Intraoperative Hämodynamik - one size fits all?

Barbara Kabon

Universitätsklinik für Anästhesie, Allgemeine Intensivmedizin und Schmerztherapie

10. anästhesie forum elisabethinen linz
12.-13. April 2024, Linz

Conflict of Interest

im Bezug auf Inhalte des folgenden Vortrags

Edwards Lifesciences - Educational grant

Das Bett des Prokrustes

- **One Size Does Not Fit All** -

Plasma Brain Natriuretic Peptide-Guided Therapy to Improve Outcome in Heart Failure

The STARS-BNP Multicenter Study

JACC Vol. 49, No. 16, 2007

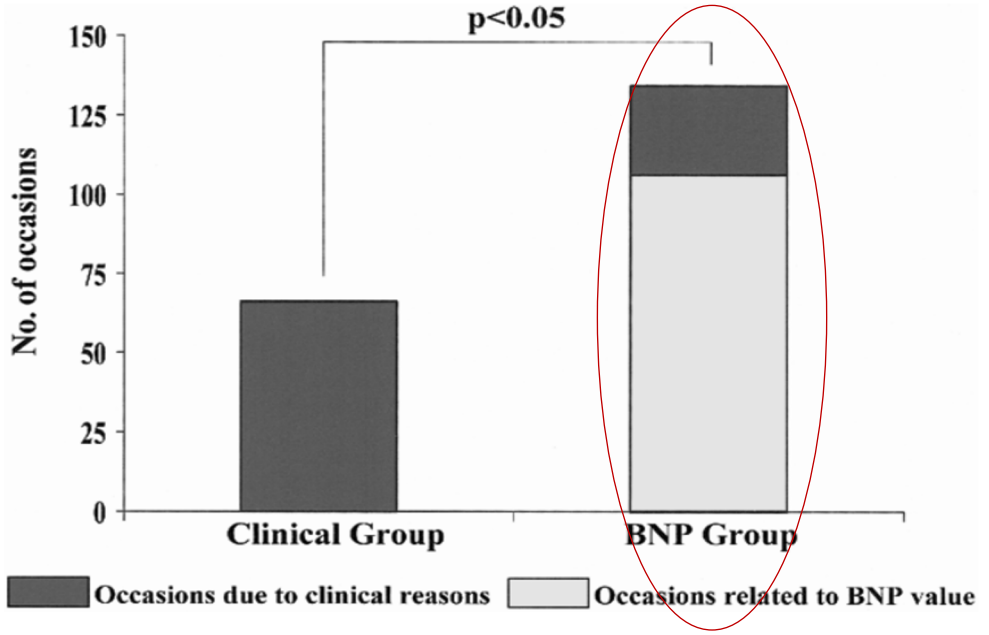
Patrick Jourdain, MD,*†‡ Guillaume Jondeau, MD, PHD,§ François Funck, MD,‡ Pascal Gueffet, MD,‖
Alain Le Helloco, MD,¶ Erwan Donal, MD,¶ Jean F. Aupetit, MD,# Marie C. Aumont, MD,§
Michel Galinier, MD, PHD,** Jean C. Eicher, MD,†† Alain Cohen-Solal, MD, PHD,‡‡
Yves Juillière, MD, PHD§§

Paris, Pontoise, Nantes, Rennes, Lyon, Toulouse, Dijon, and Vandoeuvre Les Nancy, France

- 220 Patient*innen
  - NYHA II-III
  - Aktuelle Guidelines *vs.*
  - Kardialer Biomarker BNP
    - Ziel <100 mcg/mL)
- Primärer Endpunkt

  CHF assoziierte
  - Hospitalisierung ↓
  - Mortalität ↓

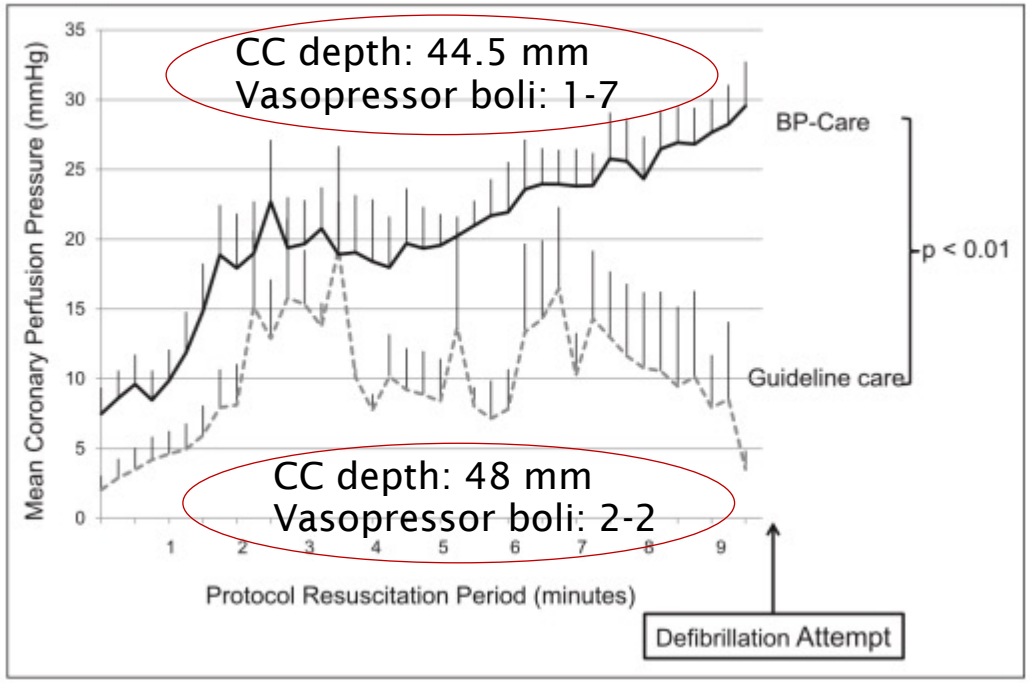
Therapieanpassungen innerhalb der ersten drei Monate



Blood Pressure– and Coronary Perfusion Pressure–Targeted Cardiopulmonary Resuscitation Improves 24-Hour Survival From Ventricular Fibrillation Cardiac Arrest

Maryam Y. Naim, MD[1]; Robert M. Sutton, MD, MSCE[1]; Stuart H. Friess, MD[2]; George Bratinov, MD[1]; Utpal Bhalala, MD[3]; Todd J. Kilbaugh, MD[1]; Joshua W. Lampe, PhD[4]; Vinay M. Nadkarni, MD, MS[1]; Lance B. Becker, MD[4]; Robert A. Berg, MD[1]

Critical Care Medicine November 2016 • Volume 44 • Number 11



Survival, *n* (%)	Guideline Care (*n* = 8)	Blood Pressure Care (*n* = 8)	*p*
45-min ICU survival	0 (0)	7 (88)	0.001
24-hr survival	0 (0)	5 (63)	0.026
Favorable neurologic outcome	0 (0)	5 (63)	0.026

Personalisiertes intraoperatives hämodynamisches Management

- Richtige*r Patient*in
- Richtiger Zeitpunkt
- Richtiger Zielparameter
- Richtige Therapie
- Richtige Dosierung

- Verbesserte patientenbezogene Outcomes
- Minimierung der Nebenwirkungen und Risiken
  - Therapeutische Breite
- Optimale Ressourcenallokation

Potentielle Anwendungsmöglichkeiten

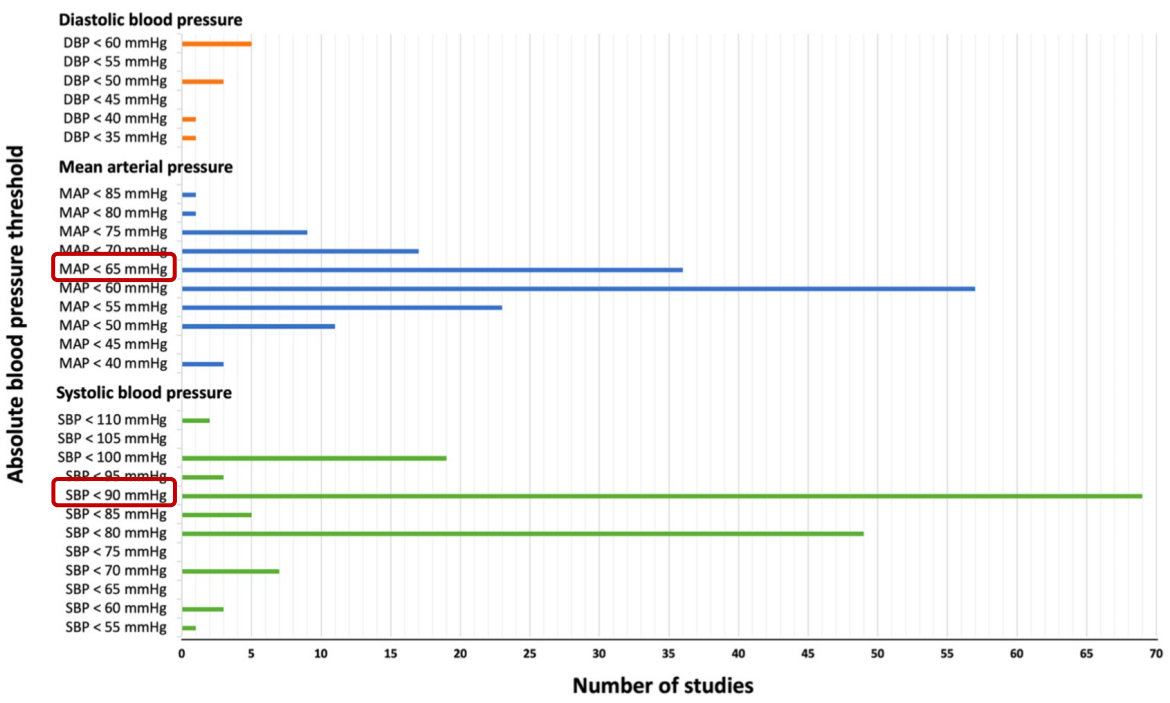
- *Intraoperatives druckgesteuertes Management*
- *Intraoperatives flussgesteuertes Management*
  - Flüssigkeit
  - Vasopressoren
  - Inotropika

Grenzwerte der intraoperative Hypotonie

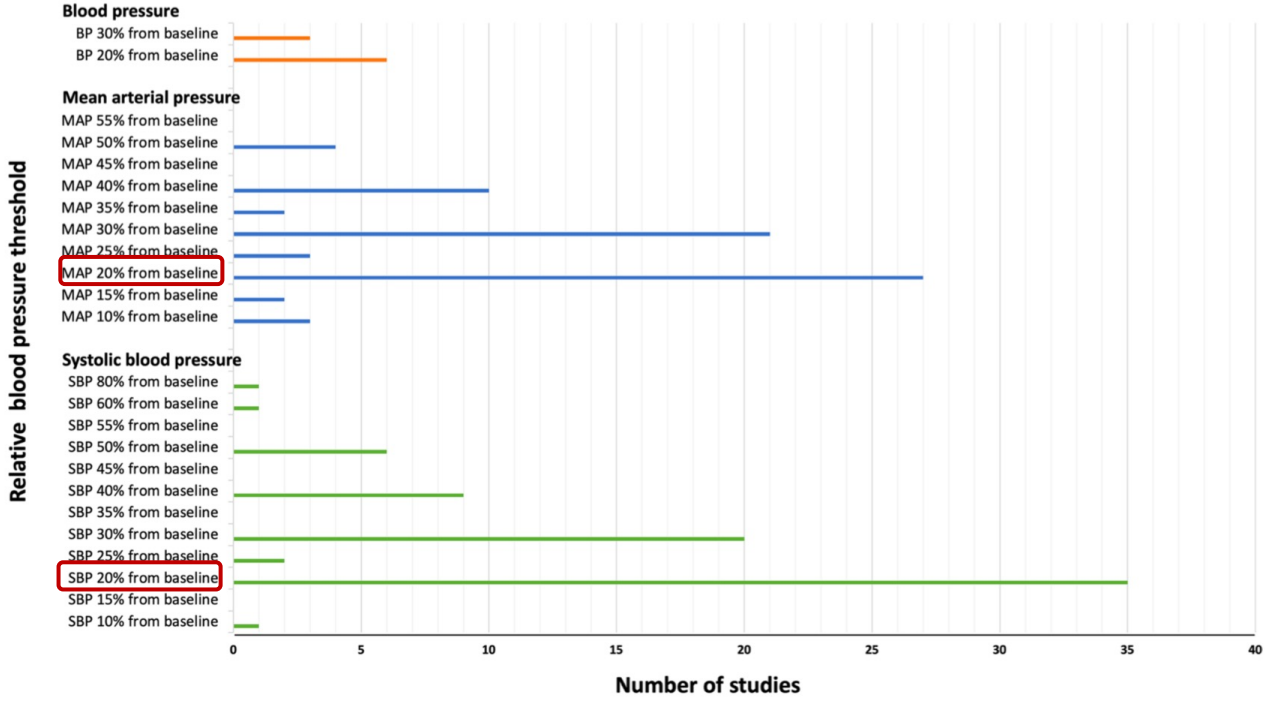
318 Studien (2000-2020)

Nicht – kardiale Eingriffe

Absolute Grenzwerte (n = 249; 78,3%)

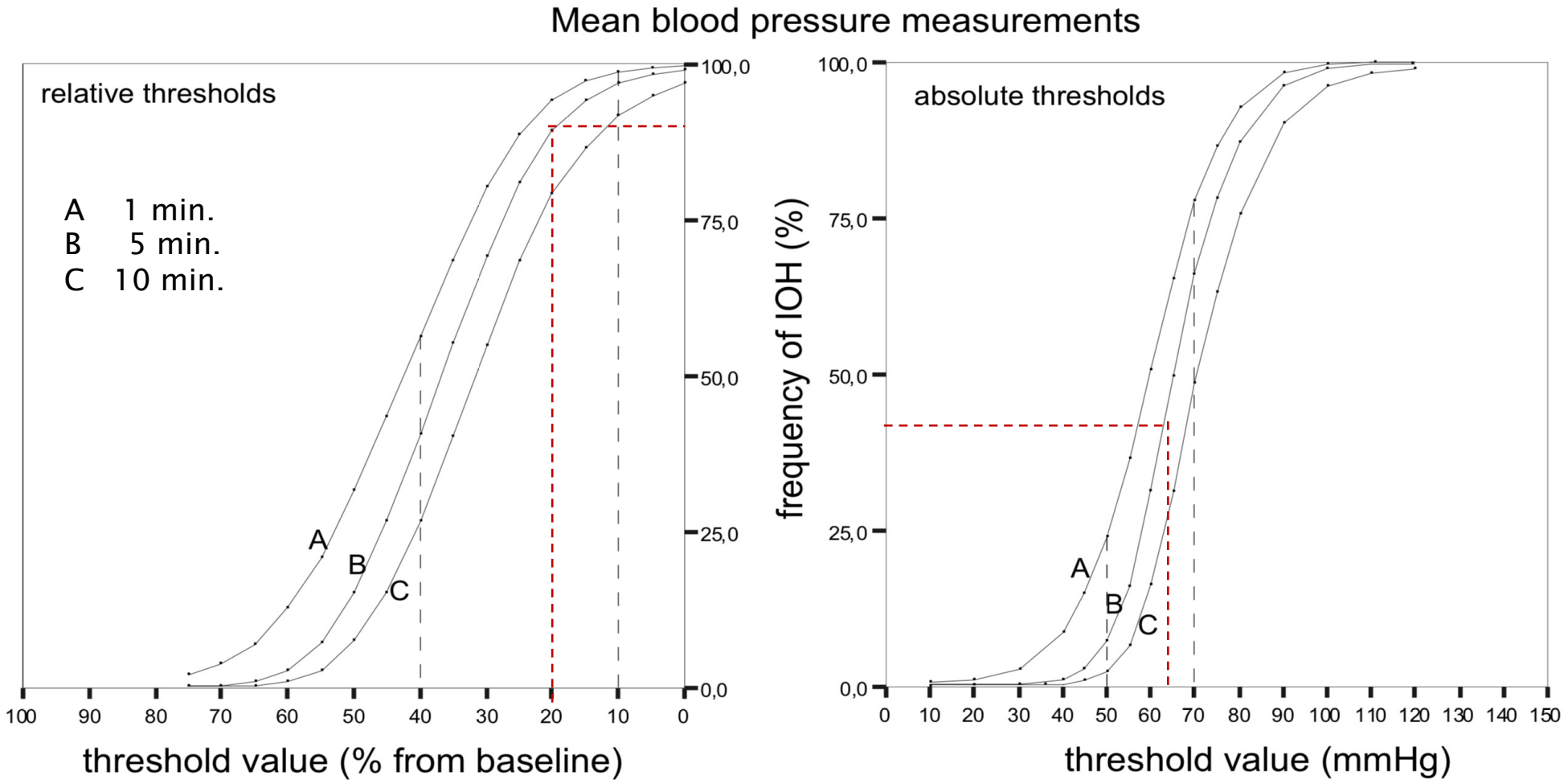


Relative Grenzwerte (n = 126; 36,9%)



Definition and Inzidenz der intraoperative Hypotonie

Konsekutive Kohorte: n = 15,509 (81,5 % Elektive Eingriffe), Universität Utrecht



Bijker JB, Anesthesiology 2007

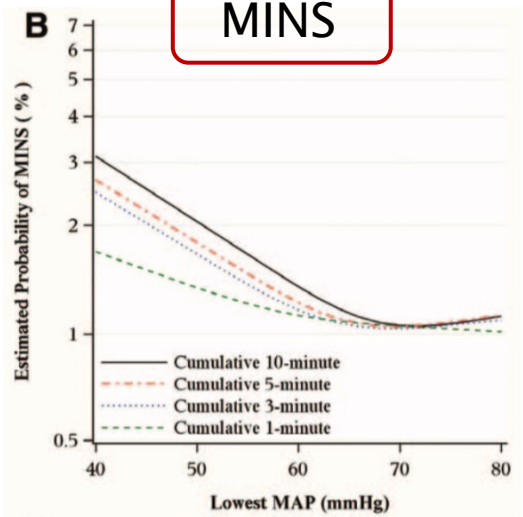
Absolute *versus* relative MAP-Grenzwerte

- Retrospektive Kohorte
- Cleveland Clinic
- 57 315 Patient*innen
- Nicht kardiochirurgische Eingriffe
  - ≥ 60 min.
- MINS, AKI
- Eindeutiger Grenzwert
  - MAP < 65 mmHg
- Absolute Werte relativen Werten nicht unterlegen
- Kumulative Zeit!

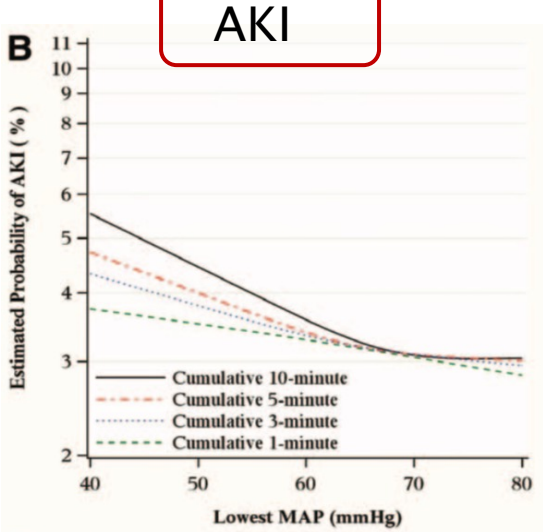
absolut

relativ

MINS



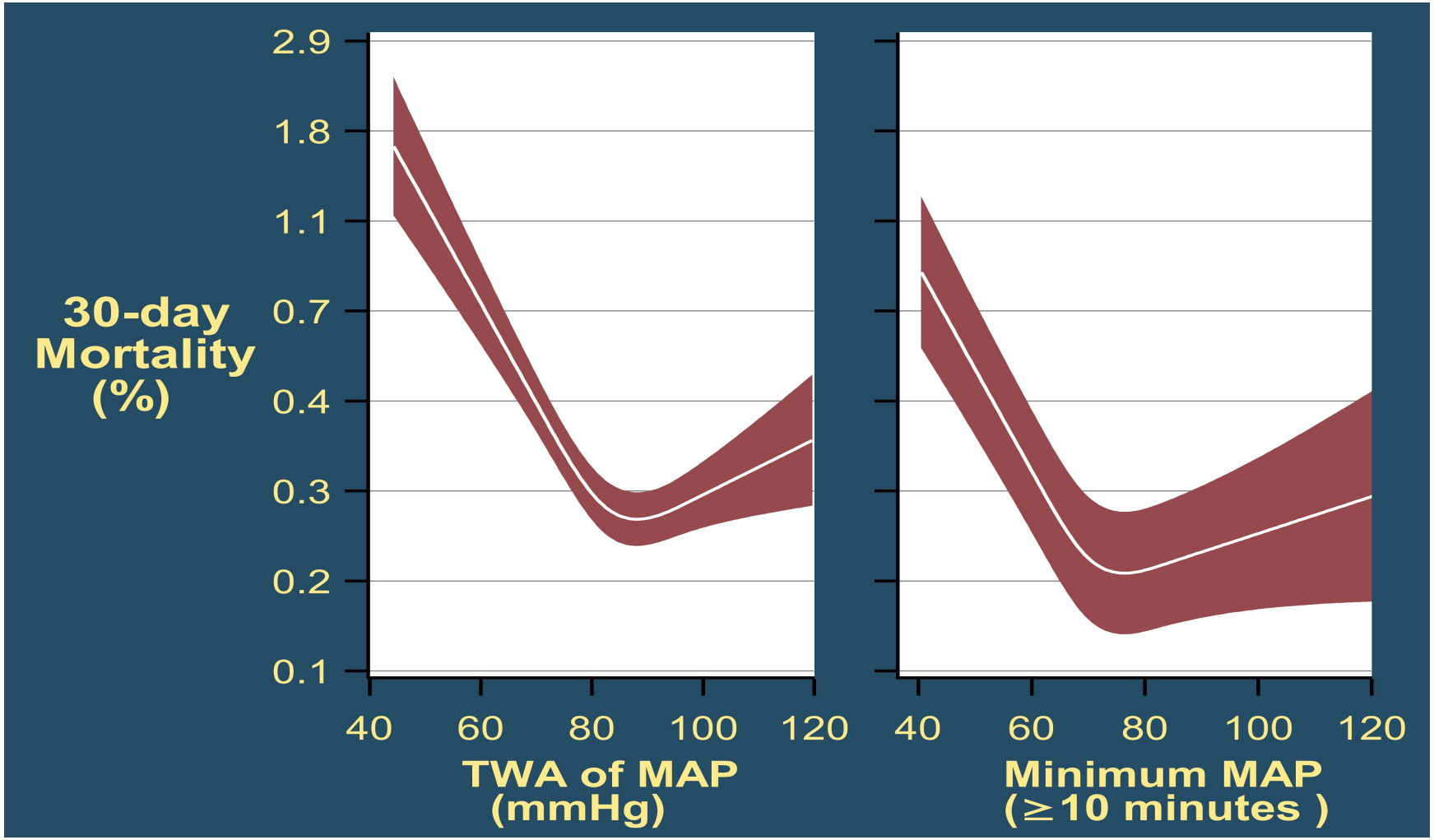
AKI



Salmasi V, Anesthesiology 2017

Assoziation zwischen MAP und 30 d Mortalität

n= 104,401, nicht kardiochirurgische Eingriffe, ≥ 1 h



Mascha EJ, Anesthesiology 2015

Faktor Zeit

Threshold	Total (n = 57,315)	MINS (n = 1,760)	Adjusted OR (98.75% CI)*	*P* Values*
Time under MAP < 65 mmHg				< 0.001
Reference (never < 65 mmHg)	16,230	247 (1.5%)	Ref = 1	
Q1 (1–5 min)	11,714	275 (2.3%)	1.01 (0.80–1.27)	0.93
Q2 (6–12 min)	9,442	270 (2.9%)	1.15 (0.90–1.45)	0.15
Q3 (13–28 min)	9,974	375 (3.8%)	1.34 (1.06–1.68)	0.0015†
Q4 (> 28 min)	9,955	593 (6.0%)	1.60 (1.28–2.01)	< 0.001†

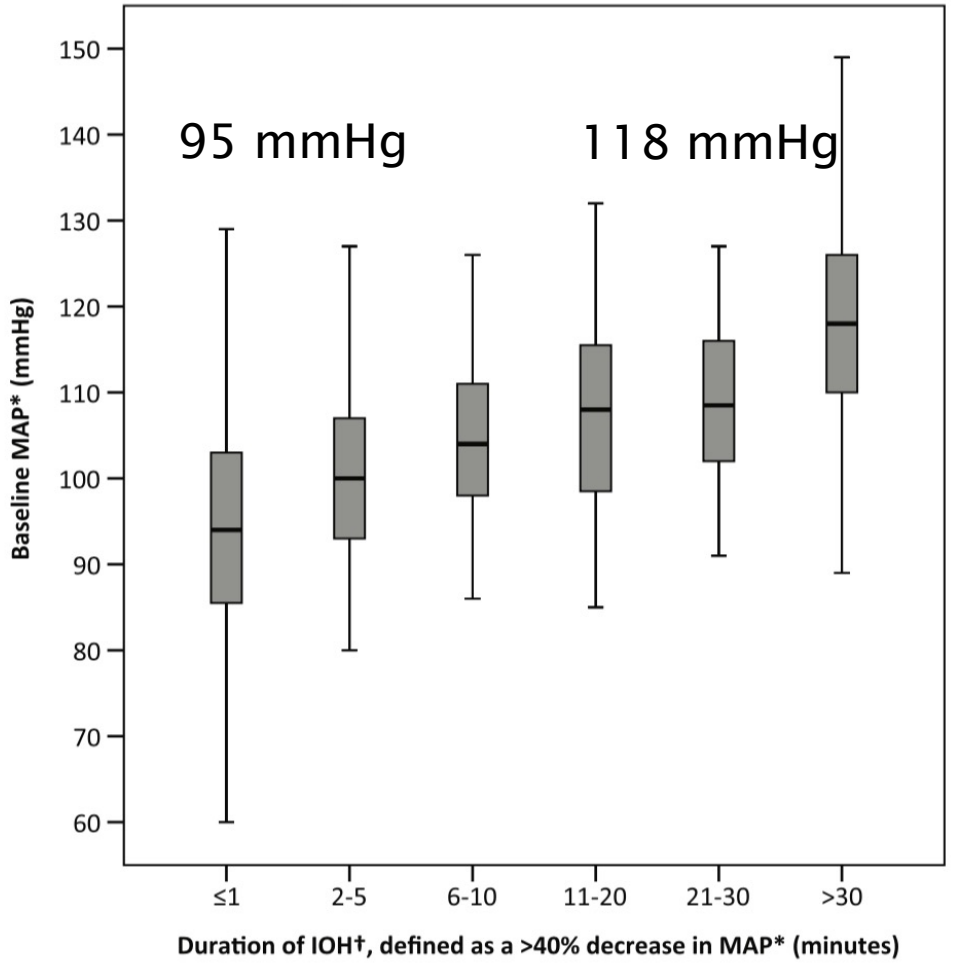
Threshold	Total (n = 57,315)	AKI (n = 3,870)	Adjusted OR (98.75% CI)*	*P* Values*
Time under MAP < 65 mmHg				< 0.001
Reference (never < 65 mmHg)	16,230	658 (4.1%)	Ref = 1	
Q1 (1–5 min)	11,714	570 (4.9%)	1.04 (0.89–1.22)	0.49
Q2 (6–12 min)	9,442	520 (5.5%)	1.15 (0.98–1.35)	0.032
Q3 (13–28 min)	9,974	597 (6.0%)	1.20 (1.02–1.40)	0.0049†
Q4 (> 28 min)	9,955	870 (8.7%)	1.35 (1.14–1.58)	< 0.001†

Salmasi V, Anesthesiology 2017

	No Myocardial Injury (N = 672)	Myocardial Injury (N = 218)	*P* Value
Median duration of IOH, min (IQR)			
MAP < 60 mmHg	10 (5–27)	18 (7–36)	0.005
MAP < 50 mmHg	5 (3–12)	7 (4–13)	0.24
≥ 30% decrease from preinduction MAP*	47 (16–113)	66 (13–147)	0.11
≥ 40% decrease from preinduction MAP*	18 (6–43)	37 (11–77)	< 0.001

z.B. 160/**120**/100 → 105/**72**/55

Dauer der Hypotonie ist abhängig vom präoperativen Blutdruck

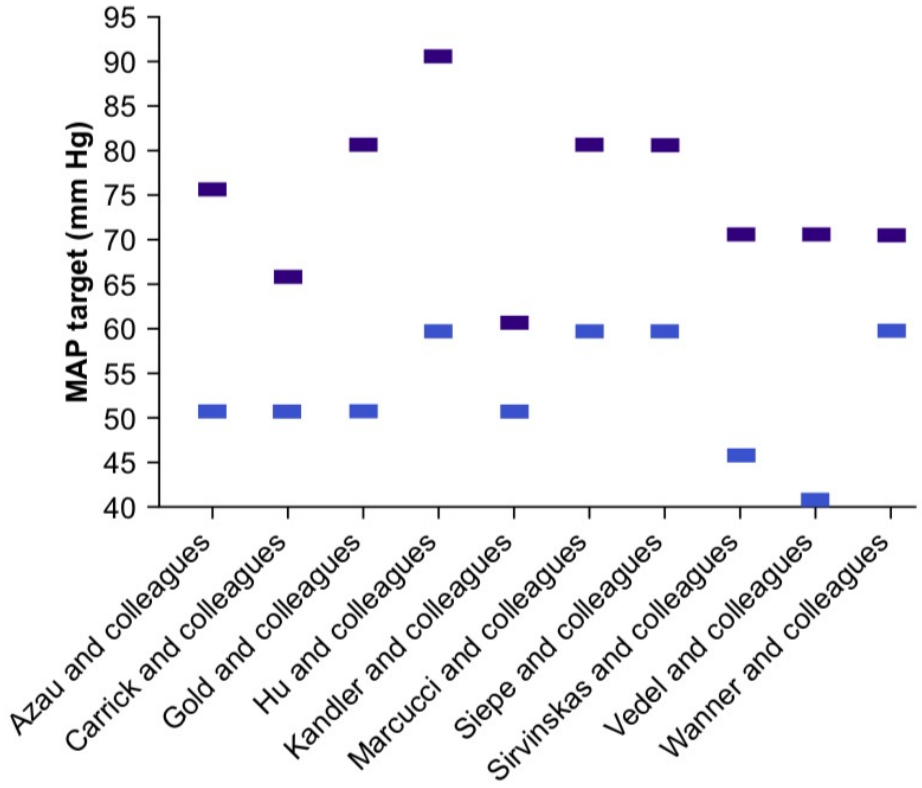


Van Waes J, Anesthesiology 2015

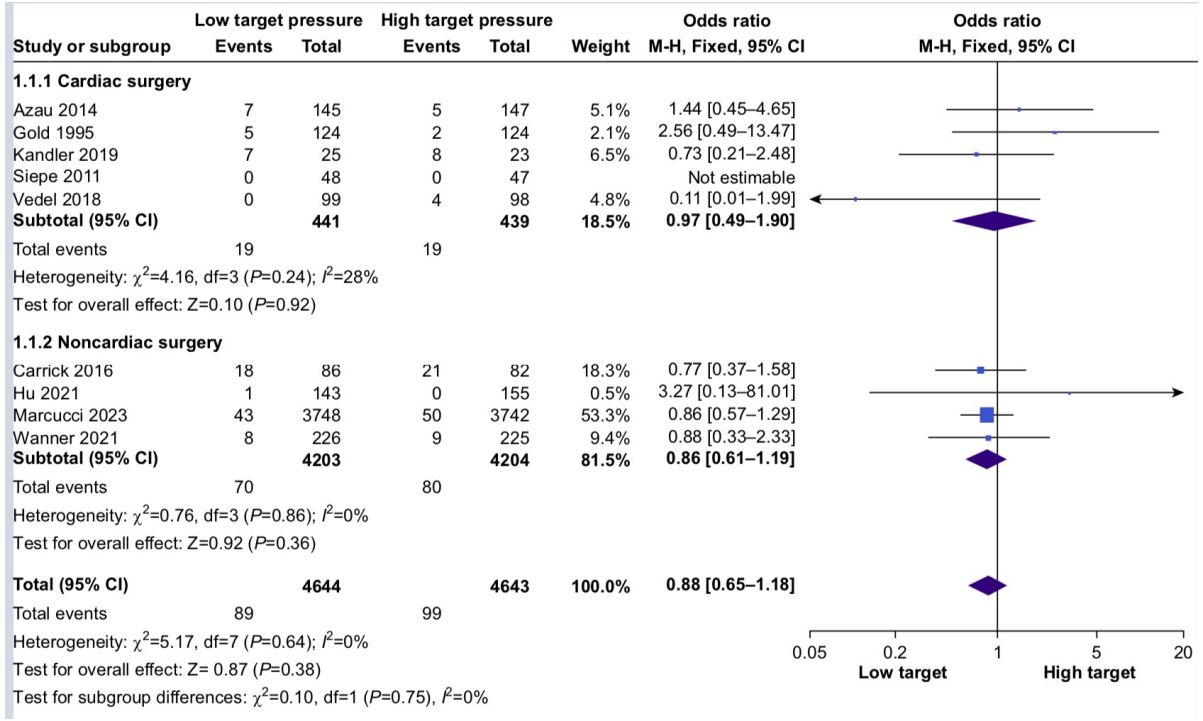
Intraoperative hypotension and postoperative outcomes: a meta-analysis of randomised trials

British Journal of Anaesthesia, 131 (5): 823–831 (2023)

Filippo D'Amico[1], Evgeny V. Fominskiy[1], Stefano Turi[1], Alessandro Pruna[1], Stefano Fresilli[1], Margherita Triulzi[1], Alberto Zangrillo[1,2] and Giovanni Landoni[1,2,*]



All Cause Mortality



Study or subgroup	Low target pressure Events	Total	High target pressure Events	Total	Weight	Odds ratio M-H, Fixed, 95% CI
1.1.1 Cardiac surgery						
Azau 2014	7	145	5	147	5.1%	1.44 [0.45–4.65]
Gold 1995	5	124	2	124	2.1%	2.56 [0.49–13.47]
Kandler 2019	7	25	8	23	6.5%	0.73 [0.21–2.48]
Siepe 2011	0	48	0	47		Not estimable
Vedel 2018	0	99	4	98	4.8%	0.11 [0.01–1.99]
Subtotal (95% CI)		**441**		**439**	**18.5%**	**0.97 [0.49–1.90]**
Total events	19		19			
Heterogeneity: χ^2=4.16, df=3 (*P*=0.24); I^2=28%						
Test for overall effect: Z=0.10 (*P*=0.92)						
1.1.2 Noncardiac surgery						
Carrick 2016	18	86	21	82	18.3%	0.77 [0.37–1.58]
Hu 2021	1	143	0	155	0.5%	3.27 [0.13–81.01]
Marcucci 2023	43	3748	50	3742	53.3%	0.86 [0.57–1.29]
Wanner 2021	8	226	9	225	9.4%	0.88 [0.33–2.33]
Subtotal (95% CI)		**4203**		**4204**	**81.5%**	**0.86 [0.61–1.19]**
Total events	70		80			
Heterogeneity: χ^2=0.76, df=3 (*P*=0.86); I^2=0%						
Test for overall effect: Z=0.92 (*P*=0.36)						
Total (95% CI)		**4644**		**4643**	**100.0%**	**0.88 [0.65–1.18]**
Total events	89		99			
Heterogeneity: χ^2=5.17, df=7 (*P*=0.64); I^2=0%						
Test for overall effect: Z= 0.87 (*P*=0.38)						
Test for subgroup differences: χ^2=0.10, df=1 (*P*=0.75), I^2=0%						

Targeting Higher Intraoperative Blood Pressures Does Not Reduce Adverse Cardiovascular Events Following Noncardiac Surgery

JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
VOL. 78, NO. 18, 2021

Patrick M. Wanner, MD,[a,*] Dirk U. Wulff, PhD,[b] Mirjana Djurdjevic,[a] Wolfgang Korte, MD,[c] Thomas W. Schnider, MD,[a] Miodrag Filipovic, MD[a]

What Did We Do?

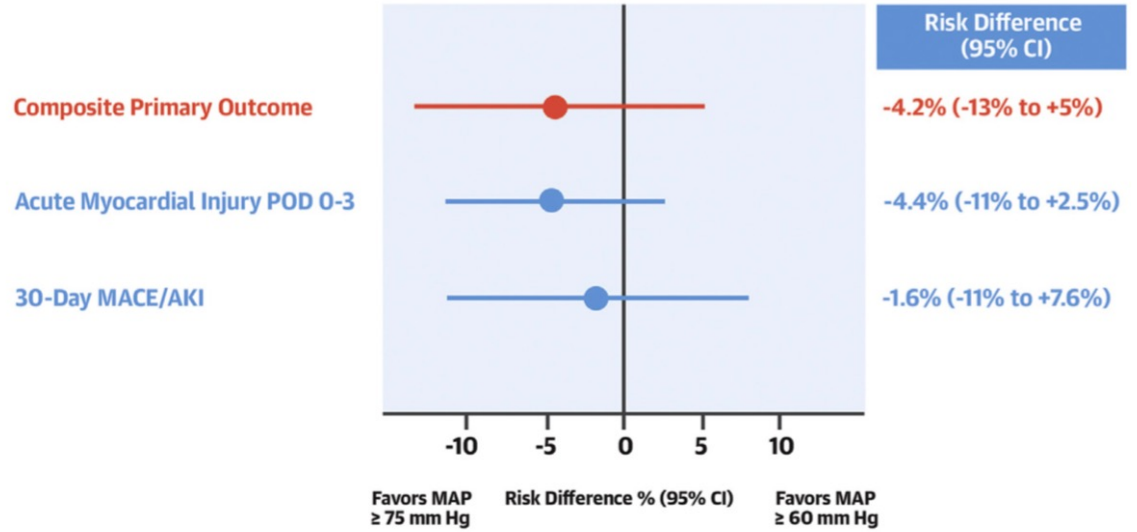
Intraoperative Randomization

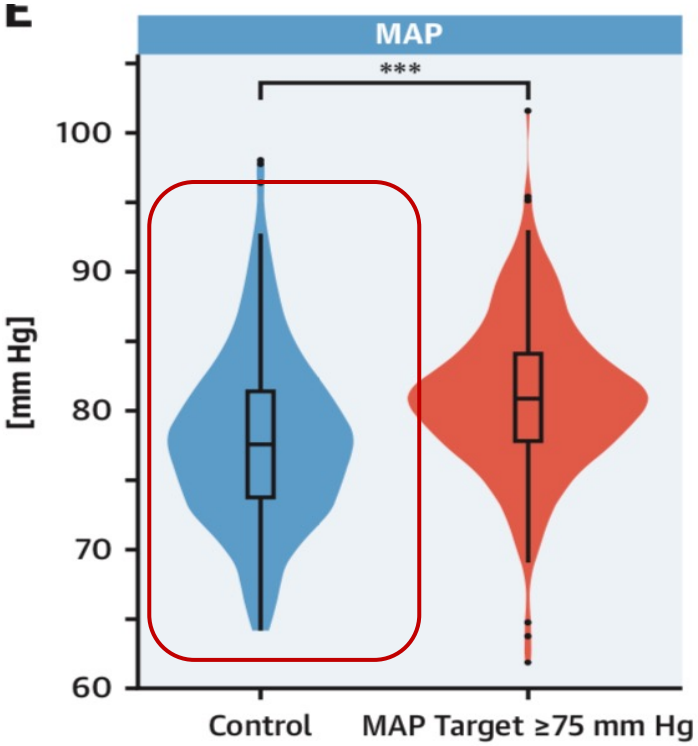
Target Mean Arterial Blood Pressure (MAP) ≥75 mm Hg (Intervention)

VS

Target MAP ≥60 mm Hg (Control)

What Did We Find?





Hypotension-Avoidance Versus Hypertension-Avoidance Strategies in Noncardiac Surgery

Annals of Internal Medicine • Vol. 176 No. 5 • May 2023

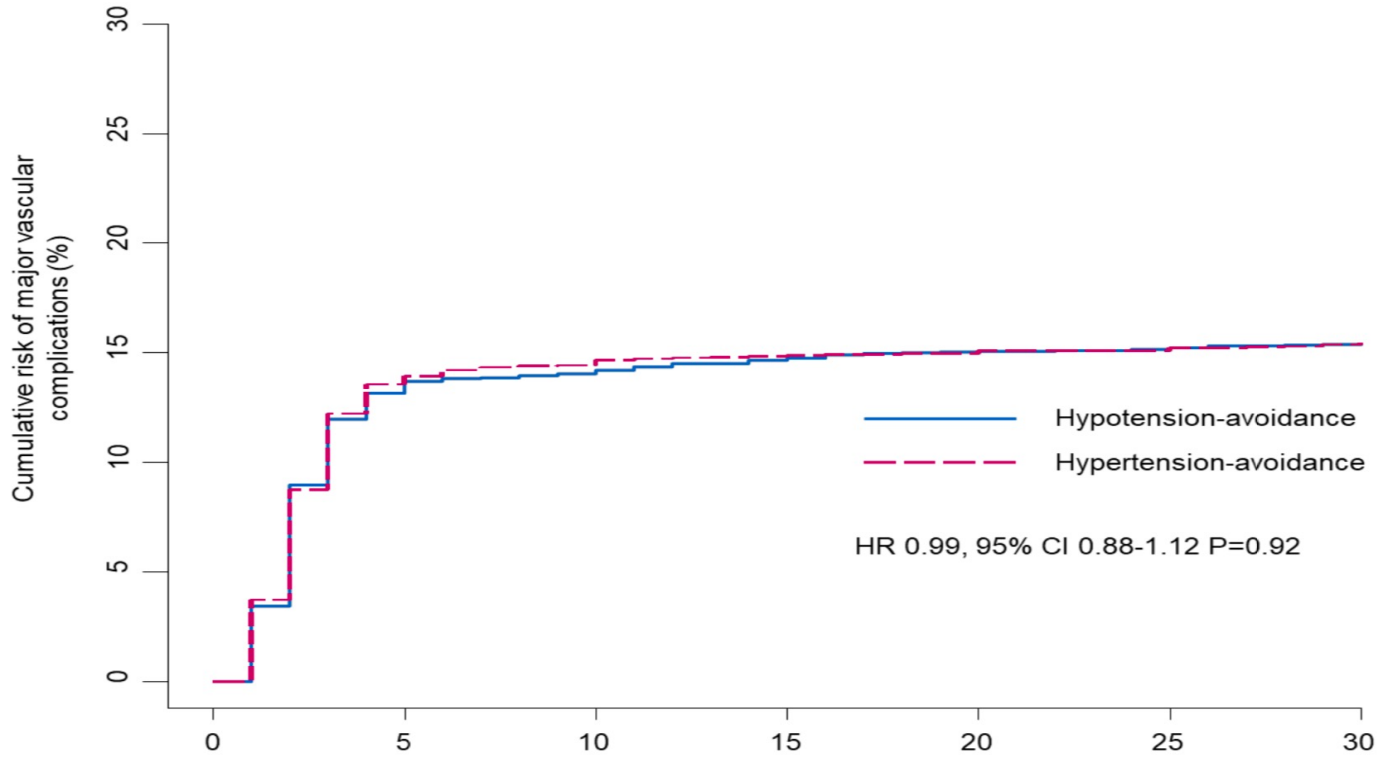
An International Randomized Controlled Trial

Maura Marcucci, MD; Thomas W. Painter, MBChB; David Conen, MD; Vladimir Lomivorotov, MD; Daniel I. Sessler, MD; Matthew T.V. Chan, MBBS; Flavia K. Borges, MD; Kate Leslie, MD; Emmanuelle Duceppe, MD; María José Martínez-Zapata, MD; Chew Yin Wang, MBChB; Denis Xavier, MD; Sandra N. Ofori, MBBS; Michael Ke Wang, MD; Sergey Efremov, MD; Giovanni Landoni, MD; Ydo V. Kleinlugtenbelt, MD; Wojciech Szczeklik, MD; Denis Schmartz, MD; Amit X. Garg, MD; Timothy G. Short, MD; Maria Wittmann, MD; Christian S. Meyhoff, MD; Mohammed Amir, MBBS; David Torres, MD; Ameen Patel, MD; Kurt Ruetzler, MD; Joel L. Parlow, MD; Vikas Tandon, MD; Edith Fleischmann, MD; Carisi A. Polanczyk, MD; Andre Lamy, MD; Raja Jayaram, MD; Sergey V. Astrakov, MD; William Ka Kei Wu, PhD; Chao Chia Cheong, MD; Sabry Ayad, MD; Mikhail Kirov, MD; Miriam de Nadal, MD; Valery V. Likhvantsev, MD; Pilar Paniagua, MD; Hector J. Aguado, MD; Kamal Maheshwari, MD; Richard P. Whitlock, MD; Michael H. McGillion, RN; Jessica Vincent, MSc; Ingrid Copland; Kumar Balasubramanian, MSc; Bruce M. Biccard, MBChB; Sadeesh Srinathan, MD; Samandar Ismoilov, MD; Shirley Pettit, RN; David Stillo, MASc; Andrea Kurz, MD; Emilie P. Belley-Côté, MD; Jessica Spence, MD; William F. McIntyre, MD; Shrikant I. Bangdiwala, PhD; Gordon Guyatt, MD; Salim Yusuf, MD; and P.J. Devereaux, MD, PhD; on behalf of the POISE-3 Trial Investigators and Study Groups*

- POISE III Studie: 7490 Patient*innen, zumindest ein Antihypertensivum
  - **Hypotension - avoidance strategy**, Ziel- MAP ≥80 mmHg
    - Antihypertensive Medikation prä- und postoperativ pausiert entsprechend eines Algorithmus
  - **Hypertension - avoidance strategy**, target MAP ≥ 60 mmHg
    - Antihypertensive Medikation kontinuierlich prä- und postoperativ

Kaplan Meier für Primären Endpunkt

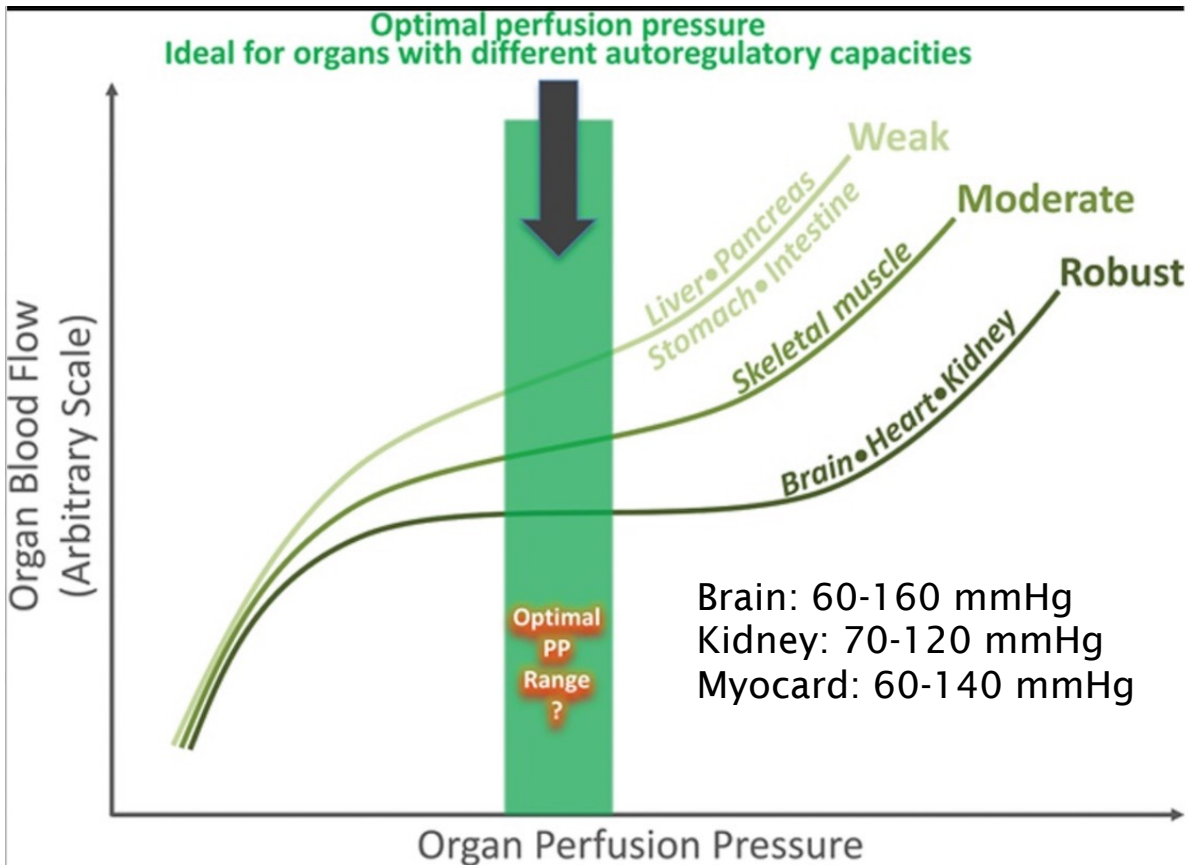
Verbund von Kardiovaskulärer Mortalität, MINS, Insult and Herzstillstand 30 Tage nach Randomiserung



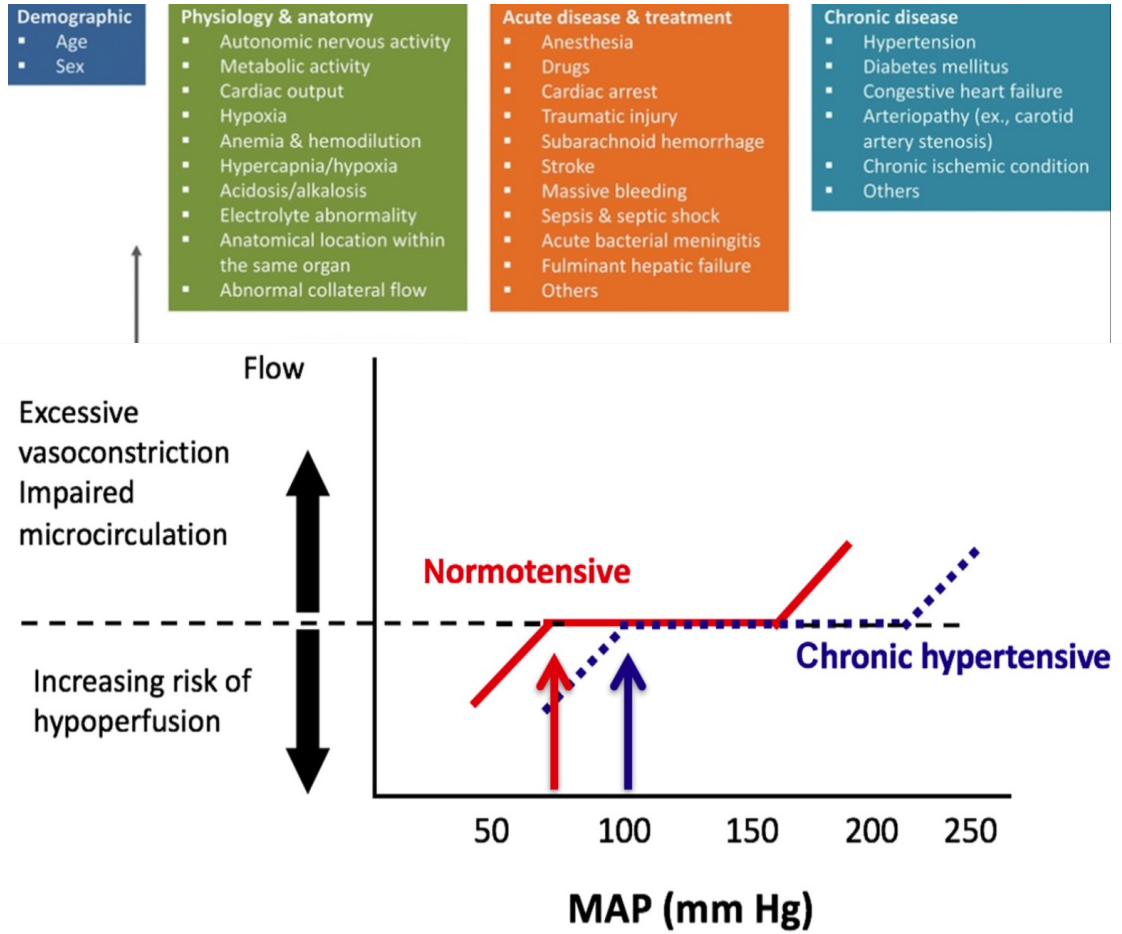
Number at Risk							
Hypotension-avoidance	3742	3304	3263	3242	3231	3227	3220
Hypertension-avoidance	3748	3299	3259	3245	3238	3234	3225

Marcucci M, Annals of Int Medicine 2023

Perfusionsdruck und Autoregulation



Brain: 60-160 mmHg
Kidney: 70-120 mmHg
Myocard: 60-140 mmHg



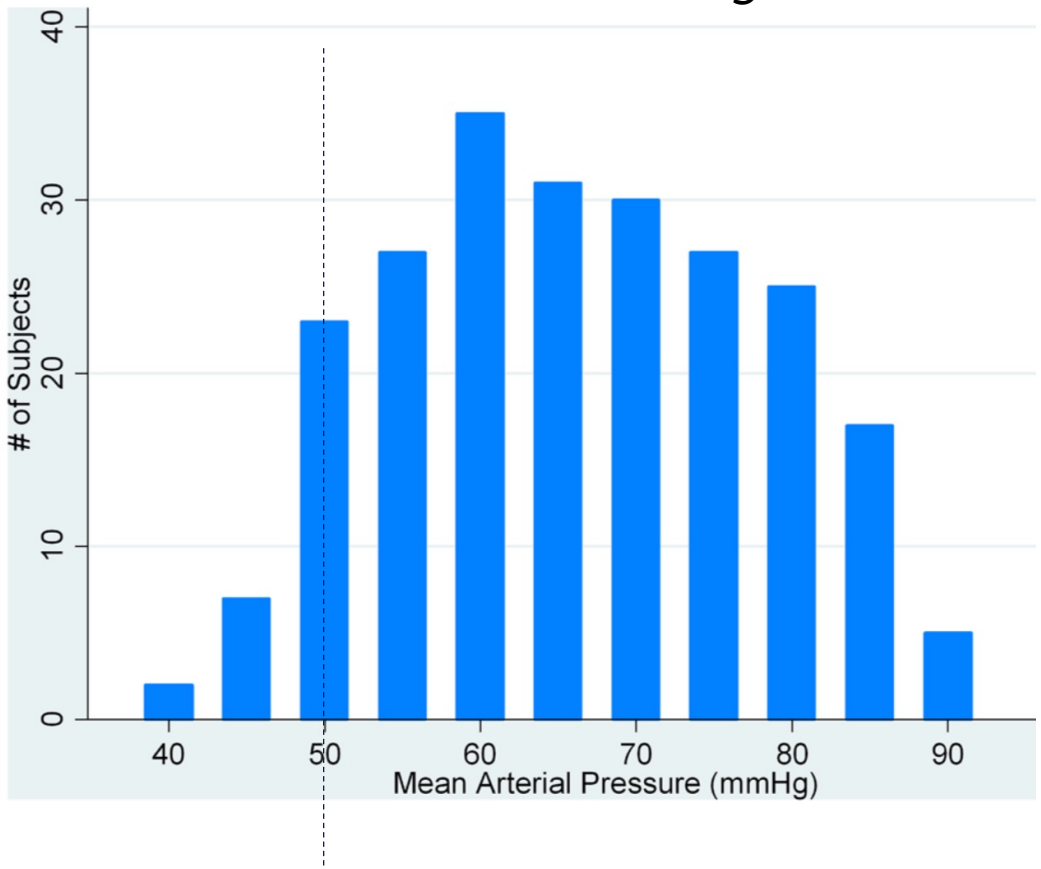
Herman R., J Hum Hypertension, 2023

Meng L, Critical Care Medicine , 2019

Cerebrale Autoregulation, Hypotonie und postoperatives Delirium

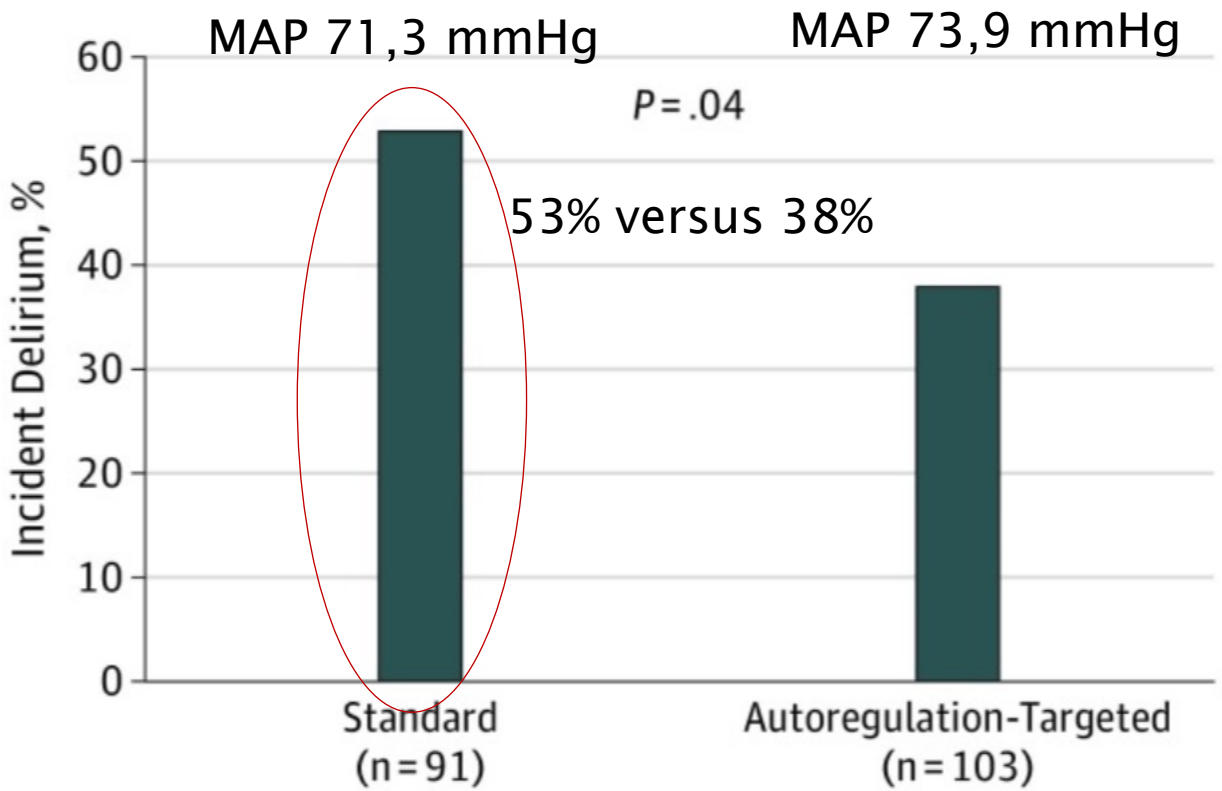
Kardiopulmonaler Bypass

Untere Grenze der Autoregulation



Joshi B, AnesthAnalg 2012

Delirium (4 postop. Tage)



Brown CH, JAMASurg 2019

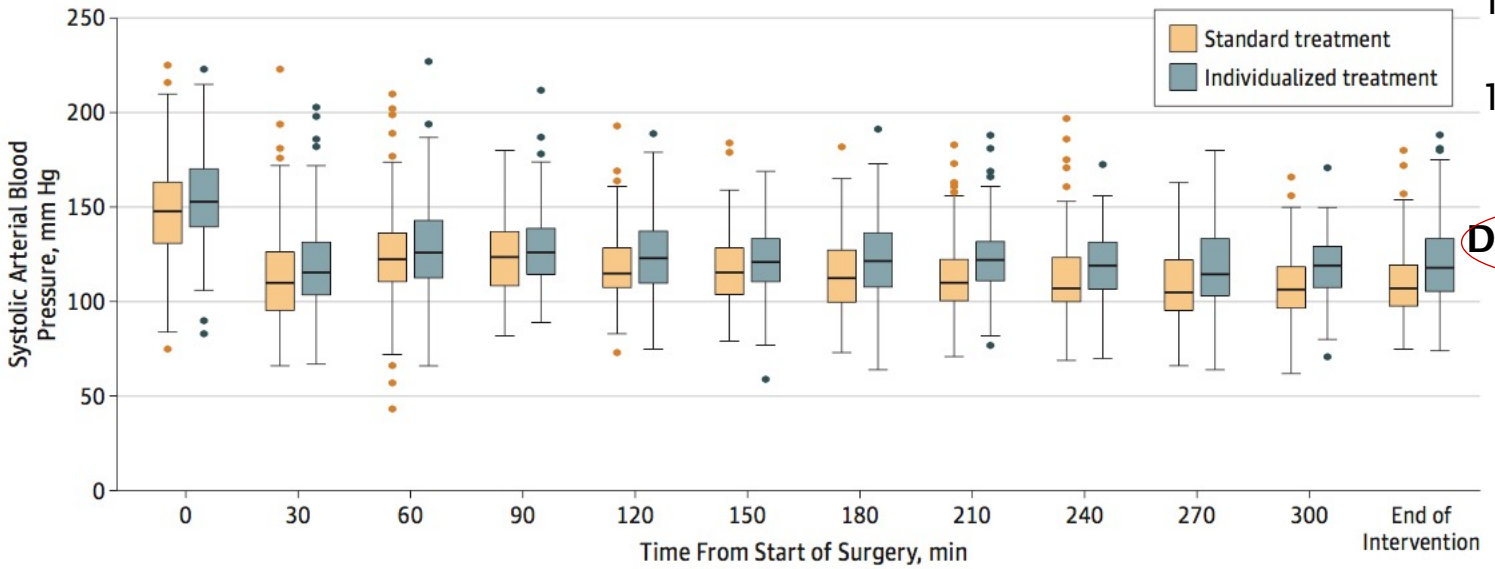
JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

Effect of Individualized vs Standard Blood Pressure Management Strategies on Postoperative Organ Dysfunction Among High-Risk Patients Undergoing Major Surgery

A Randomized Clinical Trial

Emmanuel Futier, MD, PhD; Jean-Yves Lefrant, MD, PhD; Pierre-Gregoire Guinot, MD, PhD; Thomas Godet, MD, PhD; Emmanuel Lorne, MD; Philippe Cuvillon, MD, PhD; Sebastien Bertran, MD; Marc Leone, MD, PhD; Bruno Pastene, MD; Vincent Piriou, MD, PhD; Serge Molliex, MD, PhD; Jacques Albanese, MD, PhD; Jean-Michel Julia, MD; Benoit Tavernier, MD, PhD; Etienne Imhoff, MD; Jean-Etienne Bazin, MD, PhD; Jean-Michel Constantin, MD, PhD; Bruno Pereira, PhD; Samir Jaber, MD, PhD; for the INPRESS Study Group

Published online September 27, 2017



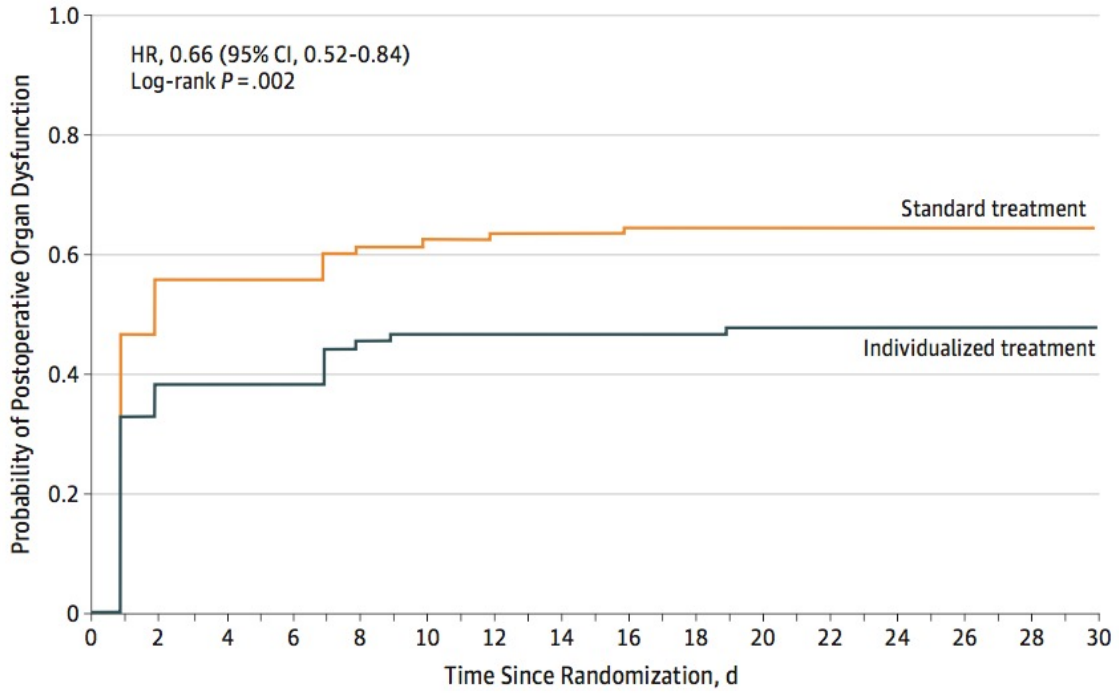
116(24) mmHg
versus
123(25) mmHg

Difference 6 mmHg

Systemic Inflammatory Response and Organ Dysfunction

- 298 Patient*innen
  - > 50a
  - ASA ≥ II
  - AKI risk index ≥ III
- Große chir. Eingriffe
  - > 2h
- 9 Zentren

Figure 3. Kaplan-Meier Estimates of the Probability of Postoperative Organ Dysfunction by Day 30 After Surgery



No. at risk

Standard treatment	145	78	65	58	54	53
Individualized treatment	147	99	91	82	80	79

63%
vs.
46%

$p = 0.001$

Futier E, JAMA 2017

ANESTHESIOLOGY

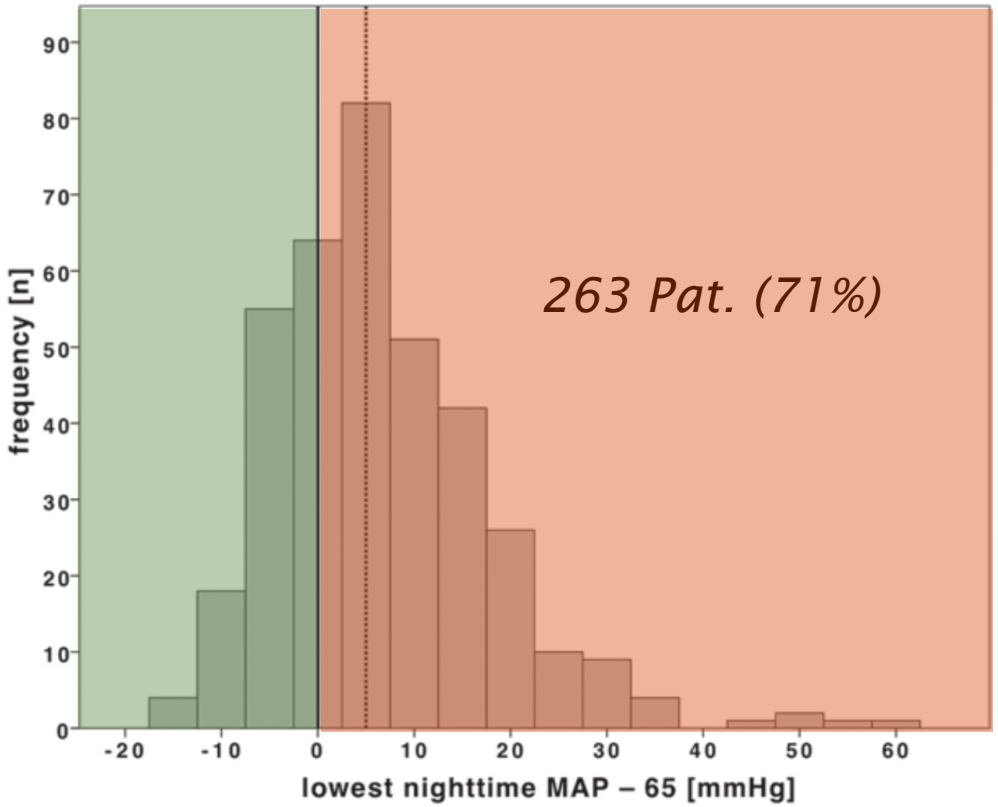
Automated Ambulatory Blood Pressure Measurements and Intraoperative Hypotension in Patients Having Noncardiac Surgery with General Anesthesia

A Prospective Observational Study

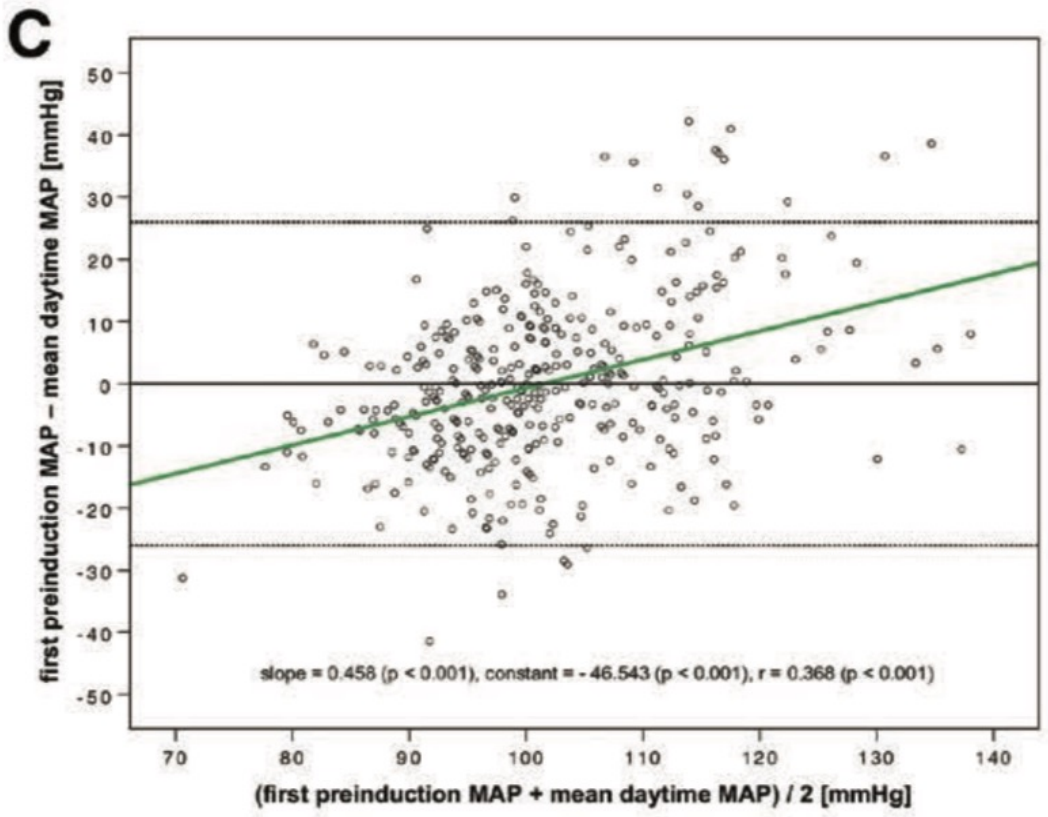
Bernd Saugel, M.D., Philip C. Reese, M.D., Daniel I. Sessler, M.D., Christian Burfeindt, Julia Y. Nicklas, M.D., Hans O. Pinnschmidt, Ph.D., Daniel A. Reuter, M.D., Stefan Südfeld, M.D.

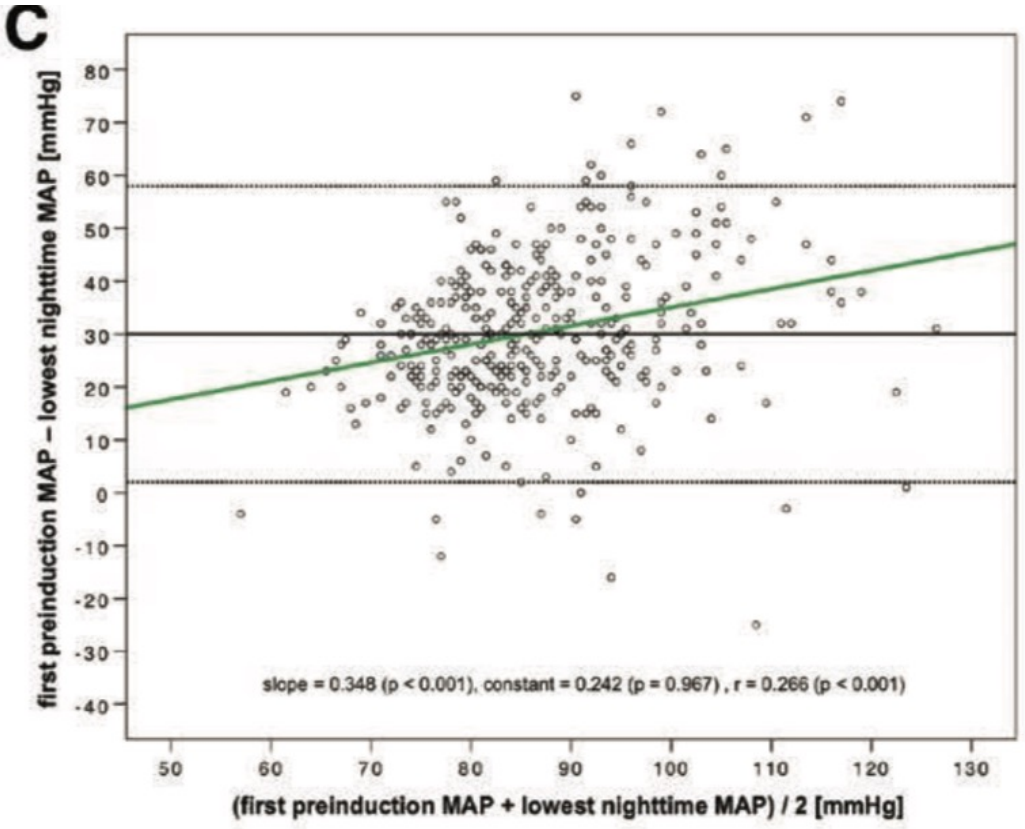
ANESTHESIOLOGY 2019; 131:74–83

- 370 Patient*innen
  - ASA I-II
  - 40-65 Jahre



Vor Einleitung gemessener MAP sollte nicht zur Definition des intraoperativen Zielwertes herangezogen werden…





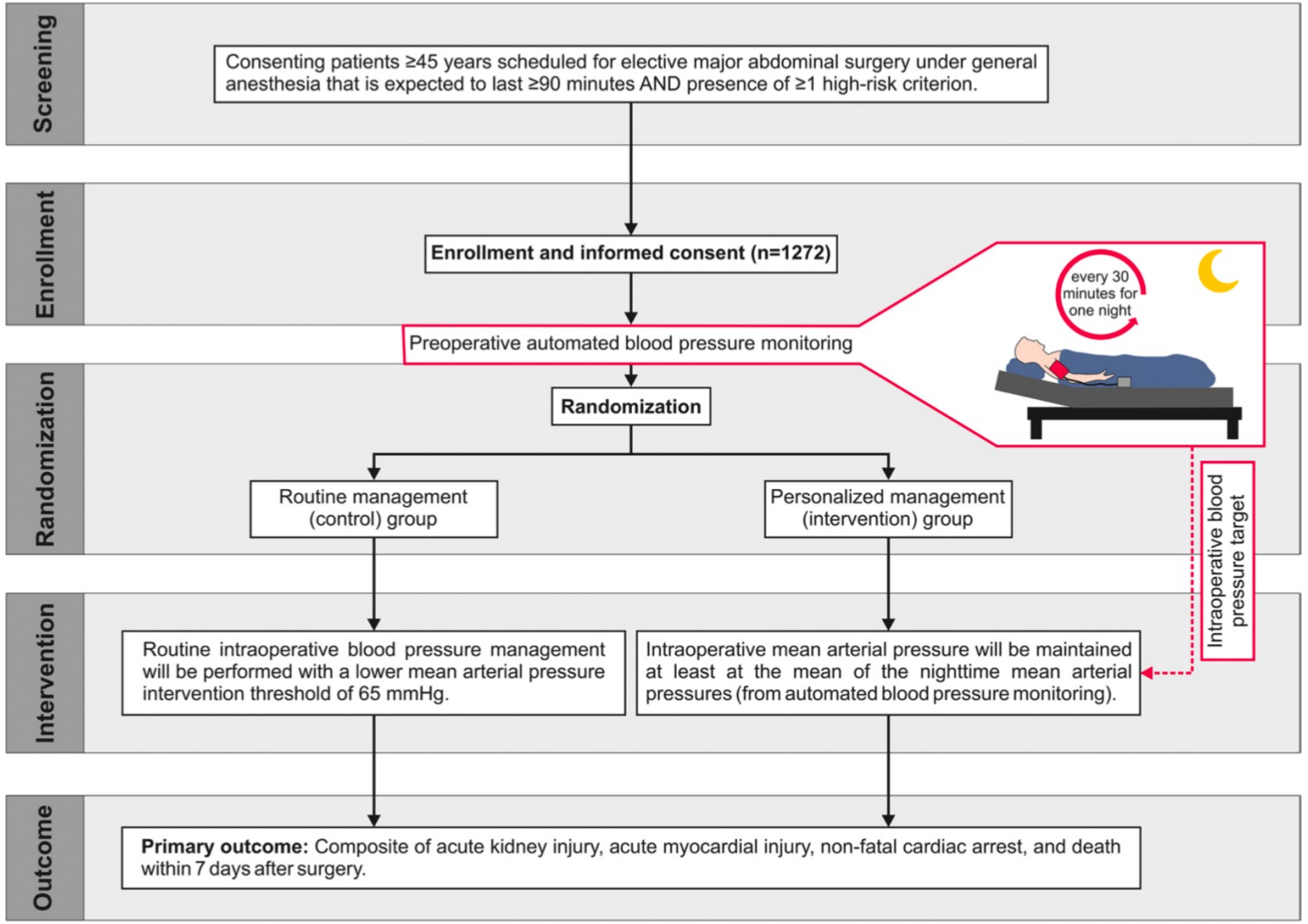
Saugel B, Anesthesiology 2019

Ausblick

Effect of personalized perioperative blood pressure management on postoperative complications and mortality in high-risk patients having major abdominal surgery: protocol for a multicenter randomized trial (IMPROVE-multi) *Trials* *(2022) 23:946*

Alina Bergholz[1], Agnes S. Meidert[2], Moritz Flick[1], Linda Krause[3], Eik Vettorazzi[3], Antonia Zapf[3], Frank M. Brunkhorst[4,5], Patrick Meybohm[6], Kai Zacharowski[7], Alexander Zarbock[8], Daniel I. Sessler[9,10], Karim Kouz[1†] and Bernd Saugel[1,10*†]

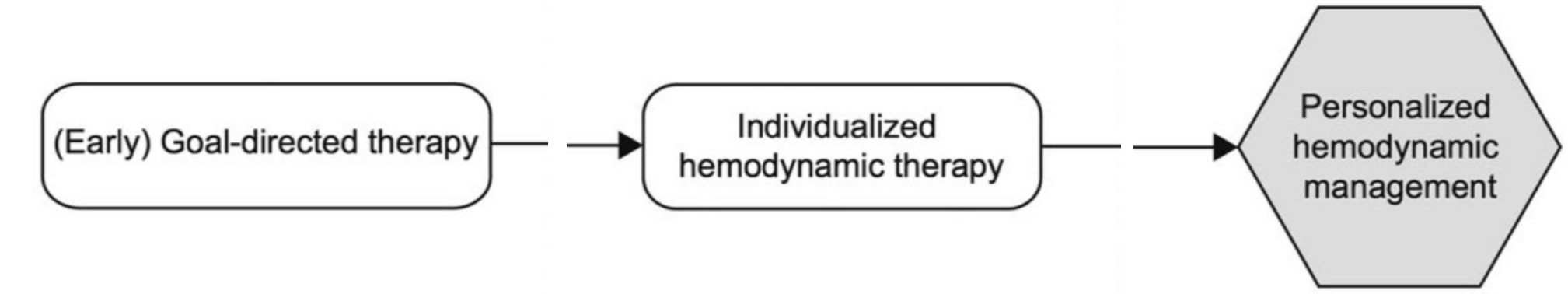
- ClinicalTrials.gov
  - (NCT05416944) on June 14, 2022
- 16 Deutsche Zentren



Potentielle Anwendungsmöglichkeiten

- *Intraoperatives druckgesteuertes Management*
- *Intraoperatives flussgesteuertes Management*
  - Flüssigkeit
  - Vasopressoren
  - Inotropika

Hämodynamische Therapie
Konzepte



(Early) Goal-directed therapy	Individualized hemodynamic therapy	Personalized hemodynamic management
• protocolized care	• protocolized care	• (protocolized care)
• fixed targets (population-based normal values)	• functional hemodynamic monitoring assessing fluid responsiveness => individual targets	• personal targets (perioperative) and adaptive multi-parametric approaches (intensive care unit)
• (supra)normalization of blood flow	• maximization of blood flow	• optimization of blood flow = „adequacy“ of blood flow

Saugel B,Curr Opin Crit Care,2017

Effect of a Perioperative, Cardiac Output–Guided Hemodynamic Therapy Algorithm on Outcomes Following Major Gastrointestinal Surgery

A Randomized Clinical Trial and Systematic Review

JAMA June 4, 2014 Volume 311, Number 21

Rupert M. Pearse, MD; David A. Harrison, PhD; Neil MacDonald, FRCA; Michael A. Gillies, FRCA; Mark Blunt, FRCA; Gareth Ackland, PhD; Michael P. W. Grocott, MD; Aoife Ahern, BSc; Kathryn Griggs, MSc; Rachael Scott, PhD; Charles Hinds, FRCA; Kathryn Rowan, PhD; for the OPTIMISE Study Group

DESIGN, SETTING, AND PARTICIPANTS OPTIMISE was a pragmatic, multicenter, randomized, observer-blinded trial of 734 high-risk patients aged 50 years or older undergoing major gastrointestinal surgery at 17 acute care hospitals in the United Kingdom. An updated systematic review and meta-analysis were also conducted including randomized trials published from 1966 to February 2014.

INTERVENTIONS Patients were randomly assigned to a cardiac output–guided hemodynamic therapy algorithm for intravenous fluid and inotrope (dopexamine) infusion during and 6 hours following surgery (n=368) or to usual care (n=366).

Effect of a Perioperative, Cardiac Output–Guided Hemodynamic Therapy Algorithm on Outcomes Following Major Gastrointestinal Surgery

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Outcomes	Cardiac Output–Guided Hemodynamic Therapy Algorithm, No. (%) (n = 366)	Usual Care, No. (%) (n = 364)
Composite of predefined moderate or major postoperative complications and mortality at 30 d following surgery[b]	134 (36.6)	158 (43.4)

P = 0.07

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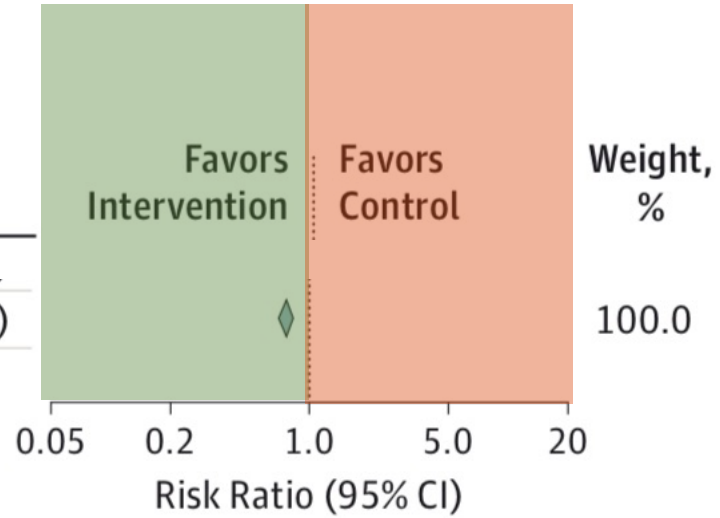
Meta-analysis of Number of Patients Developing Complications After Surgery

Source	Intervention No. of Events	Intervention Total No.	Control No. of Events	Control Total No.	Risk Ratio (95% CI)	Weight, %
Total	488	1548	614	1476	0.77 (0.71-0.83)	100.0

Heterogeneity: $\chi^2_{21} = 30.44$; $P = .08$; $I^2 = 31\%$
Test for overall effect: $z = 6.22$; $P < .001$



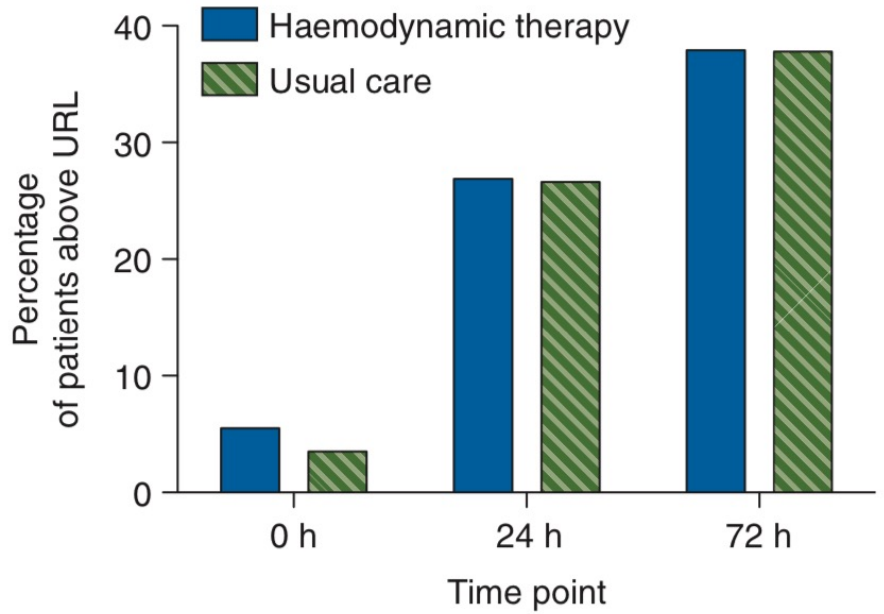
31.5% *versus* 41.6%

Perioperative myocardial injury in patients receiving cardiac output-guided haemodynamic therapy: a substudy of the OPTIMISE Trial

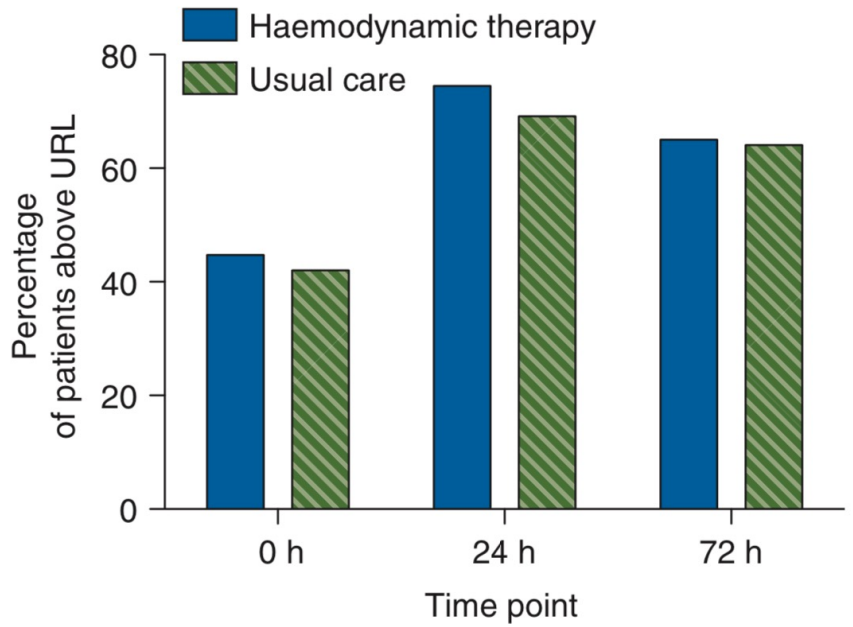
British Journal of Anaesthesia 115 (2): 227–33 (2015)

M. A. Gillies[1,*], A. S. V. Shah[2], J. Mullenheim[3], S. Tricklebank[4], T. Owen[5], J. Antonelli[1], F. Strachan[2], N. L. Mills[2] and R. M. Pearse[6]

Hs cardiac troponin I



N-terminal pro-brain natriuretic peptide



The ‘5 Ts’ of perioperative goal-directed haemodynamic therapy

British Journal of Anaesthesia, 123 (2): 103–107 (2019)

Bernd Saugel[1,2,*], Karim Kouz[1] and Thomas W. L. Scheeren[3]

- **T**arget population
  - Hohes individuelles **und** hohes chirurgisches Risiko
- **T**iming of the intervention
  - So früh als möglich
- **T**ype of intervention
  - Flüssigkeit **und** vasoaktive Substanzen
- **T**arget variable
  - Dynamische **und** volumetrische Parameter
- **T**arget value

The ‘5 Ts’ of perioperative goal-directed haemodynamic therapy

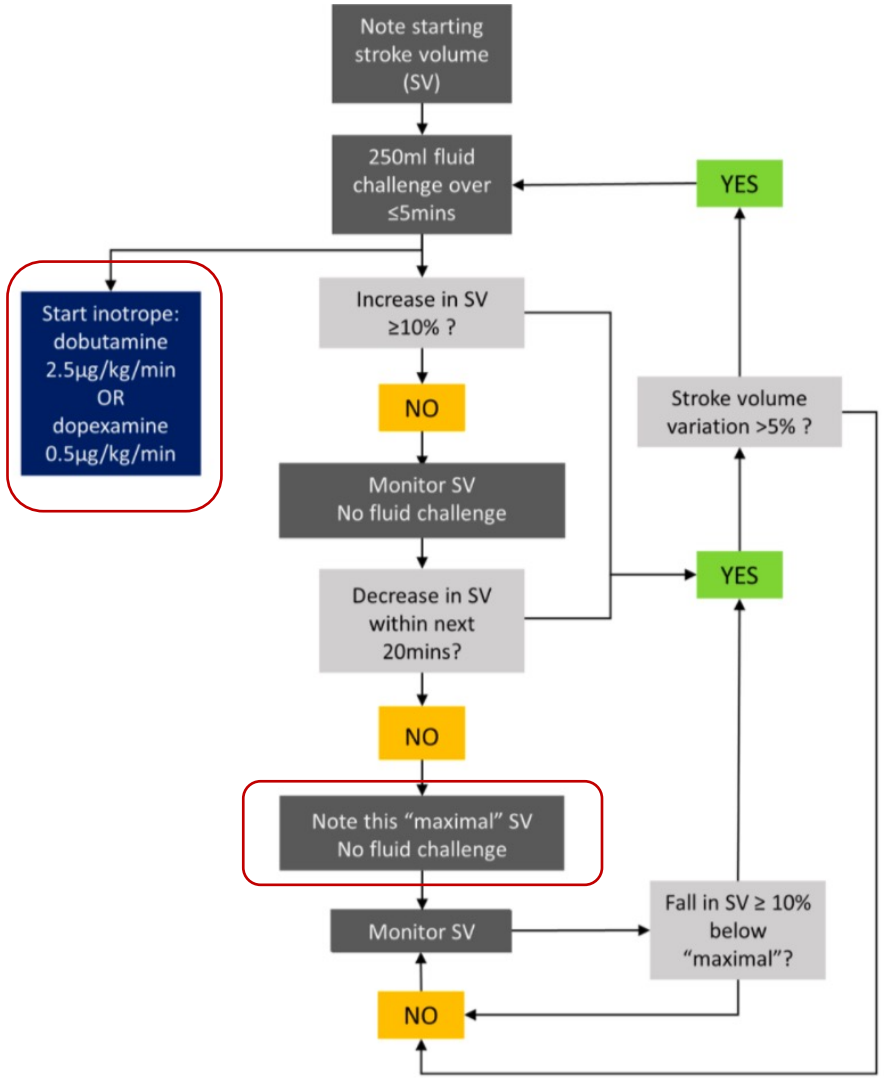
British Journal of Anaesthesia, 123 (2): 103–107 (2019)

Bernd Saugel[1,2,*], Karim Kouz[1] and Thomas W. L. Scheeren[3]

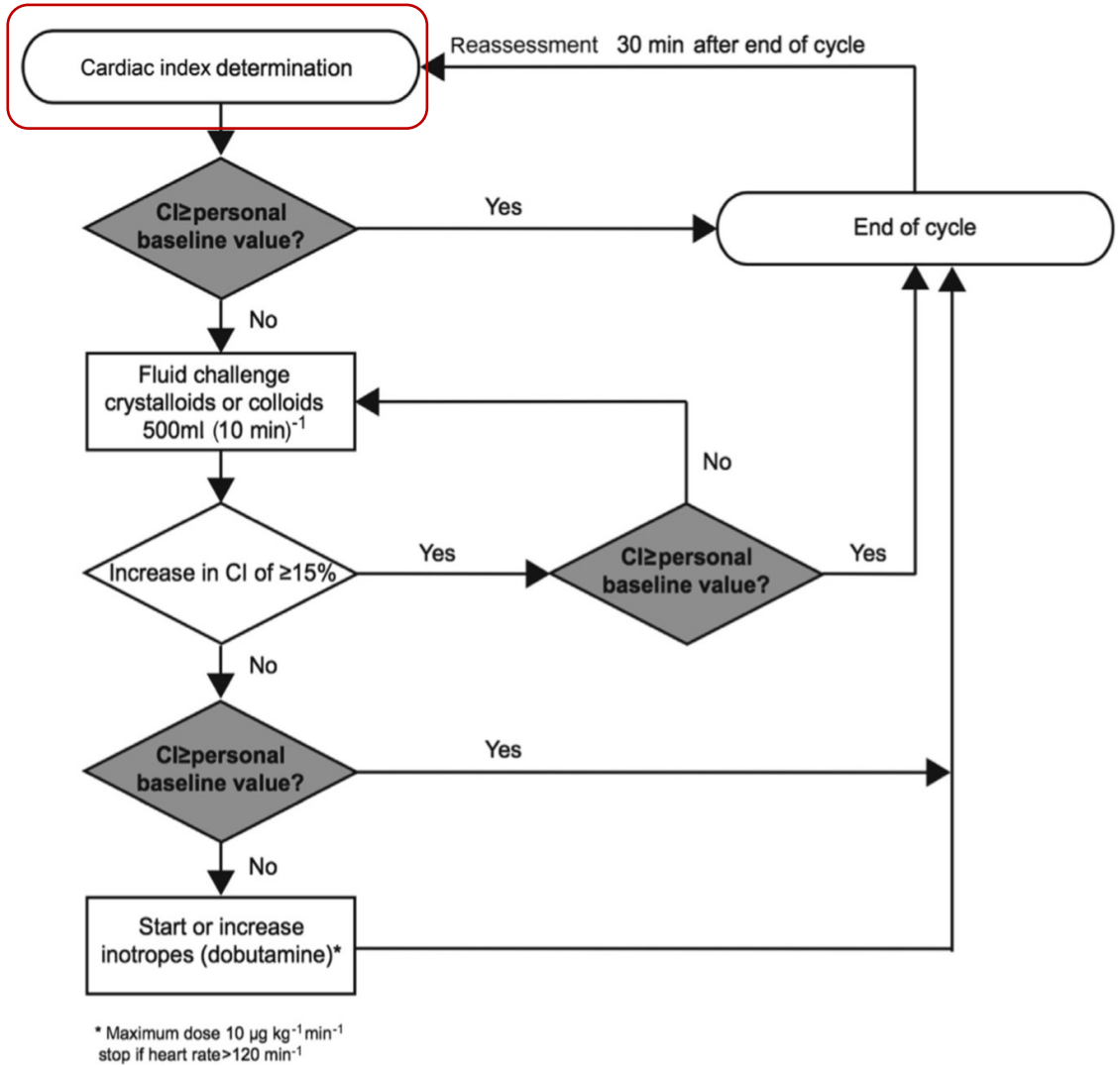
Target value

↳ personalise target values

Maximal *versus* Individuell



Optimise and Optimise II

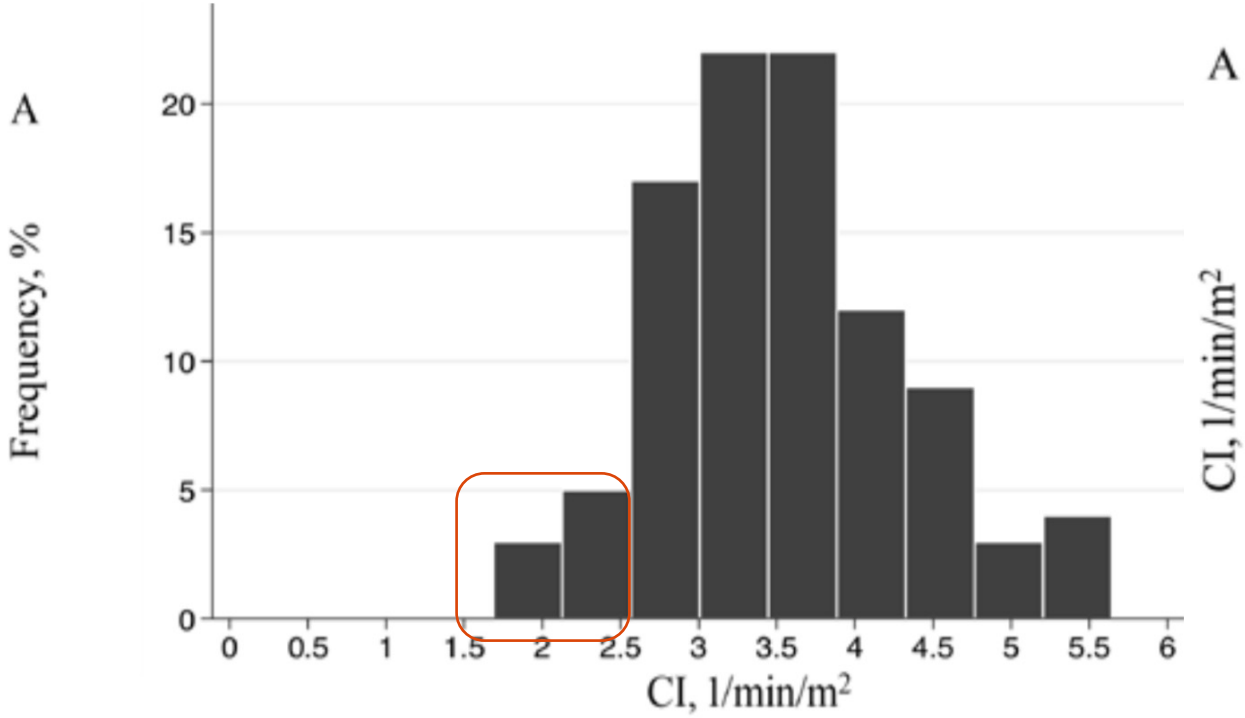


Nicklas JY, Brit J of Anaesth 2020;125 (2):122 – 132

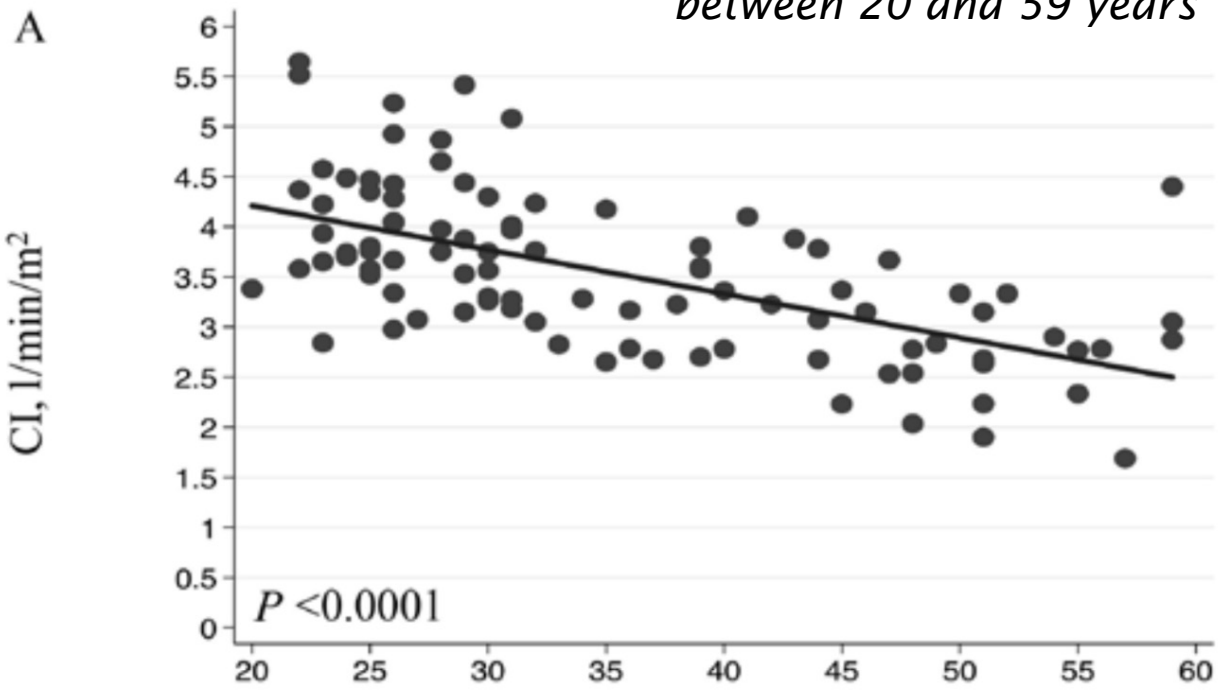
Non-invasive estimation of cardiac index in healthy volunteers

C. T. Eyeington*, P. Ancona†, L. Cioccari‡, N. Luethi§, N. J. Glassford**, G. M. Eastwood††, H. K. Proimos‡‡, F. Franceschi§§, M. J. Chan§§, D. Jones***, R. Bellomo†††

Anaesth Intensive Care 2018 | **46:3**



between 20 and 59 years



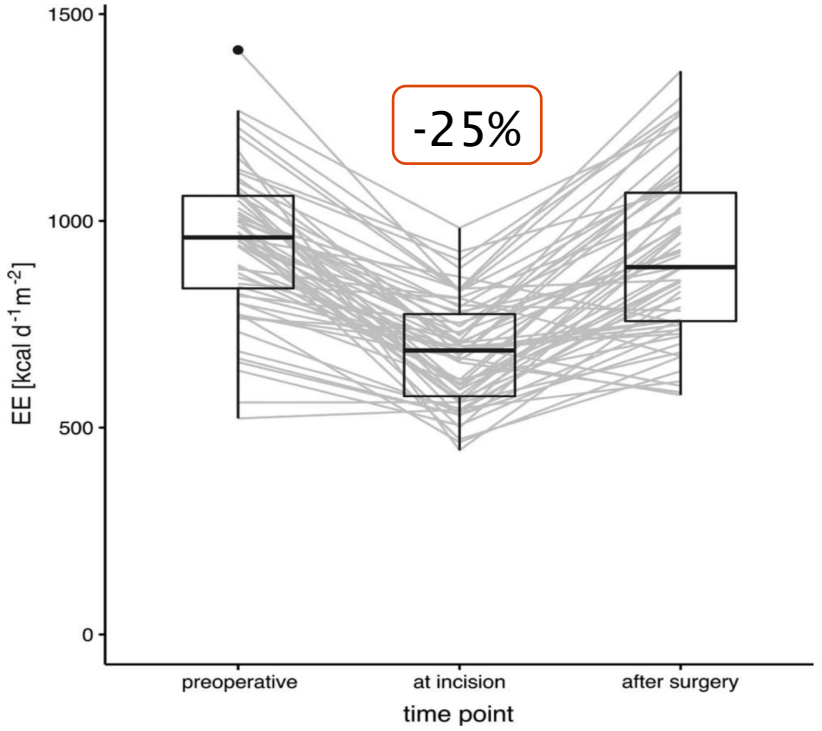
Cardiac Index variiert individuell

Energy Expenditure Under General Anesthesia: An Observational Study Using Indirect Calorimetry in Patients Having Noncardiac Surgery

July 2023 • Volume 137 • Number 1

Luisa Briesenick, MD,* Annika Schaade,* Alina Bergholz, MD,* Phillip Hoppe, MD,* Karim Kouz, MD,* Linda Krause, PhD,† Moritz Flick, MD,* and Bernd Saugel, MD*‡

- Beobachtend, ein Zentrum
- 60 Patient*innen
- indirekte Kalorimetrie
- Energieumsatz
  - Präoperativ wach in Ruhe
  - Intraoperativ in Allgemeinanästhesie
  - Postoperativ



Personalised haemodynamic management targeting baseline cardiac index in high-risk patients undergoing major abdominal surgery: a randomised single-centre clinical trial

Julia Y. Nicklas[1,*], Oliver Diener[1], Maximilian Leistenschneider[1], Christina Sellhorn[1], Gerhard Schön[2], Martin Winkler[1], Guenter Daum[3], Edzard Schwedhelm[4], Julian Schröder[5], Margit Fisch[6], Barbara Schmalfeldt[7], Jakob R. Izbicki[8], Michael Bauer[9], Sina M. Coldewey[9,10], Daniel A. Reuter[11] and Bernd Saugel[1,12]

British Journal of Anaesthesia, 125 (2): 122–132 (2020)

Baseline CI Were variierten: 1,9 to 5,2 L/min/m²

Outcome	Total, *n* (%) (*n*=188)	Personalised group, *n* (%) (*n*=94)	Routine group, *n* (%) (*n*=94)
Composite of predefined major postoperative complications and mortality at Day 30 after surgery	80 (43)	28 (30)	52 (55)

P < 0.001

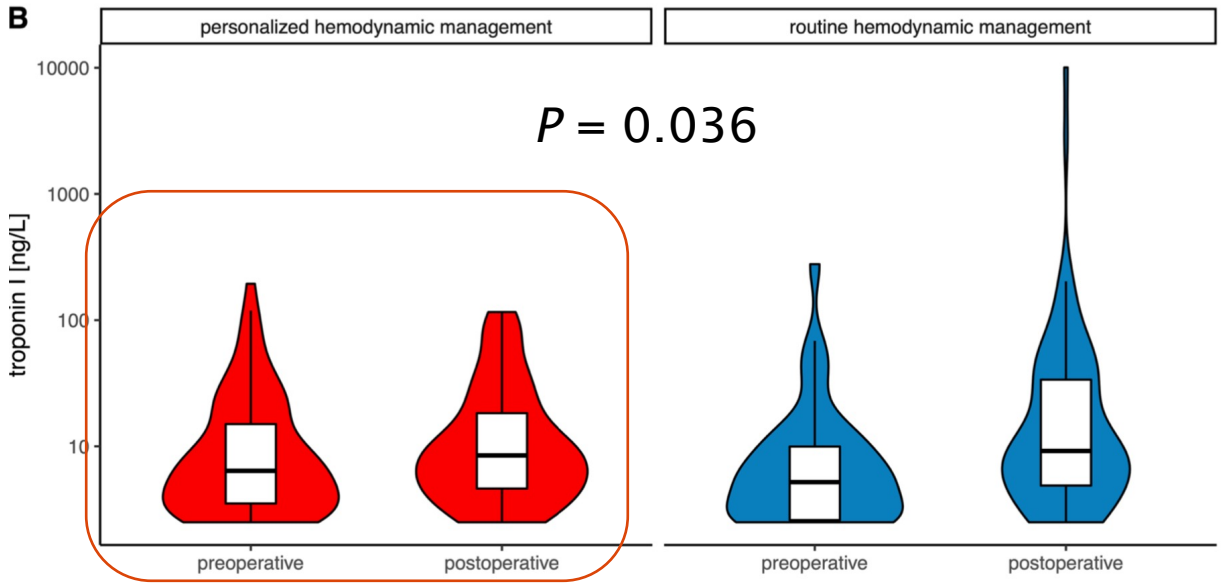
Effect of intraoperative personalized goal-directed hemodynamic management on acute myocardial injury in high-risk patients having major abdominal surgery: a post-hoc secondary analysis of a randomized clinical trial

Journal of Clinical Monitoring and Computing (2022) 36:1775–1783

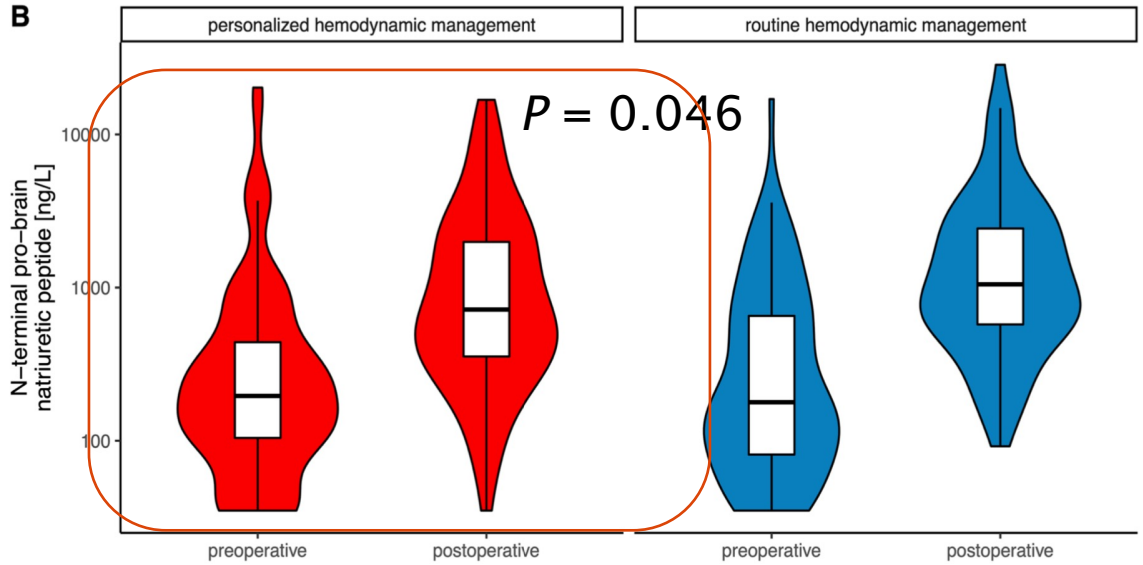
Karim Kouz[1] · Alina Bergholz[1] · Oliver Diener[1] · Maximilian Leistenschneider[1] · Christina Thompson[1] · Friederike Pichotka[2] · Constantin Trepte[1] · Edzard Schwedhelm[3] · Thomas Renné[2,4,5] · Linda Krause[6] · Julia Y. Nicklas[1] · Bernd Saugel[1,7]

Myokardschaden: 4% *versus* 16%; *P* = 0,034

Troponin I



NT pro-BNP



Ausblick

- Personalized Hemodynamic Management in High-risk Major Abdominal Surgery **(PELICAN)**

  Universitätsklinikum Hamburg-Eppendorf

  - ClinicalTrials.gov: NCT05648279
  - 1128 Patient*innen
  - Randomisierung
    - Personalisiertes HD Management *versus* Kontrollgruppe
      - Präoperativer Herzindex (Bioreaktanz –Technologie)
  - Verbund schwerer postoperativer Komplikationen innerhalb der ersten 7 Tage

Fazit

- Intraoperative Hypotonie
  - Potentiell modifizierbarer Risikofaktor für postoperative Komplikationen
- Absolute Therapieziele
  - ‘Common sense‘
  - Retrospektiv große Kohorten
  - Keine Evidenzklasse I
- Zielgerichtetes hämodynamisches Management
  - Perfusionsdruck **und** Fluss
- Individuell angepasste physiologische Zielwerte
- Standardisierung der Personalisierung
- Große randomisierte Studien!

‘If it were not for the great variability among individuals, medicine might as well be a science and not an art’

- Sir William Osler, 1892