Perioperative management for patient with low ejection fraction

Prof Dr med D. Bettex

University Hospital Zurich

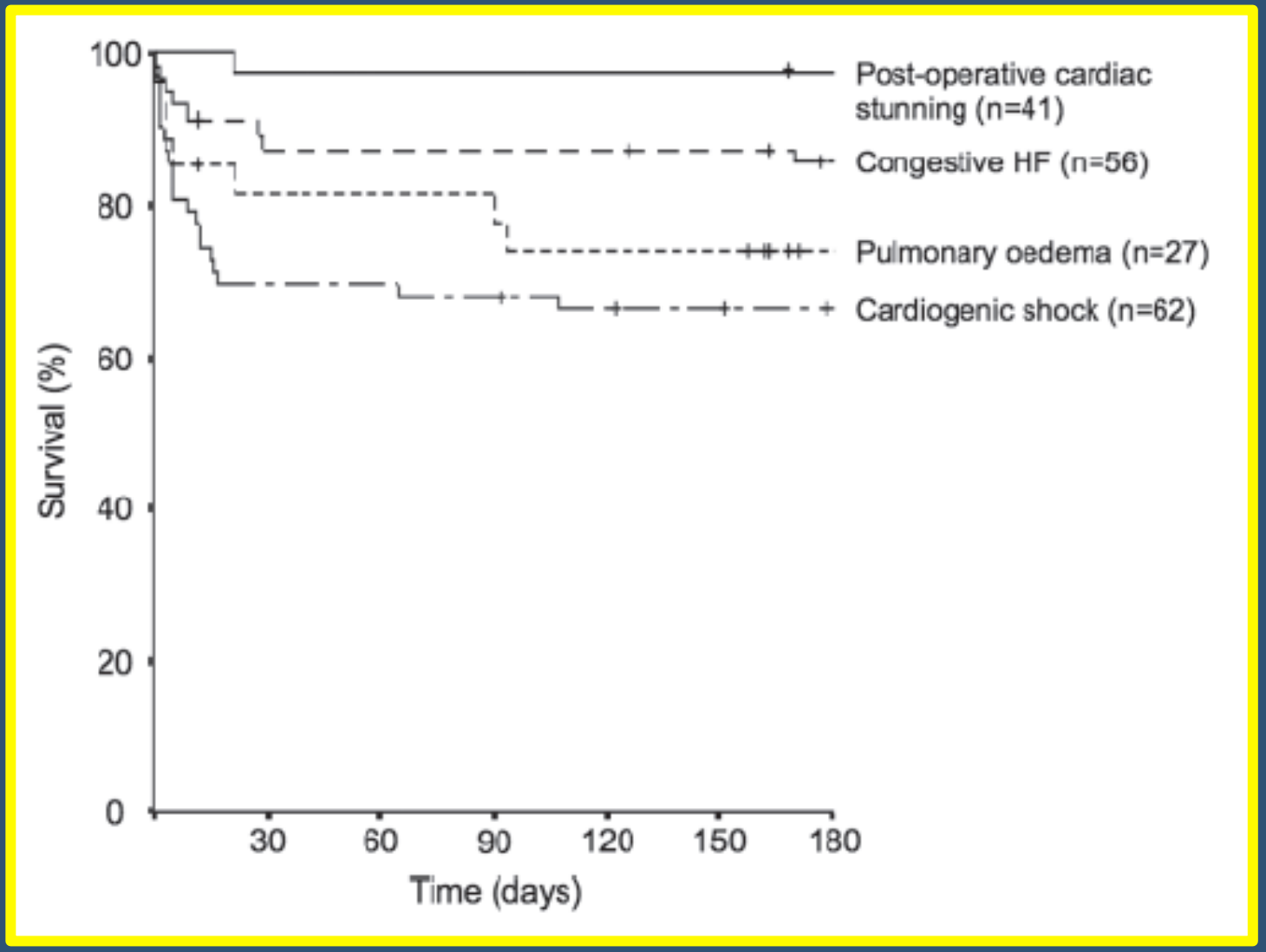
UniversityHospital Zurich

INTRODUCTION

- EF < 30% most important determinant of outcome after isolated CABG
- More than 20% of cardio-surgical patients have acute cardiovascular dysfunction in the postoperative period
- Transient postoperative stunning in 45% of elective patients
- Cardiogenic shock in 2 to 6% of cardiosurgical procedures
- RV failure present in 40% of postop cardiogenic shock, bound with increased mortality

(Biancari F, et al. AJC 2014;113:275-8
Mebazaa A, et al. CC 2010;14:201:1-14
Denault AY, et al. Current Opin Anaesthesiol 2013;26:71-81
Davila-Roman VG, et al. ATS 1995;60:1081-86))

SURVIVAL RATE OF ICU PATIENTS



(Mebazaa A, et al. CC 2010;14:201)

RISK STRATIFICATION

- Major perioperative clinical risks
  - Unstable coronary syndromes
  - Decompensated HF
  - Significant arrhythmias
  - Severe valvular disease
  - Preexisting LV dysfunction
- Euroscore: overestimates mortality in >80yo
- B-type natriuretic peptides

(Mebazaa A, et al. CC 2010;14:201
Harjola VP, et al. Eur J Heart Fail 2016;18:226-41)

Predictors of Low Cardiac Output Syndrome After Isolated Coronary Artery Bypass Grafting

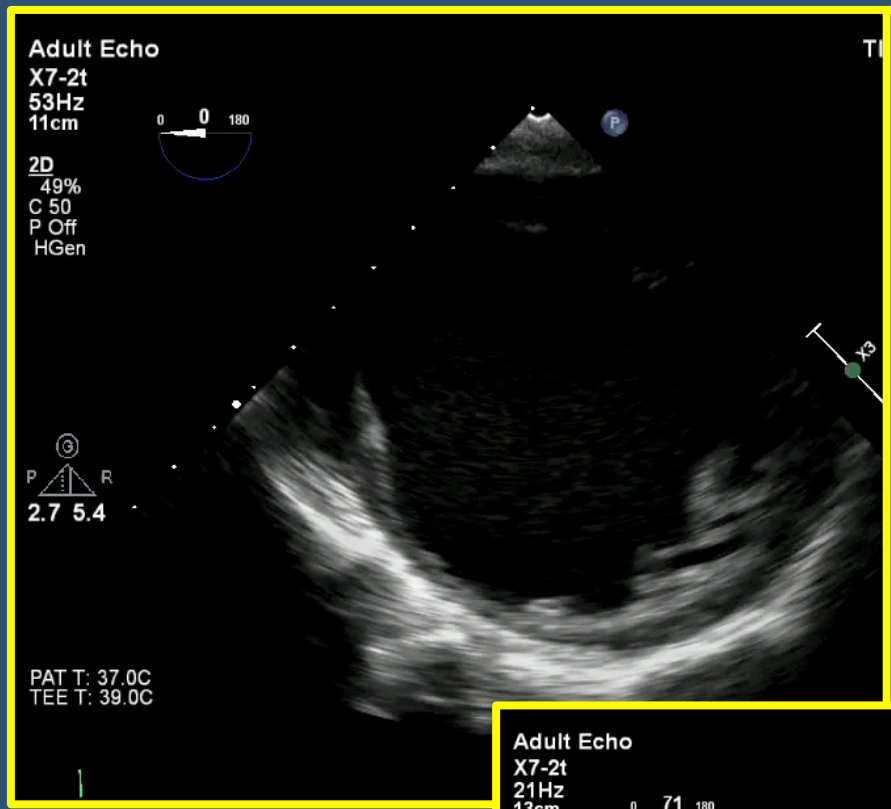
WenJun DING,[1*] MD, Qiang JI,[2*] MD, YunQing SHI,[1] MD, *and* RunHua MA,[1] MD

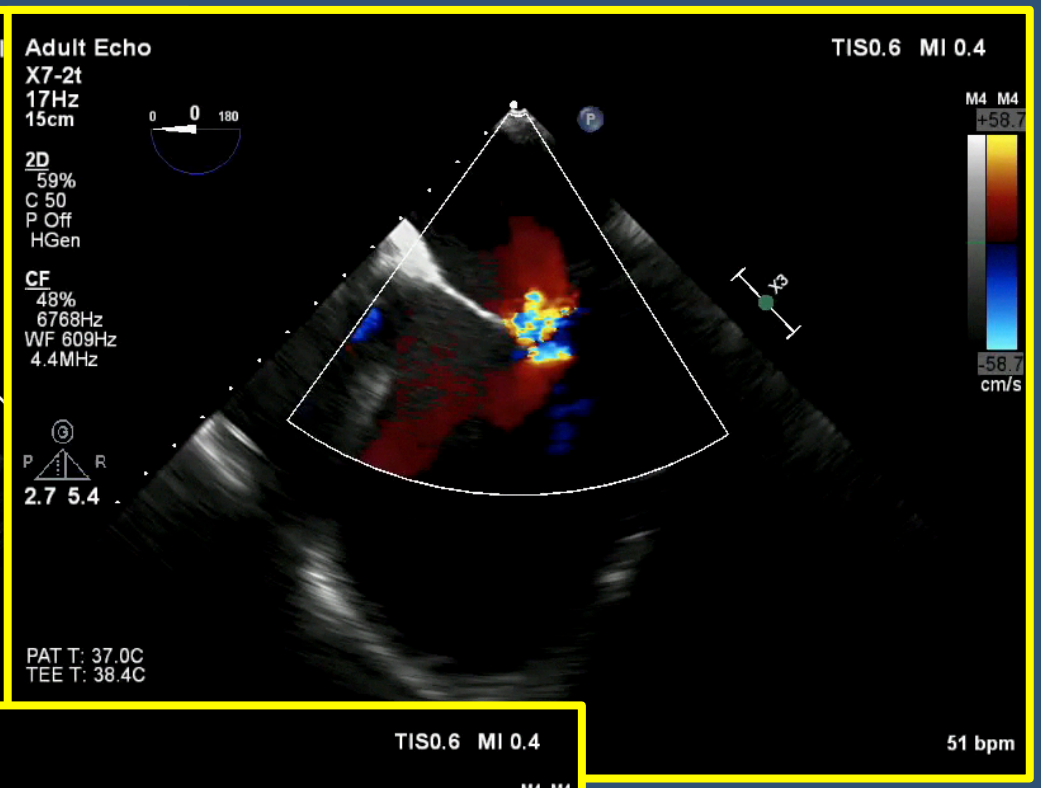
(Int Heart J 2015; 56: 144-149)

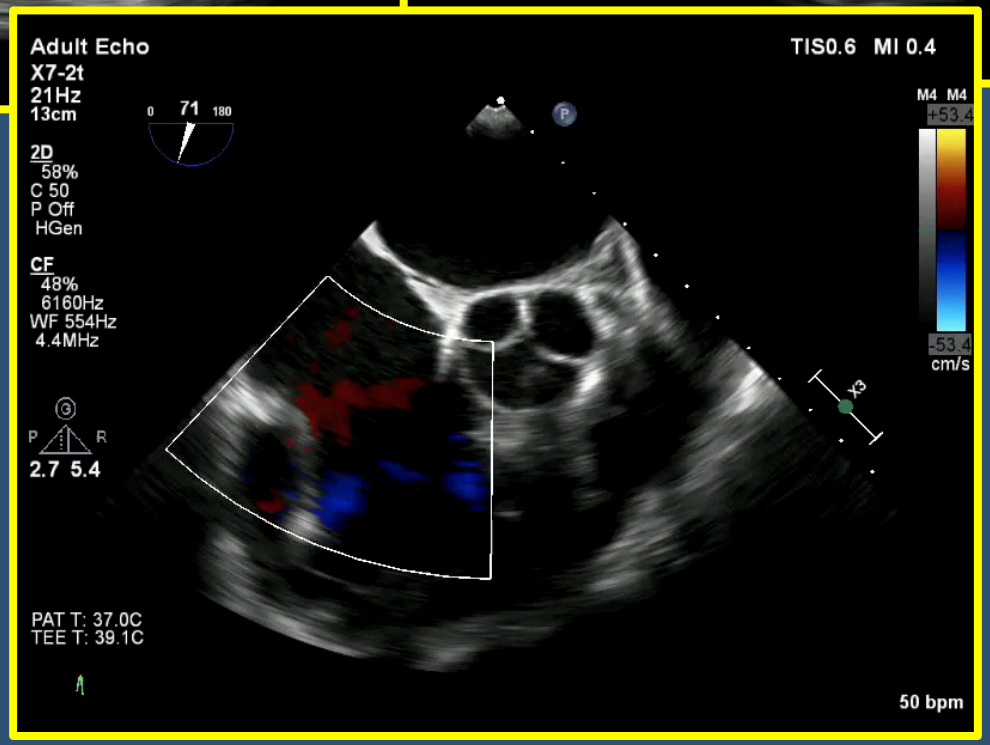
- 1524 consecutive isolated CABG 2010 to 2013
- OPCAB 72.5%
- LCOS 13.5% with a mortality of 25.4% (vs 1.8%)
- Correlation with longer ICU- and hospital-LOS, negative cerebral, respiratory and renal outcomes
- Risk factors: older age (>65yo), impaired LV function (EF<50%), on-pump CABG, emergent CPB, incomplete revascularisation

44 YO MAN

- Dilatative cardiomyopathy
  - Severe left ventricular dilatation
  - EF 16% to 24%
  - Moderate to severe secondary mitral and tricuspid regurgitation
  - PHT: >50mmHg
  - Under evaluation for transplantation


Adult Echo
X7-2t
53Hz
11cm
2D
49%
C 50
P Off
HGen
2.7 5.4
PAT T: 37.0C
TEE T: 39.0C


Adult Echo
TIS0.6 MI 0.4
X7-2t
17Hz
15cm
2D
59%
C 50
P Off
HGen
CF
48%
6768Hz
WF 609Hz
4.4MHz
M4 M4
+58.7
-58.7
cm/s
2.7 5.4
PAT T: 37.0C
TEE T: 38.4C
51 bpm


Adult Echo
TIS0.6 MI 0.4
X7-2t
21Hz
13cm
2D
58%
C 50
P Off
HGen
CF
48%
6160Hz
WF 554Hz
4.4MHz
M4 M4
+53.4
-53.4
cm/s
2.7 5.4
PAT T: 37.0C
TEE T: 39.1C
50 bpm

44 YO MAN

- Arrhythmogenic cardiomyopathy
  - ICD implantation for 3 months
  - Several episodes of inconsciousness and repetitive inefficient ICD-shocks
  - Therapy with cordarone, then sotalol
  - Electrical storm -> emergent admission
  - Acute on chronic renal insufficiency (GFR 46 ml/min, Creat 158 μM/L)
  - RF: HTA, positive FHx, Nicotine (20py)

44 YO MAN

- BP: 90/50, SaO2 94%, SvO2 48%, CI 1.5l/ $m^{2,}$,PAD 28mmHg
- NT-BNP 1831ng/l, lactate 2.4mM/l
- Coronarography: Severe 3 vessels disease
- Myocardial viability in CX territory and infero-apical
- Indication for urgent CABG surgery
- Euroscore: 15.9%

PERIOPERATIVE HF PREVENTION

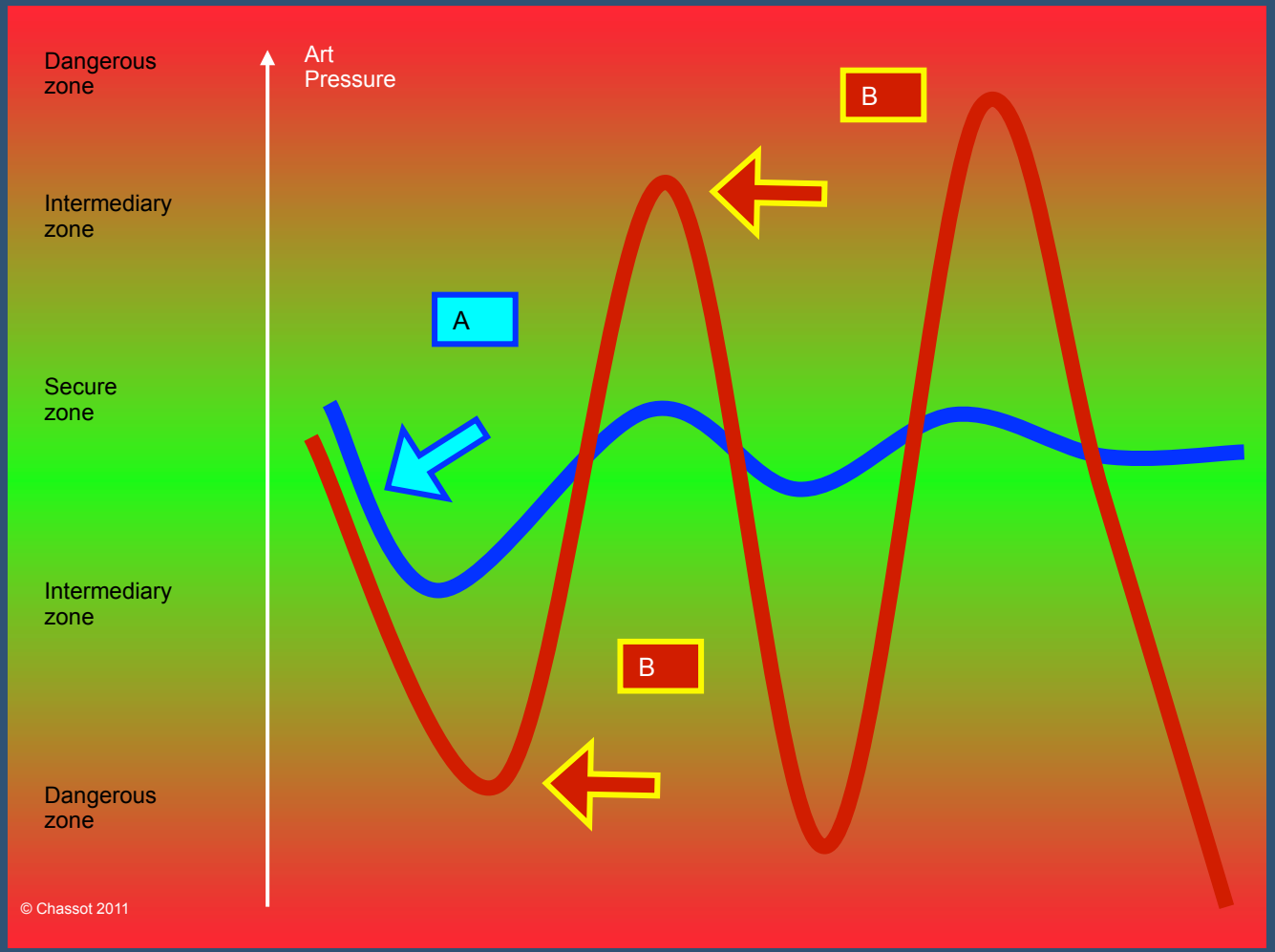
- Identification of high-risk patient
- Prevention of worsening of LV function
  - Avoid drug-induced myocardial depression
  - Optimize LV preload and contractility
  - Reduce afterload
  - Avoid tachy- brady-arrhythmias

(Srivastava D, et al. Aneth Res Pract 2014;2014)

PERIOPERATIVE HF PREVENTION

- Prevent hypoperfusion of major organs
- Avoid liver- and nephrotoxic drugs
- Avoid overdose of agents

HAEMODYNAMIC CORRECTIONS



PERIOPERATIVE HF PREVENTION

- Prevent hypoperfusion of major organs
- Avoid liver- and nephrotoxic drugs
- Avoid overdose of agents
- Use preconditioning substances (Levo, Sevo)

Acta Anaesthesiol Scand 2011; **55**: 259–266
Printed in Singapore. All rights reserved

ACTA ANAESTHESIOLOGICA SCANDINAVICA
doi: 10.1111/j.1399-6576.2010.02381.x

Review Article

Mortality reduction in cardiac anesthesia and intensive care: results of the first International Consensus Conference

G. LANDONI[1], J. G. AUGOUSTIDES[2], F. GUARRACINO[3], F. SANTINI[4], M. PONSCHAB[5], D. PASERO[6], R. N. RODSETH[7,8], G. BIONDI-ZOCCAI[9], G. SILVAY[10], L. SALVI[11], E. CAMPORESI[12], M. COMIS[13], M. CONTE[14], S. BEVILACQUA[15], L. CABRINI[1], C. CARIELLO[3], F. CARAMELLI[16], V. DE SANTIS[17], P. DEL SARTO[18], D. DINI[15], A. FORTI[19], N. GALDIERI[20], G. GIORDANO[21], L. GOTTIN[22], M. GRECO[1], E. MAGLIONI[23], L. MANTOVANI[24], A. MANZATO[25], M. MELI[21], G. PATERNOSTER[26], D. PITTARELLO[27], K. N. RANA[6], L. RUGGERI[1], V. SALANDIN[19], F. SANGALLI[28], M. ZAMBON[1], M. ZUCCHETTI[29], E. BIGNAMI[1], O. ALFIERI[1] and A. ZANGRILLO[1]

There is no consensus on which drugs/techniques/strategies can affect mortality in the perioperative period of cardiac surgery. With the aim of identifying these measures, and suggesting measures for prioritized future investigation we performed the first International Consensus Conference on this topic. The consensus was a continuous international internet-based process with a final meeting on 28 June 2010 in Milan at the Vita-Salute University. Participants included 340 cardiac anesthesiologists, cardiac surgeons, and cardiologists from 65 countries all over the world. A comprehensive literature review was performed to identify topics that subsequently generated position statements for discussion, voting, and ranking. Of the 17 major topics with a documented mortality effect, seven were subsequently excluded after further evaluation due to concerns about clinical applicability and/or study methodology. The following topics are documented as reducing mortality: administration of insulin, levosimendan, volatile anesthetics, statins, chronic β-blockade, early aspirin therapy, the use of preoperative intra-aortic balloon counterpulsation, and referral to high-volume centers. The following are documented as increasing mortality: administration of aprotinin and aged red blood cell transfusion. These interventions were classified according to the level of evidence and effect on mortality and a position statement was generated. This International Consensus Conference has identified the non-surgical interventions that merit urgent study to achieve further reductions in mortality after cardiac surgery: insulin, intra-aortic balloon counterpulsation, levosimendan, volatile anesthetics, statins, chronic β-blockade, early aspirin therapy, and referral to high-volume centers. The use of aprotinin and aged red blood cells may result in increased mortality.

Accepted for publication 9 December 2010

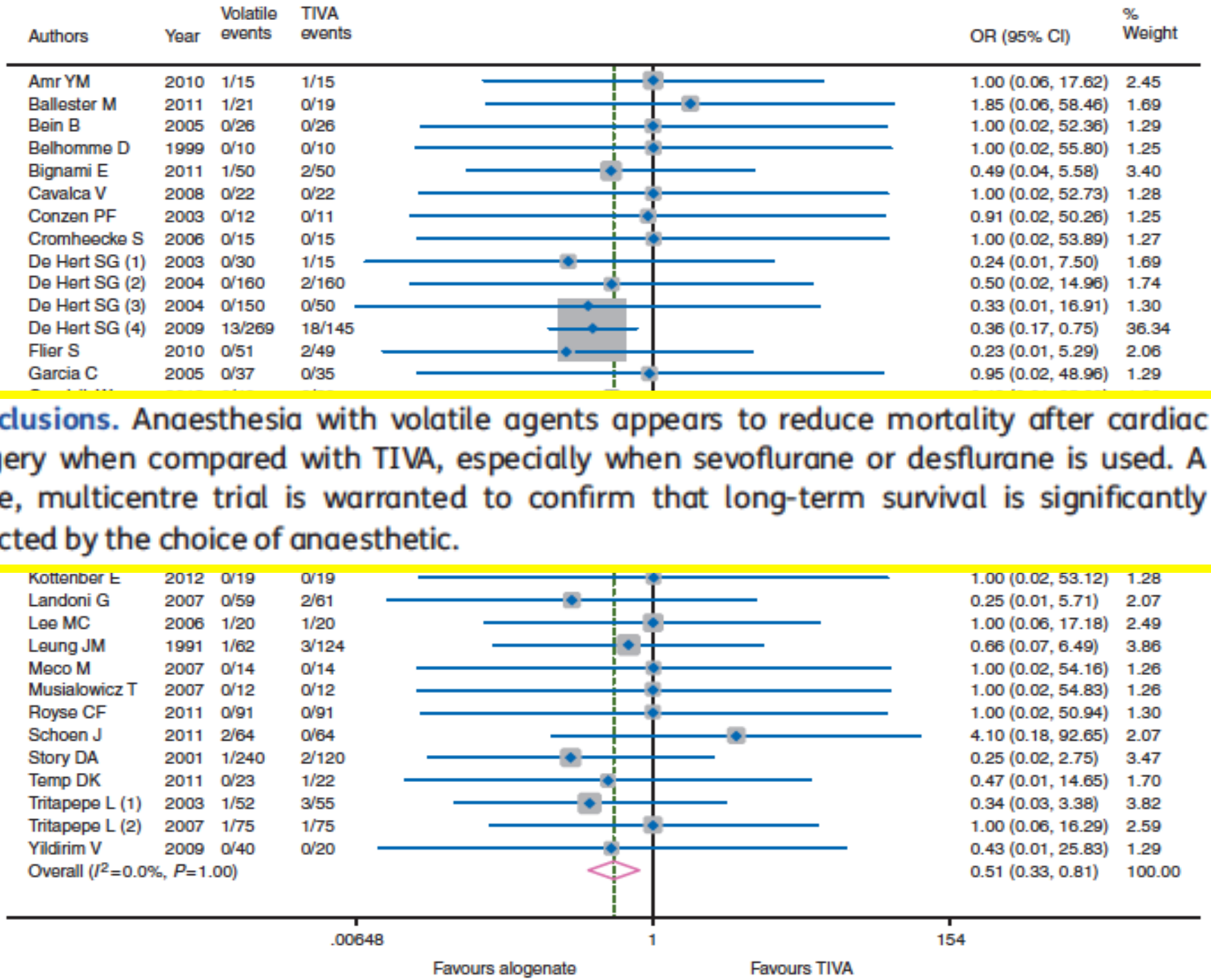
British Journal of Anaesthesia **111** (6): 886–96 (2013)
Advance Access publication 12 July 2013 · doi:10.1093/bja/aet231

BJA

Anaesthetic drugs and survival: a Bayesian network meta-analysis of randomized trials in cardiac surgery

G. Landoni[1*], T. Greco[1], G. Biondi-Zoccai[2], C. Nigro Neto[3,4], D. Febres[1], M. Pintaudi[1], L. Pasin[1], L. Cabrini[1], G. Finco[5] and A. Zangrillo[1]

- 38 randomized studies between 1991 and 2012
- 3996 patients (41% TIVA/59% Volatile)
- 63% ACBP

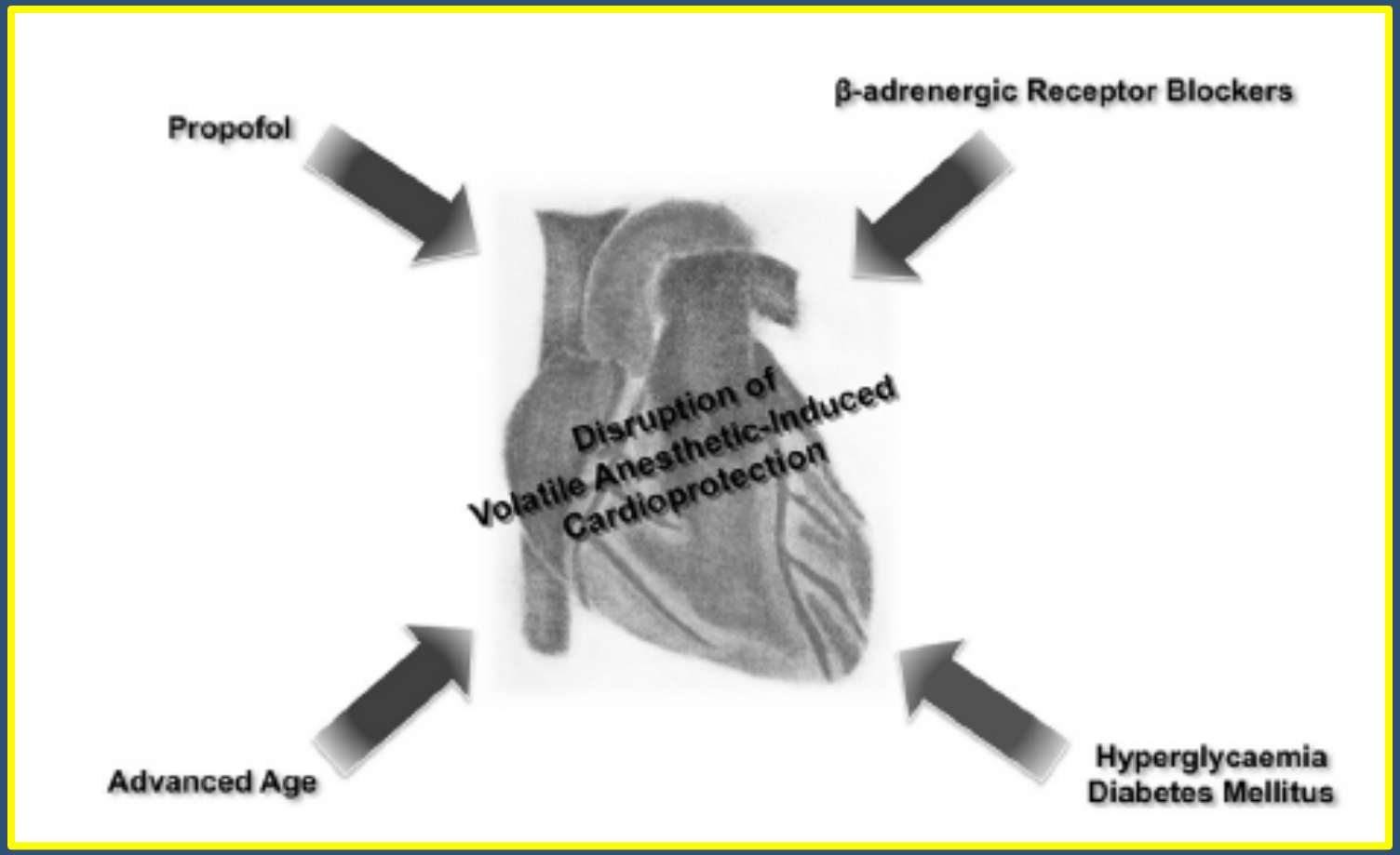


Conclusions. Anaesthesia with volatile agents appears to reduce mortality after cardiac surgery when compared with TIVA, especially when sevoflurane or desflurane is used. A large, multicentre trial is warranted to confirm that long-term survival is significantly affected by the choice of anaesthetic.

Volatile Anesthetic-Induced Cardiac Protection: Molecular Mechanisms, Clinical Aspects, and Interactions With Nonvolatile Agents

Christopher Lotz, MD,* and Franz Kehl, MD, PhD, DEAA†

Journal of Cardiothoracic and Vascular Anesthesia, Vol 29, No 3 (June), 2015: pp 749–760



JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 65, NO. 2, 2015

ISSN 0735-1097/$36.00
PUBLISHED BY ELSEVIER INC. http://dx.doi.org/10.1016/j.jacc.2014.10.031

THE PRESENT AND FUTURE

STATE-OF-THE-ART REVIEW

Remote Ischemic Conditioning

Gerd Heusch, MD,* Hans Erik Bøtker, MD, PhD,† Karin Przyklenk, PhD,‡ Andrew Redington, MD,§ Derek Yellon, PhD, DSc‖

In remote ischemic conditioning (RIC), brief, reversible episodes of ischemia with reperfusion in one vascular bed, tissue, or organ confer a global protective phenotype and render remote tissues and organs resistant to ischemia/reperfusion injury. The peripheral stimulus can be chemical, mechanical, or electrical and involves activation of peripheral sensory nerves. The signal transfer to the heart or other organs is through neuronal and humoral communications. Protection can be transferred, even across species, with plasma-derived dialysate and involves nitric oxide, stromal derived factor-1α, microribonucleic acid-144, but also other, not yet identified factors. Intracardiac signal transduction involves: adenosine, bradykinin, cytokines, and chemokines, which activate specific receptors; intracellular kinases; and mitochondrial function. RIC by repeated brief inflation/deflation of a blood pressure cuff protects against endothelial dysfunction and myocardial injury in percutaneous coronary interventions, coronary artery bypass grafting, and reperfused acute myocardial infarction. RIC is safe and effective, noninvasive, easily feasible, and inexpensive. (J Am Coll Cardiol 2015;65:177–95) © 2015 by the American College of Cardiology Foundation.

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 OCTOBER 8, 2015 VOL. 373 NO. 15

A Multicenter Trial of Remote Ischemic Preconditioning for Heart Surgery

P. Meybohm, B. Bein, O. Brosteanu, J. Cremer, M. Gruenewald, C. Stoppe, M. Coburn, G. Schaelte, A. Böning,

Upper-limb RIPC performed while patients were under propofol-induced anesthesia did not show a relevant benefit among patients undergoing elective cardiac surgery. (Funded by the German Research Foundation; RIPHeart ClinicalTrials.gov number, NCT01067703.)

trial involving adults who were scheduled for elective cardiac surgery requiring cardiopulmonary bypass under total anesthesia with intravenous propofol. The trial compared upper-limb RIPC with a sham intervention. The primary end point was a composite of death, myocardial infarction, stroke, or acute renal failure up to the time of hospital discharge. Secondary end points included the occurrence of any individual component of the primary end point by day 90.

Remote Ischemic Preconditioning and Outcomes of Cardiac Surgery

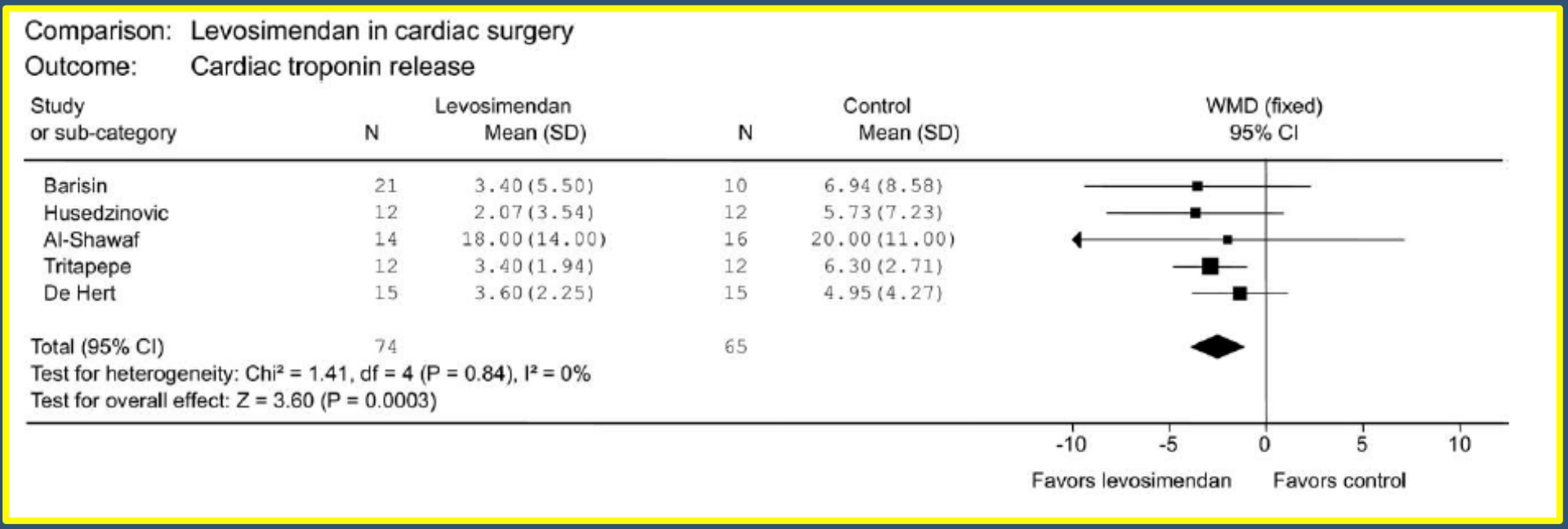
D.J. Hausenloy, L. Candilio, R. Evans, C. Ariti, D.P. Jenkins, S. Kolvekar, R. Knight, G. Kunst, C. Laing, J. Nicholas, J. Pepper, S. Robertson, M. Xenou, T. Clayton, and D.M. Yellon, for the ERICCA Trial Investigators*

(NEJM 374, oct 8, 2015;373:1408-17)

Remote ischemic preconditioning did not improve clinical outcomes in patients undergoing elective on-pump CABG with or without valve surgery. (Funded by the Efficacy and Mechanism Evaluation Program [a Medical Research Council and National Institute of Health Research partnership] and the British Heart Foundation; ERICCA ClinicalTrials.gov number, NCT01247545.)

We conducted a multicenter, sham-controlled trial involving adults at increased surgical risk who were undergoing on-pump CABG (with or without valve surgery) with blood cardioplegia. After anesthesia induction and before surgical incision, patients were randomly assigned to remote ischemic preconditioning (four 5-minute inflations and deflations of a standard blood-pressure cuff on the upper arm) or sham conditioning (control group). Anesthetic management and perioperative care were not standardized. The combined primary end point was death from cardiovascular causes, nonfatal myocardial infarction, coronary revascularization, or stroke, assessed 12 months after randomization.

LEVOSIMENDAN: CARDIOPROTECTION

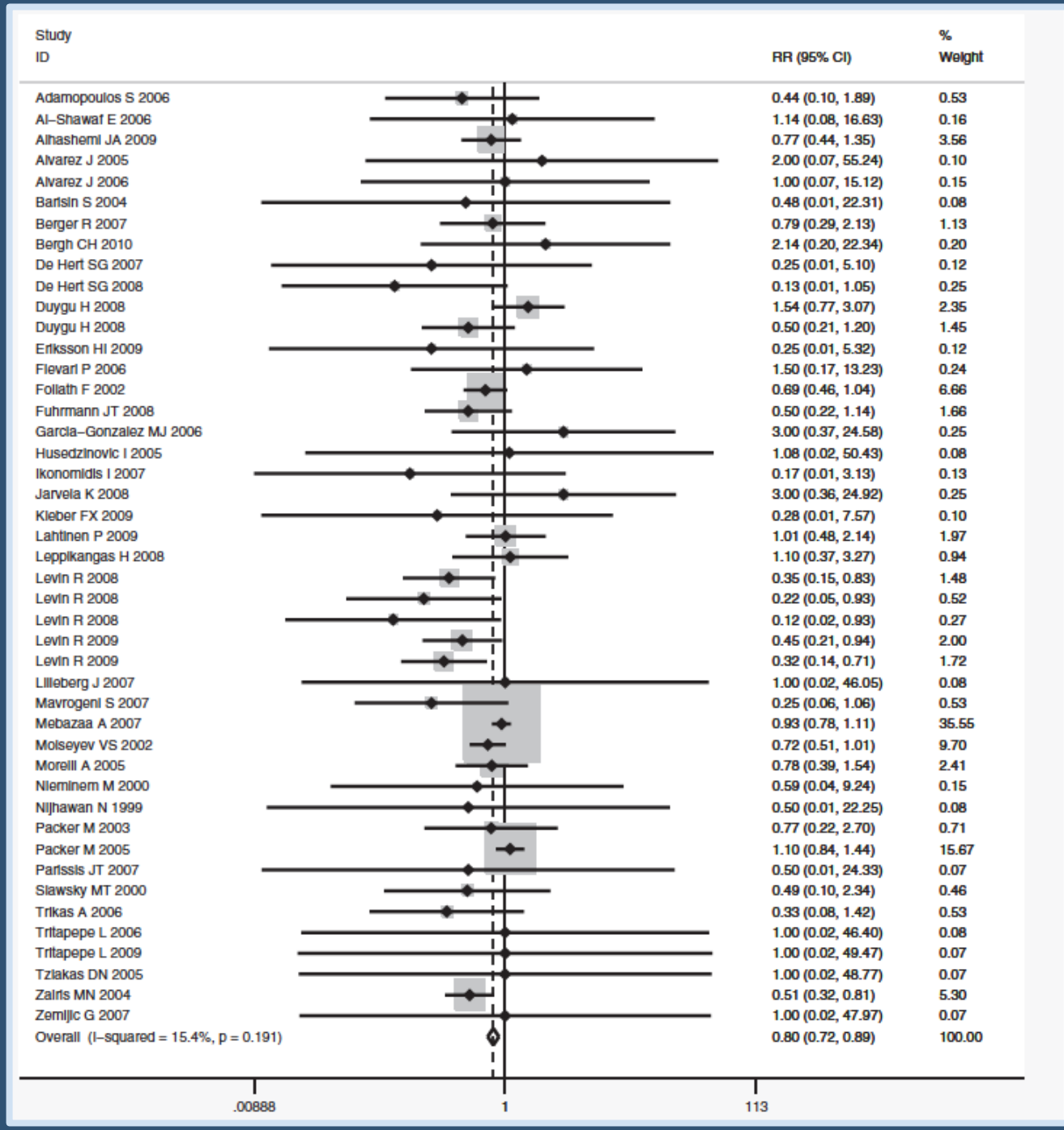


- Cardioprotective effect of levosimendan in cardiac surgery

(Zangrillo A et al. JCTVA 2009;23(4):474-8)

Levo and Mortality

Meta-analysis
5480 patients
45 RCT



(Landoni G, et al. CCM 2012;40:634)

International Journal of Cardiology 184 (2015) 323–336

Contents lists available at ScienceDirect

International Journal of Cardiology

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

Review

Preoperative and perioperative use of levosimendan in cardiac surgery: European expert opinion

W. Toller [a,*], M. Heringlake [b], F. Guarracino [c], L. Algotsson [d], J. Alvarez [e], H. Argyriadou [f], T. Ben-Gal [g], V. Černý [h], B. Cholley [i,j], A. Eremenko [k], J.L. Guerrero-Orriach [l], K. Järvelä [m], N. Karanovic [n], M. Kivikko [o], P. Lahtinen [p], V. Lomivorotov [q], R.H. Mehta [r], Š. Mušič [s], P. Pollesello [o], S. Rex [t], H. Riha [u], A. Rudiger [v], M. Salmenperä [w], L. Szudi [x], L. Tritapepe [y], D. Wyncoll [z], A. Öwall [aa]

- Low preoperative LVEF
- High-risk patients (emergency operation, decompensated heart failure)
- Weaning failure from CPB
- Scheduled for mechanical assist device (IABP/ LVAD)
- Postop LCOS

PERIOP. INDICATIONS FOR LEVOSIMENDAN

Table 1. Main recommendations for the use of levosimendan in patients undergoing cardiac surgery by a panel of 27 European experts

Indications	Preoperative administration in patients with impaired left or right ventricular function
Dosing	0.1 μg/kg/min infusion for 24 h or up to the end of the vial
	An initial bolus dose should be avoided when the drug is administered outside the operating room but can be considered when the infusion is started during or after induction of anesthesia
Timing	The day before surgery can be considered as the best time to start a preoperative infusion of levosimendan
Monitoring	The patient should be under adequate hemodynamic monitoring during the infusion to early detect and promptly treat side-effects such as hypotension
Association with vasopressors or other inotropes	An infusion of norepinephrine or vasopressin should be added if excessive vasodilation and hypotension occur
	Dobutamine is the preferred drug if additional inotropic support is needed

(Pisano A, et al. Curr Anesth 2016, Epub
Toller W. et al. JCTVA 2013;27:361-66)

INTERVENTION

- CABG x 5 under MECC
- Induction: Etomidate-Midazolam-Fentanyl-Rocuronium
- Maintenance: Sevorane-Ultiva
- Levosimendan 0.1mcg/kg/min
- Prophylactic IABP before weaning

INTERVENTION

	Before MECC	After MECC
HR	55/min	80/min
MAP	60	70
CVP	15	15
CI	1.5	2.6
PAD	25	15

ICU

- Adrenalin 5mcg/min, Noradrenalin 8mcg/min
- Extubation 4 hours, IABP weaning 8 hours postoperative
- Hemodynamic stable except for few self-limited episodes of ventricular tachycardia
- Mobilisation at 16 hours
- GFR 94 (2 days postop)
- Transfer to the ward delayed for rhythm monitoring

PERIOPERATIVE MANAGEMENT

- Identification of heart failure and underlying cardiac disease for prompt and aggressive management
- Search for reversible condition: myocardial ischemia, infarction, acute valvular dysfunction, LVOTO, tamponade, intracardial shunt, sepsis
- Golden hours for HF management

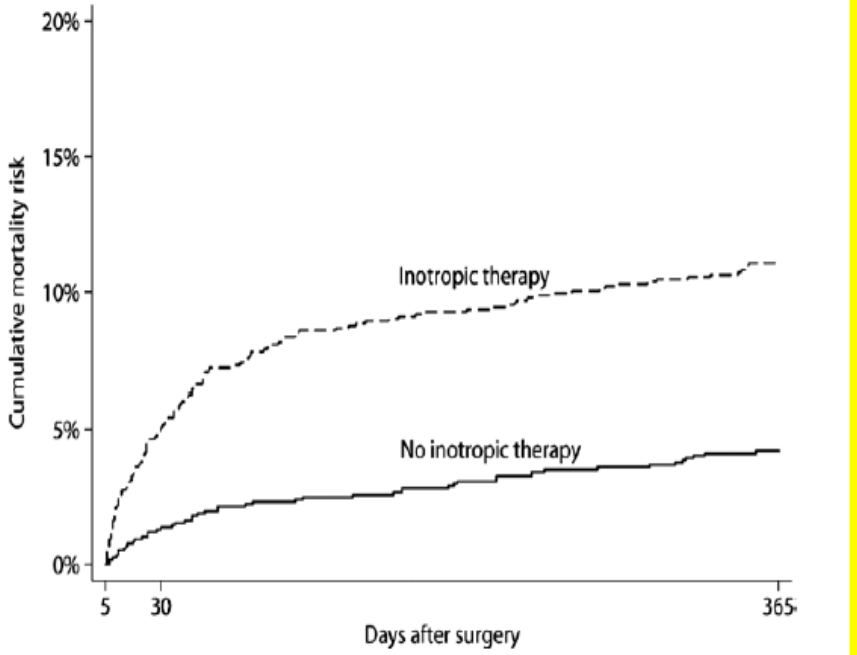
(Hauffe T, et al. Cardiac Failure Review 2015;1(2)
Soussi S, et al. Curr Opin Anaesth 2014;27:140-5
Harjola VP, et al. Eur J Heart Fail 2016;18:226-41
Liang M, et al. J Invasive Cardiol 2011;23:E219-21)

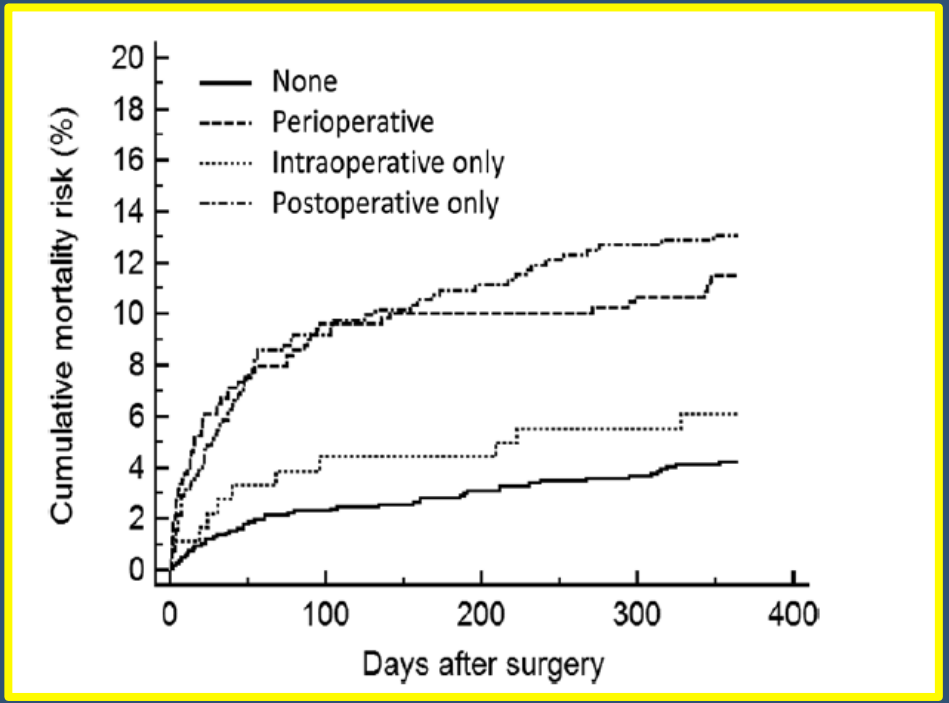
PERIOPERATIVE MANAGEMENT

Mechanical problem (e.g. tamponade, surgical bleeding)	Immediate surgical correction
Optimise preload	1. Start with crystalloid infusion 5–10 ml/kg and continue up to 20 ml/kg 2. Continue with colloid infusion up to 20ml/kg (gelatine if GFR > 35 ml/min or albumin 5 % if GFR < 35 ml/min)
Optimise vascular tone and perfusion pressure	1. NA infusion 0.1-1 µg/kg/min 2. Vasopressin infusion 0.01-0.04 U/min if NA ≥0.5 µg/kg/min 3. Consider methylene blue 1 x 2 mg/kg iv if < 24 hours after cardiac surgery and if NA ≥0.5 µg/kg/min
Optimise myocardial contractility	1. Dobutamine infusion up to 5 µg/kg/min 2. Milrinone infusion 0.01–0.25 µg/kg/min (particularly useful in patients under β-blockers) 3. Adrenaline infusion up to 0.3 µg/kg/min infusion in case of life-threatening shock. 4. Consider ECLS in non-responders to pharmacological inotropic support
Optimise heart rate and rhythm:- Bradycardia – Atrial fibrillation, VES, ventricular tachycardia	Consider external/internal pacing1. Optimise magnesium and potassium levels 2. Amiodaron 2x 150 mg over 30min iv, followed by an infusion of 600-1200 mg/d (total of 0.1g/kg) 3. Synchronised electrical cardioversion (biphasic 2x200 joule)
Optimise oxygen delivery	Deliver oxygen via face-mask (goal SaO_2 92-98 %) Early intubation and mechanical ventilation to reduce oxygen expenditure Haematocrit goal ≥27 % in the acute shock phase
Sepsis/SIRS	SIRS: Hydrocortisone 100 mg loading dose iv, followed by 50 mg qid iv for 5 days, when NA ≥0.3 µg/kg/min Sepsis: Begin empiric antibiotic therapy within one hour after suspicion of septic shock (after sampling for microbiology)

(Hauffe T, et al. Cardiac Failure Review 2015;1(2))

USE OF INOTROPES IN CARDIAC SURGERY





- 20 to 90% to treat or prevent LCOS

(Nielsen DV, et al. Anesthesiology 2014;120:1098-108)

BJA

British Journal of Anaesthesia, 115 (5): 656–75 (2015)

doi: 10.1093/bja/aev284
Review Article

The Effect of inotropes and vasopressors on mortality: a meta-analysis of randomized clinical trials

A. Belletti[1], M. L. Castro[2], S. Silvetti[1], T. Greco[1,3], G. Biondi-Zoccai[4], L. Pasin[1], A. Zangrillo[1,5] and G. Landoni[1,5,*]

- 177 trials published after 1994; 28280 patients
- Levosimendan 27.1%, dopamine13% and milrinone 10.2%
- Setting: cardiac surgery 39.5%, HF 26.5%
- Placebo control 62.7%
- More than 100 patients: 25.9% (46 trials)
- Inotropes and vasopressors have no detrimental effect on survival

PERIOPERATIVE MANAGEMENT

- If HF persists, mechanical assistance should be started as soon as possible
  - IABP: indications have been restricted following IABP-SHOCK II trial
  - ECLS: bridge to decision, to recovery, to LVAD or to HTPL

(Thiele H, et al. NEJM 2012;367:1287-96
Thiele H, et al. Lancet 2013;382:1638-45)

CONCLUSION

- Perioperative management of low EF
  - Assess the risk of heart failure
    - HF results of arrhythmias or inadequate contractility, volume or pressure overload
    - Associated with worse outcome
  - Prevent heart failure
    - Assess and optimize hemodynamic
    - Use preconditioning substances
  - Echocardiography: mainstay in the perioperative assessment
  - Use catecholamines with caution
  - Start mechanical support early if needed

THANK YOU

EJA

Eur J Anaesthesiol 2016; **33:**417–424

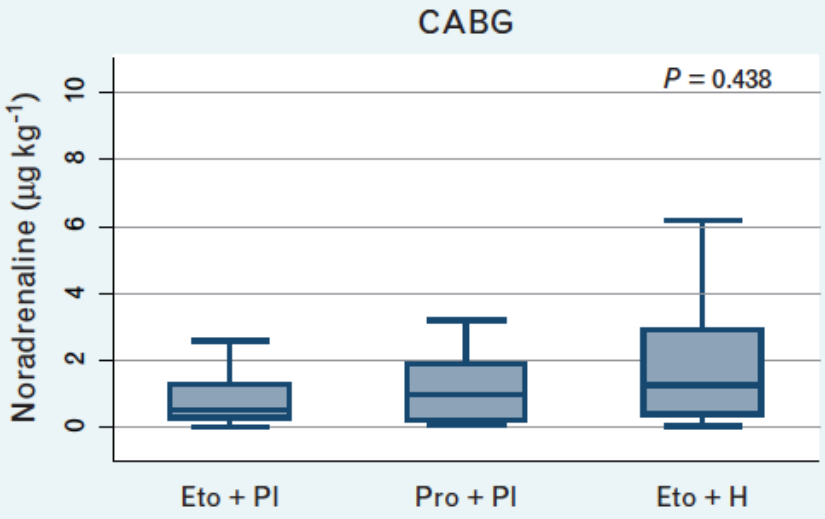
ORIGINAL ARTICLE

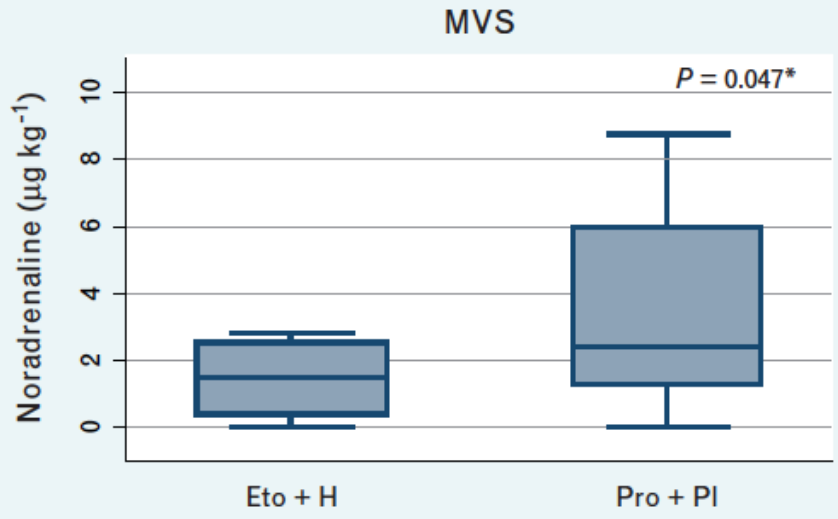
Anaesthetic induction with etomidate in cardiac surgery

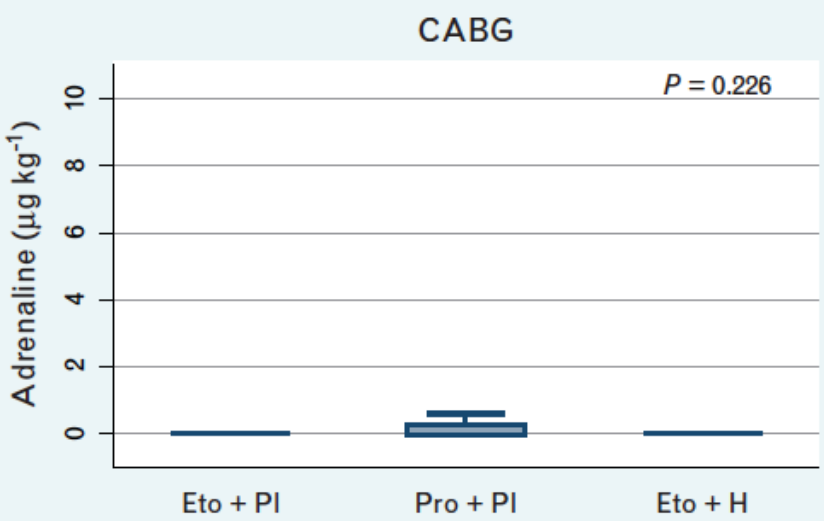
A randomised controlled trial

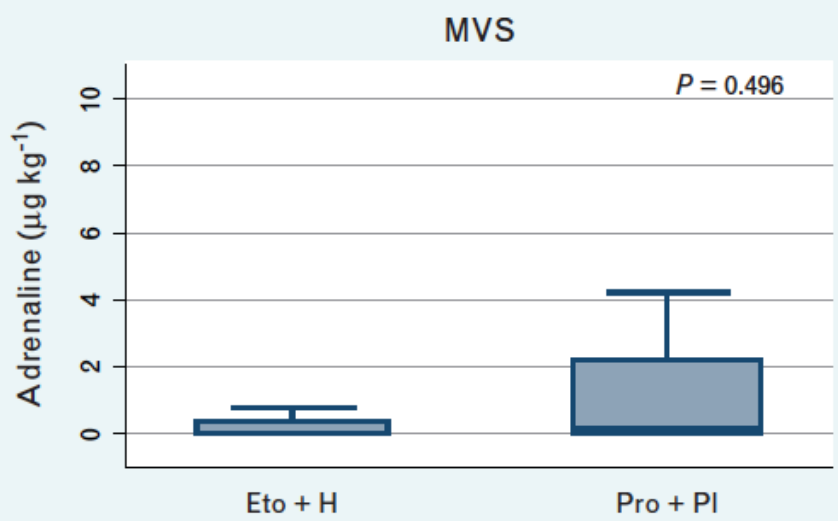
Reto M. Basciani, Antje Rindlisbacher, Esther Begert, Luc Brander, Stephan M. Jakob, Reto Etter, Thierry Carrel and Balthasar Eberle

- 90 CABG, 40 MVSurgery
- Eto 0.15mg/kg with Placebo (30 CABG, 20 MVS) or with Hydrocortisone (30 CABG patients) compared to Propofol with Placebo (30 CABG, 20 MVS)
- Synacthen test day before surgery, at 7 and 24h and day 5 and 6. Cortisol plasmatic 30min before CPB and 30 min after CPB


CABG
P = 0.438
Noradrenaline (µg kg-1)
0
2
4
6
8
10
Eto + PI
Pro + PI
Eto + H


MVS
P = 0.047*
Noradrenaline (µg kg-1)
0
2
4
6
8
10
Eto + H
Pro + PI


CABG
P = 0.226
Adrenaline (µg kg-1)
0
2
4
6
8
10
Eto + PI
Pro + PI
Eto + H


MVS
P = 0.496
Adrenaline (µg kg-1)
0
2
4
6
8
10
Eto + H
Pro + PI

ETOMIDATE

- No significant differences in
  - Cumulative vasopressor requirements
  - Haemodynamics during the first 24h
  - Failure to wean from CPB
  - Time to extubation
  - ICU- and Hospital-LOS
  - Mortality at 30 days
- Suppression of adrenal function in 85% after Etomidate and 36% after Propofol

(Basciani RM et al. EJA 2016;33:417-24)