# 32nd EACTA Annual Congress

European Association of Cardiothoracic Anaesthesiology

19-21 APRIL 2017 • BERLIN • GERMANY

PEER-REVIEWED CONFERENCE REPORT


**Controversy in Blood Transfusion**

A landmark study in patients undergoing non-emergency cardiac surgery questioned a restrictive haemoglobin value as transfusion threshold. In conclusion, haemoglobin might not be sufficient as sole transfusion trigger in high-risk patients.

read more on PAGE 10

**The Changing Role of Anesthesiologists**

A discussion on the role of anesthesiologists took place at EACTA. Since the development of interventional procedures, general anesthesia is becoming less important. However, there is a desperate need for dedicated IV lines for anaesthesia.

read more on PAGE 4

**Best Abstract Presentations**

The presentation of preoperative frailty won the price as the best abstract presented this year. Surprisingly, frail patients benefit the most from surgery.

read more on PAGE 17

MEDICOM MEDICAL PUBLISHERS

Editor Prof. dr. Nicole Juffermans, Amsterdam Medical Center, The Netherlands

# Contents


**Interview: Prof. dr. Matthias Heringlake, MD**

**3 The Future is Now**
- 3 The development of the heart team
- 3 Progress in imaging techniques
- 4 Anaesthesiologist have to be more flexible
- 4 General anaesthesia becomes less important
- 4 Transcathether aortic valve implantation will stay

**5 Heart Failure**
- 5 Major impact on postoperative health
- 6 Surgical therapy superior to medical treatment in ischemic cardiomyopathy
- 6 More focus on postoperative care

**7 Anaemia**
- 7 Unknown long-term consequences
- 8 Do symptoms make a difference?
- 9 Point-of-care coagulation monitoring offers distinct benefits

**10 Transfusion triggers Cell Salvage, Red Blood Cell Storage**
- 10 Hot topics in transfusion
- 10 Oxygenation parameters to trigger transfusion?
- 11 Viscosity might prevent oxygenation
- 11 Cell salvage aids in economic use of blood products
- 11 Recommended in current guidelines
- 12 All clear with regard to storage time of red-cell units

**13 EACTA Survey**
- 13 The future belongs to balanced fluids
- 13 EACTA Survey confirms preference for balanced fluids

**14 How to look after Heart, Kidney and Brain**
- 14 Organ protection in cardiac surgery
- 14 Troponin: a reliable marker for cardiac injury
- 14 Beware of hypotension
- 15 Neurological protection remains difficult
- 15 Kidney: the first organ to fail

**16 Nosocomial Infections**
- 16 Prevention plays a key role
- 16 Infective Endocarditis: highest risk in valve patients

**17 Frailty: The Condition of Being Weak and Delicate**
- 17 Preoperative frailty – a predictor of disability-free survival
- 17 Surprising result: Frail patients benefit most from surgery
- 18 Creatinine increase after CPB may be a marker of organ injury
- 18 Transesophageal echocardiogram training does not have to be in the OR
- 19 Adopted transfusion protocol might make sense in lung transplant patients
- 19 Acute respiratory distress syndrome after cardiac surgery: a rare, but often deadly event
- 20 No benefit of sevoflurane versus total intravenous anaesthesia


## COLOPHON


| | |
|---|---|
| **Editor** | Prof. dr. Nicole Juffermans<br>Amsterdam Medical Center, The Netherlands |
| **Advisory Board** | Prof. dr. Steffen Rex<br>University of Leuven, Belgium |
| | Prof. dr. Filip de Somer<br>University of Gent, Belgium |
| **Editorial Manager** | Lisa Colson |
| **Editorial Co-ordinators** | Dr. Rose-Minke Schure |
| | Bas Braakman, MSc. |
| **Executive Publisher** | Rene Draper, MSc. |
| **Writer** | Dr. Susanne Kammerer |
| **Production Manager** | Desiree Heijl |
| **Graphic Design** | MOOZ grafisch ontwerp |
| | Wim Kempink |





MEDICOM
MEDICAL PUBLISHERS

**Postal address**
Medicom Medical Publishers
PO Box 90
Zipcode 3740 AB
City Baarn
Country The Netherlands

**Head Office**
Medicom Medical Publishers
Faas Eliaslaan 5
3742 AR Baarn
The Netherlands

Telephone +31 85 4012 560
Fax +31 85 4012 569
E-mail publishers@medicom.nl

ISSN 2468-8765 17:5

# Brief Introduction

Written by Dr. Susanne Kammerer

Prof. dr. Nicole Juffermans

**Biography**

Prof. Dr. Nicole Juffermans is a trained internist-intensivist working at the Intensive Care Department of the Academic Medical Center (AMC), University of Amsterdam (UvA), the Netherlands. She is a co-chair of the Laboratory of Experimental Intensive Care and Anaesthesiology (L. E. I. C. A.) at the AMC in which translational research is performed in the field of organ failure and lung injury. Also, she is Editor-in-Chief of the Netherlands Journal of Critical Care, the official journal of the Dutch Society of Intensive Care.

**Dear Reader,**

The 32nd annual congress of the European Association of Cardiothoracic Anaesthesiology (EACTA) was held from the 19th to 21th of April in Berlin (Germany).
This year's main emphasis was Comprehensive Cardiovascular Cardiothoracic Care (C4). This reflects the fact that cardiothoracic anaesthetists are no longer recognised solely as anaesthesia providers, but as members of a team of dedicated specialists involved in the comprehensive periprocedural surgical as well as interventional treatment of patients with cardiovascular disease.

This report gives a synopsis of the most interesting sessions and new developments in clinical practice presented at the meeting. The aim of this report is to provide interesting data for those who were not able to attend the meeting. In addition, as so many sessions were running at the same time the report might also provide new information for those who attended the meeting.

# Interview with
# Prof. dr. Matthias Heringlake, MD
## University of Lübeck (Germany)

*By Dr. Susanne Kammerer*

> **We chose the topic of comprehensive cardiovascular and cardiothoracic care, since we feel that we have to take responsibility - together with cardiologists and cardiac surgeons as members of the heart team - for the treatment path and to decide how individual patients shall be managed.**

## Team approach to master future challenges

**Comprehensive Cardiovascular Cardiothoracic Care (C4) was the core theme of the 32nd Annual Congress of the European Association of Cardiothoracic Anaesthesiology (EACTA) in Berlin.**
**Prof. Matthias Heringlake, University of Lübeck (Germany), and Chair of the Local Organising Committee summarises necessary changes and future possibilities of members in the cardio team.**

### What was the core theme of this year's congress and why did you choose it?

The field of cardiothoracic anaesthesiology has expanded and undergone tremendous changes within the last years since we are increasingly caring also for patients undergoing interventional procedures. Additionally, there is a growing interest in looking after cardiac patients in a heart team approach. We chose the topic of comprehensive cardiovascular and cardiothoracic care, since we feel that we have to take responsibility - together with cardiologists and cardiac surgeons as members of the heart team - for the treatment path and to decide how individual patients shall be managed. In this regard, we thought it would be helpful to look beyond the operating theatre into other fields, especially into the interventional sides of our work.

### As you already mentioned, the team gets increasingly important. How can the challenges be best managed in the future?

This will depend on the way hospitals will be organised and has a lot to do with the reimbursement system. For example, here in Germany and in several other European countries, cardiologists, as well as cardiac surgeons are, of course, interested in caring for as many procedures as possible because this is directly connected to the financial success of their department. Prospectively, it would of course be much more appropriate to focus on the optimal solution for individual patients and to develop the procedural path independent from the primary medical speciality and the economic success of individual departments. Thus, we hope that some topics raised at this congress will help to move a little bit further towards a team approach.

### You were responsible for the scientific topics for the convention. What are the highlights of this year's congress? What is not to be missed?

Actually, one highlight is indeed the opening session, because we have not presented the need for interdisciplinarity in such a depth in other EACTA meetings before. In addition, we will have some dedicated sessions on the general management of patients with heart failure and the associated economic problems.

But we will not only deal with the question how to optimally treat our patients, but also go into the details of physiology using basic science; of course, a rather interesting approach. Additionally, we have a bundle of master classes that deal with specific topics important for our field, e.g. masterclasses on perfusion or perioperative ventricular assist devices or on the management of bleeding and coagulation: in these courses, many topics important for our field will be highlighted, beginning with the selection of the patient moving forward to the procedural treatment. What are the pitfalls? How can I manage a failing right ventricle? How to provide an elderly patient with the best possible post-operative care? We are expanding our discipline more from a basic anaesthetic treatment to comprehensive perioperative care.

## What are the most promising new developments in pharmacology and also regarding procedures?

**H**onestly, I have to say that I am a little bit biased by this because I have some conflicts of interest in this field. However, I still think that in pharmacology, if you look at cardiovascular drugs, the calcium sensitiser and potassium channel opener levosimendan is still one of the most important developments in the treatment of cardiac surgical patients. It has been shown to improve cardiac function without increasing myocardial oxygen consumption and to have protective effects in other organs. As highlighted in a recent publication of European expert opinion (1), numerous clinical trials have indicated favourable cardiac and non-cardiac effects of the preoperative and perioperative administration of this agent.

**T**his is despite the fact that very recently also some disappointing publications have been published, suggesting that the drug doesn't work as it should or as we supposed it would work. In a trial in patients with a reduced left ventricular ejection fraction, who were undergoing cardiac surgery with the use of cardiopulmonary bypass, prophylactic levosimendan did not reduce a short-term composite endpoint of death, renal-replacement therapy, perioperative myocardial infarction (MI), or use of a mechanical cardiac assist device compared to placebo (2). However, still, unpublished secondary analyses show that it at least works highly effectively in patients undergoing isolated coronary artery bypass surgery. I think that this is really important.

**S**taying with vasoactive drugs, we are realising that we shift away from conventional beta-adrenergic drugs towards more non-adrenergic drugs. For example, there is increasing evidence that the use of vasopressin as first-line vasopressor in comparison with norepinephrine reduces renal complications in cardiac surgery in patients needing vasopressor support (3). This development will probably have an important impact on the way we manage patients and there are some further publications showing that this may be extremely helpful.

**T**here are certainly other interesting new drug developments. However, as a cardiovascular anaesthetist, I am not so involved in the developments of antibiotics and I think that cardiovascular drugs are nearest to our field.

## Are there also innovations regarding interventional procedures?

**W**e have already discussed that interventional procedures are increasingly used, especially in Germany: we are the country with the highest implantation rates for transcatheter valves. However, now even patients with seemingly lower risk are treated by this approach resulting in a loss of the additional benefits of the conventional cardiac surgical approach. For example, someone who has not only aortic stenosis but also additional high grade mitral or tricuspid regurgitation will not undergo concomitant mitral or tricuspid valve surgery but only aortic valve implantation. This may have relevant implications for the prognosis; but has not been adequately addressed in prospective studies so far, neither by cardiologists nor by cardiac surgeons.

## What do you think is the most demanding task and necessity for change in the future?

**W**hich problems are certainly related to the fact that there are economic drawbacks in many health systems? A critical challenge will be to motivate young physicians to stay in our field. Of course, many young physicians are interested in making some initial experiences in cardiovascular anaesthesiology. However, it is increasingly difficult to motivate them to stay in this field in the economically driven atmosphere of modern hospitals. Thus, a critical challenge for the future will be to offer young colleagues a perspective to stay on the job and to further develop the field.

**References**


1- Toller W, et al. Preoperative and perioperative use of levosimendan in cardiac surgery: European expert opinion. Int J Cardiol, 2015, 184, 323-336.
2- Mehta RH, et al. Levosimendan in Patients with Left Ventricular Dysfunction Undergoing Cardiac Surgery. New Engl J Med. March 19, 2017
3- Hajiar LA, et al. Vasopressin versus Nerepinephrine in Patients with Vasoplegic Shock after Cardiac Surgery: The VANCS Randomized Controlled Trial. Anaesthesiology, 2017, 85-93.

# The Future is Now

**The management of complex cardiovascular disease has changed. The concept of a multidisciplinary heart team consisting of a cardiologist, a surgeon and an anaesthetist implies changes in the traditional role of each player on the team.**

## The development of the heart team

The rationale for team-based care is to optimise the management of complex patient care issues, which has become increasingly difficult because of the development of new devices and approaches. In the last decade, transcatheter aortic valve replacement (TAVR) has become an alternative approach to surgical aortic valve replacement in high-risk and inoperable patients. Previous trials have already shown that in patients with severe aortic stenosis who were not suitable candidates for surgery, TAVR, as compared with medical therapy alone, significantly reduced the rates of death from any cause, the composite end point of death from any cause or repeat hospitalisation, and cardiac symptoms, despite a slightly higher incidence of major strokes and major vascular events when a first generation TAVR device was used [1]. Data from the Partner 2 trial suggests a similarly short- and long-term outcome after surgical replacement versus TAVR also in intermediate-risk patients for the endpoint death and stroke. There was a significant lower event rate for the primary study endpoint death and stroke for those eligible for the transfemoral approach [2]. Most recently the SURTAVI trial once again showed non-inferiority of TAVR in comparison to surgical aortic valve replacement in intermediate risk patients [3].

As patient groups at higher risk for adverse outcomes due to advanced age or comorbidities increase, these technologies will gain further significance. "In the future, surgery will probably only be performed when there are contraindications for catheter methods," said Prof. Holger Thiele (Figure 1). First generation TAVR were still done under general anaesthesia. However, local anaesthesia becomes increasingly common with the use of the 3rd generation devices and the increasing learning curve for TAVR. Currently, a TAVR procedure takes less than 45 minutes and doing this procedure under local anaesthesia allows much faster procedure times, faster mobilisation and also faster discharge at the same patient safety.

According to Prof. Volkmar Falk, a team approach is also fuelled by technical progress such as the advent of SAPIENS 3, a new balloon-expandable transcatheter heart valve that facilitates fully percutaneous implantation in a broader range of patients with the potential for more accurate positioning and less paravalvular regurgitation.

## Progress in imaging techniques

The development of increased use of TAVR is also a consequence of image guidance: 3- and 4-dimensional visualisation and concomitant use of novel technologies, such as fusion imaging, have supported technical growth, from pre-procedural planning to intra-procedural image guidance. "Surgeons have to master these new technologies, otherwise there is no need for us in the future," said Prof. Falk.

Computed tomography (CT) visualisation and measurement of the mitral valve annulus dimensions are also very important before implantation of a percutaneous mitral valve annuloplasty device.

"But even with all these new fascinating technologies in imaging and devices, it comes to finding the right patient for the right procedure, stepping back from what is possible and instead what is best for the patient," says Prof. Falk.

The future of valve repair and replacement will be percutaneous. This is essential for percutaneous valve repair to make the decision between percutaneous valve repair and conventional surgery. An interdisciplinary teamwork, consisting of cardiologist, anesthetist and surgeon is essential. "We anaesthesiologists should become the masters of imaging in order to stay in the game," said Prof. Falk.

Other developments are to mobilise patients as soon as possible: patients who stay in bed for more than 12 hours will have an increased risk for pneumonia. This has to be avoided and fast track concepts have to be developed: the goal of this concept is to optimise the perioperative management of the patient in order to reduce morbidity, to enhance recovery of the patient after a surgical procedure, to reduce hospital stay and to reduce costs.

Last but not least, an affiliation of health care providers and facilities start to bind the patients to them and offer lifelong care. In the future, fee-for-value models will replace the

former fee-for-service model, where healthcare providers are reimbursed by third party payers like insurance companies for specific procedures. Fee-for-value encompasses a holistic approach to patient care from "cradle to grave," taking each patient's condition from onset to treatment and beyond when calculating care and cost. It accounts for a coordinated team approach motivated by the best care for the best price. So, the biggest difference between fee-for-service and fee-for-value is reimbursement. In the former, providers get paid based on services, regardless of patient improvement. In the latter, reimbursement corresponds to patient outcomes. Patients matter in value-based approaches-throughout the healthcare system.

"Value-based health care (=the best delivered care with the lowest costs) with the overarching goal to deliver value for patients will be developed and change our profession. Today, 21th-century technologies are often provided with 19th-century organisation structures," concluded Prof. Falk.

## Anaesthesiologist have to be more flexible

"Our job changed in 2002 when the EACTA took place in Dublin - at that time, Prof. Cribier dropped a bomb in our field by performing the first percutaneous TAVR," said Fabio Guarracino. Since then, numerous interventional procedures have been developed. "The question to the anaesthesia field is, are you open for change," said Guarracino. Anaesthetists are increasingly becoming involved in the provision of sedation for these procedures. These changes are not always easy: the anaesthetist have to move outside the OR to increase flexibility, a challenge in logistics for the whole heart team. Aesthetic facilities are very good in new rooms but not in old catheter labs. "We anaesthetists are used to talk to surgeons – our communication worked." In contrast, the cardiologist prefers to work alone, which can lead to problems," said Guarracino.

A change is also necessary for the staff organisation. The new imaging possibilities are fascinating. However, there is often no room for an anaesthetist. "Our space is so limited, we cannot stand at the head of the patient any more. We need to have dedicated IV lines for anaesthesia," criticised Guarracino.

## General anaesthesia becomes less important

For transcathether aortic valve implantation (TAVI) we do no longer need general anaesthesia (GA) only in very special cases. Interventional cardiology has brought anaesthesia outside the OR. Both the European Society of Cardiology and the American Heart Association think that anaesthetists have to be part of the Heart Team. According to the guidelines, the management of elderly patients with severe symptomatic aortic stenosis should be decided by a Heart Team, including a cardiologist, a valve interventionalist, a cardiac surgeon, an imaging specialist, anaesthetist, geriatrician and intensive care specialist [4].

"Now we do procedures in the most fragile patients that cannot take surgery. In addition, there are more and more unprotected airways during these procedures. It is certainly a challenge, to be without the safety net of cardiopulmonary bypass outside the OR." This change is difficult, but not changing is fatal. "Therefore, we have to put all our skills in being successful under these new circumstances," concluded Guarracino. Procedures must be performed as a harmonious teamwork (Figure 2).

## Transcathether aortic valve implantation will stay

Advances in cardiac surgery support the interdisciplinary approach of cardiologists, surgeons, and anaesthetists. "TAVR will stay, we are now in the third generation. However, expertise is of key importance. About 60 cases per year are necessary to reach a plateau of less side effects and better results," said Prof. Davy Cheng.

Another reason why TAVI will be increasingly used is its cost effectiveness. "Minimally invasive procedures will continue to grow, especially TAVRs and Mitraclip – even if they might be not as good as we predicted," said Prof. Cheng. The decision about sedation, general anaesthesia or regional anaesthesia and anticoagulation should be done in consultation with

Figure 1 Evolution of Catheter methods

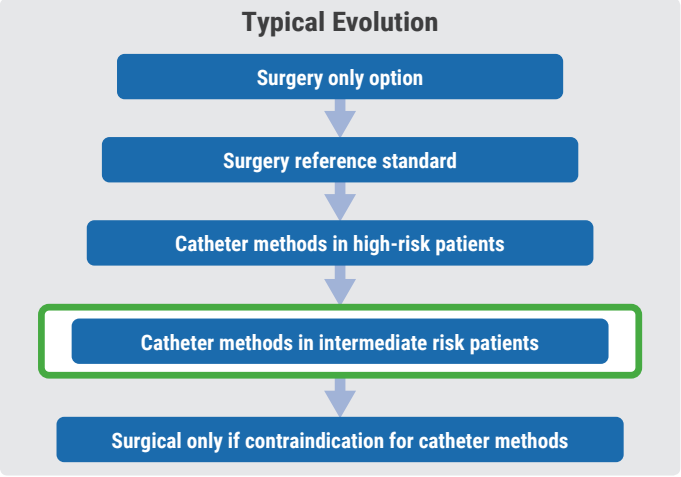
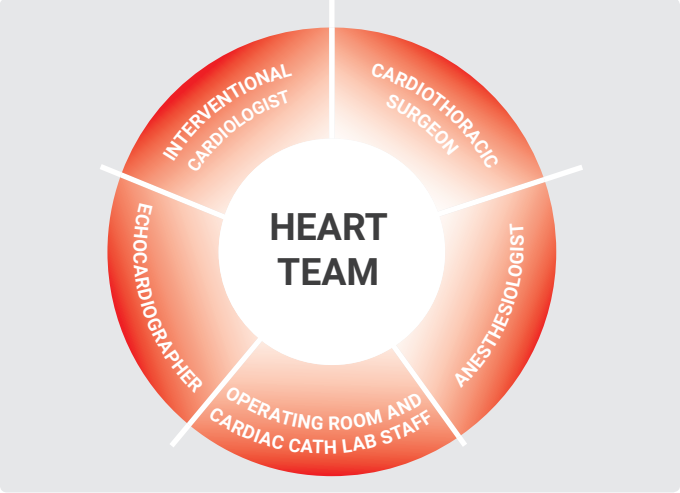


Figure 2 Procedures should be performed by the heart team




the cardiologist and cardiac surgeon. "We need to work with them, even if it can be difficult," said Prof. Cheng. The future belongs to the Heart team. Without any doubt, the combined expertise of interventional cardiologist, cardiac surgeons, imaging cardiologists, cardio anaesthetists and general physicians (in conjunction with the patient´s wishes) is critical in reaching the correct management decision [5]. "Anaesthetists are ideally positioned to provide effective leadership with broad implications in translating evidence to practise and in achieving evidence-based accountability in the acute care setting," concluded Prof. Cheng [6].

**References**


1. Leon MB, et al. Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. N Engl J Med , 1597-1607.
2. Leon MB, et al. Transcatheter or Surgical Aortic-Valve Replacement in Intermediate-Risk Patients. N Engl J Med, 374, 1609-1620.
3. Raerdon MJ, et. al, Surgical or transcathether aortic-valve replacement in intermediate-risk patients. N Engl J Med, 376, 1321-1331.
4. Pierard L., Transcatheter aortic valve implantation: indications. E-journal of cardiology practice, https://www.escardio.org/Journals/E-Journal-of-Cardiology-Practice/Volume-14/transcatheter-aortic-valve-implantation-indications.
5. Colombo A, et al. Transcatheter valve interventions: playground for cardiologists or cardiac surgeons? The cardiologist's view. EuroIntervention, 2015, 11.
6. Opening lecture: "The times are changing: cardiothoracic anaesthesiology in the era of interventional cardiology," held on the 19th of April, EACTA 2017.


# Heart Failure

**In an increasingly older surgery population, the incidence of comorbidities is rising. Heart failure plays an important role with a distinct impact on morbidity and mortality after surgery, which warrants new treatment concepts.**

## Major impact on postoperative health

According to a large British database including 159,327 patients the incidence of chronic heart failure (CHF) in patients undergoing major surgery is 18.4%. This had a tremendous influence on 30-day mortality, which was 2.4% in patients without cardiac comorbidity compared to 8% in CHF patients [1,2]. In addition, CHF patients had a 64% increased risk of renal insufficiency, a 73% higher relative risk for pneumonia, an 81% elevated risk for mechanical ventilation and a 43% elevated risk for sepsis compared to the group without CHF mortality.

"In the age over 70, there is dramatic increase in the prevalence of CHF: it rises to over 10%, compared to 1-2% before this age," said Dr. Sascha Treskatsch.

Although there is an ongoing debate on the use of inotropes and vasopressors in heart failure, they seem to be useful in cardiac surgery [3]. "This meta-analysis showed that inotropes and vasopressors reduce mortality in cardiac surgery by 30% and vasoplegic syndromes by 27%, so it is safe to use them," said Dr. Treskatsch.

Plasma B-type natriuretic peptide (BNP) is an established diagnostic and prognostic ambulatory biomarker of HF, which is released in response to increased wall stress. In a trial, increased perioperative BNP concentrations were independently associated with HF hospitalisation or HF death during the 5 year after primary coronary artery bypass graft (CABG) surgery [4].

„Preoperative BNP levels might help us to estimate the risk of our patients," said Dr. Treskatsch.

There is also an inflammation model of CHF. Proinflammatory markers such as IL-6, TNF-alpha and IL-2 are elevated in CHF. In a trial, preoperative left ventricular dysfunction was associated with a higher degree of proinflammatory cytokine release during elective CABG. These patients had impaired

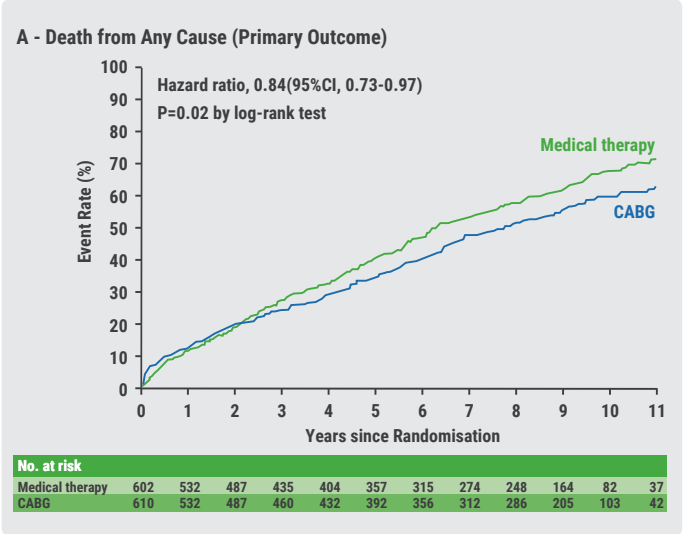
haemodynamics and a higher incidence of perioperative complications [5].

## Surgical therapy superior to medical treatment in ischemic cardiomyopathy

Coronary revascularisation is superior compared to medical treatment alone in patients with coronary artery disease, heart failure and severe left ventricular systolic dysfunction over a follow-up period of ten years: this showed the STICH trial [6]. From July 2002 to May 2007, a total of 1,212 patients with an ejection fraction of 35% or less and coronary artery disease (CAD) amenable to CABG were randomly assigned to undergo CABG plus medical therapy (CABG group, 610 patients) or medical therapy alone (medical-therapy group, 602 patients). The primary outcome was death from any cause. After a median follow-up time of 9.8 years, 58.9% in the CABG group vs 66% in the medical-therapy group met the primary endpoint (P=0.02; Figure 3). "You have only to treat 14 patients with CABG to save one life," explained Prof. Falk. Subgroup analysis confirmed the broad consistency of this effect. "The result of this trial was positive, although patients who benefit most from an CABG (CCS angina class >3 and those with left main stem >50%) were excluded from STITCH," told Prof. Falk. This trial led to a change of recommendation in the European guidelines of acute and chronic heart failure [7]. Myocardial revascularisation is now recommended when angina persists despite treatment with antianginal drugs.

"In order to have a benefit over medical therapy, you have to have viable myocardium," explained Prof. Falk. This was shown by 24 viability studies in 3,088 patients with CAD and left ventricular dysfunction (ejection fraction of 32%): The annualised mortality in patients with viable myocardium that were treated with medication only was 16% compared with a 3.2% mortality in the revascularisation group, which transfers in a 80% reduction in annual mortality rate by revascularisation [8]. Obviously, if there is only scar tissue left, there is no benefit," said Prof. Falk.

Figure 3 Kaplan-Meier Estimates for Death from any Cause (primary outcome) of medical therapy versus CABG [13]



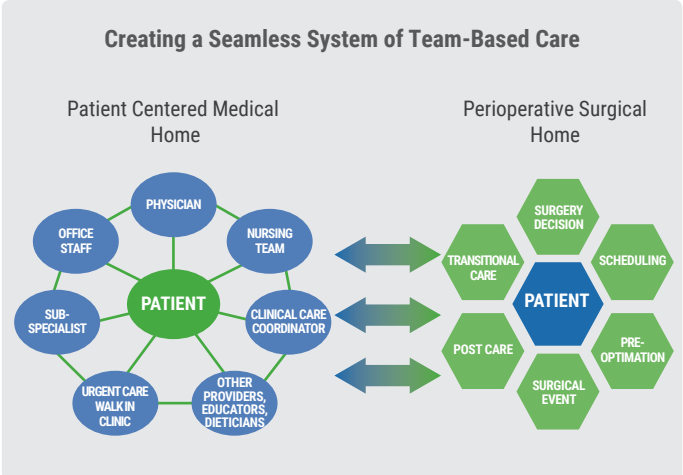

## More focus on postoperative care

After death due to heart disease and to malignant neoplasms, death within 30 days of admission for surgery is the third most frequent cause of death in the United States [9]. "This shows us that selecting patients for surgery is of key importance," said Prof. Michael Hiesmayr.

The concept of a seamless transition from the perioperative surgical home to the postoperative home after cardiac surgery is driven by the patient´s perspective. "The idea was, what do the patients want – they want autonomy and the tip of autonomy is no readmission to hospital," said Prof. Hiesmayr. For hospitals there is the advantage of early discharge. To accomplish this concept, a seamless system of team-based care has to be established (Figure 4). This new concept of a perioperative surgical home (PSH) requires an integrator that accepts responsibility.

After cardiac surgery many patients lose independence, particularly frail patients: in a trial, preoperative frailty was assessed and clinicians from surgery, anaesthesia, critical care and palliative care were notified of the patient's frailty and associated surgical risks; if indicated, perioperative plans were modified based on team input [10]. This approach leads to a reduced mortality, not only in frail, but even in robust patients. The risk of readmission is another factor which can

Figure 4 The concept of team-based care



be changed: the risk of readmission turned out to be significantly reduced in educated people. Failure to see a physician early in the postoperative period was associated with a 6-fold increase in the risk of readmission (P<0.0001) [11]. A trial showed, that readmission can be prevented, when hospitals participate in voluntary value-based reforms [12]. These trials clearly demonstrate the benefit of a patient centred care approach. According to Prof. Hiesmayr, an anaesthetist/intensivist would be an ideal cardiac PSH team leader. He knows the patient well and is used to combine competencies. However, anaesthetists have little experience in treating patients without monitoring and diagnostics. "Will we be able to do low tech? I think at the moment we do not have a chronic mindset as anaesthetists, but this new PSH expert is really needed," concluded Prof. Hiesmayr [14].


**References**

1. Hammill BG, et al. Impact of heart failure on patients undergoing major noncardiac surgery. Anesthesiology 2008, 559-567.
2. Maile MD, et al. Worsening preoperative heart failure is associated with mortality and noncardiac complications, but not myocardial infarction after noncardiac surgery: a retrospective cohort study. Anesth Analg, 2014, 119, 522-532.
3. Belleti A et. al, The Effect of inotropes and vasopressors on mortality: a meta-analysis of randomized clinical trials. 2015, Br J Anaesth, 115, 656-675.
4. Fox AA et. al, Increased periopertive b-type natriuretic peptide associates with heart failure hospitalization or heart failure death after coronary artery bypass graft surgery. Anesthesiology, 2013, 119, 284-94.
5. Deng MC, et al. Impact of left ventricular dysfunction of cytokines, hemodynamics and outcome in bypass grafting. Ann Thorac Surg, 1996, 184-90, 62.
6. Velazquez E, et al. Coronary-artery bypass surgery in patients with ischemic cardiomypathy. New Engl J Med, 2016, 1511-1520.
7. Ponikowski P, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC) Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. Eur Heart J, 2016, 2129-2200.
8. Allman KC et. al, Myocardial viability testing and impact of revascularization on prognosis in patients with coronary artery disease and left ventricular dysfunction. J Am Coll Cardiol, 2002, 1151-1158.
9. CDC death tables 2006: http://www.cdc.gov/nchs/data/dvc/LCWK9_2006.pdf
10. Hall DE, et al., Association of a Frailty Screening Initiative With Postoperative Survival at 30, 180 and 365 Days. JAMA Surg, 2017, 233-40.
11. Maniar HS et. al, Prospective evaluation of patients readmitted after cardiac surgery: analysis of outcomes and identification of risk factors. J Thorac Cardiovasc Surg, 2014, 147, 1013-1018.
12. Ryan AM, et al. Association Between Hospitals' Engagement in Value-Based Reforms and Readmission Reduction in the Hospital Readmission Reduction Program. JAMA Intern Med 2017; epub Apr 10.
13. Velazquez E et. al, Coronary-artery bypass surgery in patients with ischemic cardiomyopathy. New Engl Med 2016, 1511-1520, 374.
14. Plenary session "Pathophysiology of chronic heart failure," held on the 20th of April, EACTA 2017.


# Anaemia

**Research up to now focuses on 30-day mortality of anaemic patients. Data on the long-term sequelae of perioperative anaemia are urgently warranted.**

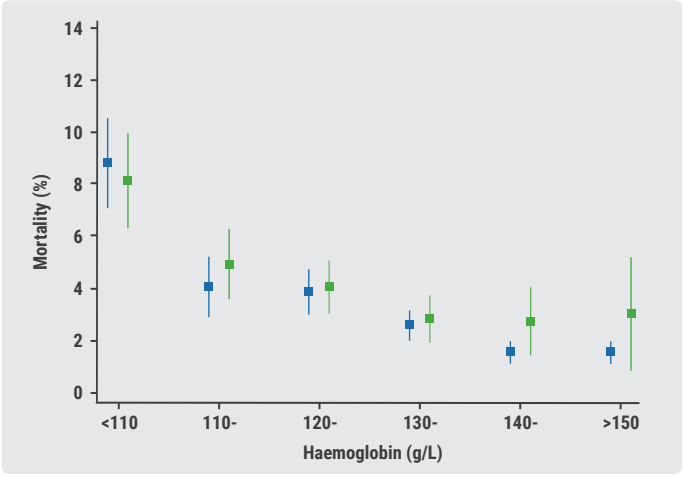
## Unknown long-term consequences

Regarding the outcomes of anaemic patients after discharge from hospital after cardiac surgery, there are still more questions than answers, in particular regarding long-term outcomes of anaemic patients. "We always focus on 30-day mortality but what happens long-term? What defines a successful outcome in cardiac surgery is not yet defined," said Dr. Tim Hayes, consultant cardiac anaesthetist.

Regarding short-term outcomes, the negative impact of anaemia has been shown in a couple of trials. According to an analysis of a big database, preoperative haematocrit (HCT) is a powerful predictor of adverse outcomes in patients undergoing CABG surgery [1]. In this database, information on 182,599 patients could be included: compared with patients with anaemia (HCT <33%), patients with HCT of at least 42% had lower mortality (1.1% versus 3.4%; P<0.0001) and lower rates of renal failure (2.0% versus 7.8%; P<0.0001), stroke (0.9% versus 1.8%; P<0.0001), prolonged ventilation (8.4% versus 17.5%; P<0.0001) and deep sternal wound infection (0.3% versus 0.6%; P<0.0001).

Each 5-point decrease in preoperative HCT was associated with an 8% higher risk of death, a 22% increase in the risk of postoperative renal failure and a 10% increase in the risk of deep sternal wound infection. The importance of pre-operative anaemia in coronary artery bypass graft surgery has previously only been evaluated in small series. Therefore, the Association of Cardiothoracic Anaesthetists carried out its first national audit on anaemia and transfusion and analysed data from 19,033 cardiac surgery patients in 12 cardiac surgical centres [2]. Anaemic patients had a nearly 3-fold relative risk for transfusion, a 42% higher risk for 30-day mortality (Figure 5) and a 15% higher relative risk for increased length of hospital stay (all comparisons

Figure 5 Mortality rates in patients with varying pre-operative haemoglobin concentrations in men (blue) and women (red). The mean mortality is depicted as a square and the 95% coincidence interval as horizontal bars [2]



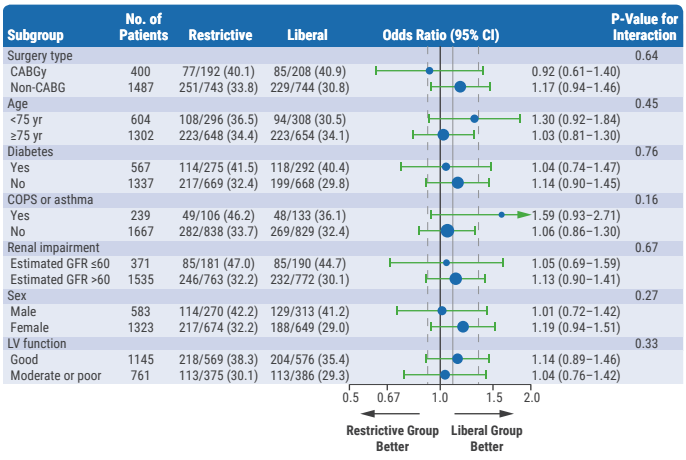

P<0.001). In addition, haemoglobin concentration per se was also independently associated with worse outcomes; a 10 g/L decrease in haemoglobin was associated with a 43% increase in the odds of transfusion and a 16% increase in the odds of mortality (both P<0.001).

There is hardly data on long-term outcomes. In an analysis including 1,262 patients aged 65 years and older that underwent surgical treatment of a hip fracture, mortality was assessed in hospital, as well as after 3- and 12-months [3]. In this trial, 42.5% of patients had postoperative anaemia. Anaemia as such had no effect on mortality. However, in hospital, 3- and 12-month mortality were negatively affected in patients with postoperative anaemia that needed an allogeneic blood transfusion. According to another trial, preoperative haemoglobin levels showed to be a predictor of late mortality in patients after CABG [4]. In this trial, patients were classified into four groups according to their preoperative haemoglobin level. Complete data could be obtained in 10,025 patients. This data was compared to survival statistics of a matched general Dutch population cohort. Multivariate logistic regression analyses revealed anaemia to be an independent risk factor for higher early mortality (defined as within the first 30 postoperative days), but also for late mortality (beyond 30-days). Compared with expected survival, patients with the lowest preoperative haemoglobin levels had a worse outcome, whereas patients with the highest haemoglobin levels had a better outcome.

## Do symptoms make a difference?

A US trial hints to the fact that there might be a difference in outcome, dependent on whether patients are symptomatic or not. This study examined whether asymptomatic patients discharged with lower haemoglobin levels had increased risk for perioperative complications and 1-year mortality [5]. In this trial including 1,107 patients after valve-only procedures, there was no difference in 1-year outcome among patients with haemoglobin level of ≤8 versus >8 g/dL. The authors conclude that the practice of blood transfusion to correct lower haemoglobin levels in asymptomatic patients should be eliminated. "This leaves us with the question, what we should be aiming for," said Dr. Hayes. An answer to this question gave a trial, in which a restrictive threshold for haemoglobin level (haemoglobin level <7.5 g/dL) in red-cell transfusions was compared with a liberal threshold (haemoglobin level <9.5 g/dL) was compared with regard to different outcomes in more than 2,000 patients undergoing cardiac surgery [6]. In this trial, the restrictive transfusion threshold after cardiac surgery was not superior to a liberal threshold with respect to morbidity or health care costs after 3 months (Figure 6): There was no difference regarding the primary end points serious infection and ischemic events. The authors conclude that restrictive threshold for transfusion is likely to be favoured because it requires the use of fewer units of allogeneic red cells [6]. Another support for giving less transfusions came from an Italian trial [7]. This study investigated the exercise tolerance during rehabilitation of cardiac surgical patients who did not receive transfusions, with respect to their level of postoperative anaemia. Patients with values of haemoglobin less than 10 g/dL at admission to the rehabilitation institute had a significantly worse performance on the 6-minute walk test than patients with higher values (P=0.007). However, this functional gap was completely recovered during a normal rehabilitation period. Therefore, the authors conclude that postoperative anaemia with haemoglobin levels of 8 and

Figure 6 A restrictive threshold of 7.5 g/dL was not superior to a liberal transfusion threshold of 9 g/dL across most subgroups [6]



10 g/dL is well tolerated in patients who have not received a transfusion and induces only a transient impairment of exercise tolerance. A limitation of this study is its small size and the observational design.

"Most of the trials only assess short-term outcomes of anaemic patients. Studies with a longer follow-up of patients are urgently needed," concluded Dr. Hayes. In addition, there are no data on the effect of anaemia and frailty. This might be the ultimate risk factor for long-term outcomes.

## Point-of-care coagulation monitoring offers distinct benefits

Standard laboratory coagulation tests (SLTs) such as prothrombin time/international normalised ratio or partial thromboplastin time are frequently used to assess coagulopathy and to guide haemostatic interventions. However, this concept has been challenged by many reports, including the current European guidelines for perioperative bleeding management. According to an analysis from the literature, only 3 prospective trials, investigating a total of 108 patients gave evidence for the usefulness of SLTs. The basis for SLTs for diagnosis of coagulopathy or to guide haemostatic therapy is therefore scarce [9]. According to Dr. Marcus Lanceé, SLT´s are far away from an in vivo situation. Another disadvantage of standard tests is the delay from blood sampling to obtaining results (45–60 min). In addition, coagulation tests are determined in plasma rather than whole blood and no information is available on platelet function.

In contrast, point-of-care coagulation monitoring devices have shown a couple of advantages. "As the methodology involves cells, they allow nearly in vivo conditions," said Dr. Lancee´. In addition, fibrinolysis can be monitored. At the moment, there are now viscoelastic tests available, the rotational thromboelastometry (ROTEM) and the thromboelastography (TEG). The accuracy of these test was assessed in a trial. Plasma samples of TEG/ROTEM showed interlaboratory coefficient of variation (CV) of 6-60% and intralaboratory CV of >10%. The authors conclude that it is extremely important to continue to standardise these tests [10]. But do these tests really influence survival? This question was answered by a review that assessed the clinical effectiveness and cost-effectiveness of viscoelastic devices to assist with the diagnosis, management and monitoring of haemostasis disorders during and after cardiac surgery, trauma-induced coagulopathy and post-partum haemorrhage [11]. There was a significant reduction in red blood cell transfusion, platelet transfusion and fresh frozen plasma transfusion (RR 0.47, 95% CI 0.35 to 0.65; five studies) in viscoelastic testing groups compared with controls.

According to a meta-analysis published this year, both TEG and ROTEM algorithm reduce mortality in bleeding patients (Figure 7). A 48% reduction in mortality with TEG- or ROTEM-guided blood transfusion was found in a systematic review of 17 randomised trials involving 1,493 patients with bleeding due to elective cardiac surgery, excision of burn wounds and liver transplantation [12].

Point-of-care guided monitoring is easy and should be incorporated in an algorithm. "An individualised approach allows a tailored therapy and thus overtreatment can be avoided," said Dr. Lancee.

**Figure 7 TEG or ROTEM-guided blood transfusion leads to a reduction of mortality of 48% versus SLTs [12]**

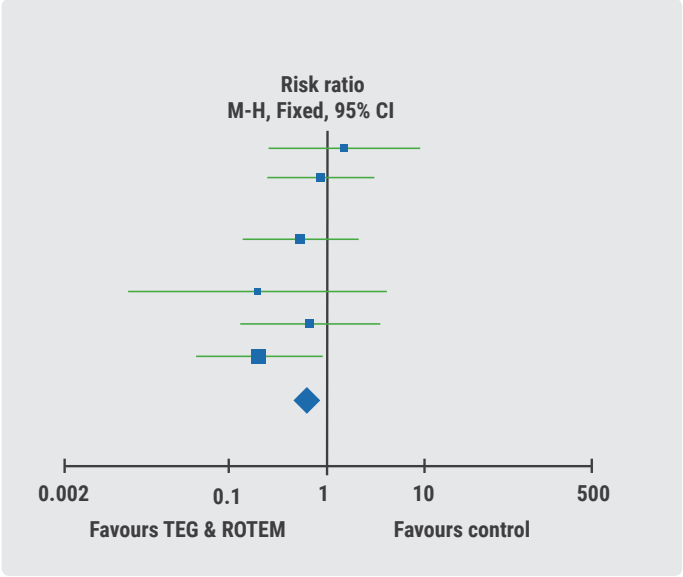
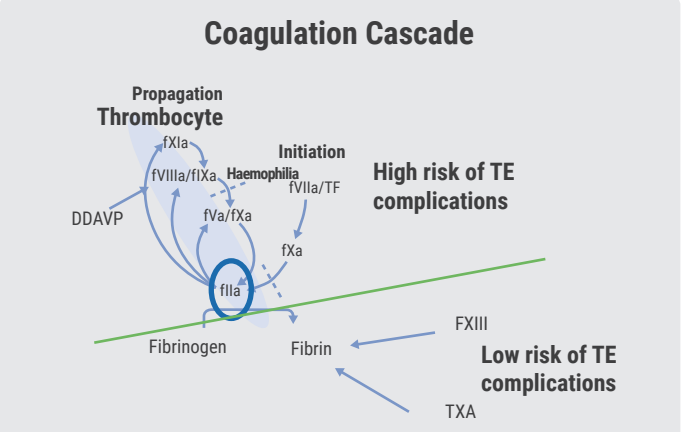



**Figure 8 Coagulation cascade from the soluble monomer fibrinogen to insoluble fibrin**



Taken together, traditional assays are not sufficient to assess coagulopathy and to guide haemostatic interventions. In contrast, viscoelastic tests have been proven to be effective. Platelet function assays allow prediction of blood loss when they are performed preoperatively, because than they are not influenced by drugs. The future will belong to thrombin generation and flow cytometry.


**References**

1. US Williams ML et. al., Preoperative hematocrit is a powerful predictor of adverse outcomes in coronary artery bypass graft surgery: a report from the Society of Thoracic Surgeons Adult Cardiac Surgery Database. Ann Thorac Surg, 2013, 96, 1628-1634.
2. Klein AA, et al. The incidence and importance of anaemie in patients undergoing cardiac surgery in the UK - the first Association of Cardiothoraric Anaesthetists national audit. 2016, 627-635, 71.
3. Vochteloo AJ, et al. Outcome in hip fracture patients related to anaemia at admission and allogeneic blood transfusion: an analysis of 1262 surgically treated patients. BMC Musculoskelet Disorder 2011, 12, 262.
4. Van Straten H, et. al, Preoperative haemoglobin level as a predictor of survival after coronary artery bypass grafting: a comparison with the matched general population. Circulation, 2009, 120, 118-125.
5. Ad N, et al. Should asymptomatic patients discharged with lower hemoglobin expect worse outcomes after valve surgery. J Thorac Cardiovasc Surg, 2015, 150, 1322-1328.
6. Murphy GJ, et al. Liberal or restrictive transfusion after cardiac surgery. New Engl J Med, 2015, 372, 997-1008.
7. Ranucci M, et al. Postoperative anaemia and exercise tolerance after cardiac operations in patients without transfusion: what haemoglobin level is acceptable? Ann Thorac Surg, 92, 25-31.
8. Ayoub K, et al. Perioperative Heparin Bridging in Atrial Fibrillation Patients Requiring Temporary Interruption of Anticoagulation: Evidence from Meta-analysis. J Stroke Cerebrovasc Dis, 2016, 25, 2215-2221.
9. Haas T, et al. Usefulness of standard plasma coagulation tests in the management of perioperative coagulopathic bleeding: is there any evidence? Br J Anaesth 2015, 114, 217-24.
10. Chittlur M, et al. Standardization of thromboelastography: values and challenges. Sem Thromb Hemost 2010, 36, 707-11.
11. Whiting P, et al., Viscoelastic point-of-care testing to assist with the diagnosis, management and monitoring of haemostasis: a systematic review and cost-effectiveness analysis. Health Technol Assess 2015, 19, 1-228.
12. Wikkelso A, et al., Thromboelastography (TEG) or rotational thromboelastometry (ROTEM) to monitor haemostatic treatment in bleeding patients: a systematic review with meta-analysis and trial sequential analysis. Anaesthesia 2017, 72, 519-31.
13. Plenary session "Bleeding, thrombosis and anaemia," 20th April EACTA 2017


# Transfusion triggers Cell Salvage, Red Blood Cell Storage

**Is haemoglobin really the right and only transfusion trigger? What is the role of cell savers and does the storage time of RBCs really matter? These were the burning questions discussed during a plenary session.**

## Hot topics in transfusion

To restore the perfusion of vital organs and tissues, oxygen-carrying RBCs must successfully enter the microcirculation and deliver oxygen to the tissues. "Until now, haemoglobin is used as transfusion trigger – but we are not sure how valid this approach is," said Prof. Christa Boer. A landmark study in patients undergoing nonemergency cardiac surgery questioned a restrictive haemoglobin value as transfusion threshold [1]. In this trial a transfusion threshold of haemoglobin level <7.5 g/dL, as compared with a liberal threshold (haemoglobin level <9.5 g/dL) was not superior: there was no difference regarding the primary end points serious infections and ischemic events. The liberal threshold was also superior in most subgroups (Figure 6). "In RBC transfusions, one size might not fit all," said Prof. de Boer. Haemoglobin might not be sufficient as sole transfusion trigger in high-risk patients.

## Oxygenation parameters to trigger transfusion?

Only limited data is available regarding the use of oxygenation parameters as transfusion triggers. However, it might be, to explore these parameters further to improve transfusion outcome.

In a retrospective trial, low $DO_2$ level during cardio-pulmonary bypass (CPB) was independently associated with postoperative acute kidney injury (AKI) [2]. According to the authors, goal-directed perfusion management aimed at maintaining the $DO_2$ level above the identified critical value of <262 mL/minute/$m^2$ might limit the incidence of postoperative AKI. To maintain an acceptable $DO_2$, the pump flow should be adjusted according to the haemoglobin

value of the perfusate, not only according to the patient's body surface area and temperature. Thereby, the pump is used to adjust the cardiac output exactly, as it happens as a compensatory physiological mechanism during acute, severe anaemia.

## Viscosity might prevent oxygenation

Blood flow is determined by many factors like: pressure gradient, the diameter of blood vessels and blood viscosity. Therefore, oxygenation levels might stay the same, even if haemoglobin is rising. Therefore, the effect of transfusion is mainly reduced to larger vessels. Accordingly, another trial showed that blood transfusion of up to three units of packed RBCs increased $DO_2$ only when HCT (or haemoglobin) was 60% lower than normal, but did not increase $DO_2$ when administered before this threshold due to increased blood viscosity [3]. "The question, therefore is, will we stick to haemoglobin as a transfusion marker for the rest of our life," concluded Prof. de Boer.

## Cell salvage aids in economic use of blood products

The rationale of using cell savers is their blood sparing effect. It has also been claimed to improve patient outcomes by removing debris from shed blood, which may decrease the risk of stroke or neurocognitive dysfunction. In the literature, there are a couple of trials and meta-analyses that support the ability to reduce exposure to allogeneic blood products, e.g. meta-analyses of 31 studies including 2,282 patients undergoing cardiac surgery [4]. In addition, the blood sparing effects were confirmed in a review on cell salvage for minimising perioperative allogeneic blood transfusion by the Cochrane Collaboration [5]. According to this analysis, cell salvage is efficacious in reducing the need for allogeneic RBC transfusion in adult elective surgery: overall, the use of cell salvage reduced the rate of exposure to allogeneic RBC transfusion by relative 39%. However, the methodological quality of trials was poor. Due to the unblinded study design, transfusion practices may have been influenced by knowledge of the patient´s treatment status biasing the results in favour of cell salvage.

Another review confirmed the benefit of this approach in surgical patients [6]. In this meta-analysis, randomised controlled trials where included, in which patients scheduled for all types of surgery were randomised to washed cell salvage or to a control group with no cell salvage. Overall, the use of washed cell salvage reduced the rate of exposure to allogeneic RBC transfusion by a relative 39% ($P<0.001$), resulting in an average saving of 0.20 units of allogeneic RBC per patient. Patients in the cell salvage group had also a reduced length of stay in hospital and fewer infections (-28%; Figure 9). However, the treatment did not significantly affect the risk of mortality.

## Recommended in current guidelines

According to the current guidelines of ESC/EACTS on myocardial revascularisation, there is strong evidence that use of cell-savers reduces allogenic blood product exposure, but also reduces the mean volume of total allogenic blood products transfused per patient [7]. Despite this recommendation, cell savers are not widely used.

"In our institution, we assessed both the effects of cell-saving devices and filters on transfusion in cardiac surgery," said Prof. Thomas Scheeren [8]. Although filtration of salvaged blood in combination with the cell-saving devices (CS) is widely used to improve the quality of retransfused blood, data to justify this approach are scarce. "In our trial, there was no significant effect of CS or filter on the total number of blood products. However, we noticed a significant reduction of RBC transfusions using what: the CS or the filter within 24 hours by 25%, but not during hospital stay," said Prof. Scheeren. Use of a CS was significantly associated with increased transfusions of fresh frozen plasma. This is logical as haemoglobin is increased during the use of CS due to reductions of fluids by the cell saving process, therefore more plasma is needed. "Our trial showed that use of a CS, with or without a filter, does not reduce the total number of allogeneic blood products, but reduces the percentage of patients who need blood products during cardiac surgery," said Prof. Scheeren. In addition to the blood sparing effect, there are other advantages such as a reduction of inflammatory markers in the blood processed by CS [9]. In this trial, the different RBC washing systems tested resulted in a significant attenuation of the inflammatory response. According, to a small study, CS were also able to remove fat particles [10]. In this trial, cell saver reduced the lipid burden returned to patients compared with cardiotomy suction. Fat emboli have been implicated in post-operative neuropsychological impairment of patients after CABG surgery. According to the authors, cell savers may lead to fewer lipid microemboli and therefore reduce cognitive impairment after CABG. These results are in line with another trial, in which the use of the cell-saving device was associated with a lesser release of non-specific markers of brain injury in elderly patients [11].

In addition, there are special indications, in which cell savers are useful: jehovah´s witness patients do accept cell savers

in contrast to blood products. Despite this advantage, cell salvage usage is not really common. In an analysis including data from 4,465,016 patients in the US Nationwide Inpatient sample database, who underwent cardiac operations between 1999 and 2010, CS usage remained below 5% [12]. However, cell savers can have also disadvantages, e.g. lead to an increased requirement of platelets [13].

In addition, not all studies show a reduction of transfusion requirement by CS [14].

"Taken together, a cell saver reduces the percentage of patients needing RBC transfusions, but not the total number of units transfused. The best effects are seen in uncomplicated patients," concluded Prof. Scheeren. The cost-saving effect of this strategy is another advantage.

## All clear with regard to storage time of red-cell units

Observational studies have reported that transfusion of red-cell units that have been stored for more than 2 to 3 weeks is associated with serious, even fatal, adverse events. Patients undergoing cardiac surgery may be especially vulnerable to the adverse effects of transfusion. To test this hypothesis, patients were randomly assigned to receive leukocyte-reduced red cells stored for 10 days or less (shorter-term storage group) or for 21 days or more (longer-term storage group) for all intraoperative and postoperative transfusions [15]. The primary endpoint was the change in multiple organ dysfunction score (MODS) from the preoperative score to the highest composite score through day 7 or the time of death or discharge.

"We did not find that the transfusion of red cells stored for 10 days or less was superior to the transfusion of red cells stored for 21 days or more among the 1,098 participants undergoing complex cardiac surgery," said PD Dr. Andreas Koster. In addition, there was no difference in a couple of secondary endpoints (Table 1).

**Figure 9 Cell salvage compared to control reduced the risk of infections [6]**

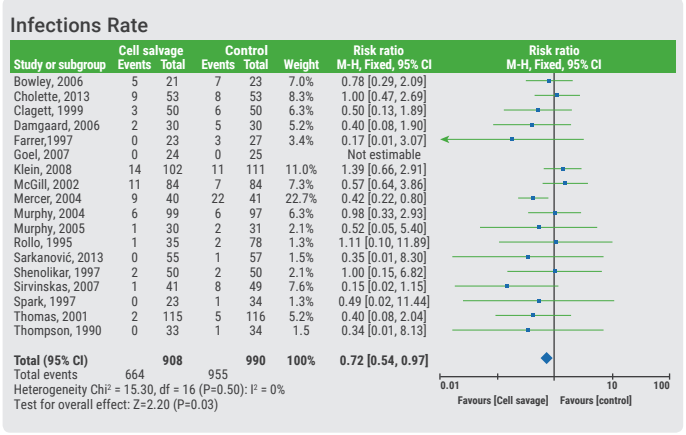



**Table 1: Primary and secondary outcomes regarding duration of red-cell storage: there is no difference between a storage time of less or more than 10 days [15]**

| | Red-Cell Storage ≤10 Days (=538) | Red-Cell Storage ≥21 Days (=560) | Estimated Treatment Effect (95% CI) | P-value |
|---|---|---|---|---|
| Primary outcomes: Δ MODS a 7 days | 8.5±3.6 | 8.7±3.6 | -0.2 (-0.6 to 0.3) | 0.44 |
| Secondary outcomes | | | | |
| Δ MODS at 28 days | 8.7±4.0 | 9.1±4.2 | -0.3 (-0.8 to 0.2) | 0.20 |
| All-cause mortality - no.(%) | | | | |
| 7 Days | 15 (2.8) | 11 (2.0) | 0.8 (-1.0 to 2.7) | 0.43 |
| 28 days | 23 (4.4) | 29 (5.3) | -0.9 (-3.4 to 1.7) | 0.57 |
| Median stay in ICU - days | 3 | 3 | 1.07 (0.95 to 1.21) | 0.27 |
| Median stay in hospital - days | 8 | 8 | 0.99 (0.88 to 1.13) | 0.92 |

ICU = intensive care unit
MODS: multiple organ dysfunction syndrome

**References**


1. Murphy GJ, et al. Liberal or restrictive transfusion after cardiac surgery. New Engl J Med, 2015, 372, 997-1008.
2. De Somer F, et al. O2 delivery and CO2 production during cardiopulmonary bypass as determinants of acute kidney injury: time for a goal - directed perfussion management? Crit Care, 2011, 192, 15.
3. Zimmermann R, et al. Posttransfusion increase of hematocrit per se does not improve circulatory oxygen delivery due to increased blood viscosity. Anesth Analg, 2017, 124, 1547-1554.
4. Wang G, et al. The efficacy of an intraoperative cell saver during cardiac surgery: a meta-analysis of randomized trials. Anesth Analg, 2009, 320-330, 109.
5. Carless PA, et al. Cell salvage for minimising perioperative allogeneic blood transfusion. Cochrane Database Syst Rev, 2006, 18. CD0018888.
6. Meybohm P, et al. Washed cell salvage in surgical patients: A review and meta-analysis of prospective randomized trials under PRISMA. Medicine 2016, 95, e4490.
7. 2014 ESC/EACTS Guidelines on myocardial revascularization. The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS). Eur Heart J, 2014, 35, 2541-2619.
8. Vermeijden WJ, et al. Effects of cell-saving devices and filters on transfusion in cardiac surgery: a multicentre randomized study. Ann Thorac Surg, 2015, 99, 26-32.
9. Amand T, et al. Levels of inflammatory markers in the blood processed by autotransfusion devices during cardiac surgery associated with cardiopulmonary bypass circuit. Perfusion, 2002, 17, 117-123.
10. Jewell AE, et al. A prospective randomised comparison of cardiotomy suction and cell saver for recycling shed blood during cardia surgery. Eur J Cardio-thor Surg, 2003, 23, 633-636.
11. Carrier M, et al. Randomized controlled trial of blood processing with cell-saving device on neurologic markers in elderly patients undergoing coronary artery bypass graft surgery. Ann Thorac Surg, 2006, 82, 51-55.
12. Robich MP, et al. Trends in blood utilization in United States cardiac surgical patients. Transfusion, 2015, 55, 805-814.
13. Al-Riyami AZ, et al. Intra-operative cell salvage in cardiac surgery may increase platelet transfusion requirements: a cohort study. Vox Sanguinis, 2015, 109, 384-390.
14. Vermeijden W, et al. Additional postoperative cell salvage of shed mediastinal blood in cardiac surgery does not reduce allogeneic blood transfuions: a cohort study. Perfussion, 2016, 31, 384-390.
15. Stiner ME, et al. Effects of red-cell storage duration on patients undergoing cardiac surgery. N Engl J Med 2015, 372, 1419-1422.

# EACTA Survey

**A recent trial emphasizes the advantage of balanced fluids versus saline: an EACTA survey shows that most centres use balanced fluids as primary fluid for CPB priming.**

## The future belongs to balanced fluids

A balanced fluid has the physiological electrolyte composition of plasma. "Balanced fluids do not cause the hyperchloremic acidosis associated with 0.9% saline," said Prof. Andrew Sham. A study that compared infusions with saline versus balanced crystalloids in healthy volunteers showed that intravenous infusion of 0.9% saline results in reductions in renal blood flow velocity and renal cortical tissue perfusion [1]. "Even in healthy volunteers there is such a difference between balanced and unbalanced fluids," said Prof. Shaw.

In a retrospective analysis of a prospectively collected data set, major complications, mortality and resource utilisation after open abdominal surgery were assessed in more than 30,000 patients, who received 0.9% saline or balanced crystalloid solution on the day of surgery [2]. The use of balanced fluid (Plasma-Lyte) versus saline resulted in a reduction of morbidity that was mainly driven by a reduction in major infections and fewer incidences of new onset renal insufficiency (Figure 10). In addition, interventions related to metabolic acidosis diagnosis and management were significantly reduced by the use of the balanced fluid.

In an observational cohort study including 23,000 patients, hyperchloremia after noncardiac surgery was independently associated with increased morbidity and mortality: the hyperchloremic group was at increased risk of mortality 30 days postoperatively and had a longer hospital stay than patients with normal postoperative serum chloride levels. In addition, patients with postoperative hyperchloremia were more likely to have postoperative renal dysfunction [3]. The trials SMART and SALTED will provide guidance on the best crystalloid to use in the critically ill. Results are expected in the next months "Even today, I think that balanced fluid is the fluid of choice," concluded Prof. Shaw.

The role of Albumin is not established yet. However, a beneficial effect could be demonstrated in a recent trial: administration of albumin immediately before surgery reduced the risk of AKI after off-pump coronary artery bypass surgery in patients with a preoperative serum albumin level of less than 4.0 g/dL [4].

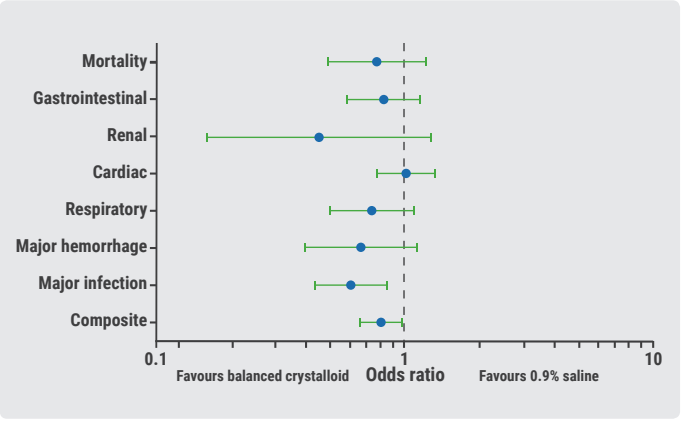
## EACTA Survey confirms preference for balanced fluids

Dr. Protsyk presented the results of a survey EACTA did in European cardiac anaesthesia departments that will be published in the course of 2017. Eighteen European countries have been involved in this survey. Participating hospitals were mainly cardiothoracic ICU (73%). The use of balanced crystalloids (e.g. Ringer) as primary fluid for CPB priming solution was most common (51.5%). Further 31.3% used a combination of crystalloid and synthetic colloid. Only 3.9% of the centres used normal saline.

Balanced crystalloid was also the most common primary fluid for intraoperative management (73.8%), followed by a combination of crystalloid and synthetic colloid (14.6%). In case there is increased need for volume, 41.7% add/increase crystalloids, further 39.8% add/increase synthetic colloids.

Most participants used scientific literature as their source of information. International guidelines and clinical needs were the two factors that primarily influenced the fluid selection. Compared with previous surveys in the field, this survey clearly showed that hydroxyethyl starch (HES) was used in former time, but now its use is markedly reduced and is replaced by balanced crystalloids: Today, gelatine seem to become the first colloid of choice [5].

**Figure 10 Odds ratios and 95% confidence intervals for prespecified clinical outcomes of balanced crystalloids versus saline [2]**



**References**
1. Chowdhury AH, et al. A randomized, controlled, double-blind crossover study on the effects of 2-L infusions of 0.9% saline and plasma-lyte® 148 on renal blood flow velocity and renal cortical tissue perfusion in healthy volunteers. Ann Surg, 2012, 256, 18-24.
2. Shaw AD, et al. Major complications, mortality and resource utilization after open abdominal surgery: 0.9% saline compared to Plasma-Lyte. Ann Surg, 2012, 255, 821-828.
3. McCluskey SA, et al. Hyperchloremia after noncardiac surgery was independently associated with increased morbidity and mortality: a propensity-matched cohort study. Anesth Analg, 2013, 117, 412-421.
4. Lee EH, et al. Effect of exogenous albumin on the incidence of postoperative acute kidney injury in patients undergoing off-pump coronary artery bypass surgery with a preoperative albumin level of less than 4.0 g/dl, Anethesiology 2016, 124, 1001-1011.
5. Session "Fluids and haemodynamics - any news?," held on the 20th of April, EACTA 2017.

# How to look after Heart, Kidney and Brain

## Organ protection in cardiac surgery

**End organ protection is an important issue in cardiac surgery. As predisposing risk factors cannot be influenced perioperatively, therapy should focus on controlling perioperative variables that have demonstrated a positive outcome.**

"Although patients get older, there was no increase in mortality for patients undergoing surgery in Great Britain during the previous years," said Dr. Gudrun Kunst, King's College Hospital NHS Foundation Trust, Department of Anaesthetics and Pain Therapy, London (Great Britain).
Nevertheless, end-organ dysfunction and/or failure remains an issue. Multiple perioperative variables, as well as pre-existing factors, exacerbate mortality and morbidity. A couple of organ injuries are markedly elevated after cardiac surgery. The incidence of postoperative AKI after cardiac surgery is up to 39% (3% requiring dialysis) [1]. Postoperative myocardial injury, incidence of MI after CABG is 13%-22% [2,3]. And finally, incidence of delirium after CABG is seen in up to 46% of patients [4].

## Troponin: a reliable marker for cardiac injury

"With troponin, we have a very precise and sensitive marker: cardiac troponin levels are an independent predictor of mortality," said Dr. Kunst. This showed a trial in 1,356 patients undergoing cardiac surgery [5]. In this trial, troponin I levels were frequently elevated after cardiac surgery. Cardiac troponin levels at 24 hours were independent predictors of postoperative cardiac death and mortality for up to 3 years. Another prospective international cohort study demonstrated an association between postoperative troponin level and 30 day mortality among patients undergoing non-cardiac surgery [6]. In another large international prospective cohort study an elevated troponin after non cardiac surgery, irrespective of the presence of an ischemic feature independently predicted 30-day mortality [7]. The author´s diagnostic criterion for myocardial injury after non-cardiac surgery was a peak troponin T level of 0.03 ng/mL or greater measured during the first three postoperative days. From the total of 15,065 patients 1,200 patients (8%) suffered myocardial injury.
"Troponin levels are particularly important in silent myocardial infarction (MI), where we see no symptoms of MI," said Dr. Kunst: 58% of the patients of the cohort trial would not have fulfilled the universal diagnosis of MI, but had only isolated elevated troponin level. Only 15.8% of patients with myocardial injury experienced ischaemic symptoms [7].

## Beware of hypotension

Intraoperative hypotension is another factor that might support myocardial injury. In a trial of elderly vascular surgery patients, intraoperative hypotension defined as a 40% decrease from the preinduction mean arterial blood pressure with a cumulative duration of more than 30 minutes was associated with postoperative myocardial injury [8].
Therefore, a mean arterial blood pressure of 80 mmHg might be better than 60 mmHg in patients undergoing vascular surgery and was also recommended in an accompanying editorial.
A perioperative beta-blocker regimen showed conflicting results in the POISE trial [9]. The perioperative intake of metoprolol in patients who were undergoing non-cardiac surgery led to a significant reduction of the composite primary endpoint of cardiovascular death, non-fatal MI and non-fatal cardiac arrest. However, there were significantly more deaths and strokes in the metoprolol group compared

to placebo and more patients in the metoprolol group had a stroke. "Therefore, perioperative metoprolol cannot be recommended," said Dr. Kunst. However, patients who take beta blockers as well as statins before surgery should be continued peri-operatively.

A factor positively associated with myocardial injury is pre-operative tachycardia. In a large prospective cohort study, a heart rate of >96 beats/minute was associated with increased myocardial injury and mortality [10].

Regarding continuing perioperative medication, the 2014 ACC/AHA Guidelines recommend to continue beta blockers and statins perioperatively [11].

Regarding the question whether volatile anaesthetic offer protection in cardiac surgery meta-analyses showed conflicting results. Probably there is a moderate benefit with regard to organ protection. "Regarding perioperative cardioprotection no one ingredient may tip the balance, but the skilful approach of the anaesthetist makes the best cake," said Dr. Kunst. Different possibilities and their level of evidence are shown in Table 2.

**Table 2 Best recipe for myocardial protection (Lecture Dr. Kunst)**

| |
|---|
| Class I recommendation (Level A evidence): |
| • beta blocker and statins should be continued peri-operatively |
| Class II a recommendation (Level B evidence) |
| • Volatile anaesthetics are beneficial in cardiac anaesthesia |
| Class II b recommendation (Level C evidence) |
| • start beta blockers (bisoprolol or metoprolol) days before surgery<br>• propofol may be beneficial in cardiac anaesthesia. |
| Class III recommendation - no benefit or harm (Level A evidence) |
| • Additional metoprolol, aspirin and clonidine should be avoided pre-operatively<br>• remote ischaemic pre-conditioning is not protective in cardiac surgery |
| Class III recommendation no benefit or harm (Level C evidence) |
| • discontinue ACE I/AT2RB in non-cardiac surgery<br>• prolonged intraoperative hypotension (>40% >30 min) should be avoided<br>• intraoperative and preoperative tachycardia should be avoided |

## Neurological protection remains difficult

According to Dr. Joseph E Arrowsmith, the prevalence of risk factors for neurologic problems are increasing due to an aging surgical population. Many neurological injuries are clinically silent.

An episode of early delirium after cardiac surgery has a short- and long-term survival disadvantage over the next 10 years: as was shown by a study of 5,034 patients undergoing CABG surgery [12]. Another trial showed that delirium after cardiac surgical procedures is independently associated with both increased length of stay in the ICU and higher hospital charges [13]. „Delirium is always an anaesthetic complication and never surgery or perfusion-related" said Dr. Arrowsmith. However, a high percentage of patients already have one or more brain injuries before surgery: old lesions were found in up to 50% [14].

"Unfortunately, there are few interventions that really make a difference," said Dr. Arrowsmith. Management of the diseased aorta seems important. The only drugs that might be neuroprotective are steroids [15]. In addition, hyperthermia and gross anaemia should be avoided.

## Kidney: the first organ to fail

Today, up to 40% of all patients experience renal injury due to an increase in old patients. Its pathogenesis involves multiple pathways. Haemodynamic, inflammatory, metabolic and nephrotoxic factors are involved and overlap each other leading to kidney injury. "The kidney is the first organ to fail, because it is the first which suffers from lack of oxygen," said Prof. Filip de Somer. A recent trial showed that a bundle of interventions mainly aimed at limiting the renal impact of haemodilution during cardiopulmonary bypass is effective in reducing acute kidney injury rate [16].

**References**


1. Vives M, et al. Cardiac surgery-associated acute kidney injury. Interact cardiovasc Thorac Surg, 2014, 18, 637-45.
2. Wang TK, et al. Diagnosis of MI after CABG with high-sensitivity troponin T and new ECG or echocardiogram changes: relationship with mortality and validation of the universal definition of MI. Europ Heart J, 2013, 2, 323-33.
3. Hausenloy DJ, et al. Remote Ischemic Preconditioning and Outcomes of Cardiac Surgery. New Engl J Med, 2015, 373, 1408-1417.
4. Saczynski, et al. Cognitive trajectories after postoperative delirium. New Engl J Med, 2012, 367, 30-39.
5. Croal BL, et al. Relationship between postoperative cardiac troponin I levels and outcome of cardiac surgery. Circulation, 2006, 1468-1475, 114.
6. VISION study investigators. Association between postoperative troponin levels and 30-day mortality among patients undergoing noncardiac surgery. JAMA, 2012, 2292-304.
7. Botto F, et al. Myocardial injury after noncardiac surgery: a large, international, prospective cohort study establishing diagnostic criteria, characteristics, predictors, and 30-day outcomes. Anesthesiology, 2014, 120, 564-578.
8. Van Waes JA, et al. Association between intraoperative Hypotension and Myocardial Injury after Vascular Surgery. Anesthesiology, 2016, 124, 35-44.
9. Devereaux PJ, et al. Effects of extended-release metoprolol succinate in patients undergoing non-cardiac surgery (POISE trial): a randomised controlled trial. POISE study group, Lancet, 2008, 371, 1839-1847.
10. Abbott TEF, et al. Preoperative heart rate and myocardial injury after non-cardiac surgery: results of a predefined secondary analysis of the VISION study. BJA, 2016, 117, 172-181.
11. Fleisher LA, et al. ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery: Executive Summary. Circulation, 2014, 130, 2215-2245.
12. Gottesman RF, et al. Delirium after coronary artery bypass graft surgery and late mortality. Ann Neurol, 2010, 67, 338-344.
13. Brown Ch 4th, et al. The Impact of Delirium After Cardiac Surgical Procedures on Postoperative Resource Use. Ann Thorac Surg, 2016, 101, 1663-1669.
14. Sun X, et al. Silent brain injury after cardiac surgery: a review: cognitive dysfunction and magnetic resonance imaging diffusion-weighted imaging findings. J Am Coll Cardiol, 2012, 60, 791-797.
15. Shum-Tim D, et al. Systemic steroid pretreatment improves cerebral protection after circulatory arrest. Ann thorac Surg, 2001, 72, 1465-1472.
16. Ranucci M, et al. Acute kidney injury and hemodilution during cardiopulmonary bypass: a changing scenario. Ann Thorac Surg, 2015, 100, 95-100.
17. Lecture Dr. Kunst, EACTS/EACTA Joint Session "Organ protection in cardiac surgery - a multi-disciplinary task?," held on 20th of April, EACTA 2017.

# Nosocomial infections

## Prevention plays a key role

**Catheter related blood stream infections are best managed by multifaceted prevention programs. Despite advances in diagnosis and management, mortality rates of infective endocarditis are still high.**

The median rate of catheter related blood stream infections (CRBSI) in ICUs of all types ranges from 1.8 to 5.2 per 1,000 catheter-days. Trials have shown that multifaceted interventions that help to ensure adherence with evidence-based infection control guidelines lead to a dramatic reduction of CRBSIs [1,2]. A blood stream infection is defined, by a patient having at least one positive blood culture for a recognised pathogen or at least one of the following: fever >38° C, chills, hypotension and two positive blood cultures from a common skin contaminant. The infection is catheter-related if the same microorganism was cultured from the catheter or symptoms improve within 48 hours after removal of the catheter. From the total, 68% of all CRBSI´s were extraluminally acquired. In his case, there is a concordance between cultures from tip, insertion site and blood. "By far the most frequent pathogen is a coagulase-negative staphylococcus," said Dr. Peter Rosseel. Risk factors for CRBSI are well established and are prolonged hospitalisation before catheterisation, a prolonged duration of catheterisation, emergent placement and use for parenteral nutrition [3].

A couple of guidelines for the prevention and management for bloodstream infections have been published [4-6].

"The main focus in the management of CRBSI are the 3 P´s: prevention, prevention and once more prevention" told Dr. Rosseel. During insertion, appropriate use of hand and skin hygiene (2% chlorhexidine skin preparation) and full-barrier precautions (cap, surgical mask, sterile gown), are of key importance. In case of an infection, the catheter shall be removed. However, antibiotics are not required, if there is a positive catheter tip culture but no clinical signs of infection [4].

## Infective Endocarditis: highest risk in valve patients

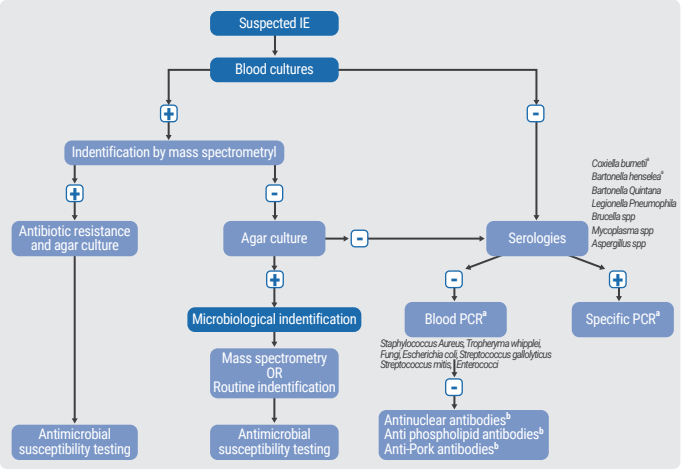
Prosthetic valve endocarditis (PVE) occurs in up to 6% of patients having had valve surgery. Patients are at greatest risk during the initial 3 months, but risk remains high through 6 months.

Risk factors of PVE are younger age, male sex, a history of diabetes, COPD, and postoperative stroke. "Every patient should have good dental care before he goes to surgery," recommended Dr. Rosseel.

Echocardiography plays an essential role in diagnosis and decision making [6]. Infections are mainly caused by *Staphylococcus Aureus* and coagulase-negative staphylococci.

"Blood cultures are the cornerstone of diagnosis and should be done prior to starting treatment in all cases," recommended Dr. Rosseel. The microbiological diagnostic algorithm were depicted in the Guidelines (Figure 11) [8]. The Management of PVE is similar to native valve endocarditis. Although most series suggest that surgical treatment has better results than medical treatment alone, it is very difficult to select the most appropriate treatment for the individual patient [7]. Heart failure, perivalvular infections and high

**Figure 11 Microbiological diagnostic algorithms in culture-positive and culture-negative endocarditis [8]**




BCNIE = blood culture-negative infective endocarditis; IE = infective endocarditis; PCR = polymerase chain reaction.
[a]Qualified microbiological laboratory
[b]Immunological laboratory

embolic risk are the three main indications for early surgery [6]. Despite advances in diagnosis and treatment along with improved antimicrobial treatments and potentially curative surgery, mortality in IE is still high, particularly in the ICU [9].


**References**

1. Pronovost P, et al. An intervention to decrease catheter-related bloodstream infections in the ICU New Engl J Med, 2006, 355, 2725-2732.
2. Berenhotz SM, et al. Eliminating catheter-related bloodstream infections in the intensive care unit. 2004, 32, 2014-2020.
3. Marschall J, et al. Strategies to prevent central line-associated bloodstream infections in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol, 2014, 753-771.
4. Mermel LA, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: 2009 update by the infectious disease society of America. Clin Infect Dis, 2009, 49, 1-45.
5. O'Grady NP, et al. Guidelines for the prevention of intravascular catheter-related infections. Am J Infect Control, 2011, 39.
6. Habib G, et al. Recommendations for the practice of echocardiography in infective endocarditis. Eur J Echocardiography, 2010, 02-11219.


# Frailty: The Condition of Being Weak and Delicate

### Best Abstract Presentation EACTA 2017

The best abstract sessions I and II were certainly one of the highlights of this year's EACTA meeting, which attracted the interest of many attendants. Finally, the presentation of preoperative frailty won the price as the best abstract presented this year.

## Preoperative frailty – a predictor of disability-free survival

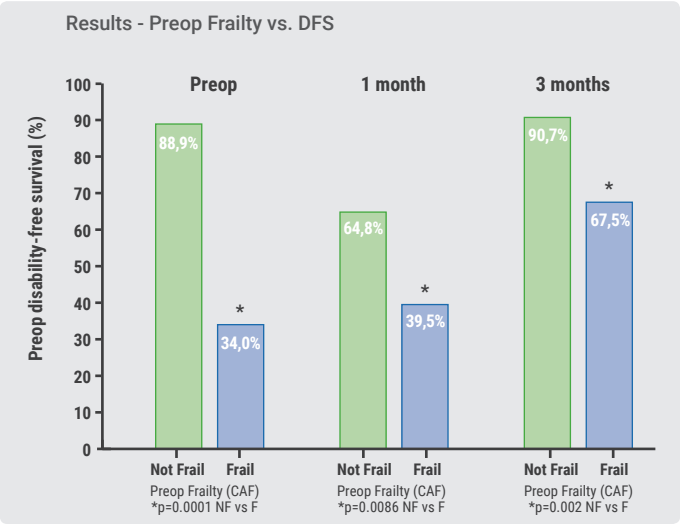
Due to the demographic change, cardiac surgical patients become increasingly older and therefore have more comorbidities and increased operative risk. "Therefore, a risk stratification of patients gets increasingly important," said Dr De Carvalho. Today, the EuroSCORE (European System for Cardiac Operative Risk Evaluation) is most commonly used. However, frailty is a separate entity to chronological age. Various frailty scores have been studied to date in surgery, e.g., the Modified frailty index [1], the Multidimensional geriatric assessment [2] or the Comprehensive assessment of frailty (CAF) [3]. "Of the many scores being available, we decided to use the CAF score as it is quick: A 10 minutes assessment can be done at the bedside or clinic," said Dr De Carvalho. In this Score, biological markers (e.g. body mass index, serum creatinine) and a couple of physical tests of strength and stability (grip strength, static balance tests) and patient-reported exhaustion/activity (physical activity, tiredness) are evaluated. The trial should answer the question, whether a preoperative frail score can predict disability free survival (DFS). The problem of mortality is that disability, morbidity and pain are ignored. DSF indicates the percentage of those alive and without disability at a certain time point. This endpoint is relevant for patients and physicians, as it describes longevity with good holistic wellbeing [4]. DFS can be assessed with the World Health Organisation Disability Assessment Schedule 2.0, a validated score for global disability from health conditions. This score assesses five domains (cognition, mobility, self-care, getting along, life activities and participation) by 12 questions in an interview form. "Our hypothesis was that a preoperative frailty score using CAF can predict DFS (using WHODAS) at 3 months postoperatively, in patients undergoing major cardiac surgery," said Dr De Carvalho.

In addition, associations between preoperatively frailty scores and DFS at 1 month, mortality (in-hospital and at 1 and 3 months), delirium (at day 3) and postoperative adverse events (organ dysfunction) was assessed. In 146 patients, the preoperative assessment could be performed. Patients were assessed at day 3 postoperatively (CAM delirium test). One and three months after surgery they underwent a telephone interview of 5-10 minutes.

## Surprising result: Frail patients benefit most from surgery

Regarding age, gender and ethnicity, there were no significant differences between frail and non-frail groups. However, frail patients on average had a higher preoperative disability (66% vs. 11%; P<0.001), a higher EuroSCORE II score (P<0.001), a higher NYHA class (P<0.05), an increased incidence of stroke

Figure 12 Preoperative frailty versus Disability-free survival (DFS) [5]




(P<0.05) and fewer were on aspirin (P<0.05), and more on ACE inhibitors (P<0.05). Regarding type of surgery, cross-clamp time or blood products used there were no differences between groups.

Frailty was positively associated with disability at all timepoints (Figure 12). In addition, frailty predicted DFS at 3 months, whereas EuroSCORE II did not. "Our trial is ongoing – we will have a follow up of up to 1 year. Even these preliminary data justify to incorporate frailty into practice.

"Interestingly and unexpectedly, frail patients improved after surgery, they benefited most from the intervention," said Dr De Carvalho.

Frailty should therefore not be reviewed as a cause not to deliver care but rather as a means of delivering it in a more patient-centred fashion [5].

## Creatinine increase after CPB may be a marker of organ injury

Preoperative renal insufficiency is an important predictor of mortality after cardiac surgery. In an earlier trial, an association between small serum creatinine changes within 48 hours after cardiac surgery and 30-day mortality has been demonstrated [6]. In addition, it has been shown recently that also a preoperatively elevated baseline small serum creatinine is a predictor for worse outcomes [7]. "In our present investigation, we wanted to assess the influence of early changes in creatinine after surgery on long-term mortality in patients below and above the initial Creatinine (iniCrea) cut-off value of >1.3 mg/dL, where mortality increases," said Dr. Martin Bernardi.

In this trial, elective adult cardiac surgical patients between 1997 and 2008 at the Medical university of Vienna were included. This cohort was split into the two iniCrea-groups: one group with low iniCrea: ≤1.3 mg/dL and those with high iniCrea of >1.3 mg/dL. Within 120 minutes after end of surgery the difference in creatinine between the highest measured creatinine and the iniCrea value was calculated for each patient. Depending on their change in serum creatinine, patients were divided in four cohorts depending on their change in creatinine.

- Cohort A: (decrease of more than -0.3)
- Cohort B: (-0.3 to 0)
- Cohort C: (increases of 0 to 0.5)
- Cohort D: (increases of more than 0.5)

Data from 8,030 patients (2,834 women) could be assessed. Patient had a mean age of 65.6 years (from 18 to 94). High iniCrea values were found in 1,517 patients. Overall 2,764 patients died within the observational period of 14 years. In general, there was a low mortality in the group with the low iniCrea concentrations. The mortality was lowest in patient within group B that showed hardly a change in creatinine and highest in cohort D with a creatinine change of 0.5 and more. Mortality in the group with high initial creatinine values was high and nearly equal in patients within cohort A and B. Again, the mortality was highest in the patients who had the greatest changes in creatinine (0.5 and more). "Our study shows that a slight decrease in serum creatinine is the reaction to fluid supply and blood loss. In patient with low initial creatinine values, both a profound decline and a rise in the change of creatinine increase the risk of mortality," concluded Dr. Bernardi. However, in patients with a high initial creatinine value, a decline in creatinine does not seem to increase the risk of mortality, but even a slight increase of creatinine worsens the outcome. "This data suggests that an increase of the change in creatinine early after CPB is deleterious and may be a marker of diffuse organ injury. We think, that a renoprotective postoperative course should be warranted in those patients," concluded Dr. Bernandi [8].

## Transesophageal echocardiogram training does not have to be in the OR

Unfortunately, transesophageal echocardiogram training is often limited by the fact that no trainers or suitable patients are available. „With our study we tried to assess, whether there is a difference in teaching the 11 basic transesophageal echocardiogram views between online training, simulator

training or the conventional hands-on training," said Dr. Ulrike Weber. Study participants were 3 groups of residents with no prior knowledge of echocardiography.

After a theoretical multiple choice test they were randomised into three groups. One group did the online training of the University of Toronto (site www.pie.med.utoronto.ca/TEE), the second group the simulation with a CAE Vimedix simulator and the third group took part in a hands-on training in the operation room.

In all three groups, the theoretical test after the training improved significantly (P<0.01). In the practical test after the training, there was no significant difference between the groups. The study effect was similar and best in the simulation group "We conclude that simulation is a useful alternative to the training in the OR, and is not limited by time factors and OR schedule," said Dr. Weber [9].

## Adopted transfusion protocol might make sense in lung transplant patients

"In lung surgery, we are not sure how to solve the transfusion dilemma: perioperative anaemia is an independent risk factor for adverse outcomes after cardiovascular surgery, but restrictive RBC transfusion is recommended to minimise risk associated with exposure to allogeneic blood," said Dr. Johannes Menger (Table 1).

In the literature, one trial found no association between RBC transfusion (first 24 hours) and mortality in 308 patients undergoing lung transplantation [10]. This result is in contrast to cardiothoracic surgery in general. "To assess a possible association, we did a retrospective cohort study in lung transplant patients," said Dr. Menger. All lung transplant patients between January 2009 and July 2015 were included in the study. Haemoglobin levels immediately after surgery at arrival on the ICU were assessed and patients were stratified into two groups according to mean and median haemoglobin values. Primary endpoint of this study was all-cause mortality during the first year after transplantation.

A total iof 719 patients have been transplanted during the study period. Mean haemoglobin level at arrival on the ICU was 11.9 ± 1.5 g/dL and median was 11.9 g/dL. Patients with haemoglobin values of <11.9 g/dL had a significantly worse survival compared to those with haemoglobin levels of >11.9 g/dL.

After one year, the high haemoglobin group had a survival rate of 90%, the low haemoglobin group below 79%, this difference was highly statistically significant.

"An adopted transfusion policy might therefore be required for patients undergoing double lung transplantation in comparison to patients undergoing general cardiothoracic surgery," concluded Dr. Menger [11].

**Table 1 Risks associated with red cell transfusion**

| Risks associated with red cell transfusion |
|---|
| Infection (viruses, bacteria, parasites) |
| Transfusion mediated immunosuppression |
| Allergic and immune transfusion reaction |
| Creation of a chimera |
| Immunomodulation with recurrence in cancer |
| Hyperkalaemia |

## Acute respiratory distress syndrome after cardiac surgery: a rare, but often deadly event

Acute respiratory distress syndrome (ARDS) is a leading cause of hypoxic respiratory failure after cardiac surgery. Development of this syndrome is associated with high mortality. "In our trial, we wanted to assess the incidence, risk factors and mortality of ARDS following cardiac surgery according to the American-European Consensus Conference (AECC) definition (1994)," said Alexander Kogan. In addition, these parameters were compared with the Berlin definition from 2012 [12]. Therefore, prospectively-collected data in the time period between January 2004 and December 2016 were collected and incidence, risk factors and mortality according to the original definition were evaluated. In the period between September 2012 and December 2016 these parameters were compared between the American-European Consensus Conference and Berlin definition of ARDS. Clinical disorders associated with the development of ARDS is direct lung injury (e.g. following aspiration of gastric contents or other causes of chemical pneumonitis), pulmonary contusion or a penetrating lung injury. However, also indirect lung injury e.g. by sepsis or severe trauma with shock, hypoperfusion, but also drug overdose or cardiopulmonary bypass can cause ARDS. In addition, multiple blood product transfusion has been identified as a risk factor for acute lung injury and ARDS (Table 2) [13].

**Table 2 Risk factors for acute respiratory distress syndrome and acute lung injury**

| Risk factors | Univariate analysis | | | Multivariate analysis | | |
|---|---|---|---|---|---|---|
| | Odds ratio | 95% CI | P-value | Odds ratio | 95% CI | P-value |
| Previous cardiac surgery | 3.9 | 2.4-5.5 | 0.01 | 4.4 | 3.6-5.2 | 0.01 |
| Complex cardiac surgery | 2.3 | 1.5-3.1 | 0.01 | 10.8 | 7.1-20.7 | 0.01 |
| More than 3 transfusions of packed red blood cells | 2.7 | 1.6-4 | 0.001 | 2.9 | 1.4-4.3 | 0.05 |
| Sepsis | 2.5 | 1.6-3.3 | 0.03 | 3.2 | 1.5-4.9 | 0.05 |

During the study period, 9,405 patients underwent cardiac surgery. From the total 111 (1.18%) developed ARDS/ALI (acute lung injury) according to the AECC definition, and 39 (35.1%) died. Of the 3,346 patients who underwent cardiac surgery between September 2012 and December 2016, 37 patients developed ARDS: 1.11% according to the AECC definition, and 1.17% according to the Berlin definition, with a mortality of 32.4% and 30.8% respectively (12 patients). "Our data shows good accordance between the Berlin score versus the old definition," said Kogan. In addition, the risk factors that were identified were similar for the patients who developed ARDS according to both the AECC and the Berlin definitions. Incidence of ARDS varied from 0.17% to 9.4% and mortality from 10% to 91.6%.

This data shows that development of ARDS in patients after cardiac surgery is a rare, but serious complication was associated with significant mortality. "We found four risk factors, namely previous cardiac surgery, complex cardiac surgery, sepsis and transfusions of >3 packed RBC that were significant independent predictors for developing ARDS," said Kogan. However, incidence, mortality and risk factors were very similar according to the AECC and Berlin definition. We do not need measurement of wedge pressure for an ARDS diagnosis and these are good news [14].

## No benefit of sevoflurane versus total intravenous anaesthesia

A meta-analysis published 10 years ago showed that both desflurane and sevoflurane can reduce postoperative mortality and incidence of MI following cardiac surgery. Presumably, due to their cardioprotective effect with significant advantages in terms of reduced postoperative cardiac troponin release, the need for inotropic support, time on mechanical ventilation, ICU and overall hospital stay [15]. But are inhalational anaesthetics really superior or cardioprotective? To test this, a cohort study involving data from 17,771 patients of the West Denmark Heart Registry was performed. Participants underwent surgery procedures from 2007-2015. Patients who got total intravenous anaesthesia (TIVA; n=7,796) were compared with those who got sevoflurane (n=9,975). Patient´s and procedure´s characteristics were described primarily by EuroSCORE indices. Each TIVA patient was matched with a sevoflurane patient with the nearest propensity score. Of all TIVA patients 6,800 (87.2%) were matched. Short-term outcomes were the 30-days mortality, in-hospital MI, creatine kinase-MB level, stroke and new dialysis. Long-term outcomes consisted of 6-month mortality and new ischaemic event (CAG, PCI, re-do CABG).

In the analysis of crude data, there was a clear advantage of sevoflurane versus TIVA on 6 month survival. However, in the matched results, there were no significant differences between TIVA and volatiles, not even in subgroups. "Although I am disappointed by this outcome, we could detect no difference between the volatile and TIVA group, not even in the subgroup of patients with acute coronary syndrome," concluded Dr. Peter Blom Jensen [16].

**References**


1. Adams P, et al. Frailty as a predictor of morbidity and mortality in inpatient head and neck surgery. JAMA Otolaryngol Head Neck Surg, 2013, 139, 783-789.
2. Stortecky S, et al. Evaluation of multidimensional geriatric assessment as a predictor of mortality and cardiovascular events after transcatheter aortic valve implantation. JACC Cardiovasc Interv, 2012, 5, 489-489.
3. Sundermann S et al. Comprehensive assessment of frailty for elderly high-risk patients undergoing cardiac surgery. Eur J Cardiothorac Surg, 2011, 39, 33-37.
4. Shulman MA, et al. Measurement of disabilty-free survival after surgery. Anaesthesiology, 2015, 122, 524-536.
5. De Carvalho JL, et al. Pre-operative frailty scores as markers in predicting disability-free survival in cardiac surgical patients - a pilot study. EACTA 2017 Abstract Nr. OP 59.
6. Lassnigg A, et al. Minimal changes of serum creatinine predict prognosis in patients after cardiothoracic surgery: a prospective cohort study. J Am Soc Nephrol, 2004, 15, 1597-1605.
7. Bernardi MH. Impact of preoperative serum creatinine on short- and long-term mortality after cardiac surgery: a cohort study. Br J Anaesth, 2015, 114, 53-62.
8. Bernardi M, et al. Changes of serum creatinine in the early postoperative period and prognosis prediction of patients after cardiac surgery. EACTA 2017 Abstract Nr. OP50.
9. Weber U, et al. Evaluation of simulator training on transoesophageal echocardiography performance in anaesthesia resident. Abstract EACTA 2017 Nr. OP53.
10. Ong LP, et al. Allogeneic blood transfusion in bilateral lung transplantation: impact on early function and mortality. Eur J Cardiothorac Surg, 2016, 49, 668-674.
11. Menger J. Intraoperative red blood cell transfusion trigger in lung transplantation: the higher the better? Abstract EACTA 2017 Nr. OP 55.
12. Ranieri VM, et al. Acute respiratory distress syndrome: the Berlin Definition. JAMA, 2012 307, 2526-2533.
13. Sachs UJ. Pathophysiology of TRALI current concepts. Intensive Care Med. 2007, 33, 3-11.
14. Kogan A, et al. Incidence of ARDS following cardiac surgery: comparison between American-European Consensus Conference Definition and Berlin Definition. EACTA 2017. Abstract Nr. OP58.
15. Landoni G, et al. Desflurane and sevoflurane in cardiac surgery: a meta-analysis of randomized clinical trials. Cardiothorac Vasc Anesth, 2007, 21, 502-511.
16. Jensen Pb, et al. The preconditioning properties of seveflurane seems not superior to TIVA - a cohort study of 17.771 patients. EACTA 2017 OP 62.