56e REAGSO
7 & 8 Octobre 2023

Optimisation Cardiocirculatoire peropératoire du patient grave

Emmanuel FUTIER, MD, PhD

Anesthésie Réanimation, CHU de Clermont-Ferrand

Université Clermont Auvergne, CNRS UMR 6293, INSERM U1103, GReD

UNIVERSITÉ Clermont Auvergne
FACULTÉ DE MÉDECINE

- Déclaration / **Liens d'intérets**
  - **Consultant** : Dräger Medical, GE Healthcare
  - **Intervenant (congrès)** : Fisher & Paykel Healthcare, GE Healthcare, Fresenius kabi, Baxter, Getinge
  - **Support technique** : Dräger Medical, GE Healthcare

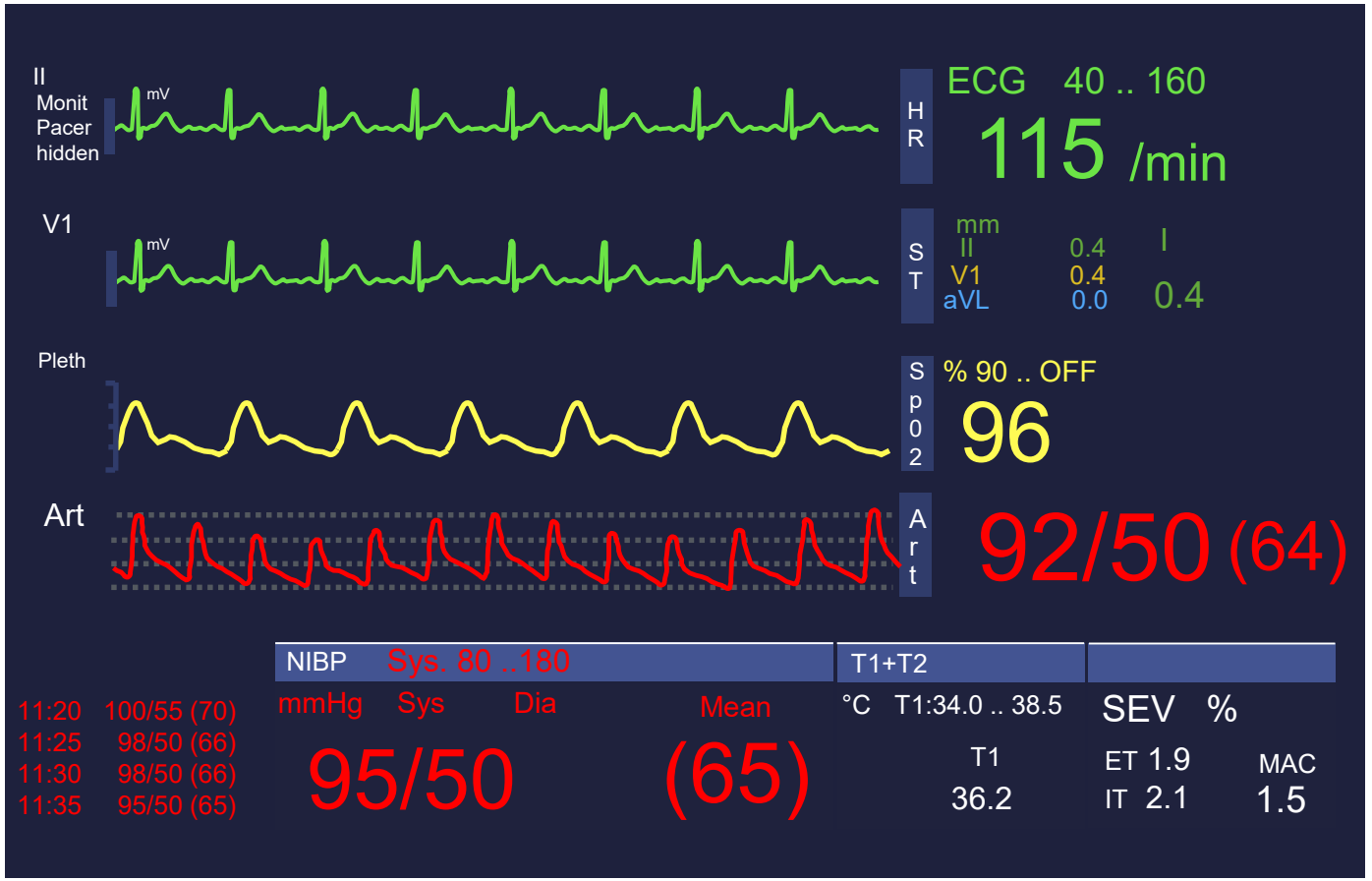
Dans cette situation, au bloc, que faites-vous ?

A. Vasopresseur

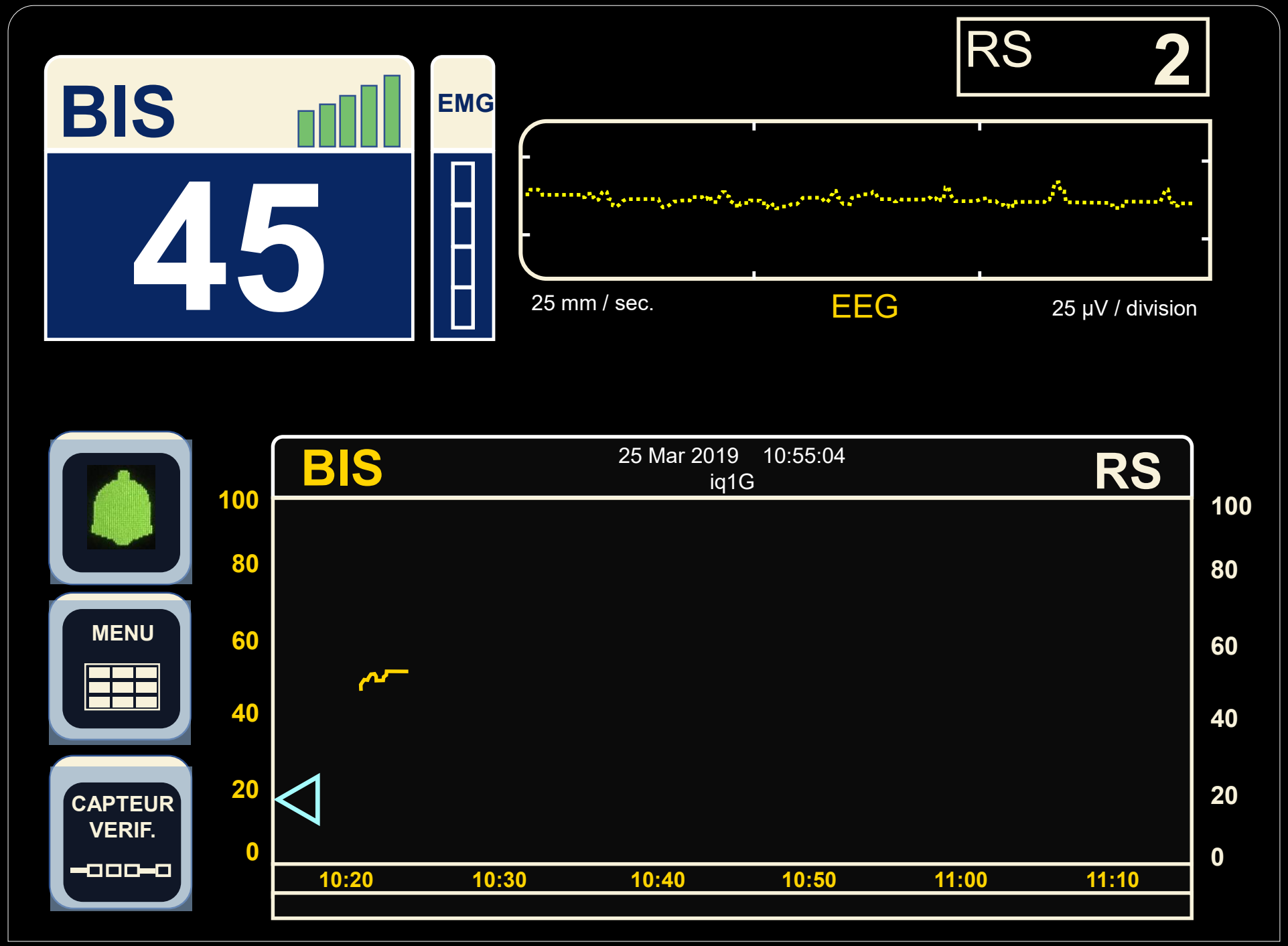
B. Remplissage vasculaire

C. Aucun des 2

D. Autre



Message N°1 : Primum non nocere


BIS
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25 mm / sec.
EEG
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25 Mar 2019 10:55:04
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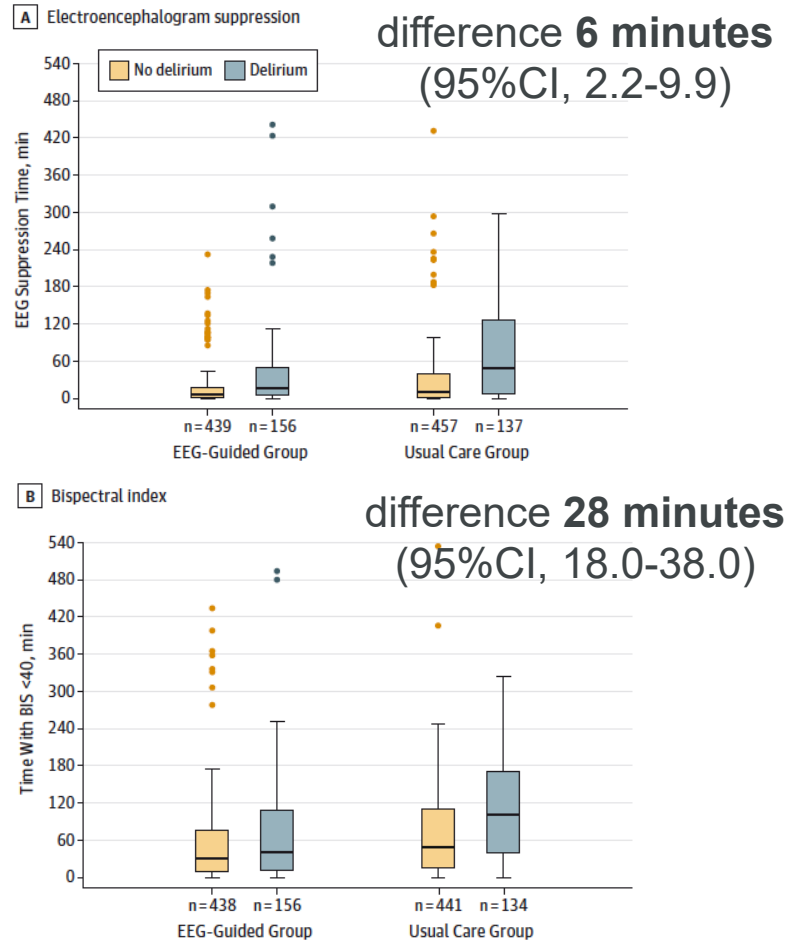
JAMA | Original Investigation

Effect of Electroencephalography-Guided Anesthetic Administration on Postoperative Delirium Among Older Adults Undergoing Major Surgery

Troy S. Wildes, MD; Angela M. Mickle, MS; Arbi Ben Abdallah, PhD; Hannah R. Maybrier, BS; Jordan Oberhaus, BS; Thaddeus P. Budelier, MD, MSF; Alex Kronzer, BA; Sherry L. McKinnon, BS; Daniel Park, BS; Brian A. Torres, DNP; Thomas J. Graetz, MD; Daniel A. Emmert, MD, PhD; Ben J. Palanca, MD, PhD; Shreya Goswami, MBBS, DNB; Eric Jacobsohn, MBChB, MPHE, FRCPC; Eva M. Schmitt, PhD; Sharon K. Inouye, MD, MPH; Susan Stark, PhD; Eric J. Lenze, MD; Michael S. Avidan, MBBCh

ENGAGES trial

- RCT
- N=1232 patients - Major surgery and general anesthesia
- Randomized 1:1 to EEG-guided anesthetic administration vs usual care
- **Primary outcome**: delirium days 1 to 5
  26% vs 23% ; difference 3.0% (95%CI −2.0 to 8.0)
- **Intraoperative phenylephrine**:
  1.37 mg (0.20 to 5.14) vs **2.02 mg** (0.30 to 5.90)
  (difference −0.63%; 95%CI −1.22 to −0.03)
- **Mortality day 30**: **0.7%** vs **3.1%**
  (difference −2.42%; 95%CI −4.3 to −0.8)



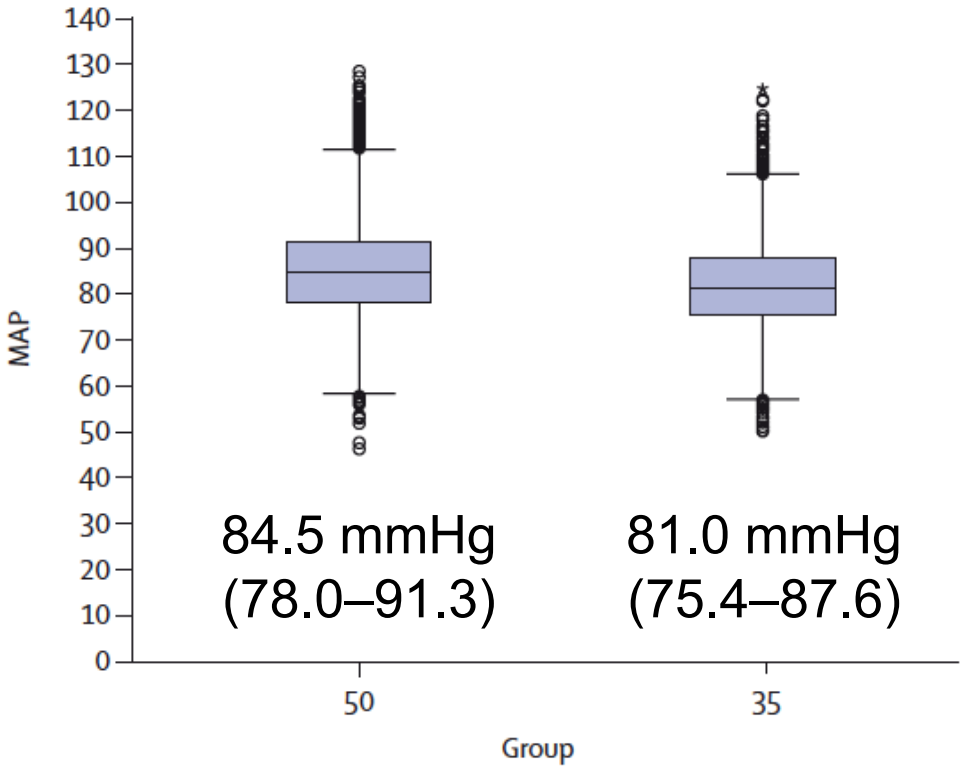
JAMA. 2019;321(5):473-483

Anaesthetic depth and complications after major surgery: an international, randomised controlled trial

Timothy G Short, Douglas Campbell, Christopher Frampton, Matthew T V Chan, Paul S Myles, Tomás B Corcoran, Daniel I Sessler, Gary H Mills, Juan P Cata, Thomas Painter, Kelly Byrne, Ruquan Han, Mandy H M Chu, Davina J McAllister, Kate Leslie

BALANCED trial

- RCT
- N=6664 patients ≥60 yr with ASA 3-4 and were having surgery with expected duration >2h
- Randomization 1:1 to light general anaesthesia (**BIS target 50**) or deep general anaesthesia (**BIS target 35**) using volatile anaesthetic
- **Primary endpoint**: 1-year all-cause mortality **6%** vs **7%** ; RR 0.88 (95%CI 0.73–1.07)



Inotrope or vasopressor use	2538 (**77%**)	2853 (**86%**)

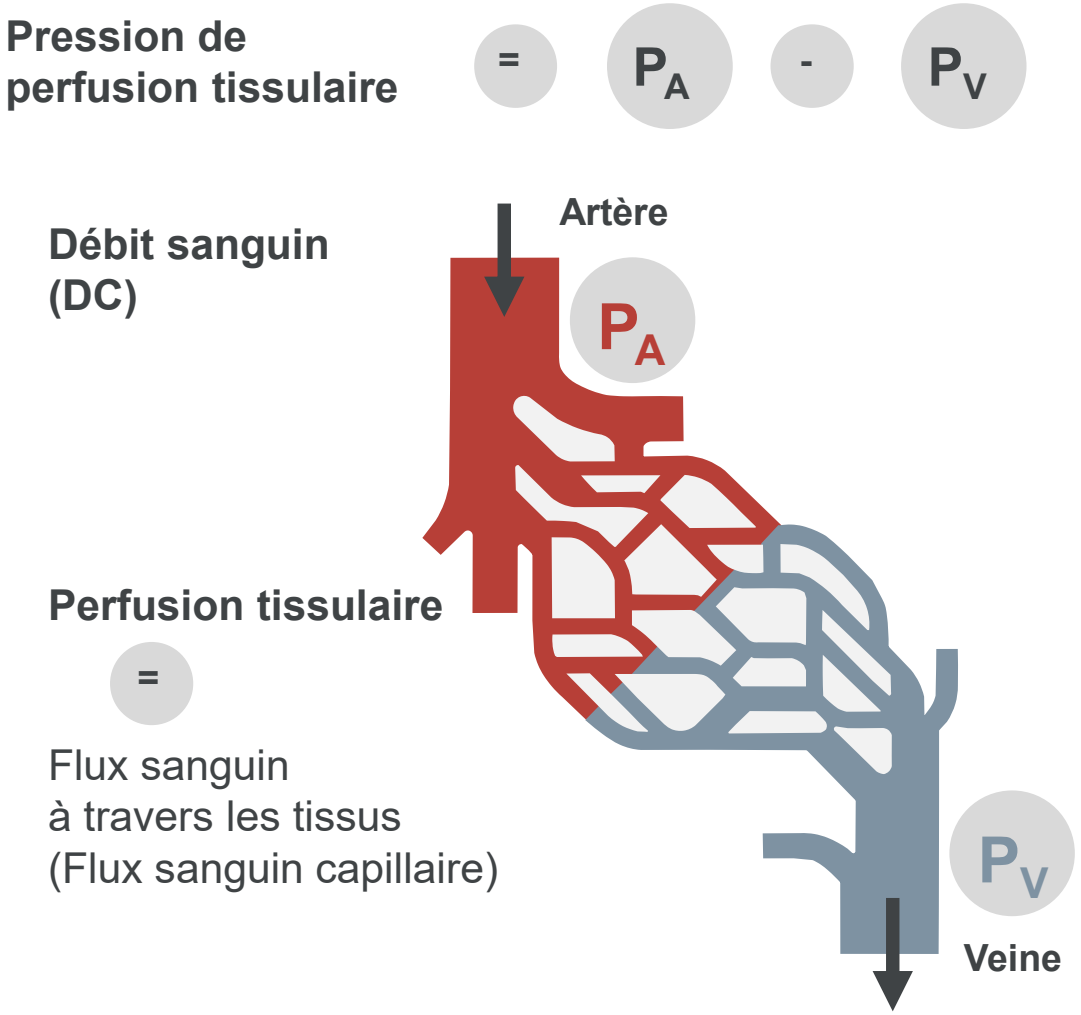
Lancet 2019; 394: 1907–14

Système Circulatoire: Pression et Débit

La fonction cardiovasculaire est modulée pour répondre aux besoins métaboliques de l'organisme

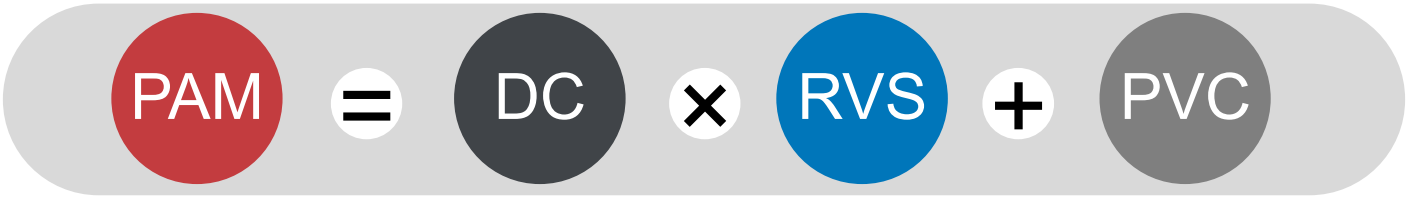
Pour être atteint, ceci nécessite **2 objectifs physiologiques** :

1. **Pression de perfusion adéquate** afin de « forcer » le sang dans les capillaires de tous les organes
2. **Débit sanguin (cardiaque) adapté** pour fournir de l'oxygène et des substrats, et éliminer le CO_2 et d'autres produits métaboliques



Système Circulatoire: Pression et Débit

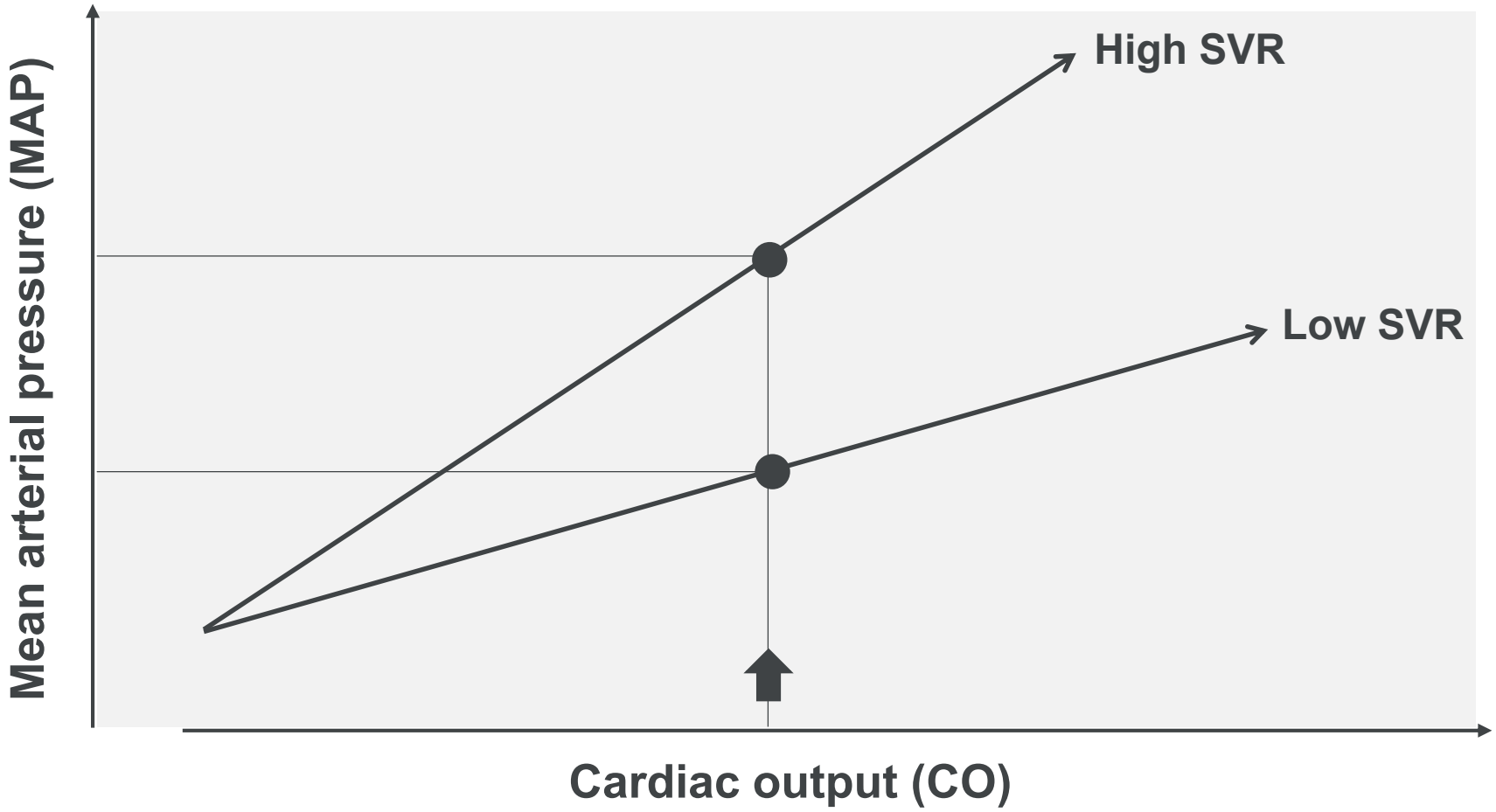
Relation entre Pression et Débit



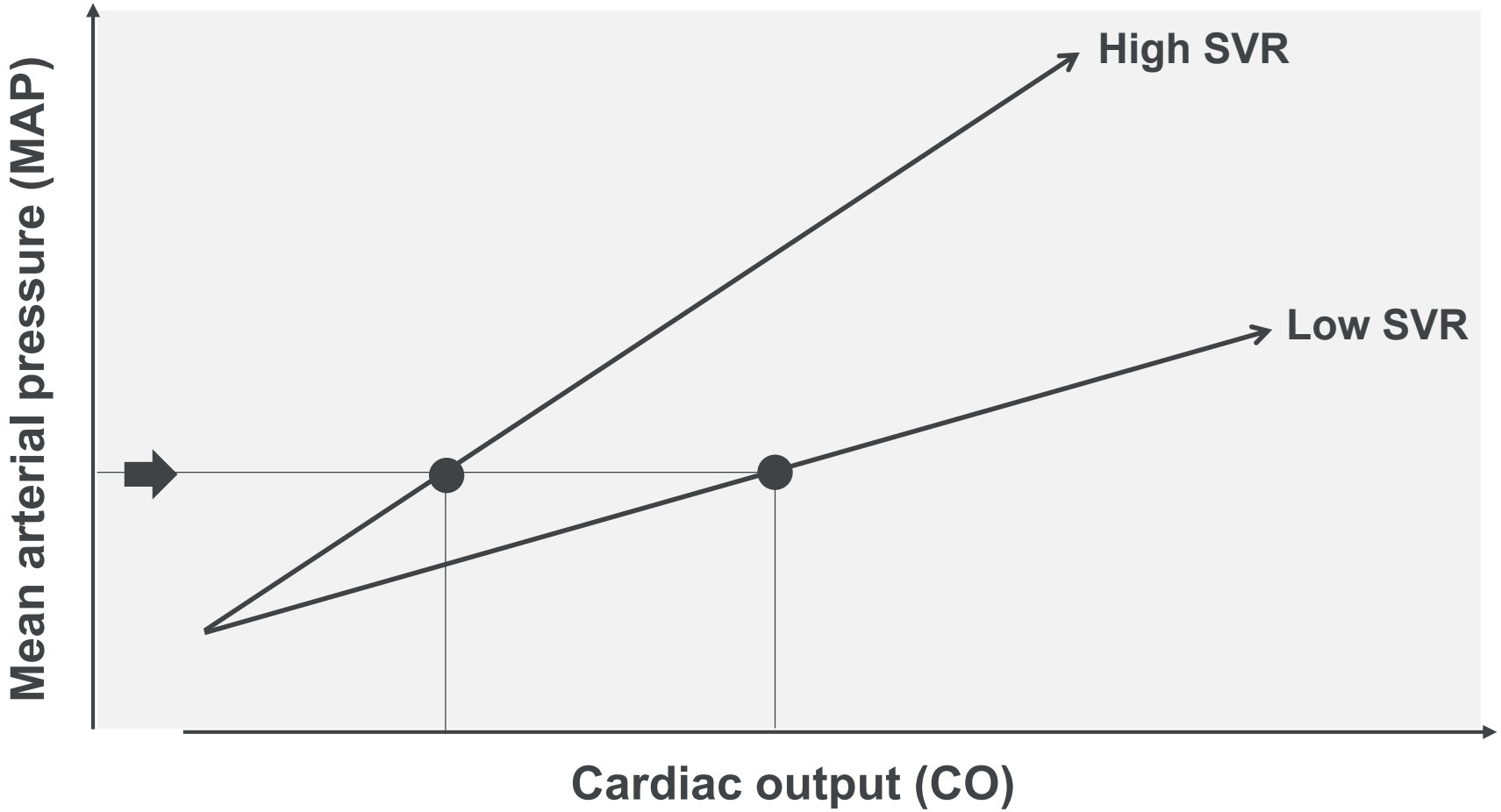
Une pression adéquate ne garanti pas un débit adéquat
(et vice versa)

Relation entre Pression et Débit : RVS

MAP = CO × SVR + CVP



Relation entre Pression et Débit : RVS

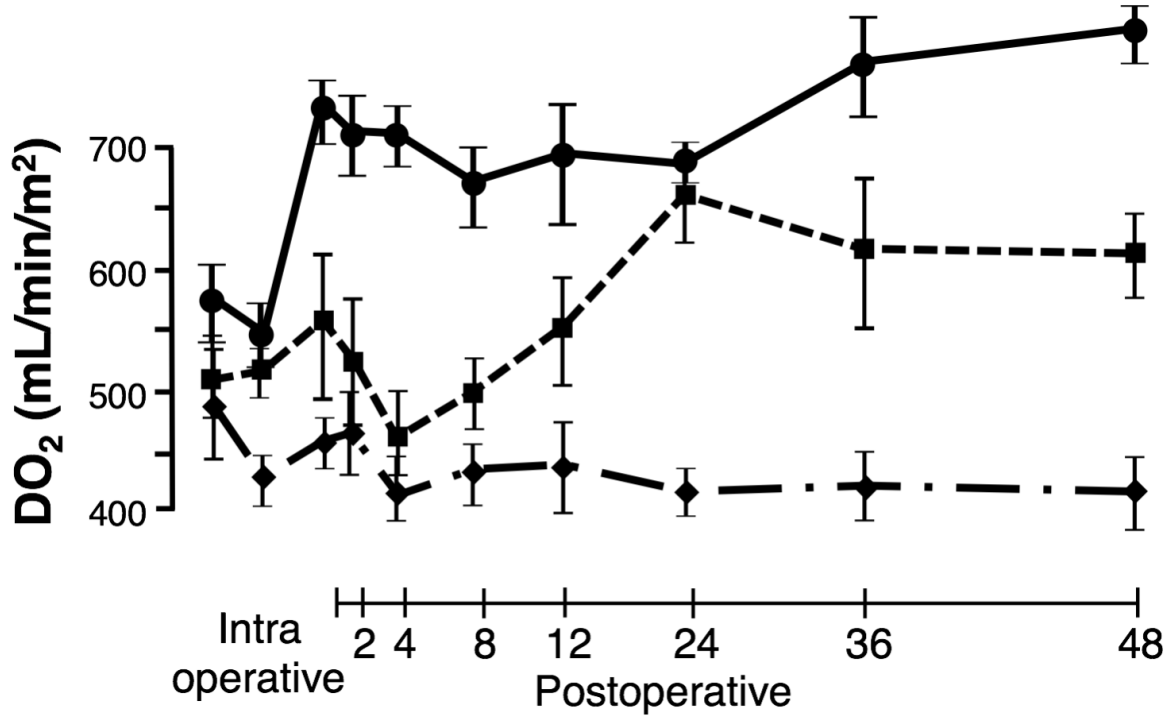


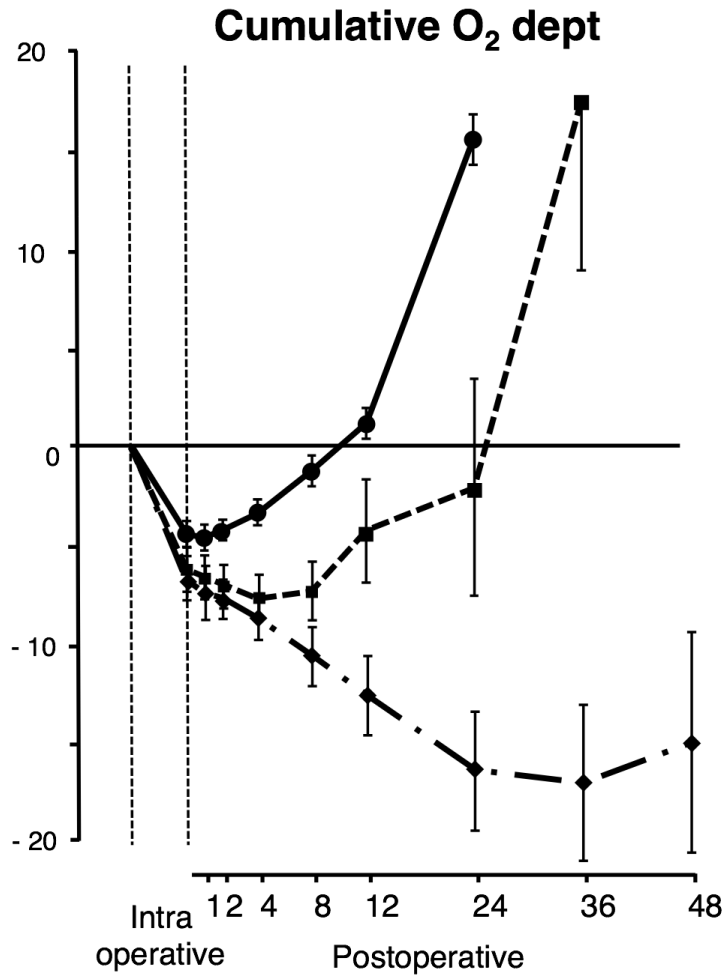
Message N°2 : Assurer une PAM et un DC adaptés

Role of Oxygen Debt in the Development of Organ Failure Sepsis, and Death in High-Risk Surgical Patients

AMERICAN COLLEGE OF CHEST PHYSICIANS®
Chest 1992; 102:208-15

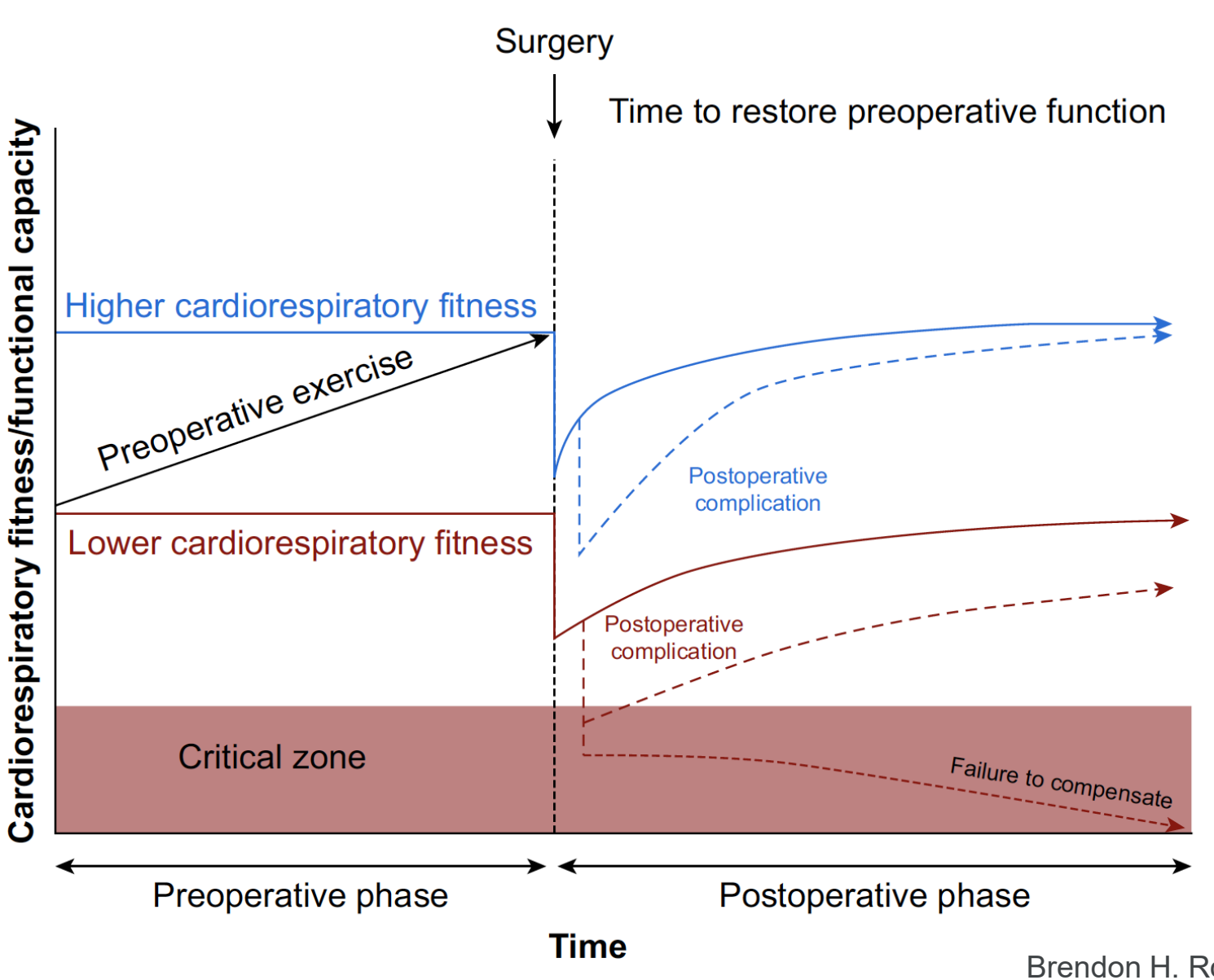
William C. Shoemaker, M.D.; Paul L. Appel, M.P.A.; and Harry B. Kram, M.D.





Survivors without complications
Survivors with complications and/or organ failure
Non survivors

High Risk Surgical Patient?



Higher cardiorespiratory fitness

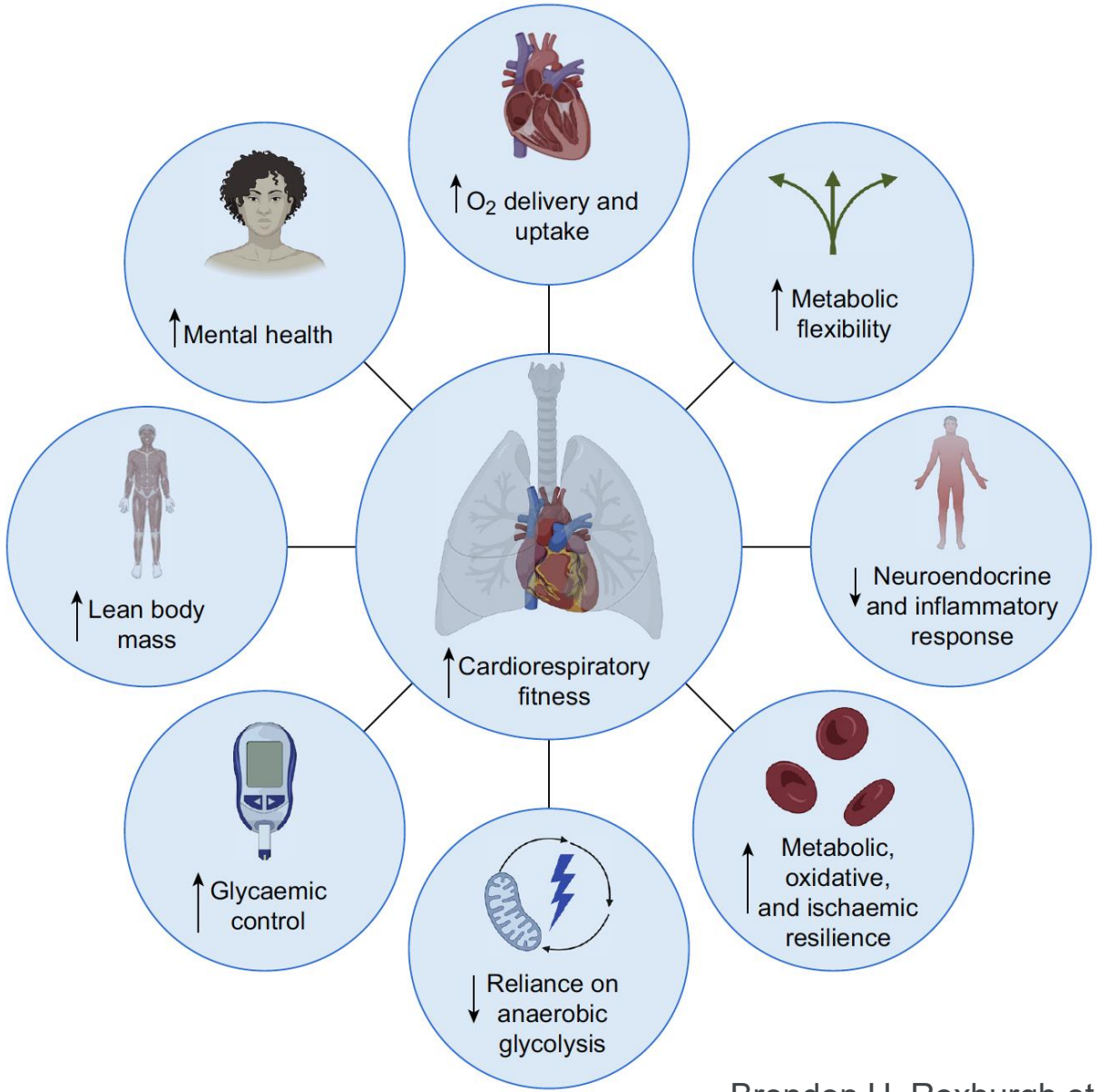
- Greater capacity/resilience to withstand complications
- Quicker rate of recovery to preoperative fitness/function

Lower cardiorespiratory fitness

- Lower capacity/resilience to withstand complications
- Slower rate of recovery to preoperative fitness/function

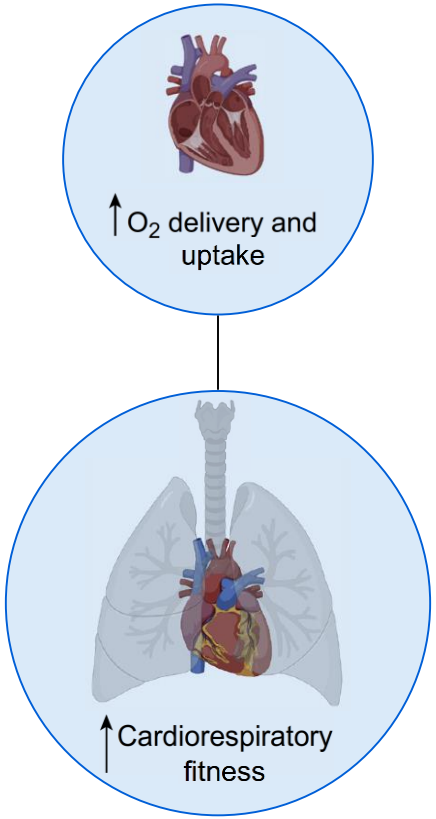
Brendon H. Roxburgh et al. Br J Anaesth 2023, 130 (2): 122-132

High Risk Surgical Patient?



Brendon H. Roxburgh et al. Br J Anaesth 2023, 130 (2): 122-132

High Risk Surgical Patient?

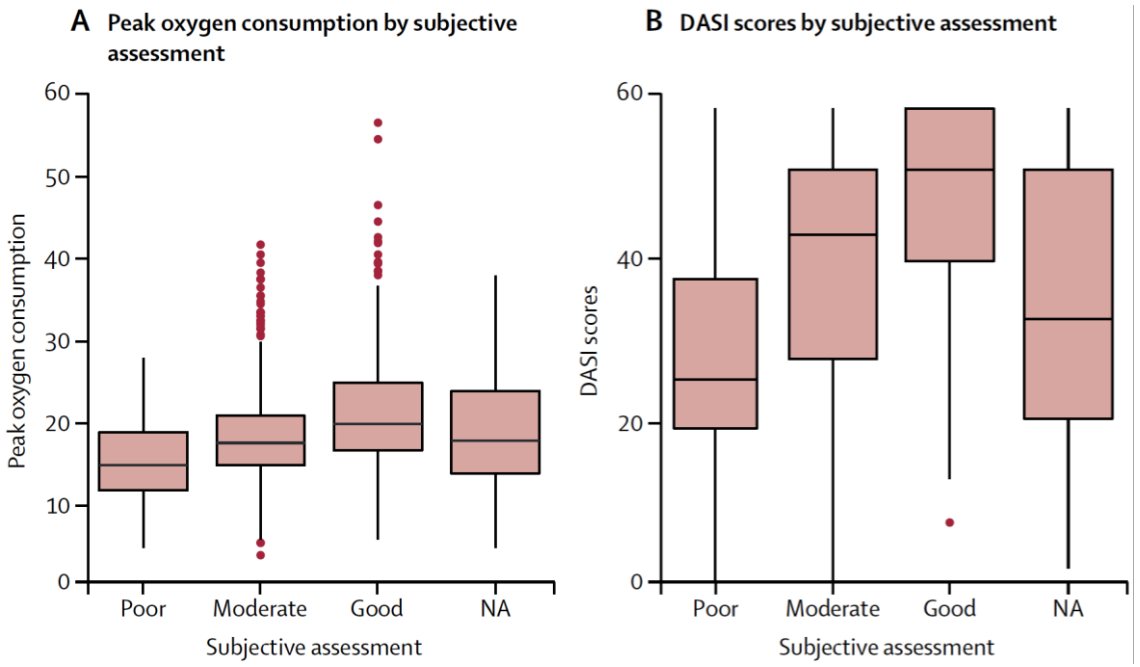


Brendon H. Roxburgh et al. Br J Anaesth 2023, 130 (2): 122-132

Assessment of functional capacity before major non-cardiac surgery: an international, prospective cohort study

Duminda N Wijeysundera, Rupert M Pearse, Mark A Shulman, Tom E F Abbott, Elizabeth Torres, Althea Ambosta, Bernard L Croal, John T Granton, Kevin E Thorpe, Michael P W Grocott, Catherine Farrington, Paul S Myles, Brian H Cuthbertson, on behalf of the METS study investigators

- Multicentre, international, prospective study (25 hospitals)
- N=1401 patients ≥40 years, major non-cardiac surgery, and deemed to have one or more risk factors for cardiac complications (eg, a history of heart failure, stroke, or diabetes) or coronary artery disease
- Functional capacity subjectively assessed preoperatively in METs by the responsible anesthesiologists and graded as poor (<4), moderate (4–10), or good (>10)
- All participants had DASI questionnaire and CPET (VO_2max)
- **Primary outcome**: death or myocardial infarction within 30 days after surgery



DASI score showed significant adjusted **associations with death or myocardial infarction** 30 days after surgery

Lancet 2018; 391: 2631–40

Duke Activity Status Index (DASI)

Estimates functional capacity

Is the patient able to:

Take care of self e.g. eating, dressing, bathing, using the toilet	No 0	Yes +2.75
Walk indoors	No 0	Yes +1.75
Walk 1–2 blocks on level ground	No 0	Yes +2.75
Climb a flight of stairs or walk up a hill	No 0	Yes +5.5
Run a short distance	No 0	Yes +8
Do light work around the house e.g. dusting, washing dishes	No 0	Yes +2.7
Do moderate work around the house e.g. vacuuming, sweeping floors, carrying in groceries	No 0	Yes +3.5
Do heavy work around the house e.g. scrubbing floors, lifting or moving heavy furniture	No 0	Yes +8
Do yardwork e.g. raking leaves, weeding, pushing a power mower	No 0	Yes +4.5
Have sexual relations	No 0	Yes +5.25
Participate in moderate recreational activities e.g. golf, bowling, dancing, doubles tennis, throwing a baseball or football	No 0	Yes +6
Have sexual relations	No 0	Yes +5.25
Participate in moderate recreational activities e.g. golf, bowling, dancing, doubles tennis, throwing a baseball or football	No 0	Yes +6
Participate in strenuous sports e.g. swimming, singles tennis, football, basketball, skiing	No 0	Yes +7.5

58.2 points

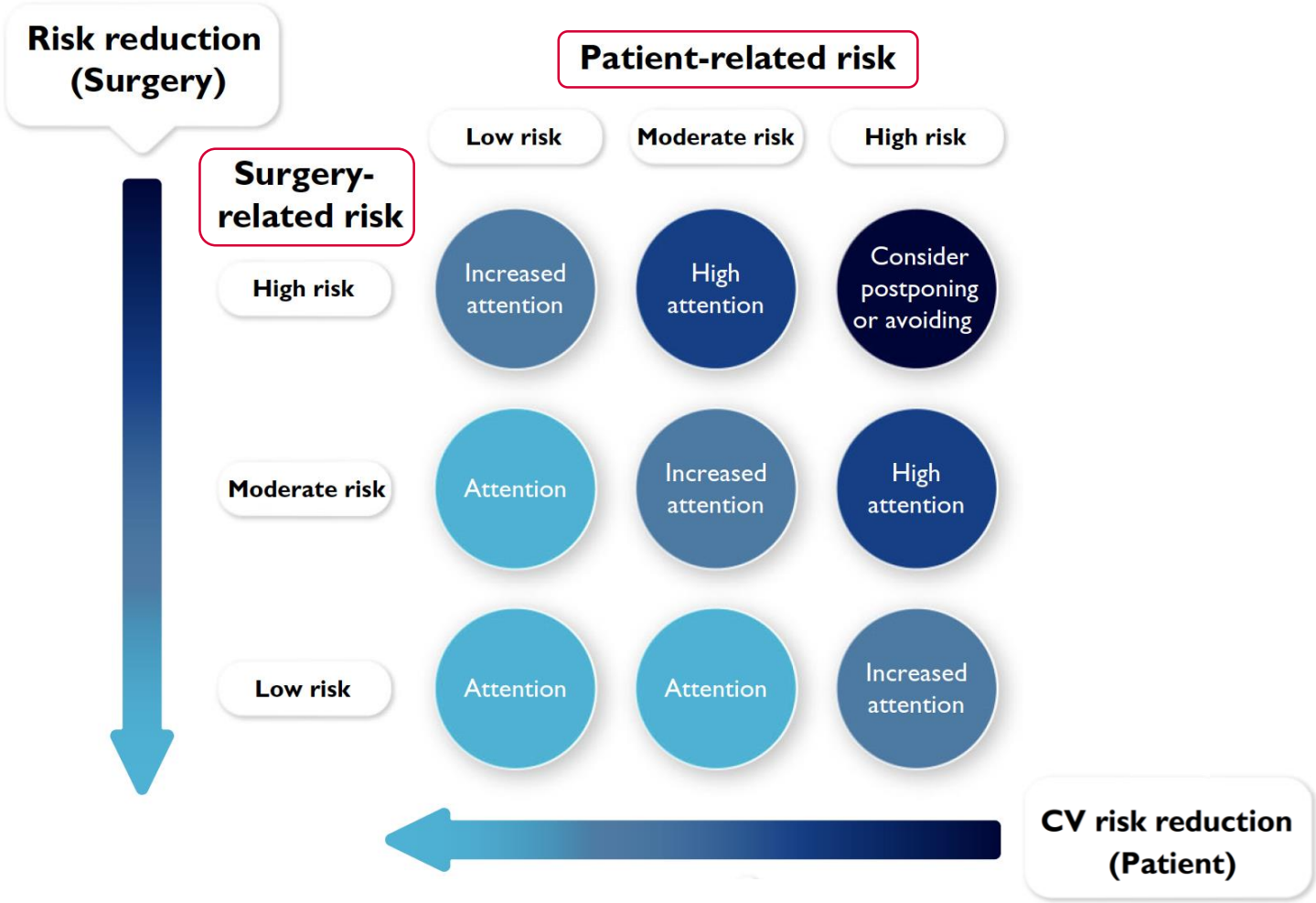
The higher the score (maximum 58.2), the higher the functional status.

9.89 METs

Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

Endorsed by the European Society of Anaesthesiology and Intensive Care (ESAIC)



Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

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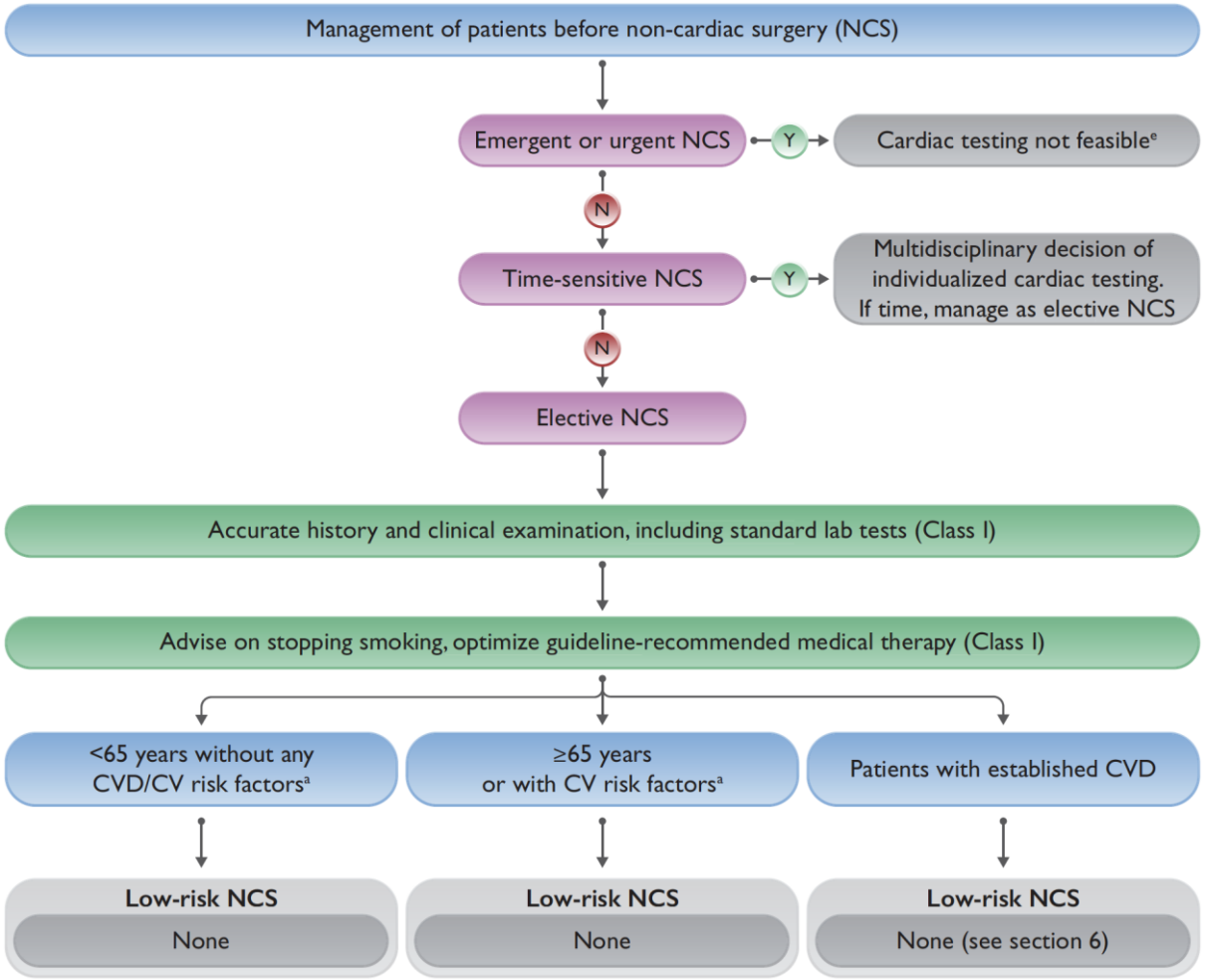
Table 5 Surgical risk estimate according to type of surgery or intervention

Low surgical risk (<1%)	Intermediate surgical risk (1–5%)	High surgical risk (>5%)
• Breast	• Carotid asymptomatic (CEA or CAS)	• Adrenal resection
• Dental	• Carotid symptomatic (CEA)	• Aortic and major vascular surgery
• Endocrine: thyroid	• Endovascular aortic aneurysm repair	• Carotid symptomatic (CAS)
• Eye	• Head or neck surgery	• Duodenal-pancreatic surgery
• Gynaecological: minor	• Intraperitoneal: splenectomy, hiatal hernia repair, cholecystectomy	• Liver resection, bile duct surgery
• Orthopaedic minor (meniscectomy)	• Intrathoracic: non-major	• Oesophagectomy
• Reconstructive	• Neurological or orthopaedic: major (hip and spine surgery)	• Open lower limb revascularization for acute limb ischaemia or amputation
• Superficial surgery	• Peripheral arterial angioplasty	• Pneumonectomy (VATS or open surgery)
• Urological minor: (transurethral resection of the prostate)	• Renal transplants	• Pulmonary or liver transplant
• VATS minor lung resection	• Urological or gynaecological: major	• Repair of perforated bowel
		• Total cystectomy

Surgical risk estimate is a broad approximation of 30 day risk of CV death, MI, and stroke without considering the patient's comorbidities.

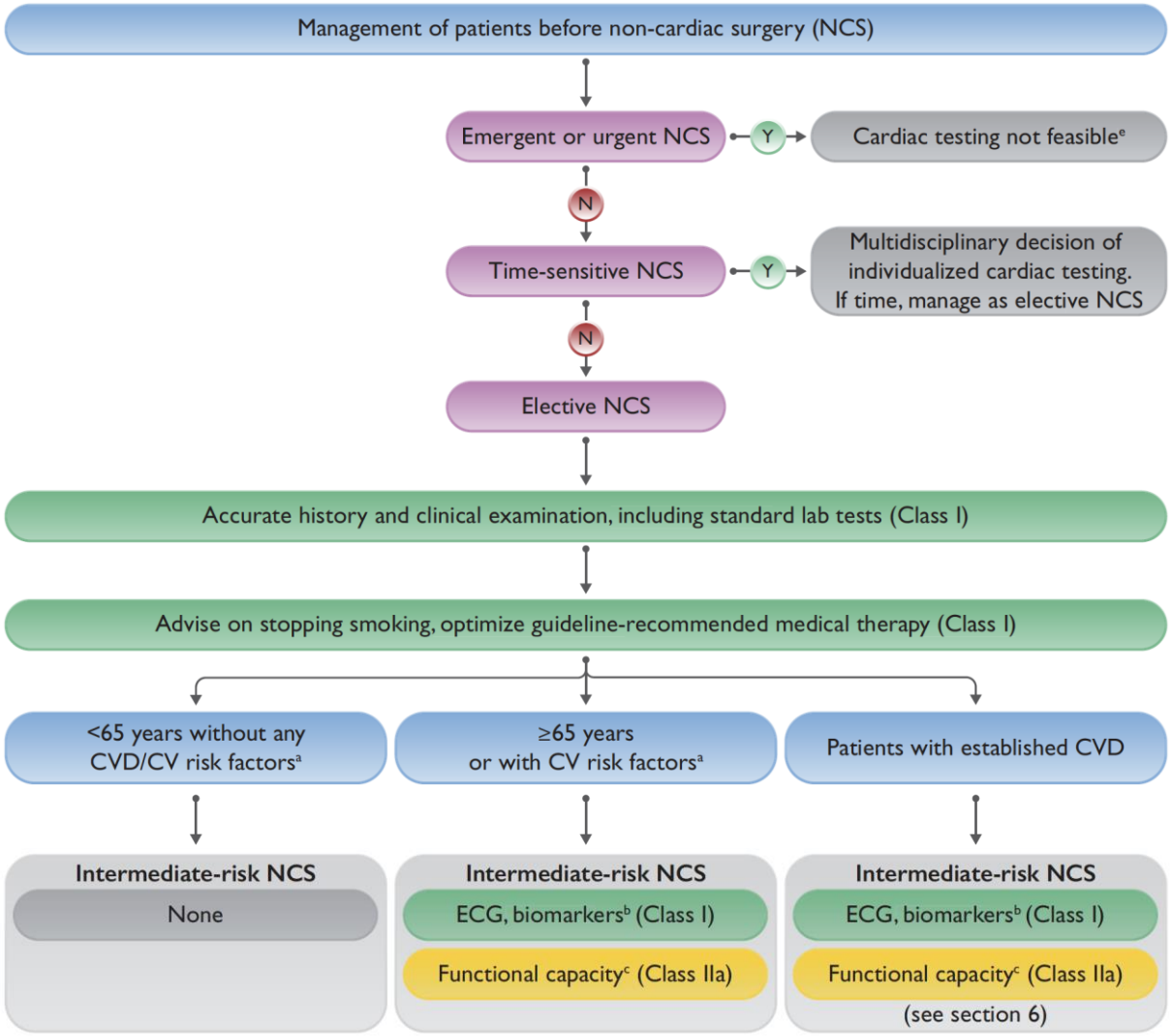
Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

Pre-operative assessment before non-cardiac surgery



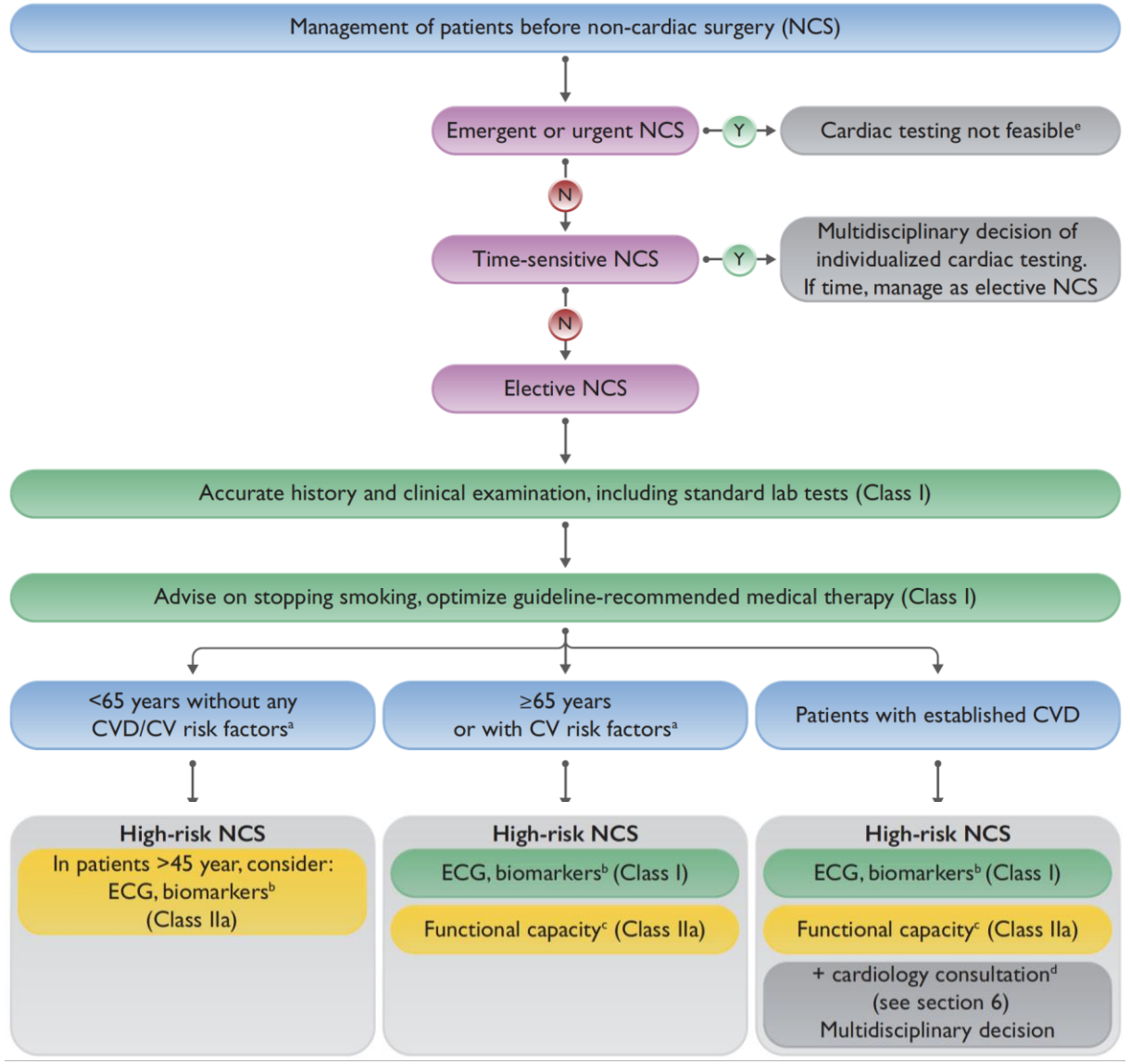
Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

Pre-operative assessment before non-cardiac surgery

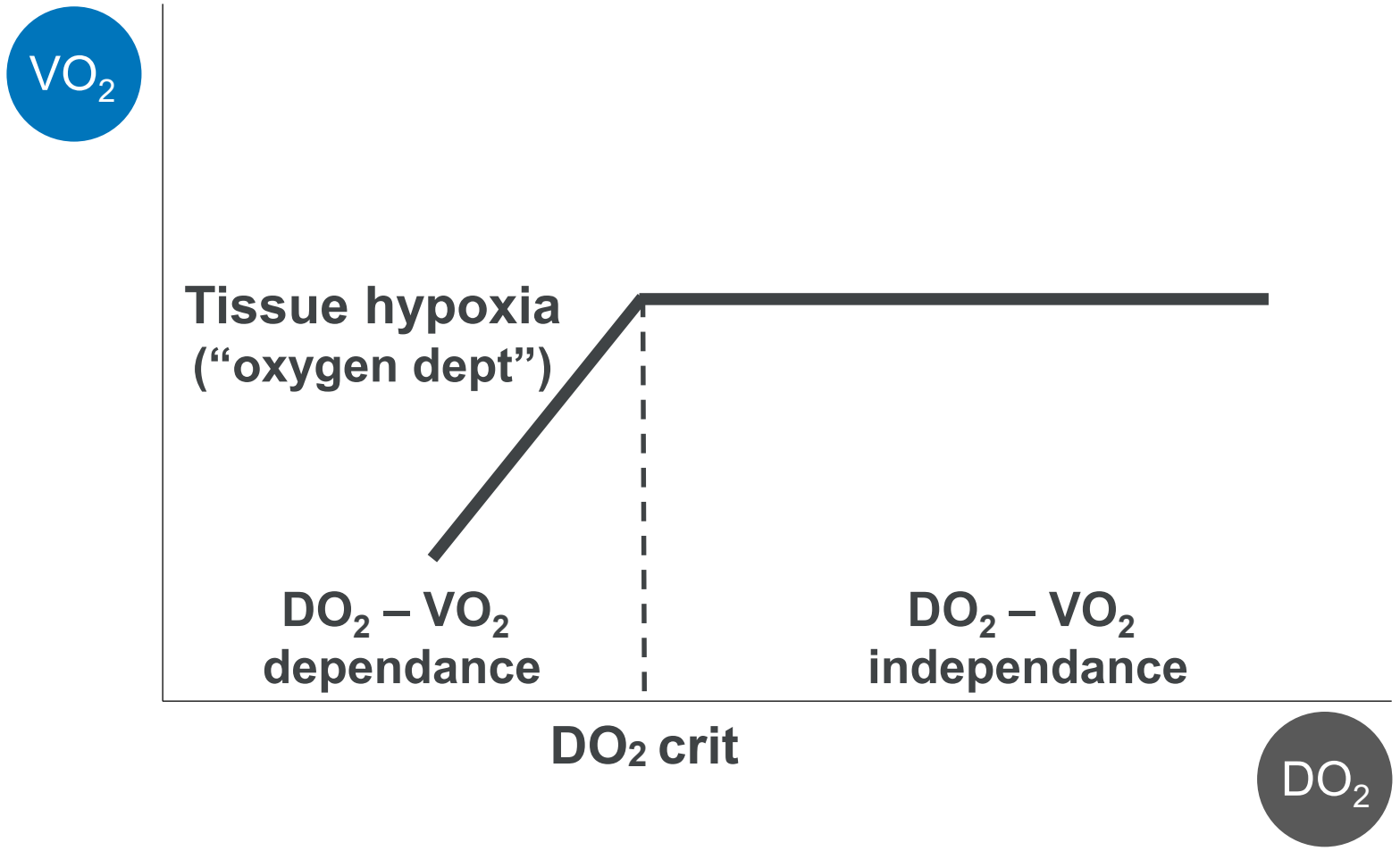


Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

Pre-operative assessment before non-cardiac surgery

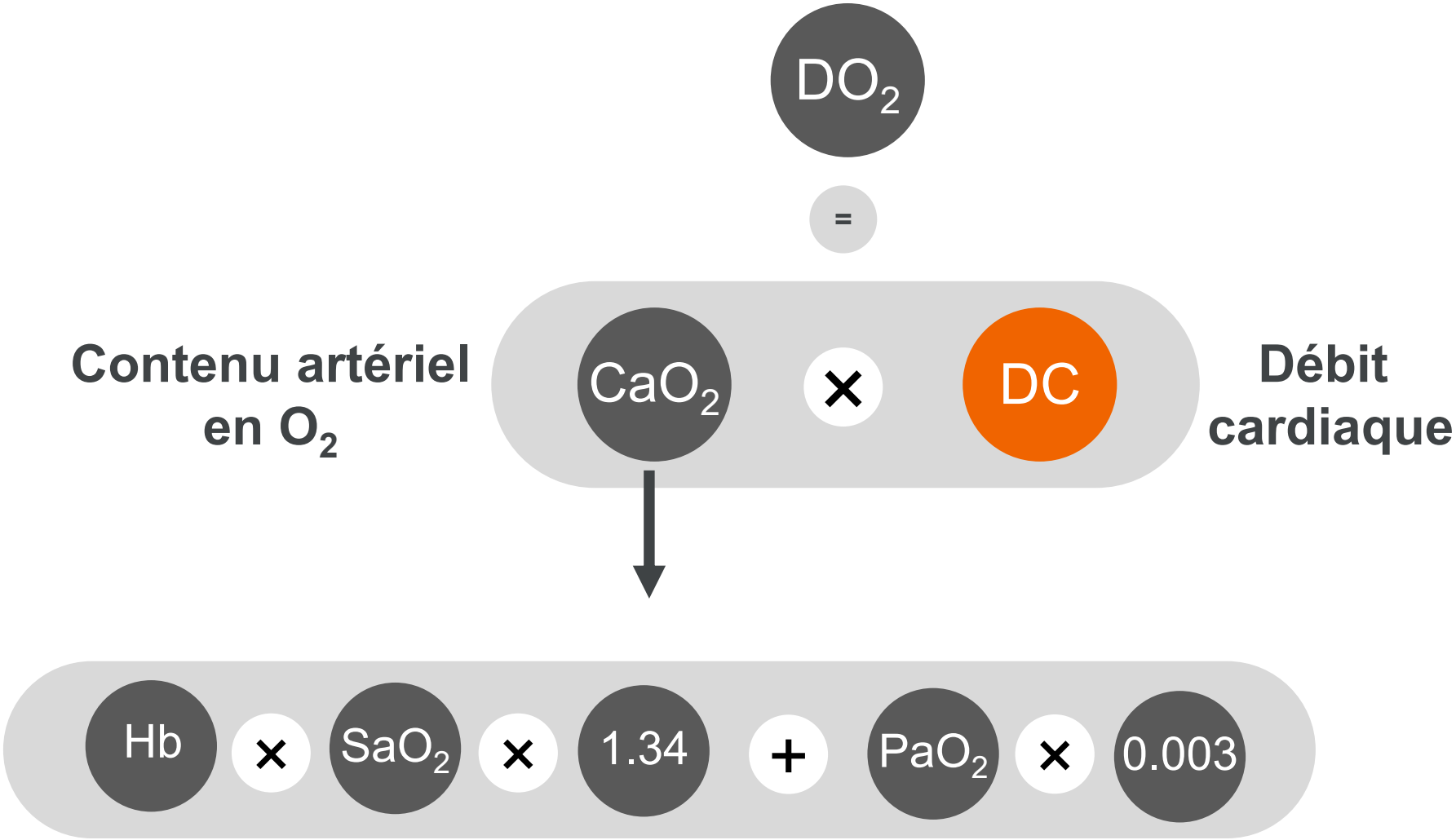


Relation DO_2 – VO_2



DO_2 = (Hb × SaO_2 × 1.34) × CO et **VO_2** = (CaO_2 - CvO_2) × CO

Transport artériel en O_2 (DO_2)



Débit cardiaque (DC)

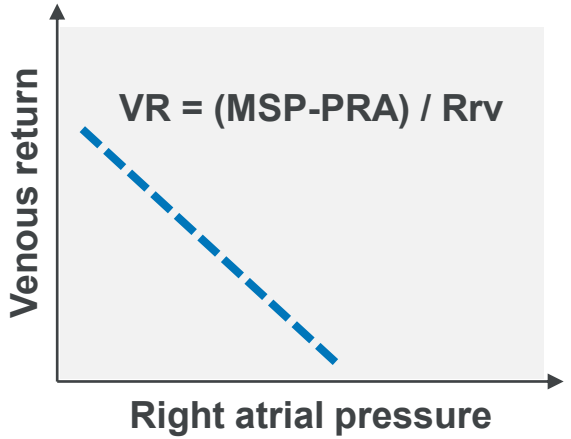
DC = FC × VES

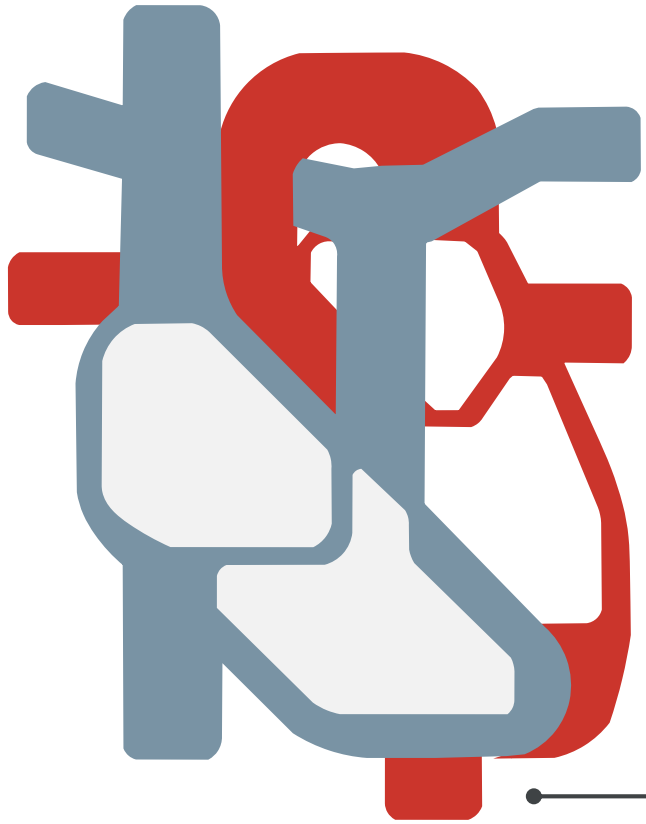
Précharge

Influencée par :

- **Retour veineux (VR)**
  - Volume sanguin
  - POD
- Compliance

VR = MSP − PRA ÷ RRV





Fréquence cardiaque

Inotropisme

Influencée par :

- SN sympathique
- SN parasympathique
- Dépression myocardique (agents anesthésiques, …)

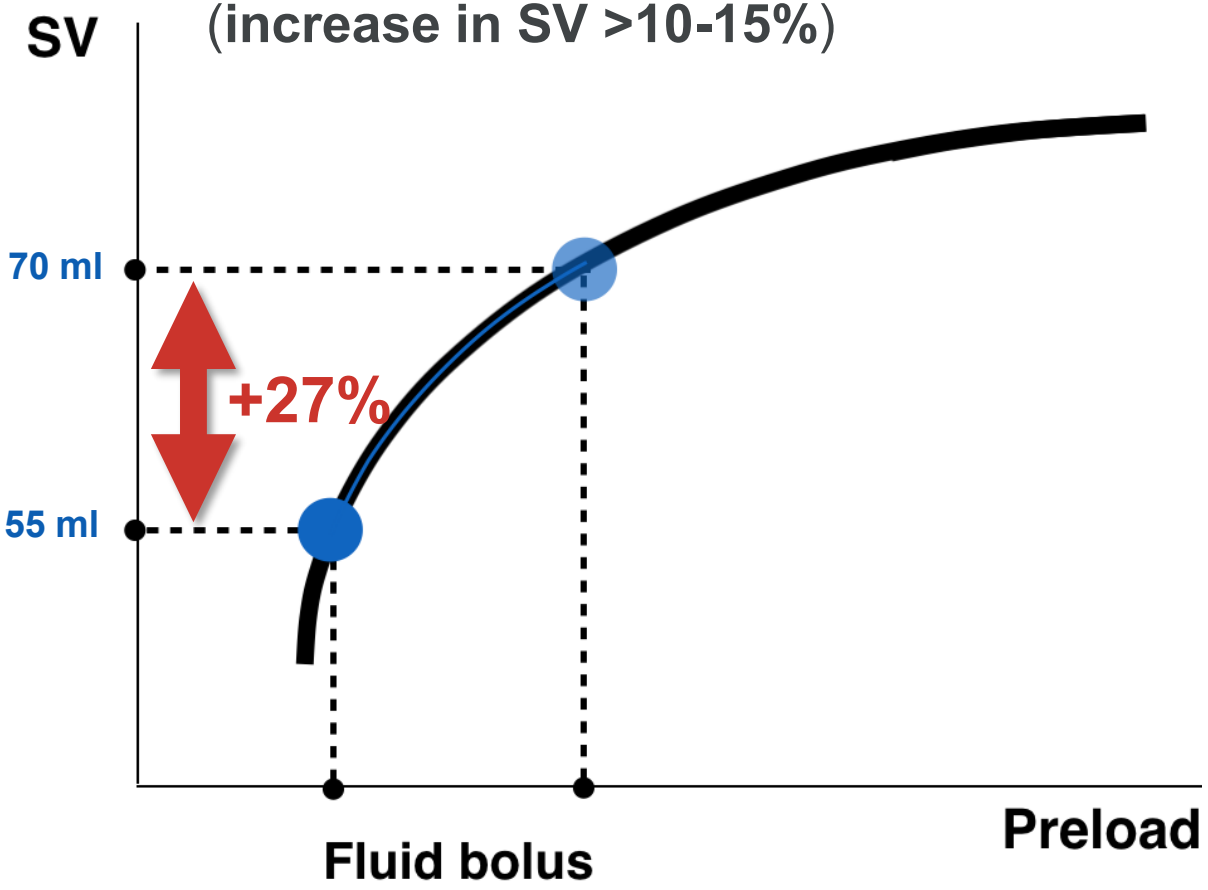
Postcharge

Influencée par :

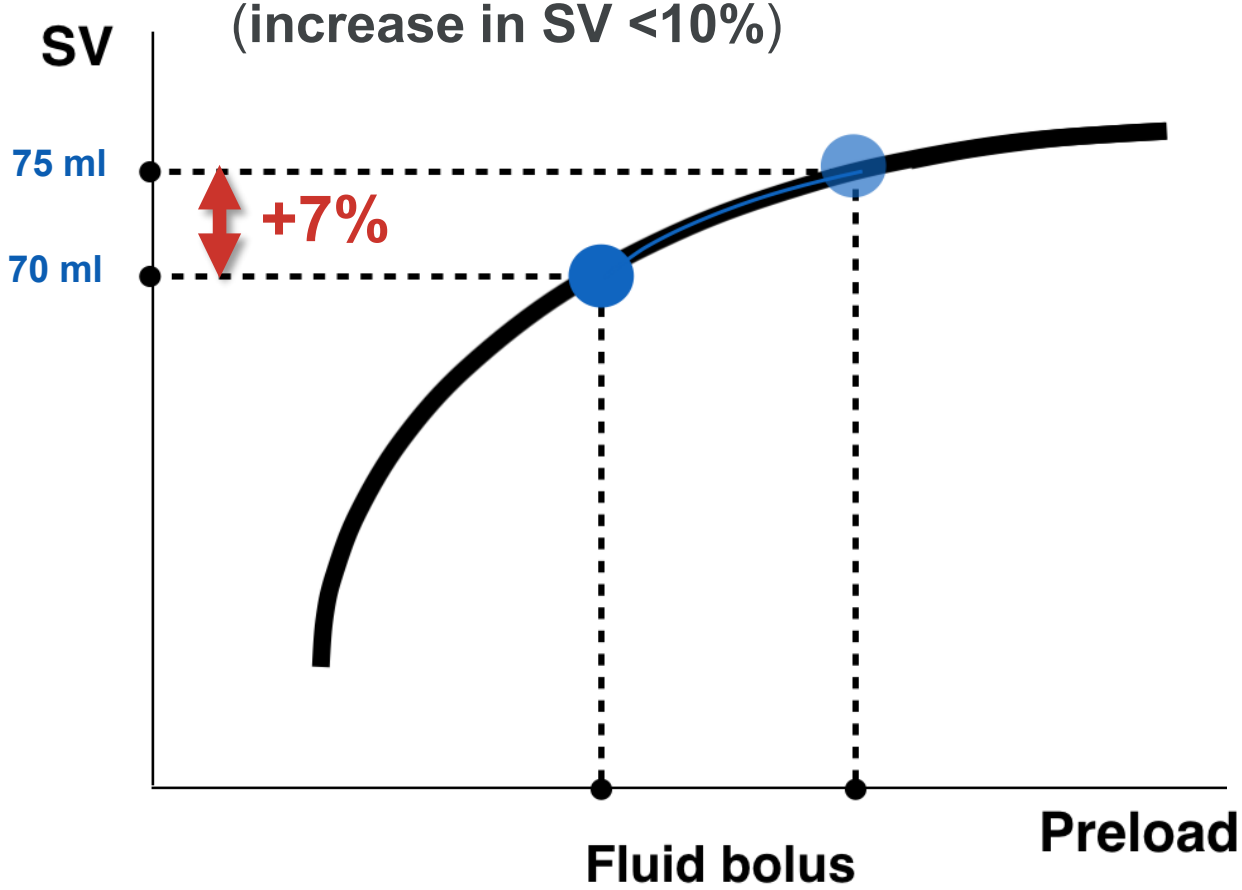
- Elasticité vasculaire
- Epaisseur paroi vasculaire
- Pression ventriculaire
- Pression intrathoracique

Stroke volume (SV) optimization

Response to fluid
Bolus (200 ± 50 ml): **POSITIVE**
(**increase in SV >10-15%**)



Response to fluid
Bolus (200 ± 50 ml): **NEGATIVE**
(**increase in SV <10%**)



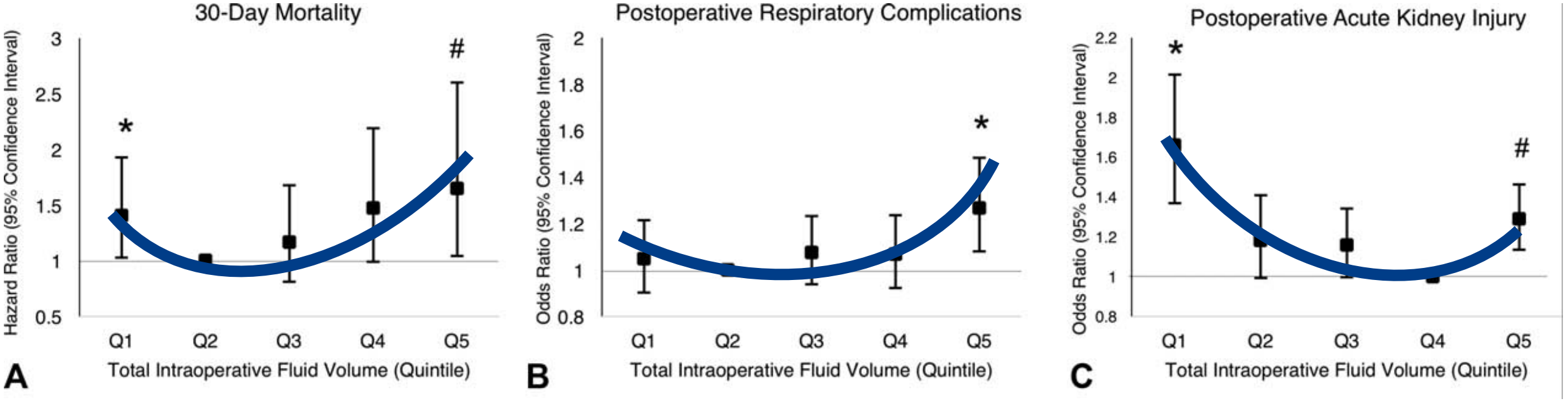
CO = HR × SV

Message N°3 : Administration guidée (VES et/ou DC) du remplissage vasculaire

Effects of Intraoperative Fluid Management on Postoperative Outcomes

Christina H. Shin, MD, Dustin R. Long, MD, Duncan McLean, MBChB, Stephanie D. Grabitz, Cand. Med, Karim Ladha, MD, MSc, Fanny P. Timm, Cand. Med, Tharusan Thevathasan, Cand. Med, Alberto Pieretti, MD, Cristina Ferrone, MD, Andreas Hoeft, MD, PhD, Thomas W. L. Scheeren, MD, PhD, Boyd Taylor Thompson, MD, Tobias Kurth, MD, ScD, and Matthias Eikermann, MD, PhD

- Data from 92,094 adult patients undergoing noncardiac surgery with endotracheal intubation
- Primary exposure variable: Total intraoperative volume of crystalloid and colloid
- **Primary outcome**: 30-day survival.
  Secondary outcomes: Respiratory complications within 3 postoperative days (pulmonary edema, reintubation, pneumonia, or respiratory failure) and AKI



Ann Surg. 2018 Jun;267(6):1084-1092

Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

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Recommendation Table 33 — Recommendations for peri-operative monitoring

Recommendations	Class[a]	Level[b]
In order to preserve optimal CV stability, it is recommended to apply goal-directed haemodynamic therapy in patients undergoing high-risk NCS.[614–618]	I	A

Assurer une PAM et un DC adaptés

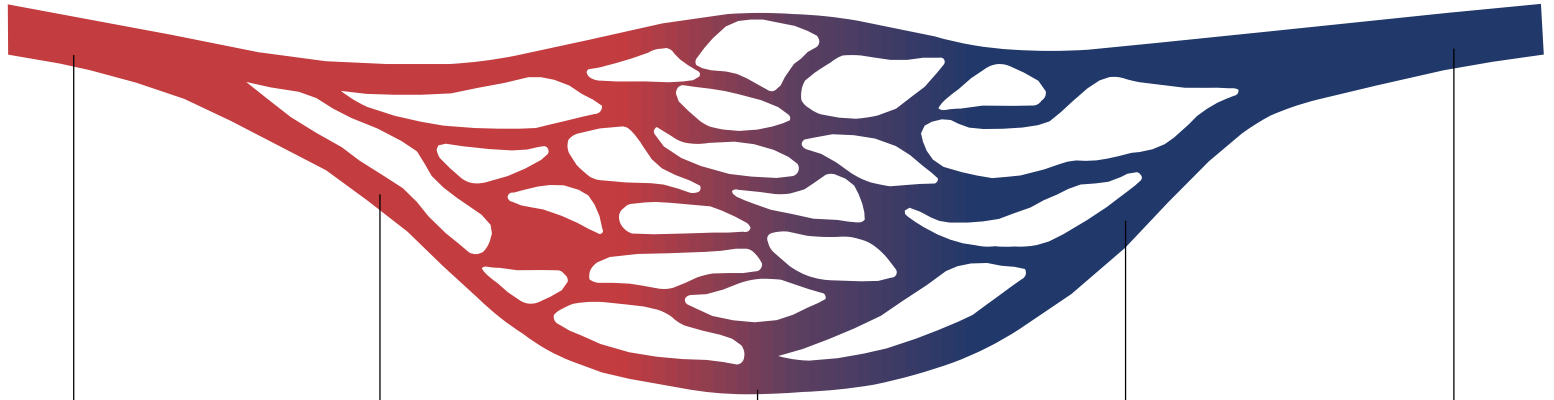
MAP: driving pressure of tissue perfusion

Mean perfusion pressure (MPP)

MAP - Pcc
Inflow pressure

Organ perfusion pressure

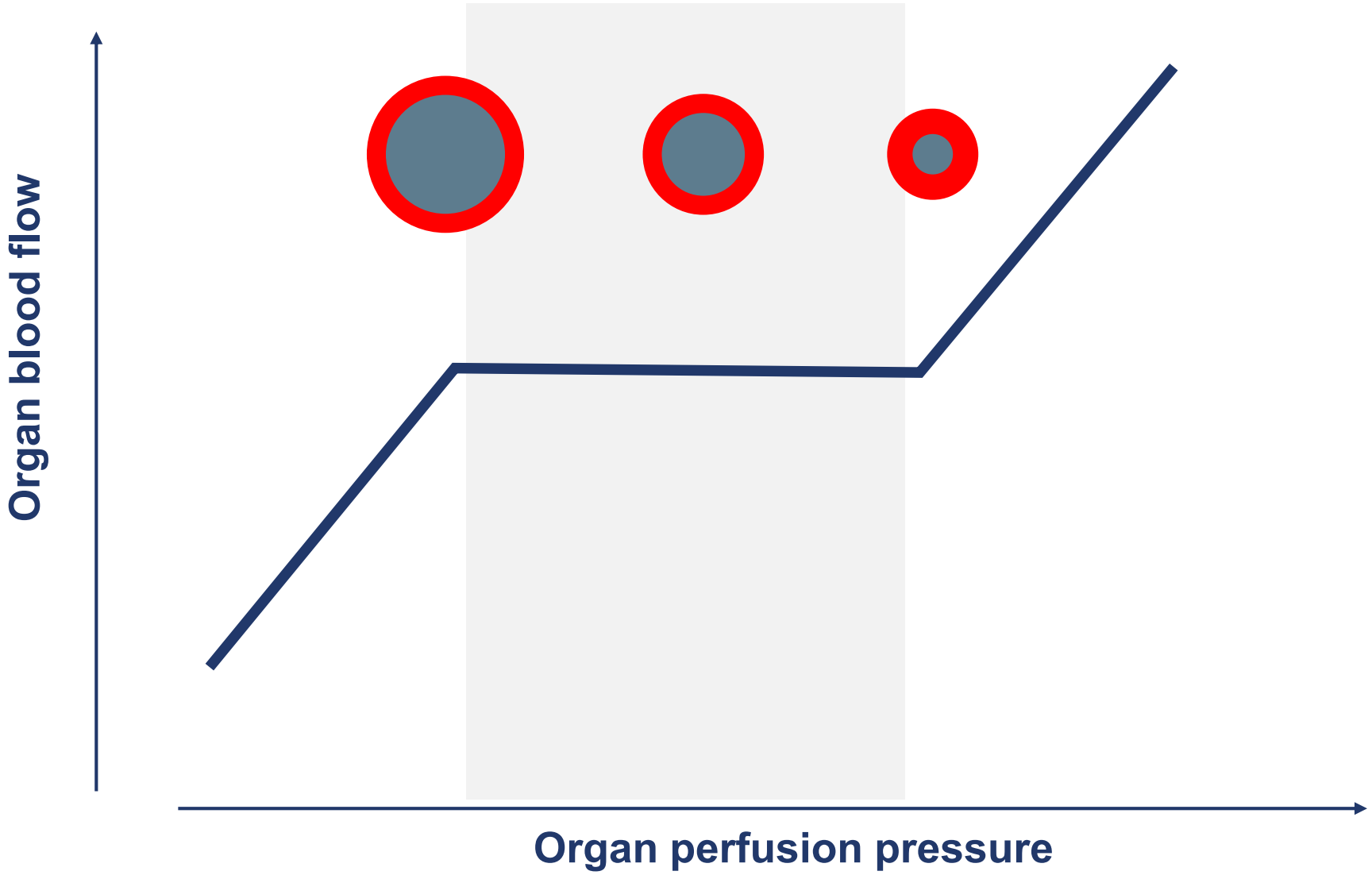
Pmsf - CVP
Outflow pressure



Artery | Arteriole | Capillaries | Venule | Vein

Curr Opin Crit Care 2018;24(6):554-559

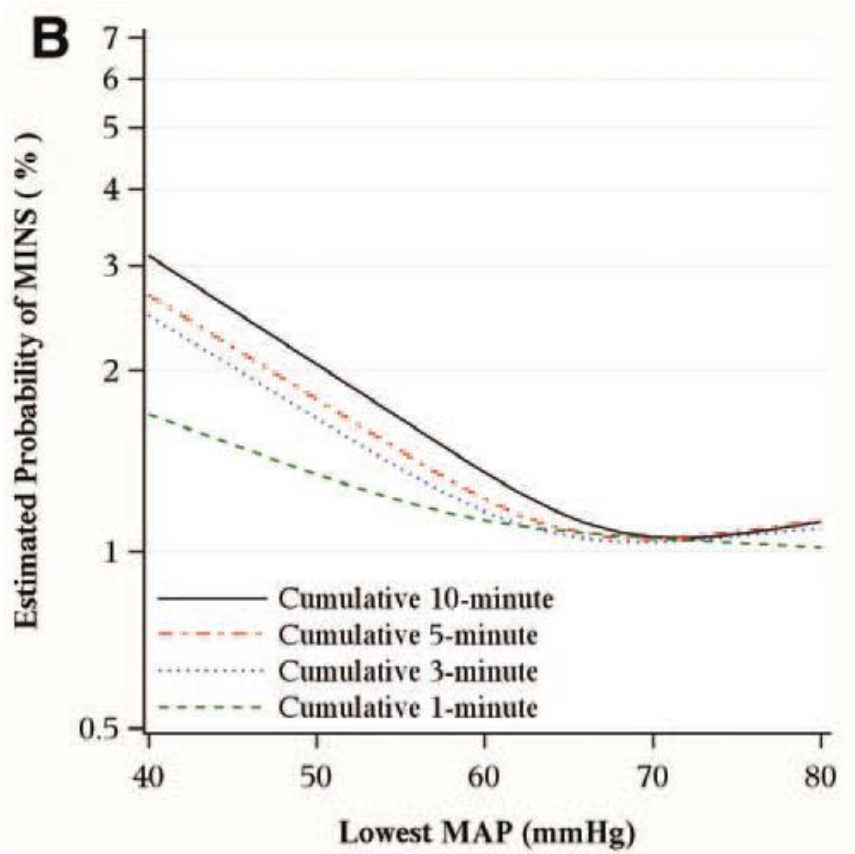
Organ pressure-flow autoregulation



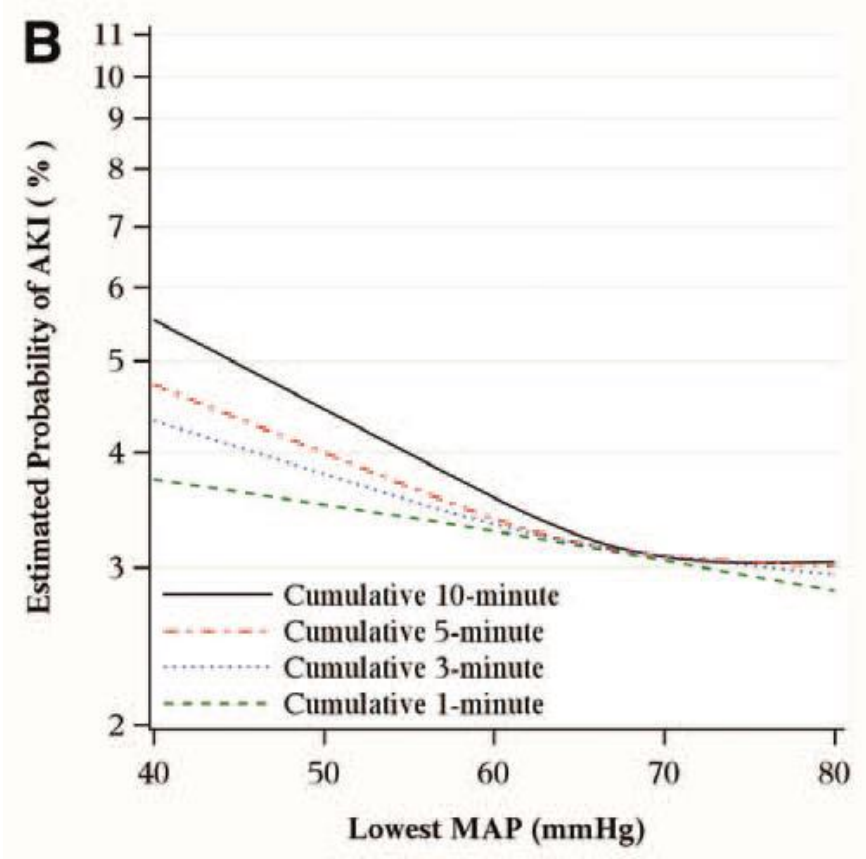
Relationship between Intraoperative Hypotension and Acute Kidney and Myocardial Injury after Noncardiac Surgery

Vafi Salmasi, M.D., Kamal Maheshwari, M.D., M.P.H., Dongsheng Yang, M.A.,
Edward J. Mascha, Ph.D., Asha Singh, M.D., Daniel I. Sessler, M.D., Andrea Kurz, M.D.

MINS



AKI

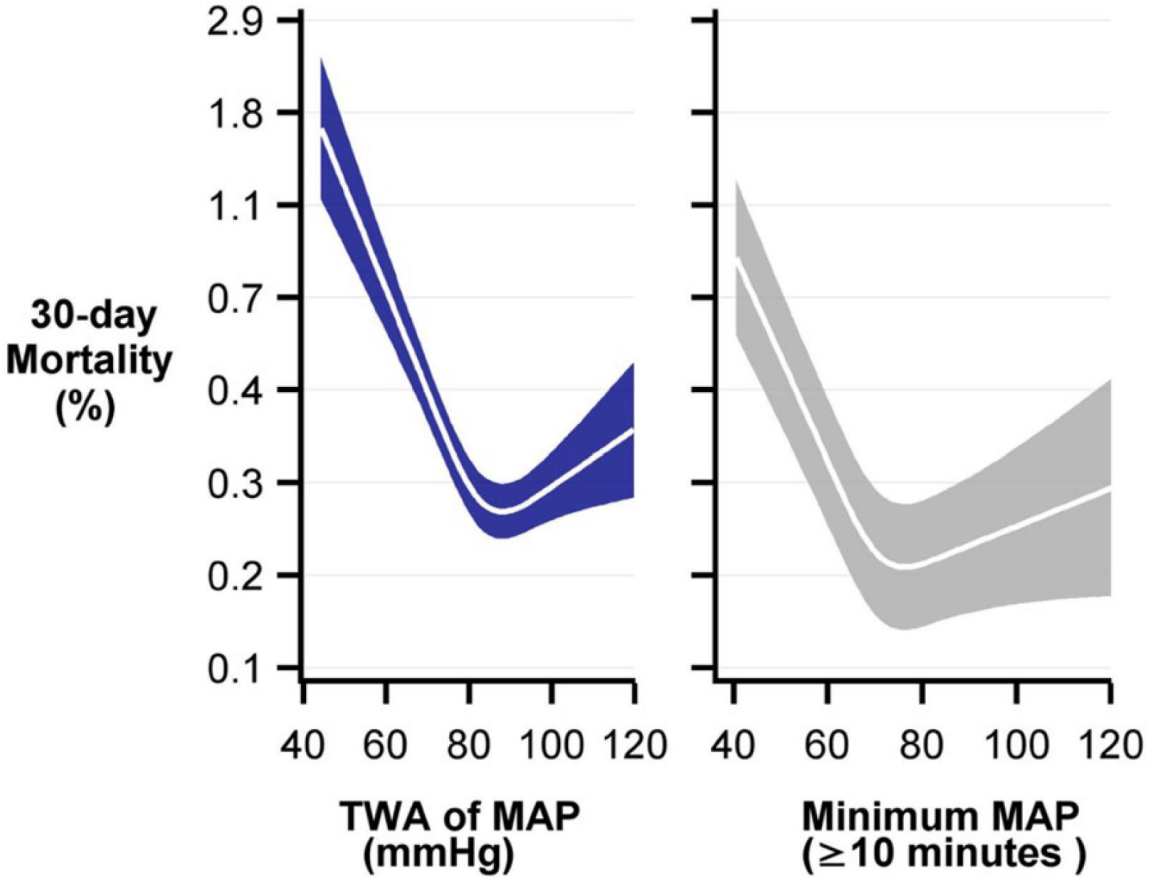


ANESTHESIOLOGY 2017; 126:47-65

Intraoperative Mean Arterial Pressure Variability and 30-day Mortality in Patients Having Noncardiac Surgery

Edward J. Mascha, Ph.D., Dongsheng Yang, M.S., Stephanie Weiss, M.D., Daniel I. Sessler, M.D.

- Retrospective cohort analysis of 104,401 noncardiac adults patients
- Surgery lasting 60 min or longer



Risk increases when minimum MAP is < 70 mmHg for 10 min or more

Anesthesiology 2015; 123:79-91

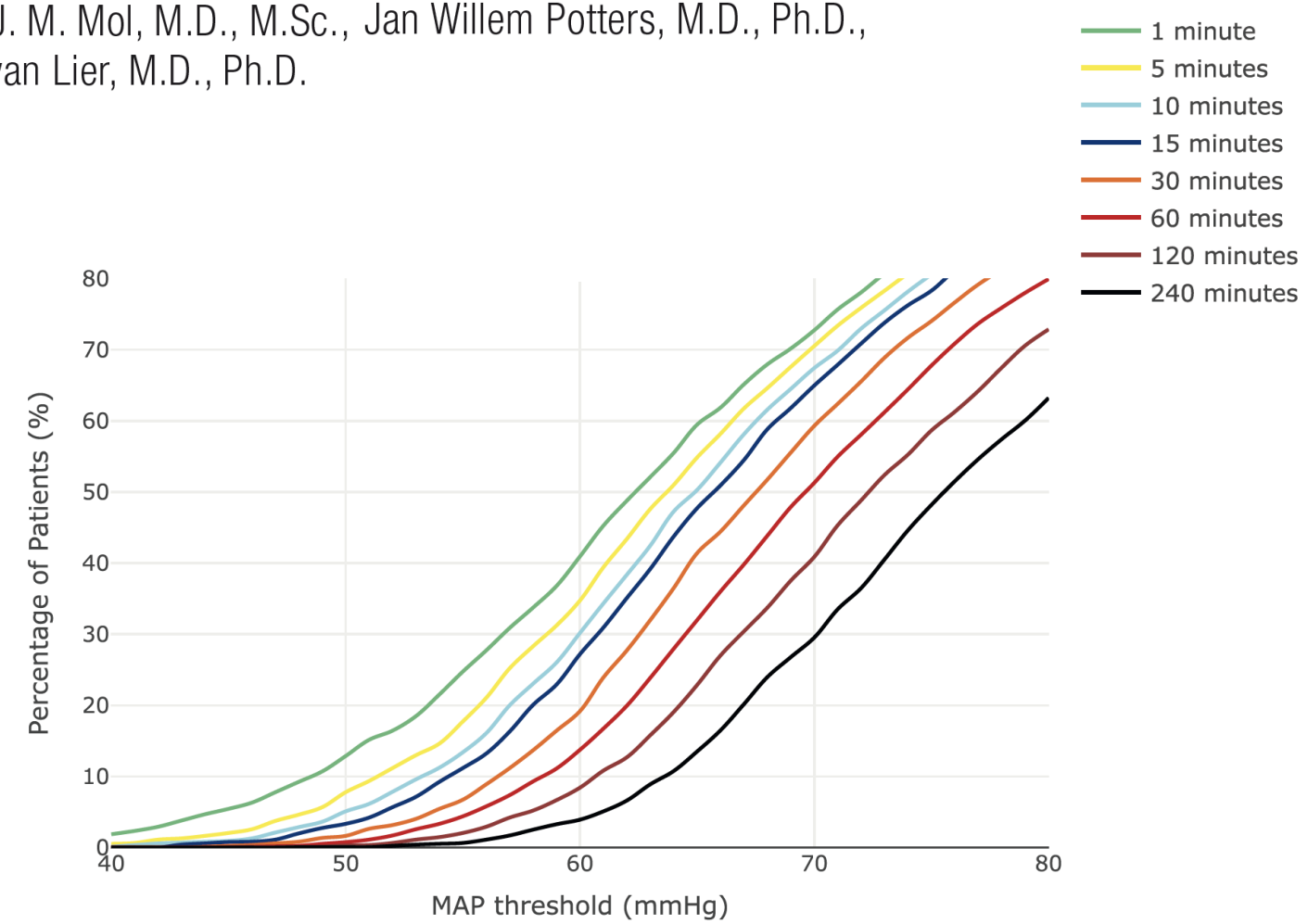
ANESTHESIOLOGY

Postoperative Hypotension after Noncardiac Surgery and the Association with Myocardial Injury

Victor G. B. Liem, M.D., M.Sc., Sanne E. Hoeks, Ph.D., Kristin H. J. M. Mol, M.D., M.Sc., Jan Willem Potters, M.D., Ph.D., Frank Grüne, M.D., Ph.D., Robert Jan Stolker, M.D., Ph.D., Felix van Lier, M.D., Ph.D.

Observational cohort
N=1710 patients aged ≥60 yr undergoing intermediate- to high-risk noncardiac surgery

Cumulative durations of 2 to 4 h **below a MAP threshold of 60** and durations of more than 4 h **less than 65 mmHg** were associated with myocardial injury



Anesthesiology. 2020 Sep;133(3):510-522

Perioperative Quality Initiative consensus statement on intraoperative blood pressure, risk and outcomes for elective surgery

Daniel I. Sessler[1,*,†], Joshua A. Bloomstone[2,3,4,9,†], Solomon Aronson[5], Colin Berry[6], Tong J. Gan[7], John A. Kellum[8], James Plumb[11,12,13], Monty G. Mythen[9,10], Michael P. W. Grocott[9,11,12,13], Mark R. Edwards[11,12,13], Timothy E. Miller[5,9], the Perioperative Quality Initiative-3 workgroup[‡]

Consensus statements

Consensus statement 1: *Intraoperative mean arterial blood pressures below 60–70 mm Hg are associated with myocardial injury, acute kidney injury, and death. Systolic arterial pressures below 100 mm Hg are associated with myocardial injury and death. Injury is a function of hypotension severity and duration.*

British Journal of Anaesthesia, 122 (5): 563–574 (2019)

Sigrun Halvorsen et al. European Heart Journal 2022; 43, 3826–3924

2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery

Endorsed by the European Society of Anaesthesiology and Intensive Care (ESAIC)

Recommendation Table 33 — Recommendations for peri-operative monitoring

Recommendations	Class[a]	Level[b]
In order to minimize the risk of post-operative organ dysfunction, it is recommended to avoid an intra-operative mean arterial pressure decrease of >20% from baseline values or <60–70 mmHg for ≥10 min.[214,600–602,634]	I	B

Arterial Hypotension: different mechanisms

Decrease in SVR and/or CO

Loss of vascular tone

Sedation
Anesthetic drugs
Inflammation
Spinal anesthesia
Associated

Abnormal vascular tone

Age
Diabetes
Anesthetic drugs
Inflammation
Associated

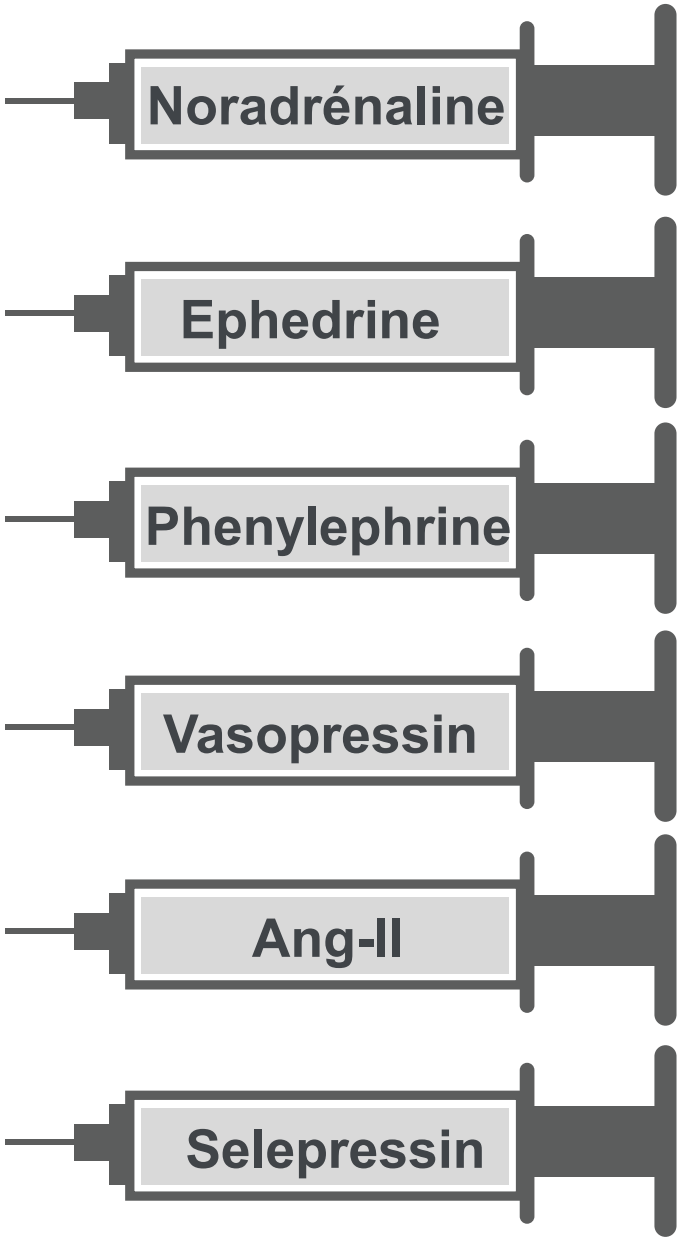
Cardiac Dysfunction

RV dysfunction
Pulmonary hypertension
Chronic LV failure
Arrhythmia

Acute Hypovolemia

Acute bleeding
Vascular leak
Surgical clamping
Excessive fluid

Vasopresseurs : Arsenal Thérapeutique



Récepteurs α1/β1, β2 adrénergique

Récepteurs α1/β1 adrénergique

Récepteurs α1 adrénergique (agoniste selectif)

Récepteurs $V1_A$/$V1_B$,V2 vasopressinergique

Récepteurs AT-1

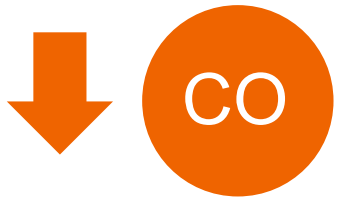
Récepteurs $V1_A$ vasopressinergique (agoniste selectif)

Phenylephrine vs Norepinephrine

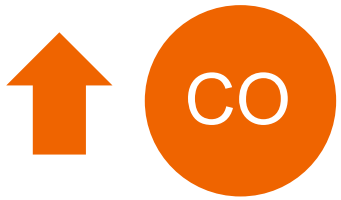
Pharmacology	α1 (selective)	α1, β1 > β2
Blood pressure	++	++
Heart rate	↓	± or ↑
SVR	↑	↑
Contractility	± or↓	↑
Venous resistance	↑	↓
Cardiac output	↓	↑

Vasopresseurs : Effet sur le débit cardiaque

Vasopressor
(α-1 adrenergic agonist)



Inotropic vasopressor



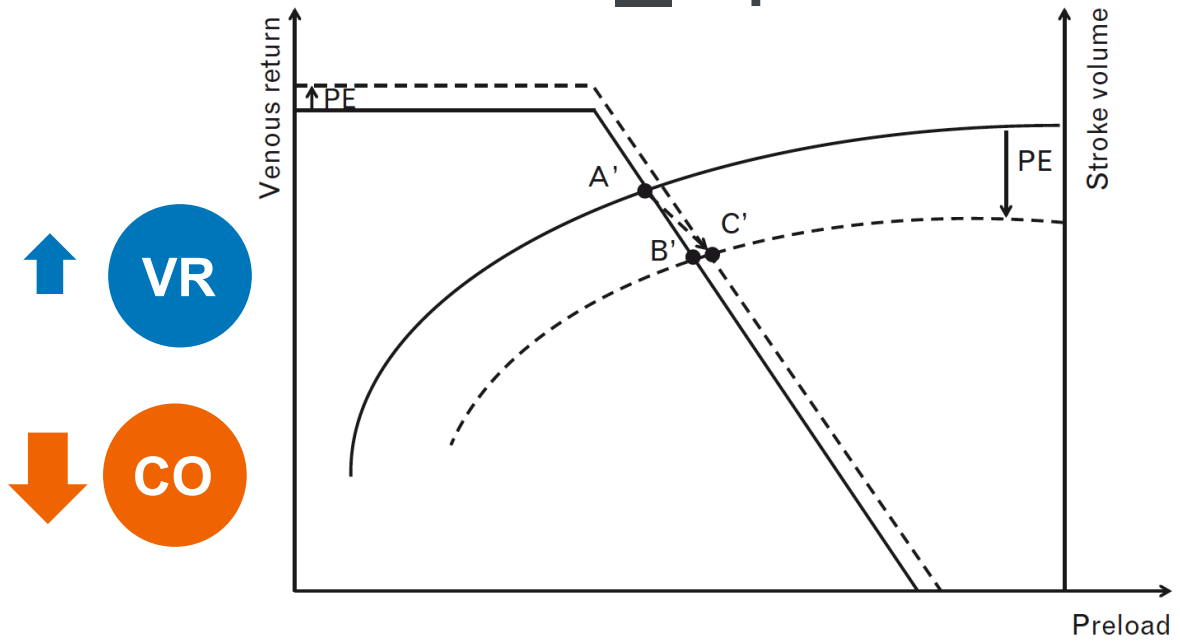
Funk D et al. Crit Care Med 2013; 41:255–262

Preload dependency determines the effects of phenylephrine on cardiac output in anaesthetised patients

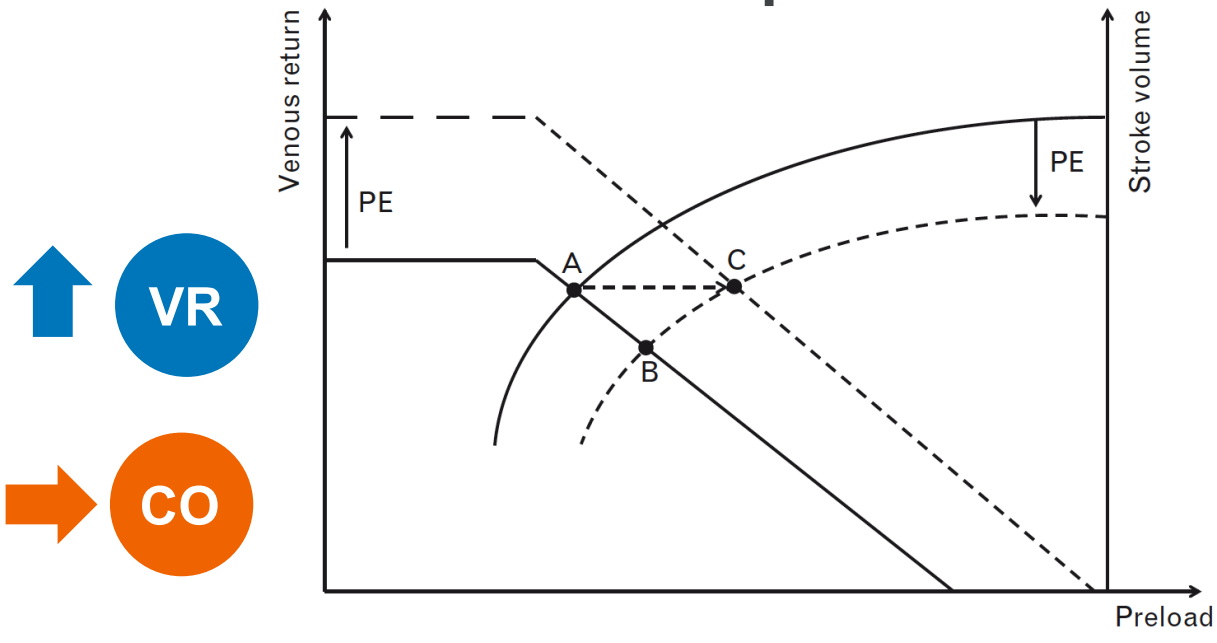
Olivier Rebet, Olivier Andremont, Jean-Louis Gérard, Jean-Luc Fellahi, Jean-Luc Hanouz and Marc-Olivier Fischer

- **N=50 ventilated patients undergoing surgery were studied during hypotension (SAP <90mmHg or MAP <60mmHg) before and after administration of phenylephrine (50 to 150 µg)**

Preload Independent



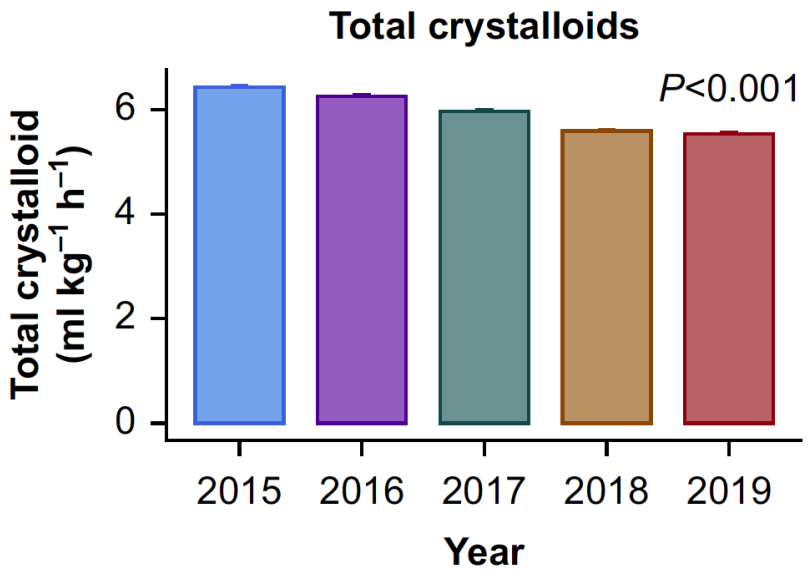
Preload Dependent

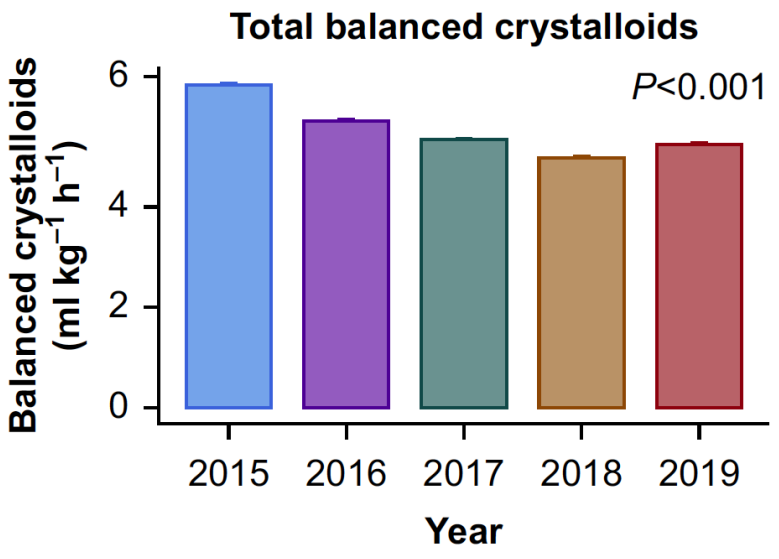


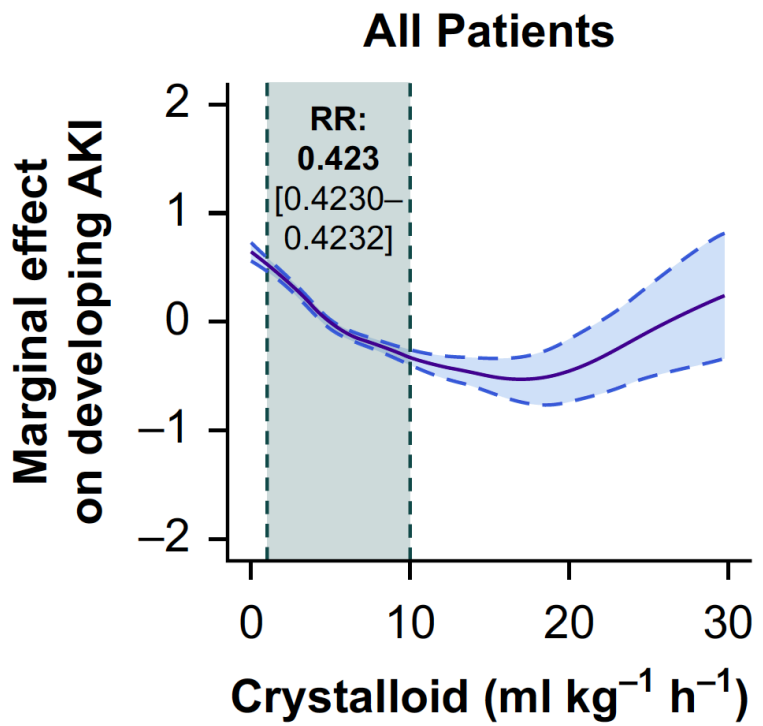
Fluids, vasopressors, and acute kidney injury after major abdominal surgery between 2015 and 2019: a multicentre retrospective analysis

Catherine Chiu[1], Nicholas Fong[1], Daniel Lazzareschi[1], Orestes Mavrothalassitis[1], Rishi Kothari[1], Lee-lynn Chen[1], Romain Pirracchio[1], Sachin Kheterpal[2], Karen B. Domino[3], Michael Mathis[2] and Matthieu Legrand[1,*]

Retrospective data analysis of 32 250 patients with major abdominal surgeries in 26 US hospitals
Primary outcome: AKI (KDIGO serum creatinine criteria)







https://doi.org/10.1016/j.bja.2022.05.002

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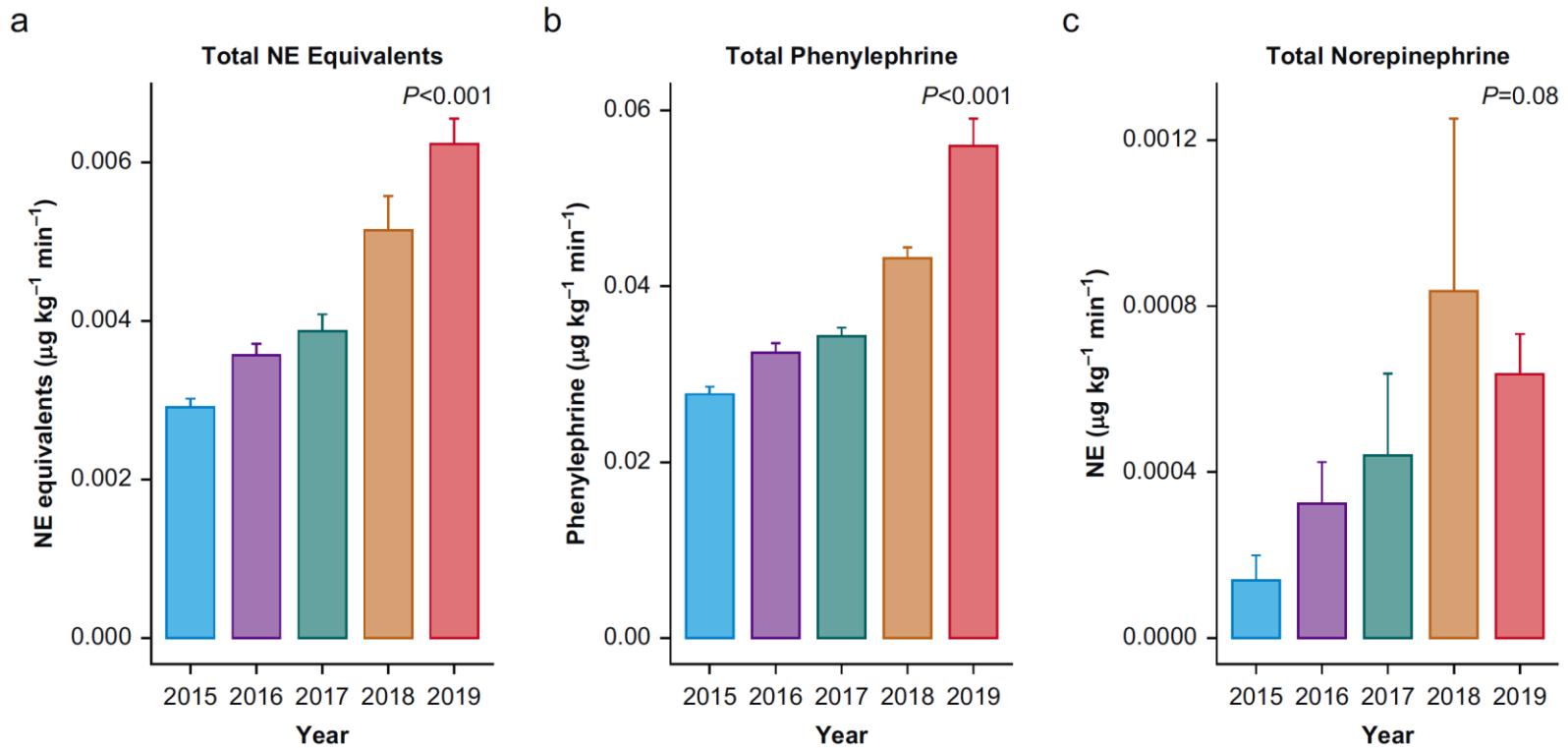


https://doi.org/10.1016/j.bja.2022.05.002

56e REAGSO
7 & 8 Octobre 2023

Optimisation Cardiocirculatoire peropératoire du patient grave

Take Home Messages

- La pression artérielle et le débit sanguin sont des déterminants essentiels de l'hémodynamique systémique
  — Une valeur adéquate de PAM ne garanti pas un débit adéquat

- Une inadéquation du transport en O_2 en lien avec une augmentation de la VO_2 expose à un risque accru de dysfonctions d'organes

- La pression artérielle moyenne (PAM – Pcc) est un déterminant important de la pression de perfusion

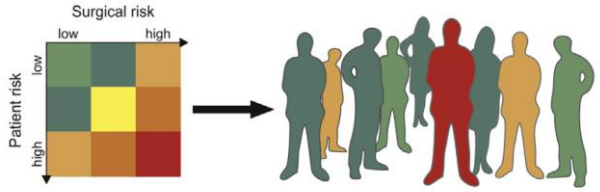
- Le maintien d'une pression de perfusion et une optimisation du DC sont essentiels, particulièrement chez le patient grave et/ou lors de chirurgies à risques

- Il n'existe pas une valeur cible unique de PA
  - Valeur seuil « critique » : PAM 65-70 mmHg
  - Pas de durée minimale acceptable

- Une stratégie individualisée visant à **personnaliser** la cible de PA (comme le choix du vasopresseur) et **optimiser** le DC en fonction du terrain et du contexte clinique est probablement raisonnable

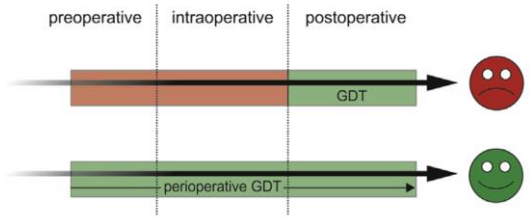
5Ts of goal-directed hemodynamic therapy

Target population



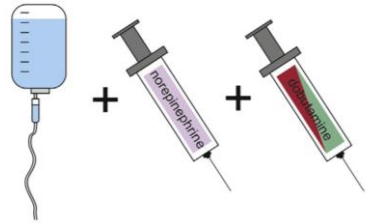
Timing of the intervention

↳ Start early

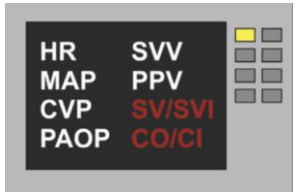


Type of intervention

↳ Fluids, vasopressors, inotropes

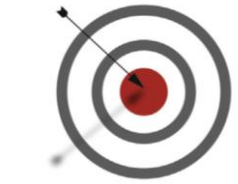


Target variable



Target value

↳ Personalize target values



Saugel B et al. Br J Anaesth. 2019;123:103-107

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pour votre attention