Packed red blood cells	35 (69)	34 (68)	92 (85)	0.01
Fresh frozen plasma	0	2 (4)	16 (15)	0.003
Platelets	1 (2)	2 (4)	14 (13)	0.02

Conclusion.

Following algorithms based on point of care tests or on structured clinical practice with standard laboratory tests does not decrease blood loss, but reduces the transfusion of PRBCs and blood components after routine cardiac surgery, when compared with clinician discretion.

BJA

CLINICAL PRACTICE

Point-of-care coagulation testing and transfusion algorithms

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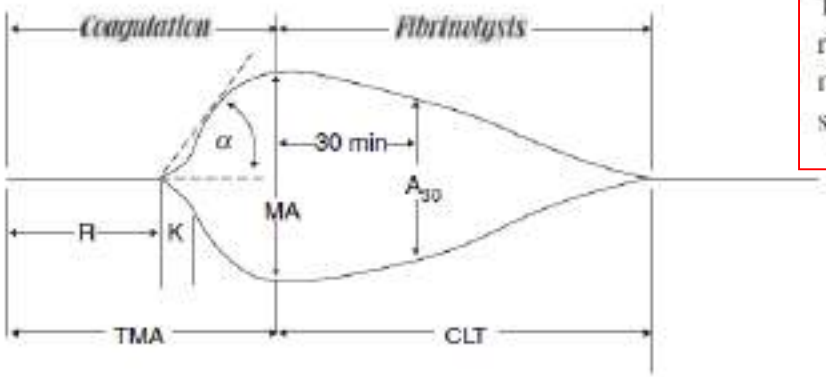


Fig 2 The signature thromboelastograph tracing is shown here with parameters labelled. See text for further details.

Conclusions

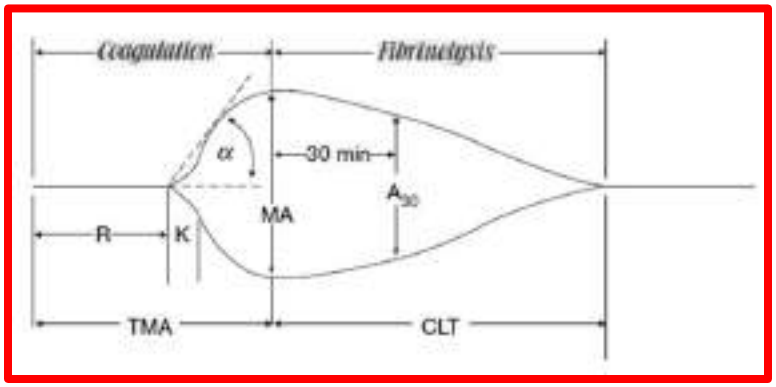
The benefits of POC testing in surgical patients include rapid turnaround times and specific measurements of haemostasis defects that can direct therapy. The use of specific tests that can be used at the bedside has enabled

There are five parameters to the TEG tracing that measure different stages of clot development:

R, K, a angle, maximum amplitude (MA), and MA60.

In addition, clot lysis indices are measured at 30 and 60 min after MA (LY30 and LY60). Normal values vary depending on the type of activator used.

TEG graph detail



-The R value is a measure of clotting time (CT) which is the period of time from the start of the test to the initial fibrin formation.

-The K value is the clot kinetics measurement of the speed to reach a specific level of clot strength: the time from beginning of clot formation (the end of R time) until the amplitude reaches 20 mm.

-The a angle is the angle between the horizontal line in the middle of the TEG tracing and the line tangential to the developing ‘body’ of the TEG tracing at 2 mm amplitude. The a angle represents the acceleration (kinetics) of fibrin build up and cross-linking (clot strengthening).

-The MA reflects the ultimate strength of the clot which depends on the number and function of platelets and their interaction with fibrin. The MA is the parameter most frequently measured because it correlates with platelet dysfunction in cardiac surgery.

-LY30, or the lysis index at 30 min after MA, is increased with fibrinolysis.

Espinosa et al. BMC Anesthesiology 2014, 14:80
http://www.biomedcentral.com/1471-2253/14/80

BMC Anesthesiology

RESEARCH ARTICLE Open Access

Comparison of three point-of-care testing devices to detect hemostatic changes in adult elective cardiac surgery: a prospective observational study

Aurora Espinosa[1*], Roar Stenseth[2,3], Vibeke Videm[1,4] and Hilde Pleym[3,5]

Conclusions

In conclusion, TEG and RoTEM can be used to detect postoperative hemostatic changes following cardiac surgery, whereas the Sonoclot seems to be less suitable, at least in patients without grave hemostatic changes.

Variables from TEG, RoTEM and Sonoclot may be useful to monitor fibrinogen levels.

Lehmann et al. BMC Anesthesiology (2019) 19:24
https://doi.org/10.1186/s12871-019-0689-7

BMC Anesthesiology

RESEARCH ARTICLE Open Access

Why does a point of care guided transfusion algorithm not improve blood loss and transfusion practice in patients undergoing high-risk cardiac surgery? A prospective randomized controlled pilot study

F. Lehmann[1*], J. Rau[2], B. Malcolm[3], M. Sander[4], C. von Heymann[5], T. Moormann[6], T. Geyer[1], F. Balzer[1]

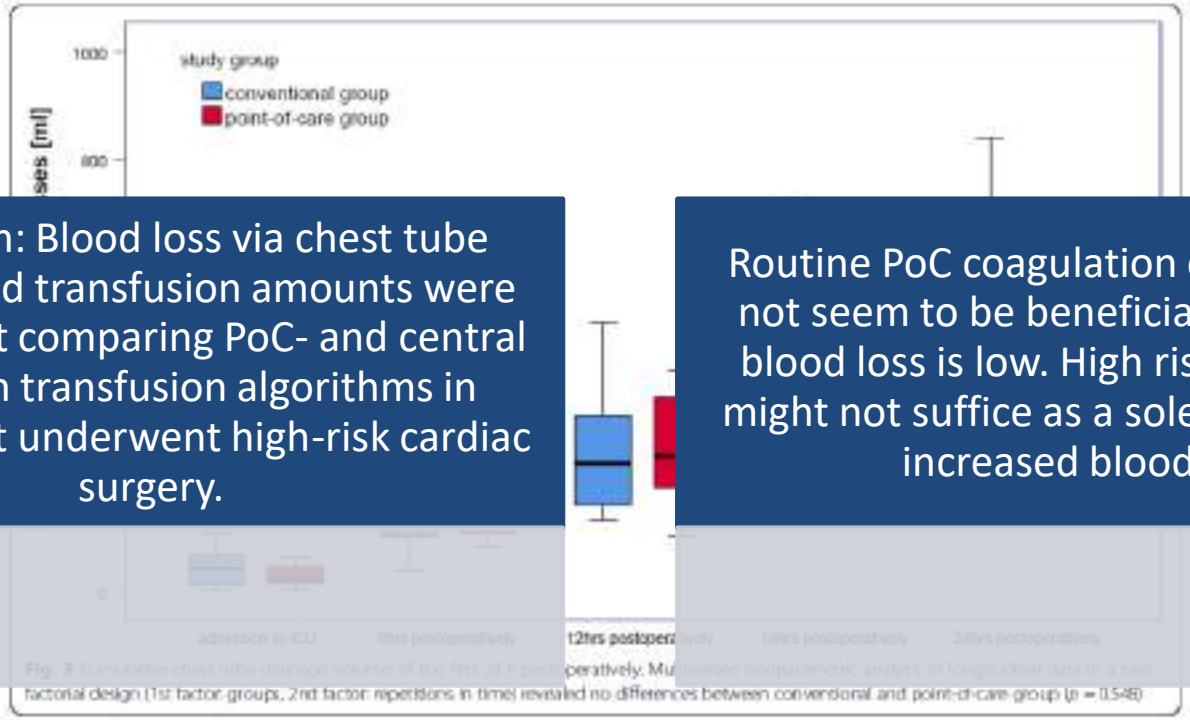


Fig. 3 Cumulative chest tube drainage volume of the first 24 h post operatively. Multivariate comparisons analysis of longitudinal data in a two-factorial design (1st factor: groups, 2nd factor: repetitions in time) revealed no differences between conventional and point-of-care group ($p = 0.548$)

Conclusion: Blood loss via chest tube drainage and transfusion amounts were not different comparing PoC- and central lab-driven transfusion algorithms in subjects that underwent high-risk cardiac surgery.

Routine PoC coagulation diagnostics do not seem to be beneficial when actual blood loss is low. High risk procedures might not suffice as a sole risk factor for increased blood loss

Original Article

ASIAN ANNALS

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SAGE

Rotational thromboelastometry in prediction of bleeding after cardiac surgery

Alireza Alizadeh Ghavidel[1], Zia Toutounchi[2], Farshad Jalili Shahandashti[2] and Yalda Mirmesdagh[1]

Four hundred patients (296 males and 104 females, mean age 60.89 years) scheduled for first-time coronary artery bypass graft surgery were prospectively enrolled.

Blood samples were obtained for ROTEM testing before surgery and 30 min after heparin reversal.

The patients were divided into 2 groups: group 1 was patients with no abnormal postoperative bleeding and group 2 was patients who required reexploration for abnormal postoperative bleeding.

Conclusion: Measuring coagulation factors by ROTEM both before surgery and after heparin reversal can identify patients at increased risk of postoperative bleeding.

Journal of Cardiothoracic and Vascular Anesthesia 32 (2018) 141–150

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ScienceDirect

journal homepage: www.jcvaonline.com

Original Article

Prediction of Postoperative Blood Loss Using Thromboelastometry in Adult Cardiac Surgery: Cohort Study and Systematic Review

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11 study

Two studies found a good predictive value, whereas the other 9 studies showed a poor predictability for major postoperative bleeding after cardiac surgery. The overall negative predicting value was high.

Thromboelastometry does not predict which patients are at risk for major postoperative bleeding

	1st Pillar Optimise haemopoiesis	2nd Pillar Minimise blood loss and bleeding	3rd Pillar Harness and optimise tolerance of anaemia
Postoperative	• Treat anaemia/iron deficiency • Stimulate erythropoiesis • Be aware of drug interactions that can cause/increase anaemia	• Vigilant monitoring and management of post-operative bleeding • Avoid secondary haemorrhage • Rapid warming – maintain normothermia (unless hypothermia specifically indicated) • Autologous blood salvage • Minimising iatrogenic blood loss • Haemostasis/anticoagulation management • Prophylaxis of upper gastrointestinal haemorrhage • Avoid/treat infections promptly • Be aware of adverse effects of medication	• Optimise tolerance of anaemia • Treat anaemia • Maximise oxygen delivery • Minimise oxygen consumption • Avoid/treat infections promptly • Restrictive, evidence-based transfusion strategies

J Extra Corpor Technol. 2017;49:283–290
The Journal of ExtraCorporeal Technology

TEG-Directed Transfusion in Complex Cardiac Surgery: Impact on Blood Product Usage

Kevin Fleming, CCP;* Roberta E. Redfern, PhD;† Rebekah L. March, MPH;‡
Nathan Bobulski, CCP;* Michael Kuehne, PhD, PA-C;§ John T. Chen, PhD;¶ Michael Moront, MD§

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Intotal,681patients were identified, 370 in the pre-TEG period and 311 patients post-TEG

Table 1. TEG result interpretation and treatment decision guidance.

TEG Result	Hemostasis State	Common Treatment
R value (minutes)		
<4	Enzymatic hypercoagulability	Anticoagulant of choice
11–14	Low clotting factors	2 units FFP
>14	Very low clotting factors	4 units FFP
MA value (mm)		
46–54	Low platelet function	.3 mcg/kg DDAVP
41–45	Very low platelet function	1 unit platelet pheresis
≤40	Extremely low platelet function	2 units platelet pheresis
>73	Platelet hypercoagulability	Antiplatelet therapy
Angle (degrees)		
<45	Low fibrinogen level	.06 units/kg cryoprecipitate

Table 4. Blood product usage.

	Before TEG (n = 370)	After TEG (n = 311)	p-Value
	Mean ± SEM	Mean ± SEM	
Perioperative			
RBC	2.99 ± .14	2.38 ± .13	.002
FFP	2.15 ± .09	.70 ± .07	<.001
Cryo	.91 ± .07	.17 ± .03	<.001
Platelets	1.28 ± .05	1.26 ± .08	.83
>24 and <48 hours			
RBC	.43 ± .04	.34 ± .04	.13
FFP	.008 ± .006	.04 ± .02	.17
Cryo	0 ± 0	0 ± 0	N/A
Platelets	.02 ± .008	.02 ± .008	.99
>48 hours			
RBC	1.11 ± .17	.60 ± .11	.01
FFP	.22 ± .06	.03 ± .01	.006
Cryo	.02 ± .01	.01 ± .007	.55
Platelets	.11 ± .04	.07 ± .02	.40
Reoperative			
RBC	.25 ± .06	.10 ± .04	.04
FFP	.07 ± .02	.009 ± .007	.007
Cryo	.05 ± .02	.02 ± .01	.25
Platelets	.04 ± .01	.04 ± .01	.70
Total RBC	4.78 ± .26	3.41 ± .20	<.001
Total FFP	2.45 ± .12	.80 ± .08	<.001
Total cryoprecipitate	.98 ± .07	.20 ± .03	<.001
Total platelets	1.45 ± .07	1.38 ± .09	.53
Total units periop	7.33 ± .28	4.44 ± .24	<.001
Total units 24–48 hours	.46 ± .04	.39 ± .06	.37
Total units >48 hours	1.46 ± .23	.75 ± .13	.005
Total units reop	.41 ± .10	.17 ± .06	.03
Total units over stay	9.66 ± .44	5.79 ± .34	<.001

Mean units of red blood cells, plasma, and cryoprecipitate were significantly reduced after TEG was implemented (all, p < .0001)

Use of platelets was reduced but did not reach significance.

Mean units of all blood products in the perioperative period and over the entire stay were reduced by approximately 40% (both, p < .0001).

Conclusion

The potential for bleeding in patients undergoing cardiac surgery represents an ongoing problem for clinicians.

The increasing use of anticoagulation and antiplatelet agents creates a need for multiple pharmacologic approaches and are potential problems in managing surgical patients.

Meticulous surgical hemostasis has a crucial role in PBM

Multidisciplinary protocol based individualized blood product transfusion seems mandatory

Antifibrinolytics may have an important role in hemostasis and limitation of transfusion

Point of care (POC) tests of hemostatic function can facilitate the optimal management of excessive bleeding and reduce transfusion