Perioperative fluid management

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Possible conflicts of interests

- Educational grants: Medtronic, Getinge and LivaNova.
- Lecture fees: Medtronic.

Topics

- “Quadruple hit”.
- Fluid therapy with crystalloids
    - saline (NaCl 0.9%) vs. balanced solutions
    - Ringer acetate vs. Ringer lactate.
- Albumin.
- RBC.
- Role of MiECC in fluid management.

“Quadruple hit”

JAMA 2022

Opinion

EDITORIAL

Albumin vs Crystalloid Fluid for Resuscitation in Cardiac Surgery

New Evidence and Arguments in the Timeless Debate

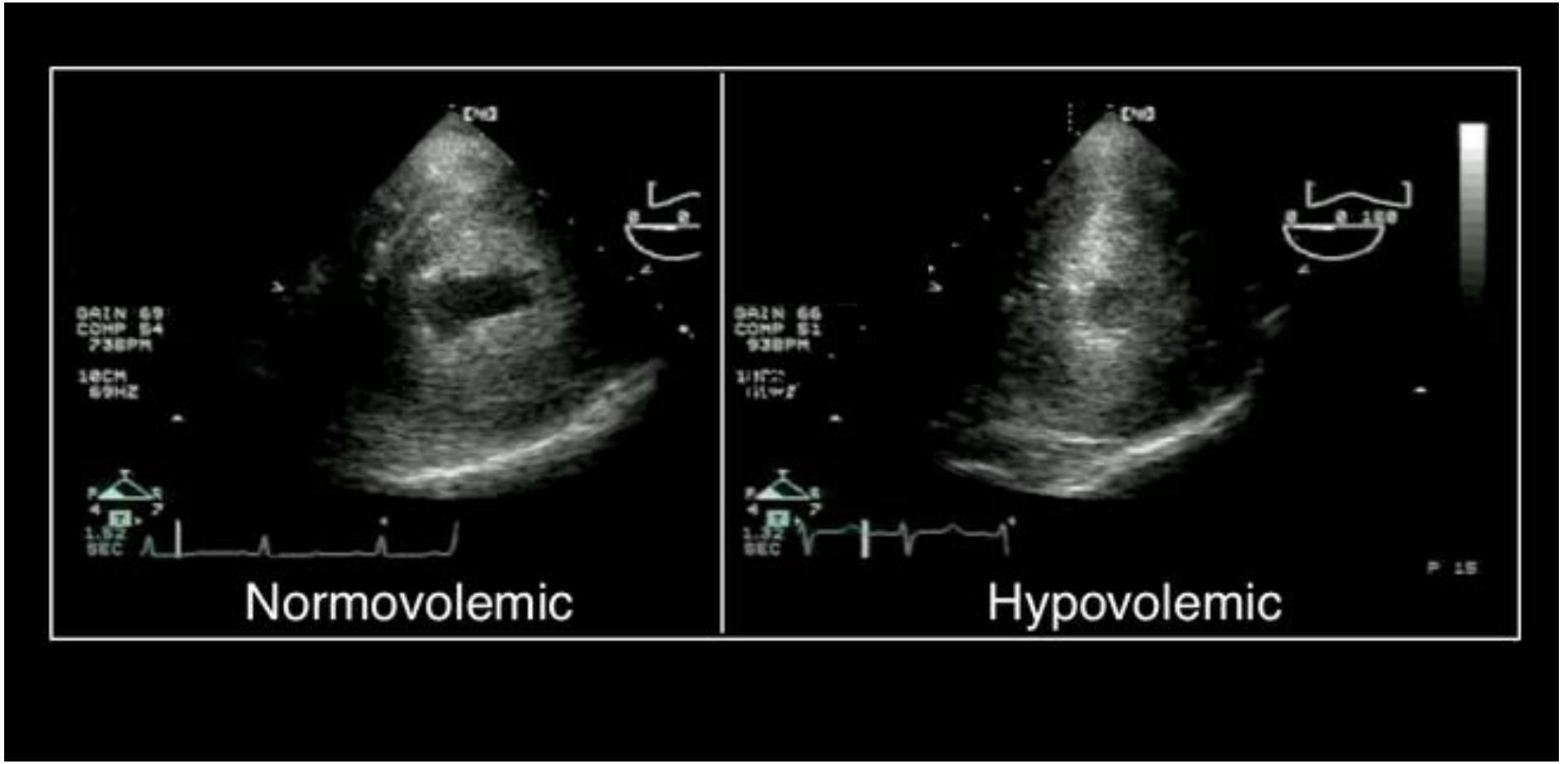
Mihai V. Podgoreanu, MD; Negmeldeen Mamoun, MD, PhD

- Exposure to nonpulsatile extracorporeal circulation.
- Ischemia-reperfusion injury.
- Controlled trauma.
- Hemorrhage or/and hemodilution.

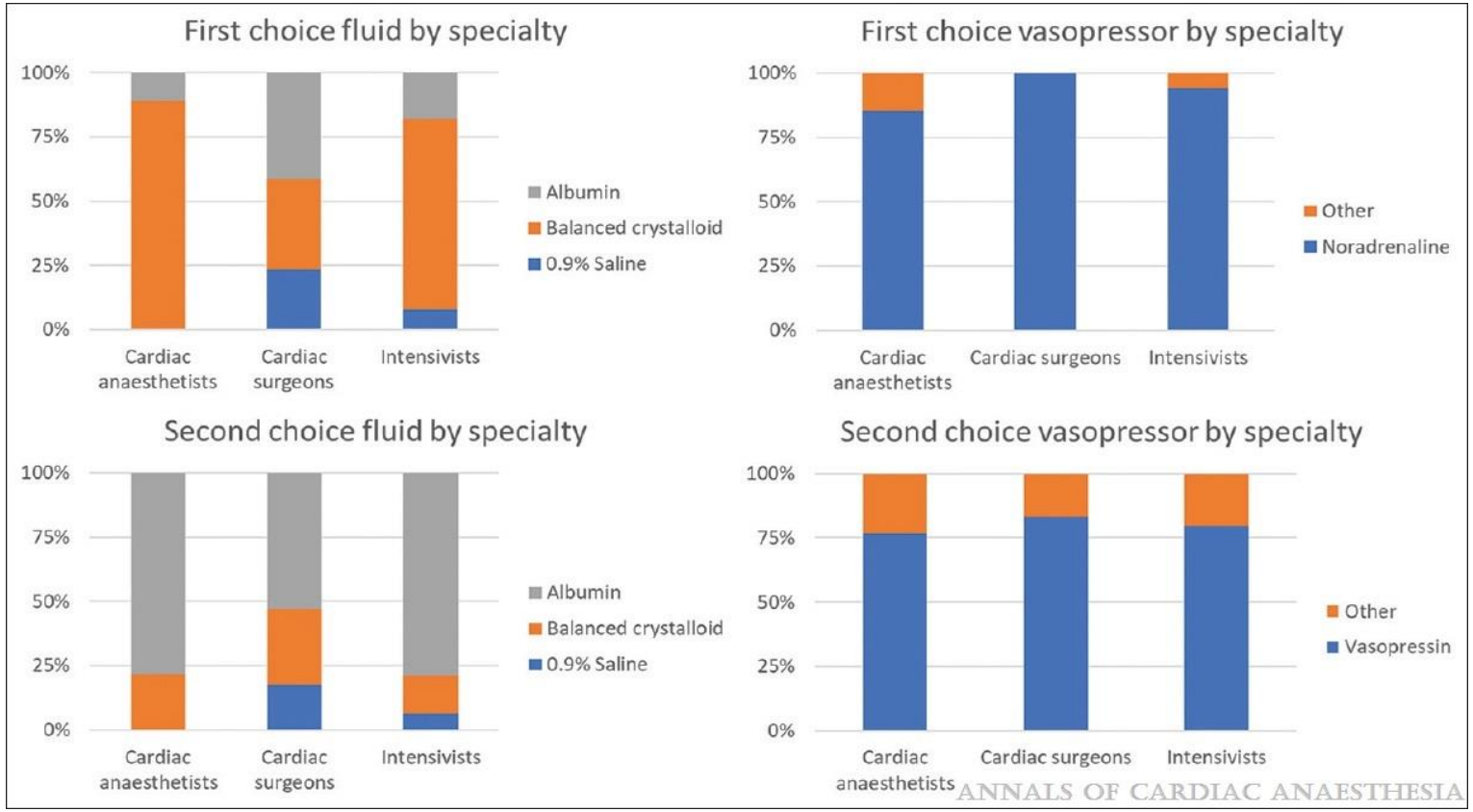
All of the above will determine the need for optimal Perioperative fluid management.

Non-correct fluid management and complications

- Excessive bleeding.
- Fluid overload.
- Acute kidney injury (AKI).
- Systemic inflammatory response syndrome (SIRS).


Normovolemic
Hypovolemic

Fluids and vasopressors in use



Fluid and vasopressor preferences. This stacked column chart shows the first and second choice fluids and vasopressors by specialty

Fluid Resuscitation after Cardiac Surgery in the Intensive Care Unit: A Bi-National Survey of Clinician Practice. (The FRACS-ICU Clinician Survey)

Ramanan, Mahesh; Roberts, Shaun; McCullough, James Patrick Adrian; Naidoo, Rishendran; Rapchuk, Ivan; Matebele, Mbakise; Tabah, Alexis; Kruger, Peter; Smith, Julian; Shekar, Kiran

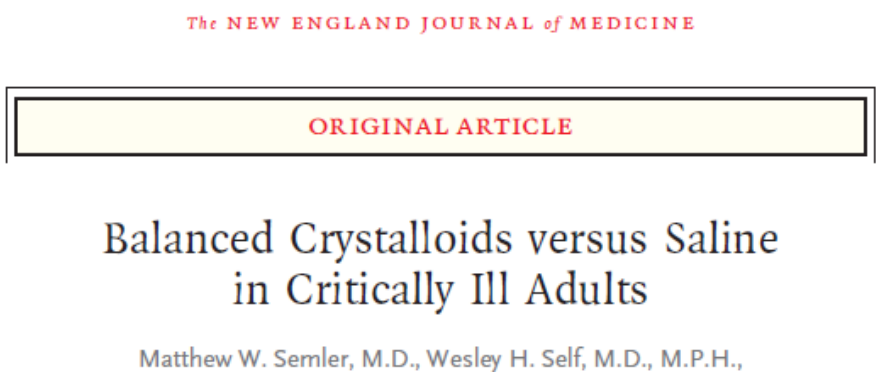
Annals of Cardiac Anaesthesia24(4):441-446, Oct-Dec 2021.

doi: 10.4103/aca.ACA_190_20

Wolters Kluwer

Crystalloids. NaCl 0.9% vs. balanced solutions

NEJM 2018, Semler et al.



- 15 000 ICU patients .
- Balanced solutions (Ringer lactate, Plasma-Lyte A) in favor.

CONCLUSIONS

Among critically ill adults, the use of balanced crystalloids for intravenous fluid administration resulted in a lower rate of the composite outcome of death from any cause, new renal-replacement therapy, or persistent renal dysfunction than the use of saline. (Funded by the Vanderbilt Institute for Clinical and Translational Research and others; SMART-MED and SMART-SURG ClinicalTrials.gov numbers, NCT02444988 and NCT02547779.)

Crystalloids. Balanced solutions

Crit. Care 2019, Pfortmueller et al.

- RCT, 150 patients.
- Ringer lactate vs. acetate.
- Inopressor requirements in cardiac surgery.

Pfortmueller *et al. Critical Care* (2019) 23:159
https://doi.org/10.1186/s13054-019-2423-8

Critical Care

RESEARCH Open Access

Fluid management in patients undergoing cardiac surgery: effects of an acetate- versus lactate-buffered balanced infusion solution on hemodynamic stability (HEMACETAT)

Carmen A. Pfortmueller[1*], Livia Faeh[1], Martin Müller[2,3], Balthasar Eberle[4], Hansjörg Jenni[5], Björn Zante[1], Josef Prazak[1], Lars Englberger[5], Jukka Takala[1] and Stephan M. Jakob[1]

Conclusion: In this study, hemodynamic profiles of patients receiving Ringer's lactate and Ringer's acetate were comparable, and the evolution of acid-base parameters was similar. These study findings should be evaluated in larger, multi-center studies.

Albumine. Theoretical benefits

- Main determinant of plasma oncotic pressure.
- Protective effects on endothelial glycocalyx (maintaining the vascular barrier, hemostasis, prevention of cell adhesion to the endothelium and transmission of shear stress).
- Protective effects on microvascular integrity.
- Reduces platelet consumption.
- Prevents acute kidney injury.

Albumine vs. balanced crystalloids

ALBICS, JAMA 2022, Pesonen et al.

(ALBumin In Cardiac Surgery).

- RCT, 1400 patients.
- Albumin 4% vs. Ringer acetate.

Research

JAMA | Original Investigation

Effect of 4% Albumin Solution vs Ringer Acetate on Major Adverse Events in Patients Undergoing Cardiac Surgery With Cardiopulmonary Bypass

A Randomized Clinical Trial

MAIN OUTCOMES AND MEASURES The primary outcome was the number of patients with at least 1 major adverse event: death, myocardial injury, acute heart failure, resternotomy, stroke, arrhythmia, bleeding, infection, or acute kidney injury.

CONCLUSIONS AND RELEVANCE Among patients undergoing cardiac surgery with cardiopulmonary bypass, treatment with 4% albumin solution for priming and perioperative intravenous volume replacement solution compared with Ringer acetate did not significantly reduce the risk of major adverse events over the following 90 days. These findings do not support the use of 4% albumin solution in this setting.

Albumine vs. balanced crystalloids

Post hoc of ALBICS

(ALBumin In Cardiac Surgery)

Perioperative & Critical Care: Research

CARDIOTHORACIC ANESTHESIOLOGY:

The Annals of Thoracic Surgery CME Program is located online at http://www.annalsthoracicsurgery.org/cme/home. To take the CME activity related to this article, you must have either an STS member or an individual non-member subscription to the journal.

Albumin Infusion and Blood Loss After Cardiac Surgery

Akseli Talvasto,[1] Minna Ilmakunnas, MD, PhD,[1] Peter Raivio, MD, PhD,[2] Hanna Vlasov, MD,[1] Seppo Hiippala, MD, PhD,[1] Raili Suojaranta, MD, PhD,[1] Erika Wilkman, MD, PhD,[1] Liisa Petäjä, MD, PhD,[1] Otto Helve, MD, PhD,[3,4] Tatu Juvonen, MD, PhD,[2] and Eero Pesonen, MD, PhD[1]

METHODS Ringer acetate and 4% albumin were compared in a randomized, double-blinded fashion in 1386 on-pump adult cardiac surgery patients. The study end points for bleeding were the Universal Definition of Perioperative Bleeding (UDPB) class and its components.

CONCLUSIONS Perioperative administration of albumin, compared with Ringer's acetate, resulted in increased blood loss and higher UDBP class. The magnitude of this effect was similar to the complexity and urgency of the surgery.

(Ann Thorac Surg 2023;116:392-400)

Albumine vs. crystalloids

2019, Wigmore et al.

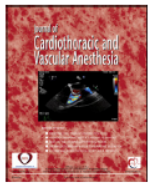
- Albumine 20%.
- 100 post cardiac surgery ICU patients.
- Albumine in favor.

Journal of Cardiothoracic and Vascular Anesthesia 33 (2019) 2920–2927

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com



Original Article

20% Human Albumin Solution Fluid Bolus Administration Therapy in Patients After Cardiac Surgery (the HAS FLAIR Study)

Conclusion: Post–cardiac surgery fluid bolus therapy with 20% albumin when compared with crystalloid fluid resulted in less positive fluid balance as well as several hemodynamic and potential ICU treatment advantages.

Red Blood Cells. Adverse efects

- Transfusion reactions.
- Infectious complications.
- Immunomodulation.
- Morbidity.
- Mortality.
- Dose related.

RBC. Restrictive vs liberal transfusion strategy

NEJM 2023, Carson et al.

- 7-8 g/dL vs. 10 g/dL Hgb level.
- 3500 patients.
- The primary outcome - composite of myocardial infarction or death at 30 days.

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Restrictive or Liberal Transfusion Strategy in Myocardial Infarction and Anemia

J.L. Carson, M.M. Brooks, P.C. Hébert, S.G. Goodman, M. Bertolet, S.A. Glynn,

CONCLUSIONS

In patients with acute myocardial infarction and anemia, a liberal transfusion strategy did not significantly reduce the risk of recurrent myocardial infarction or death at 30 days. However, potential harms of a restrictive transfusion strategy cannot be excluded. (Funded by the National Heart, Lung, and Blood Institute and others; MINT ClinicalTrials.gov number, NCT02981407.)

MiECC. Guidelines

Journal of Cardiothoracic and Vascular Anesthesia 35 (2021) 2569–2591

Contents lists available at ScienceDirect

Journal of Cardiothoracic and Vascular Anesthesia

journal homepage: www.jcvaonline.com

Special Article

STS/SCA/AmSECT/SABM Update to the Clinical Practice Guidelines on Patient Blood Management

Minimally invasive extracorporeal circulation is reasonable to reduce blood loss and red cell transfusion as part of a combined blood conservation approach.

Class IIA, Level B-R

European Journal of Cardio-Thoracic Surgery 57 (2020) 210–251
doi:10.1093/ejcts/ezz267 Advance Access publication 2 October 2019

2019 EACTS/EACTA/EBCP guidelines on cardiopulmonary bypass in adult cardiac surgery

Recommendations for the cardiopulmonary bypass circuit

Recommendations	Class[a]	Level[b]	Ref[c]
MiECC should be considered over standard conventional CPB systems to reduce blood loss and the need for transfusion.	IIa	B	[130, 131]

MiECC.

2021, Ellam et al

RCT, 240 patients.

Original Paper

Perfusion

Impact of minimal invasive extracorporeal circulation on perioperative intravenous fluid management in coronary artery bypass surgery

Perfusion
1–7

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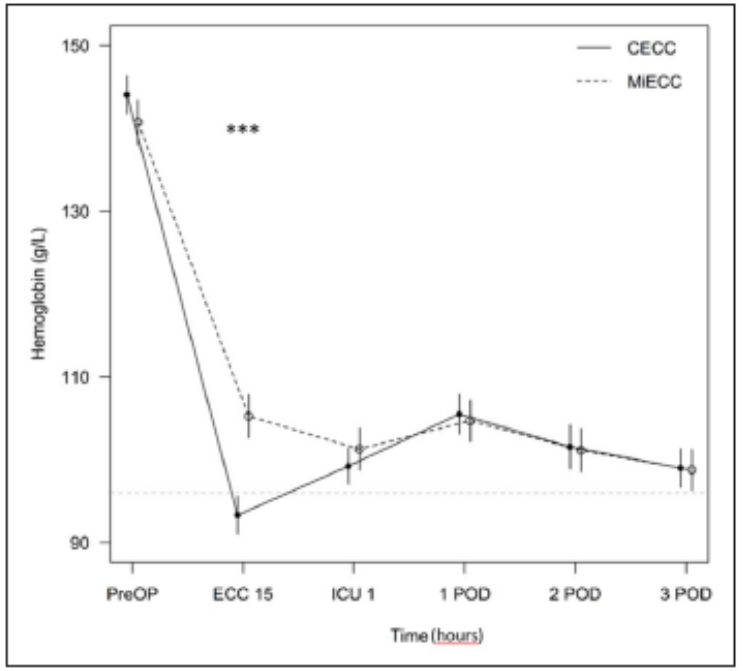
Table 2. Intraoperative clinical characteristics.

	MiECC ($n=120$)	CECC ($n=120$)	p Value
RBC transfusions given (ml)	316 [255–500]	500 [300–625]	0.125
RBC transfusions (patients)	11 (9.2)	28 (23.3)	0.005
Total IV fluid intake (ml)	3300 [2950–4000]	4800 [4000–5500]	<0.001
Hemoglobin drop (g/l)	35.5 ± 8.9	50.7 ± 9.0	<0.001
Hemoglobin drop percent (%)	25.3 ± 6	35.3 ± 5.9	<0.001
Aortic cross clamp time (minutes)	80.3 ± 25.8	77.7 ± 23.8	0.420
Perfusion time (minutes)	93.7 ± 30.4	89.5 ± 28.5	0.267

MiECC: minimal invasive extracorporeal circulation; CECC: conventional extracorporeal circulation; POAF: postoperative atrial fibrillation; iv: intravenous; [IQR]: interquartile range.
The values are *n* (%) or median (IQR) or mean ± SD.



“Quadruple hit” and perioperative fluids. Conclusion

For the optimal Perioperative fluid management:

- Minimal invasive cardiac surgery (MICS), less trauma and tissue oedema.
- MiECC, less need for fluids, including RBC.
- Balanced crystalloids, the best (first) choice.
- Restrictive RBC transfusion strategy.
- Albumine, 20%?