Hôpitaux de Lyon

Cours Européens
d'Enseignement en Anesthésie-Réanimation
Lacanau - 2017

Inserm
Institut national
de la santé et de la recherche médicale

Protection myocardique péri-opératoire

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Inserm U1060 « Cardioprotection », Université Claude Bernard, Lyon I

Ischémie myocardique péri-opératoire

Chirurgie NON CARDIAQUE

Myocardial Injury after Noncardiac Surgery

A Large, International, Prospective Cohort Study Establishing Diagnostic Criteria, Characteristics, Predictors, and 30-day Outcomes

The Vascular events In noncardiac Surgery patIents cOhort evaluatioN (VISION) Writing Group, on behalf of The Vascular events In noncardiac Surgery patIents cOhort evaluatioN (VISION) Investigators

Etude de Cohorte, Prospective, Internationale / 15.065 patients

What We Already Know about This Topic

- Myocardial injury after noncardiac surgery was defined as prognostically relevant myocardial injury due to ischemia that occurs during or within 30 days after noncardiac surgery

What This Article Tells Us That Is New

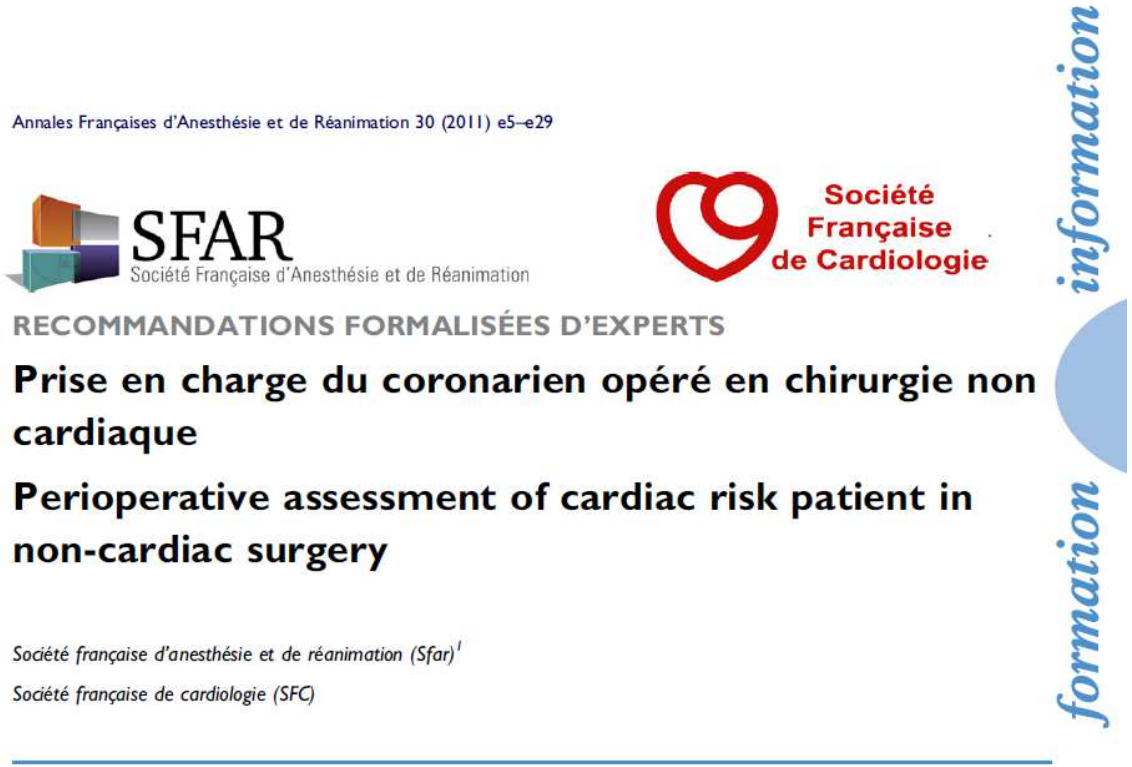
- Myocardial injury after noncardiac surgery is common among adults undergoing noncardiac surgery and associated with substantial mortality

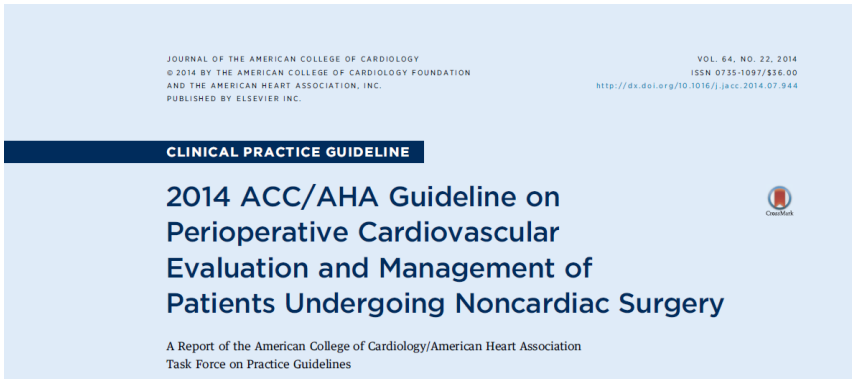
Predictor	Prevalence of Predictors (%)	Patients Dying within 30 Days after Surgery		Model Derivation		Model Validation		Population-attributable Risk (95% CI‡)
		n	% (95% CI)	Adjusted HR (95% CI)	*P* Value	Adjusted HR† (95% CI)	*P* Value	
Perioperative adverse complications‖								
MINS	1,200 (8.0)	115	9.6 (8.0–11.4)	3.87 (2.96–5.08)	<0.001	3.90 (2.90–5.27)	<0.001	34.0% (26.6–41.5)

MINS = **M**yocardial **I**njury after **N**oncardiac **S**urgery

Anesthesiology 2014;120:564-78

Protection myocardique péri-opératoire





Protection myocardique péri-opératoire

Evaluation et stratification **PRE**-opératoire

+

Gestion **PER**-opératoire

+

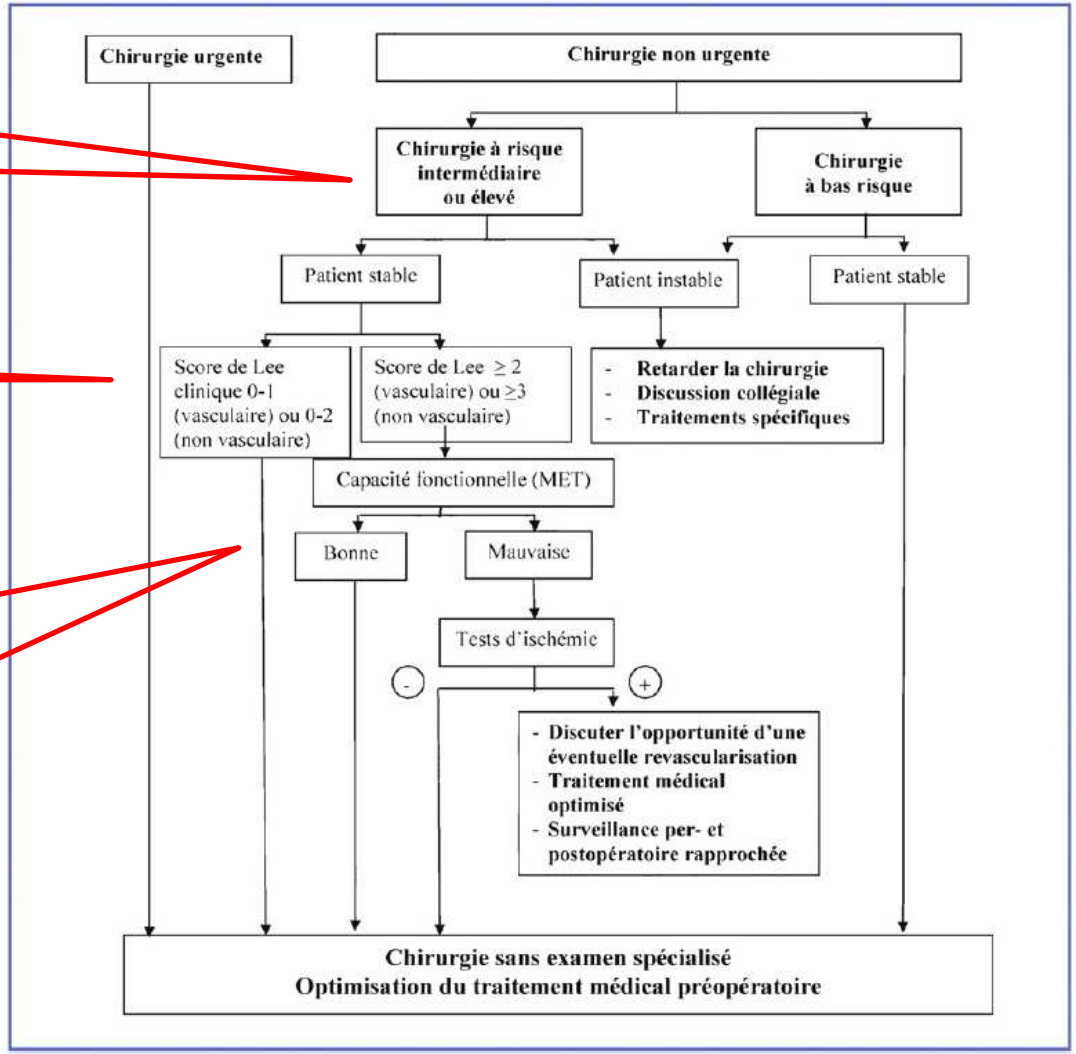
Gestion **POST**-opératoire

Evaluation et stratification **PRE**-opératoire

Risque lié à la chirurgie:
Faible – intermédiaire - élevé

Score de **Lee**

Capacité fonctionnelle:



V Piriou, G Derumeaux AFAR 2011;30:e5-e29

Protection myocardique péri-opératoire

Gestion PER-opératoire

Intraoperative Tachycardia and Hypertension Are Independently Associated with Adverse Outcome in Noncardiac Surgery of Long Duration

David L. Reich, MD, Elliott Bennett-Guerrero, MD, Carol A. Bodian, DrPH, Sabera Hossain, MSc, Wanda Winfree, RN, and Marina Krol, PhD

- **Tachycardie**
- **Hypertension Artérielle**

Table 7. Multivariate Analysis of Negative Surgical Outcome in Long Operations (>220 minutes)

Variable	Odds ratio	*P* value
Operation duration >220 min (per minute)	1.003	0.02
POSSUM physiological score (per point of score)	1.096	0.0001
High heart rate	2.704	0.01
High systolic arterial blood pressure	2.095	0.009

Reich et al. Anesth Analg 2002;95:273-7

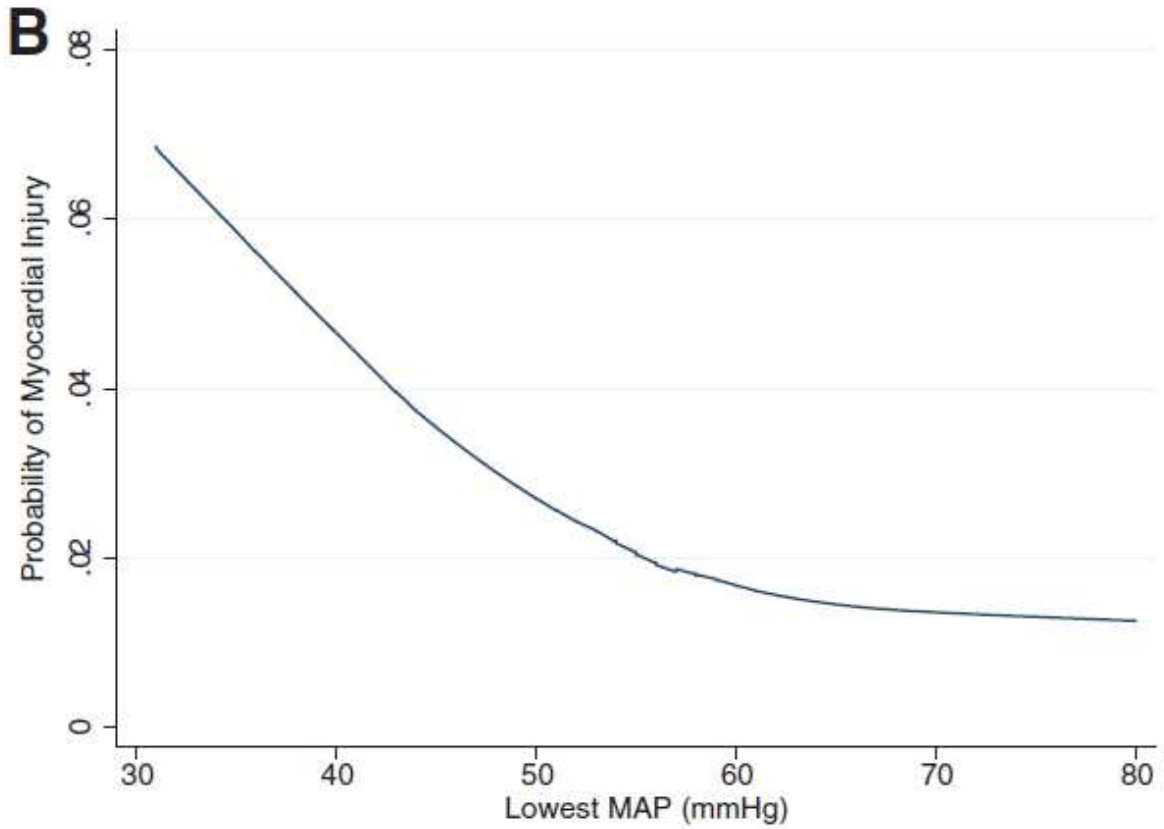
Protection myocardique péri-opératoire

Gestion **PER**-opératoire

Relationship between Intraoperative Mean Arterial Pressure and Clinical Outcomes after Noncardiac Surgery

Toward an Empirical Definition of Hypotension

- **Hypotension Artérielle**



Walsh et al. Anesthesiology 2013;119:507-15

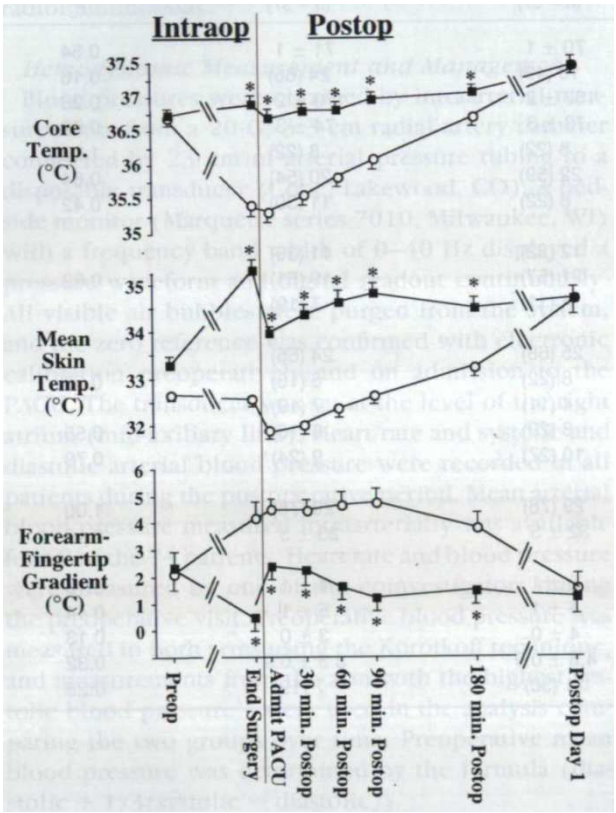
Protection myocardique péri-opératoire

Gestion **PER**-opératoire

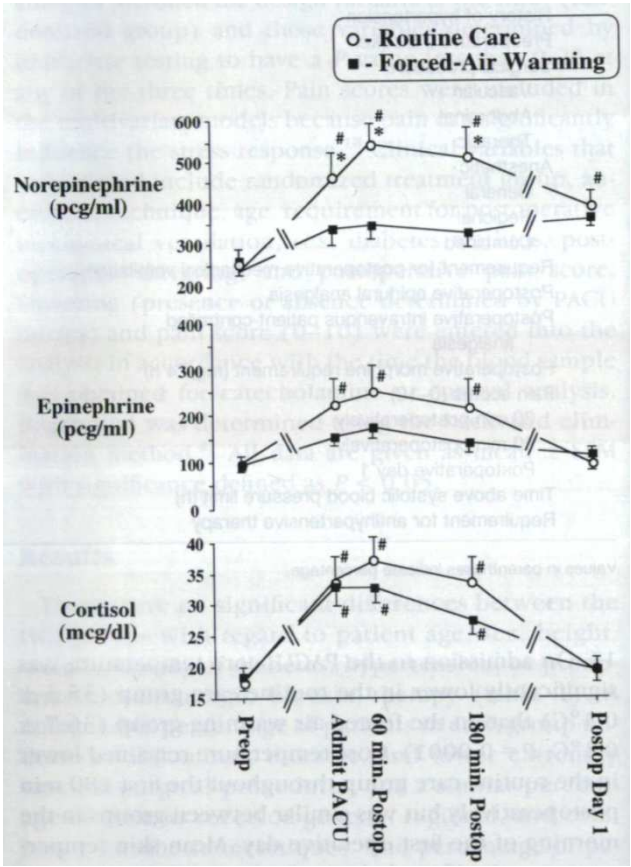
The Catecholamine, Cortisol, and Hemodynamic Responses to Mild Perioperative Hypothermia

A Randomized Clinical Trial

Steven M. Frank, M.D.,* Michael S. Higgins, M.D.,† Michael J. Breslow, M.D.,‡ Lee A. Fleisher, M.D.,* Randolph B. Gorman, M.D.,† James V. Sitzmann, M.D.,§ Hershel Raff, Ph.D.,‖ Charles Beattie, M.D.#



- **Hypothermie**



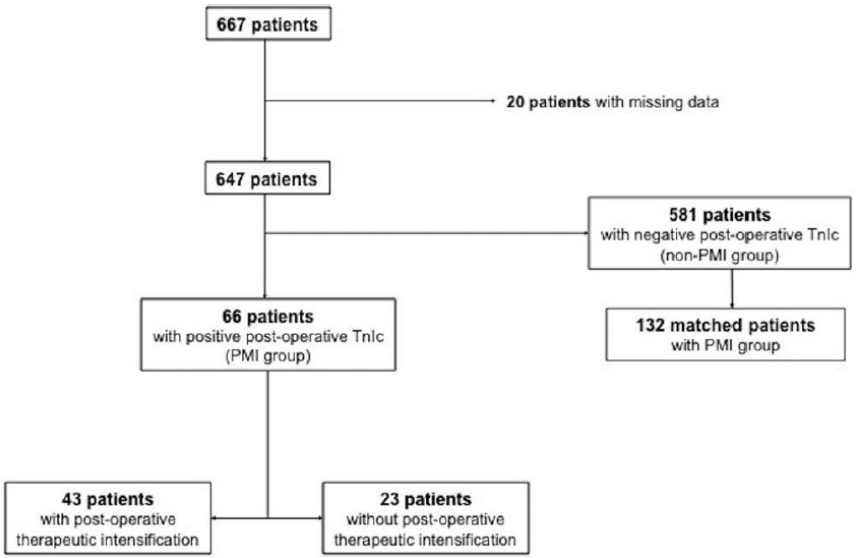
Frank et al. Anesthesiology 1995;82:83-93

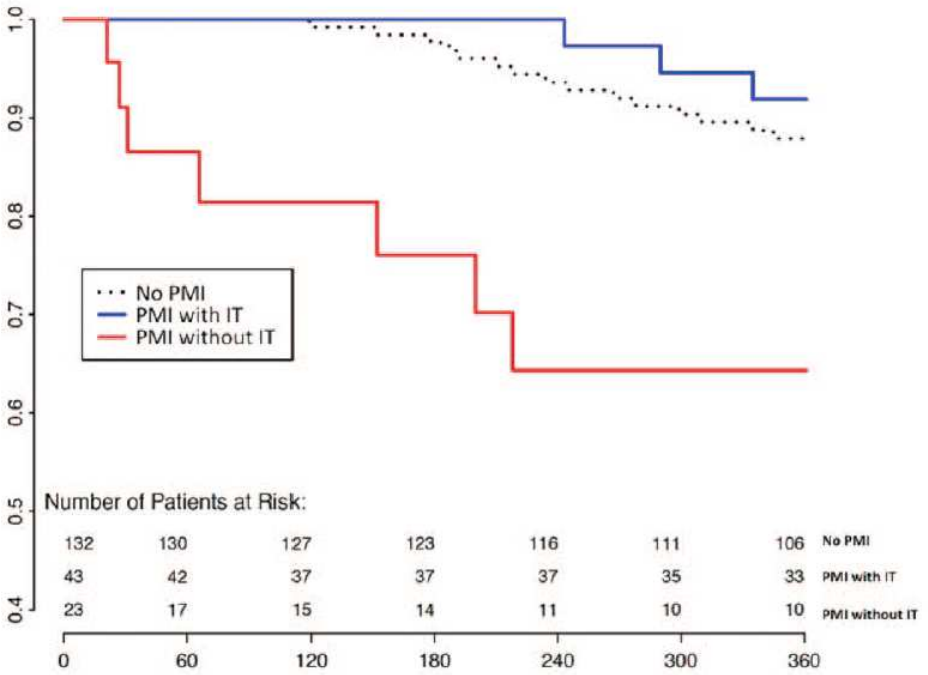
Protection myocardique péri-opératoire

Gestion **POST**-opératoire

The Long-Term Impact of Early Cardiovascular Therapy Intensification for Postoperative Troponin Elevation After Major Vascular Surgery

Etude observationnelle





Therapeutic Intensification = **ACE inhibitor + aspirin + β-blockers + statins**

Foucrier et al. Anesth Analg 2014;119:1053-63

Protection myocardique péri-opératoire

Evaluation et stratification **PRE**-opératoire

+

Gestion **PER**-opératoire

+

Gestion **POST**-opératoire

Protection myocardique péri-opératoire

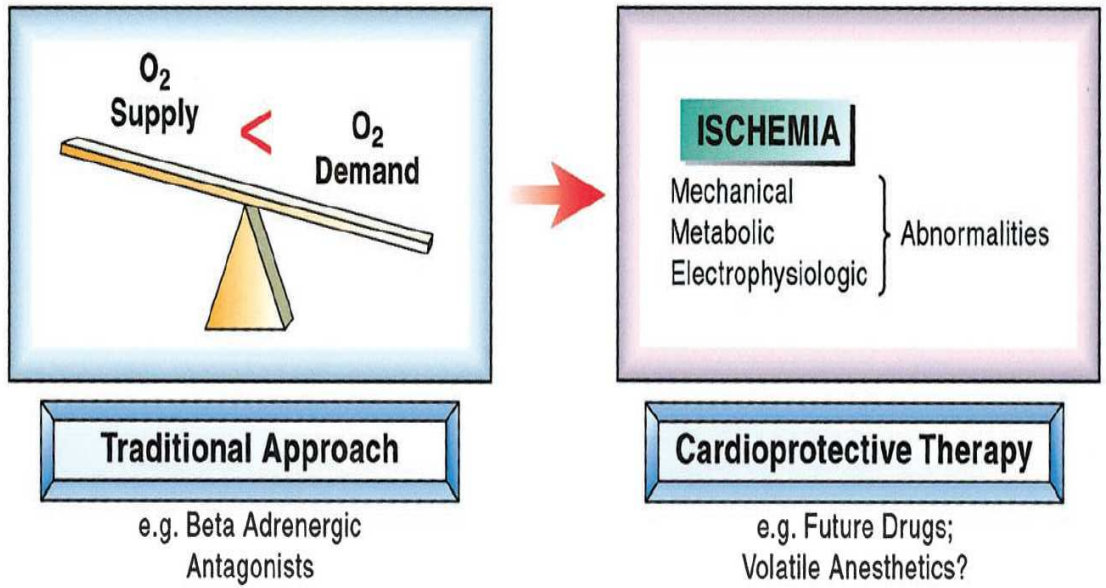
Evaluation et stratification **PRE**-opératoire

+

Gestion PER-opératoire

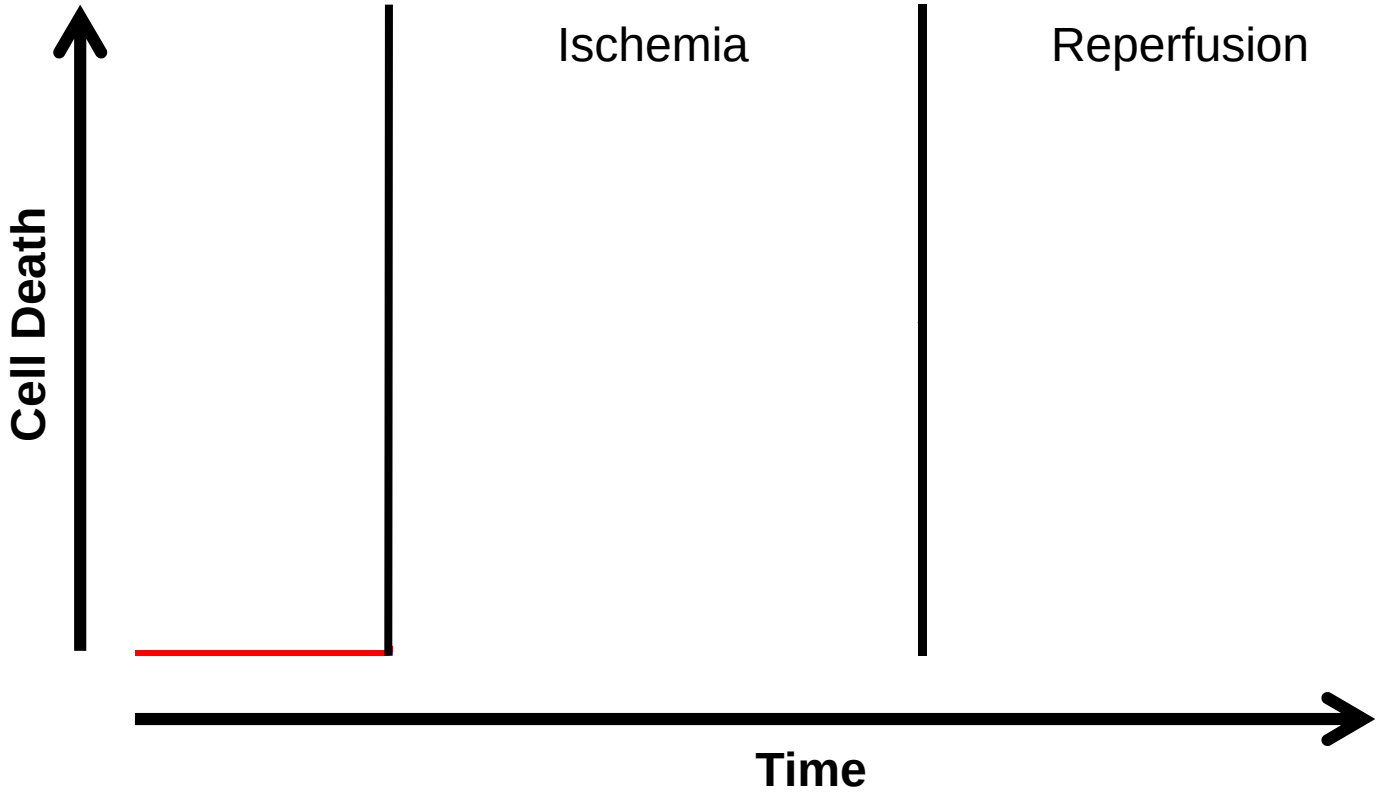
+

Gestion **POST**-opératoire



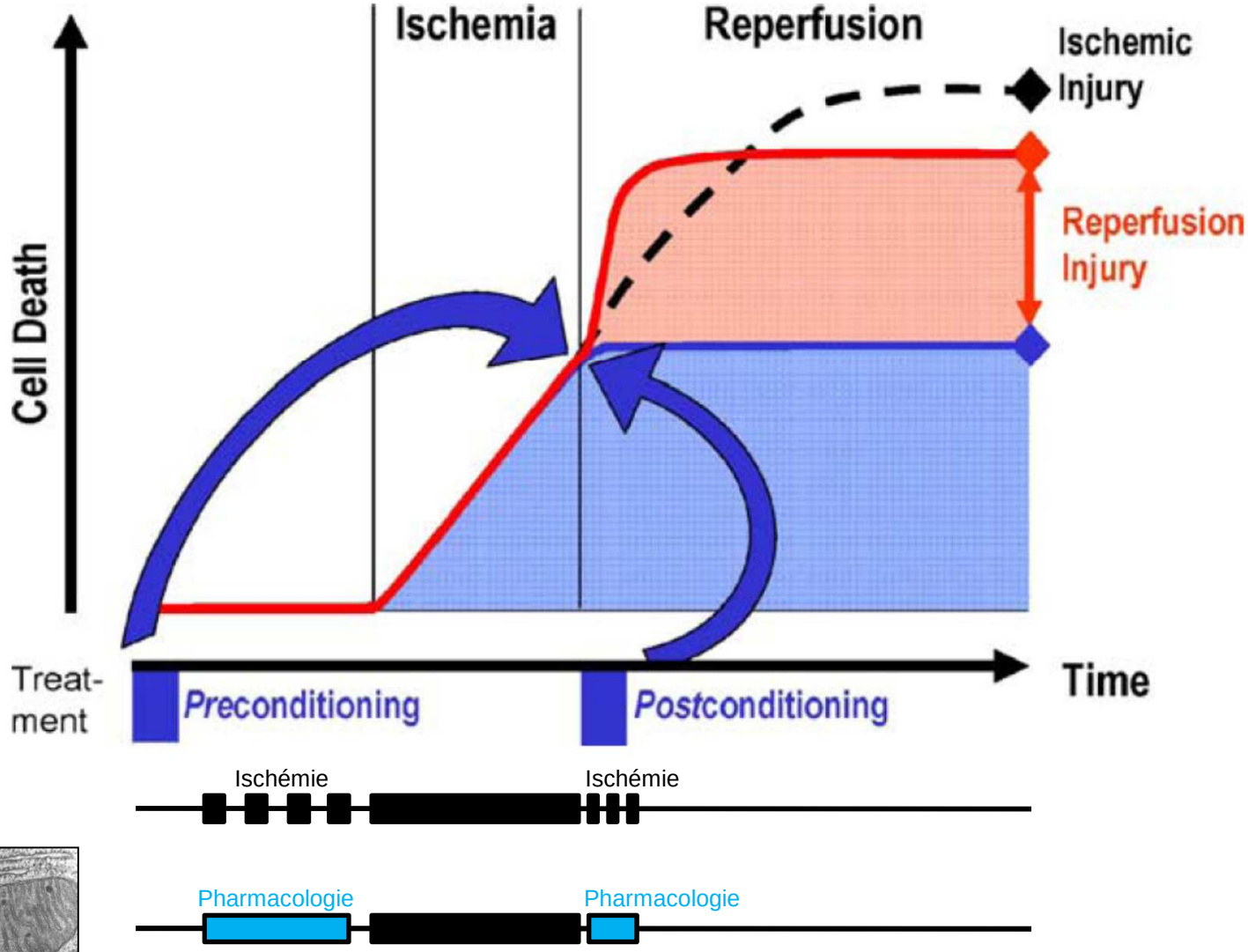
Warltier et al. Anesthesiology 2000;92:253-9

Lésions myocardiques



Lésions = Ischémie + Reperfusion

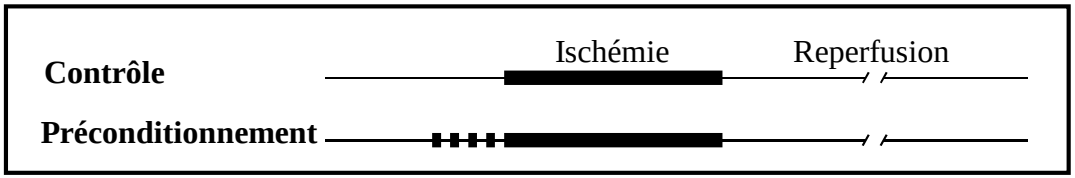
Conditionnement Myocardique



Garcia-Dorado and Piper Cardiovasc Res 2006;69:1-3

PRE-conditionnement

1986… PubMed le 14/06/2017 …!!!



preconditioning - PubMed...

https://www.ncbi.nlm.nih.gov/pubmed/?term=preconditioning

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1. Eff ect of a single asenapine treatment on Fos expression in the brain catecholamine-synthesizing neurons: impact of a chronic mild stress **preconditioning**.
Osacka J, Horvathova L, Majercikova Z, Kiss A.
Endocr Regul. 2017 Apr 25;51(2):73-83. doi: 10.1515/enr-2017-0007.
PMID: 28609288
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2. Protection of Lipopolysaccharide (LPS) **Preconditioning** against Endotoxin-Induced Uveitis (EIU) in Rats Is Associated with Overexpression of Interleukin-1 Receptor-Associated Kinase M(IRAK-M).
Yu S, Liu X, Zhang N, Yang S, Mao C, Feng S, Lu H.
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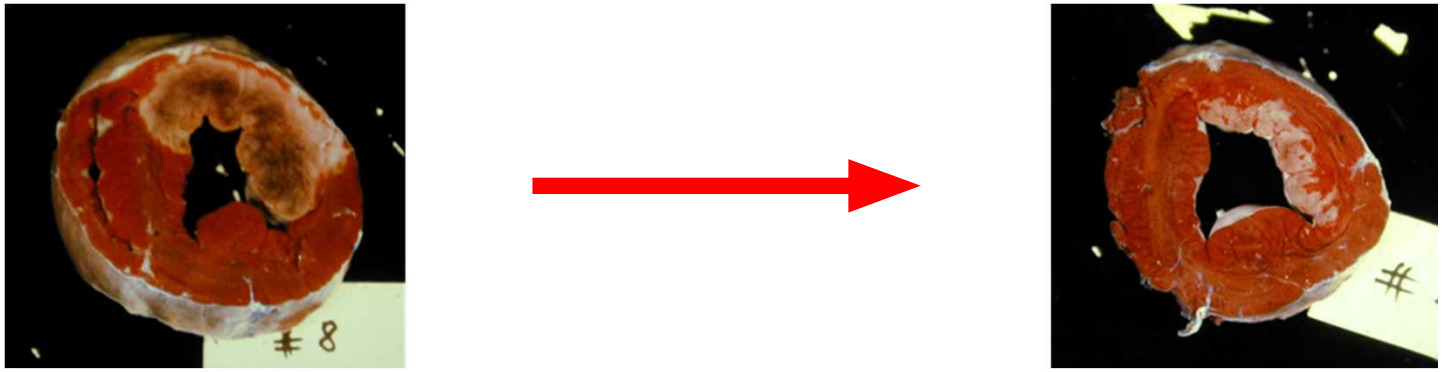
Le PRE-conditionnement



- Le mécanisme de cardioprotection **le + puissant**!

- Actif dans **toutes les espèces** animales, et chez l'**homme**!

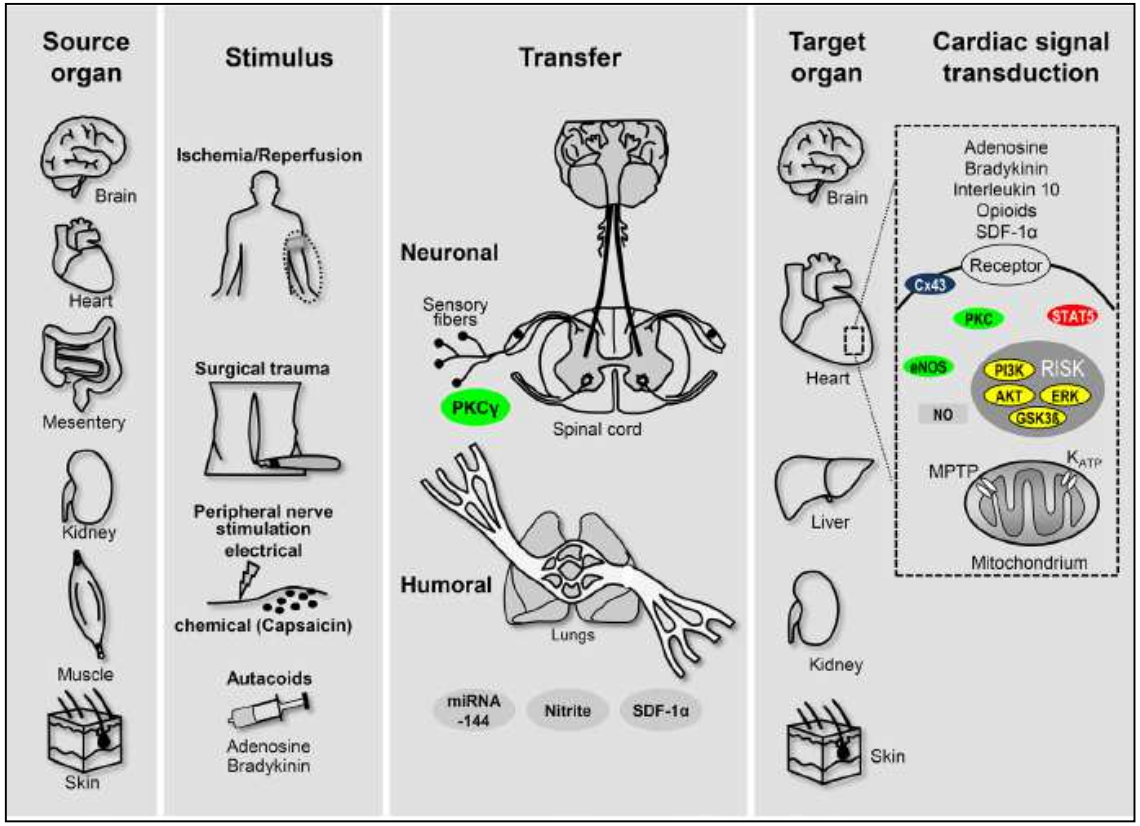
- Sur **≠ organes** : **cœur, SNC, poumon, rein, TD, muscles squelettiques…**

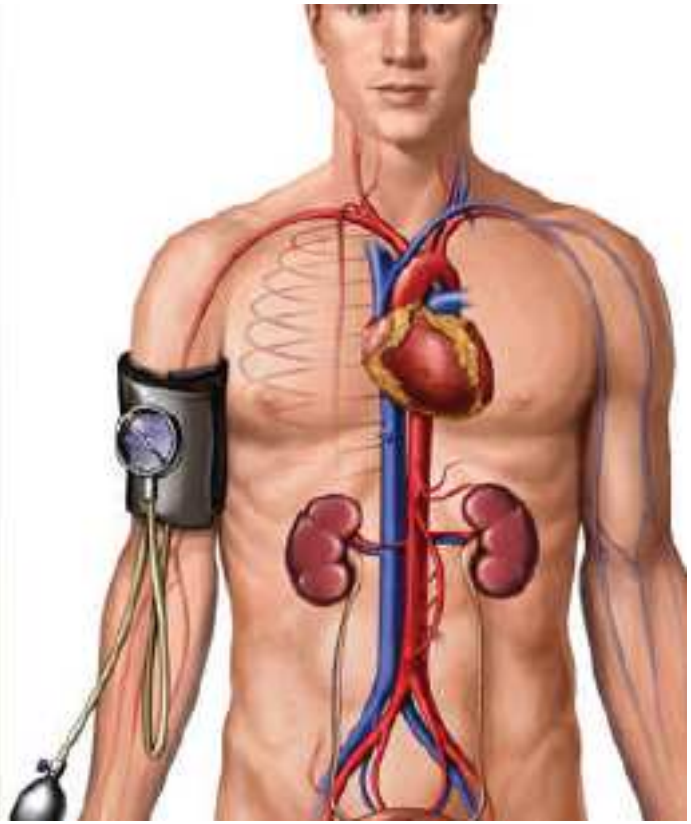
- Actif **à distance** : ischémie IVA → protection artère marginale

ischémie → rein / mb } Cardio-Protection

RIPC
(remote ischemic preconditioning)

Remote Ischemic Pre-Conditioning - RIPC





3 ou 4 cycles	- 5 min Ischémie / 5 min Reperfusion du Mb Sup. ou Mb Inf. - Inflation supra-systémique / Déflation du brassard

Heusch et al. J Am Coll Cardiol 2015;65:177-95.

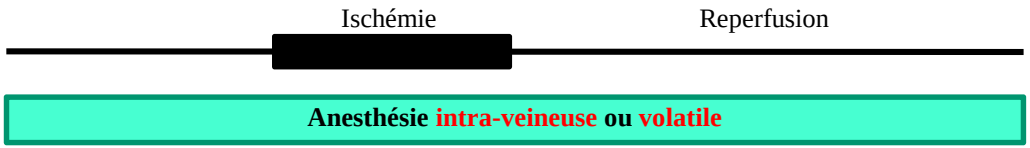
"…are some anesthetics better than others at protecting the heart?"

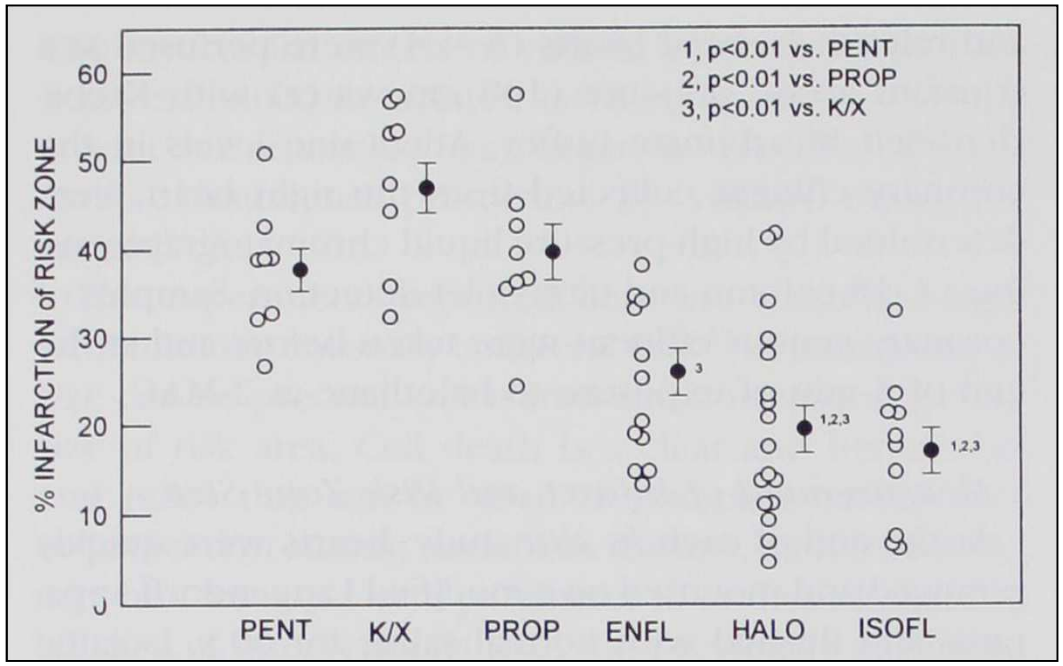
Hobai Anesthesiology 2017

Anesthesiology
1997; 86:699–709

Volatile Anesthetics Protect the Ischemic Rabbit Myocardium from Infarction

Doris K. Cope, M.D., W. Keyser Impastato, B.S.,† Michael V. Cohen, M.D.,‡ James M. Downey, Ph.D.§*





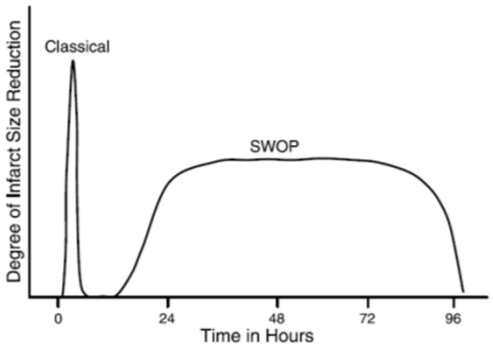
Les **Halogénés** sont
les seuls agents hypnotiques
qui diminuent la taille
de l'infarctus du myocarde!

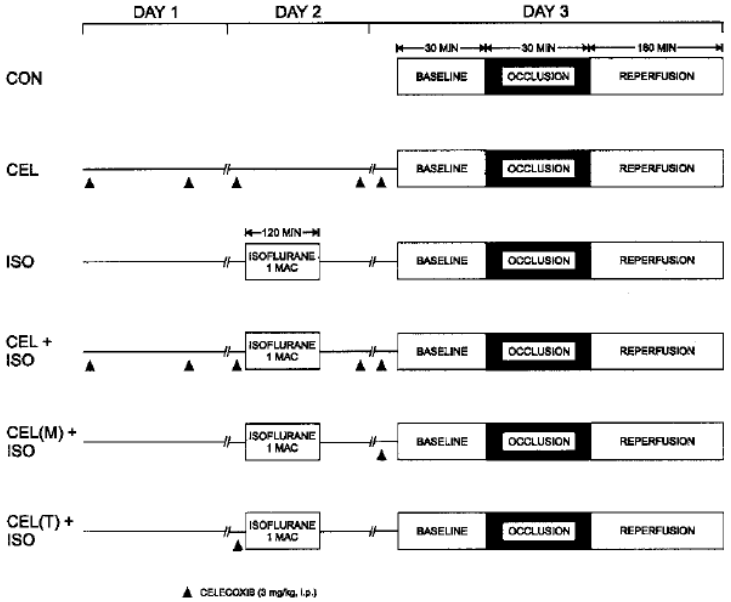
Cope et al. Anesthesiology 1997;86:699-709

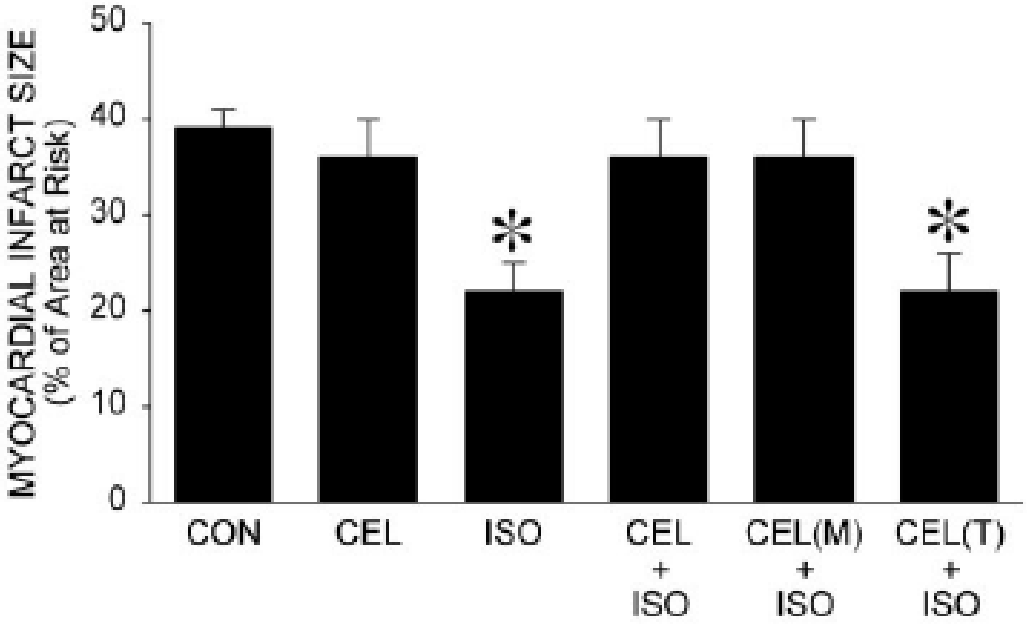
Isoflurane Produces Delayed Preconditioning against Myocardial Ischemia and Reperfusion Injury

Role of Cyclooxygenase-2

Katsuya Tanaka, M.D., Lynda M. Ludwig, B.S.,† John G. Krolikowski, B.A.,‡ Dunbar Alcindor, B.S.,§ Phillip F. Pratt, Ph.D.,‖ Judy R. Kersten, M.D.,# Paul S. Pagel, M.D., Ph.D.,** David C. Warltier, M.D., Ph.D.††*



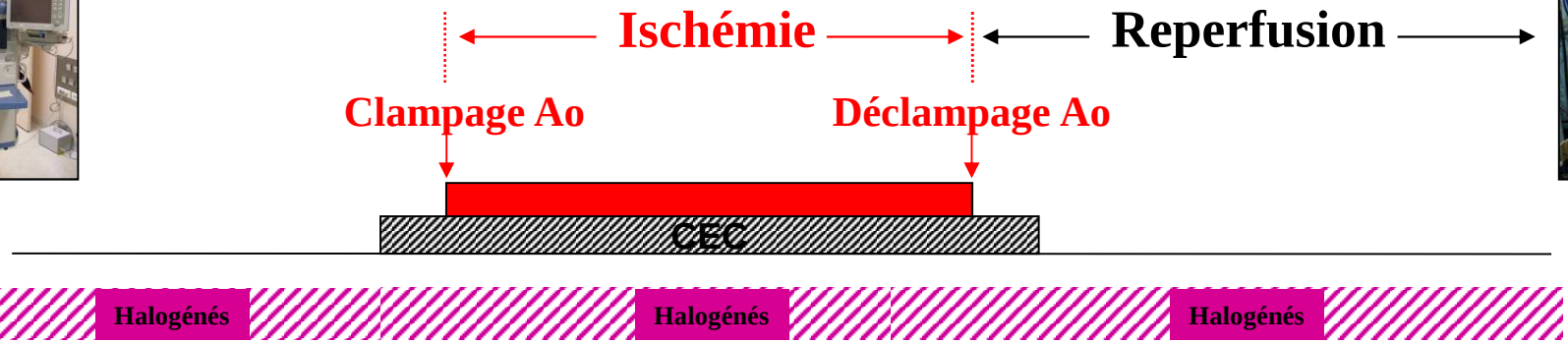


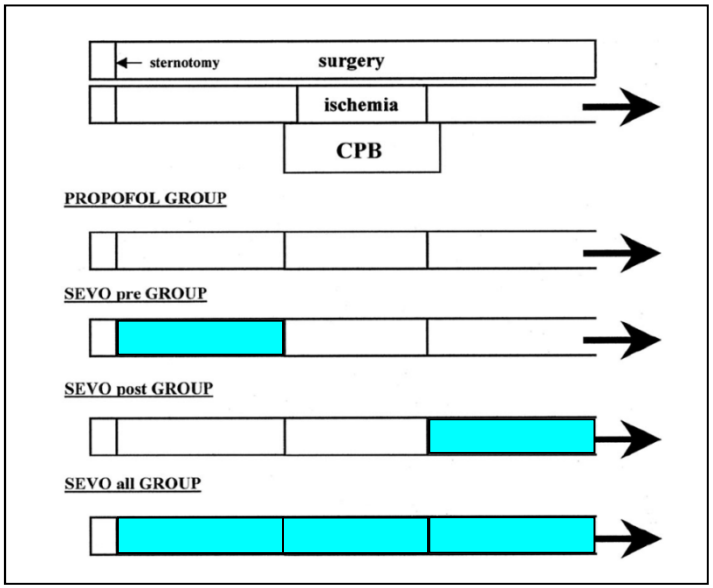


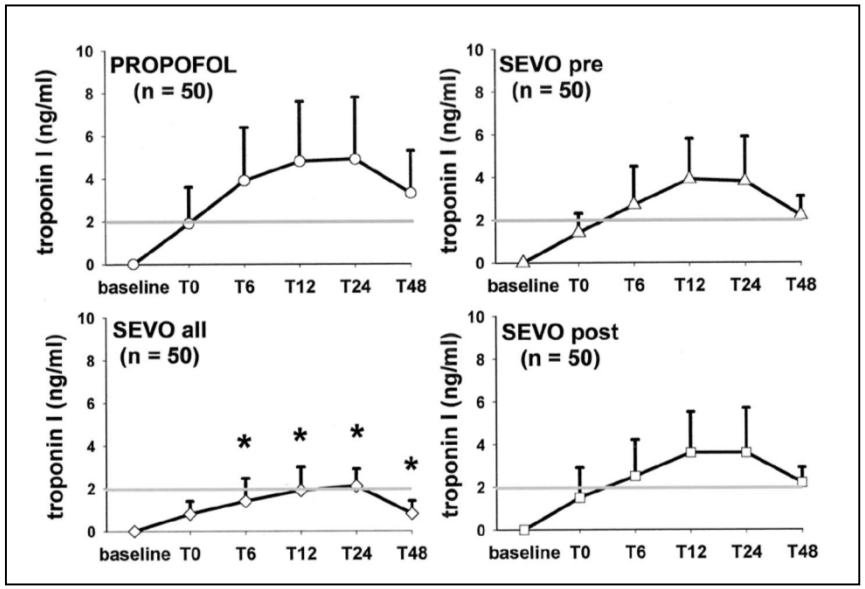
Halogénés = Cardioprotection retardée (J+1)

Tanaka et al. Anesthesiology 2004;100:525-31

Halogénés – Cardioprotection – Chirurgie Cardiaque







Chirurgie coronaire sous CEC **50 patients / groupe**

De Hert et al. Anesthesiology 2004;101:299-310

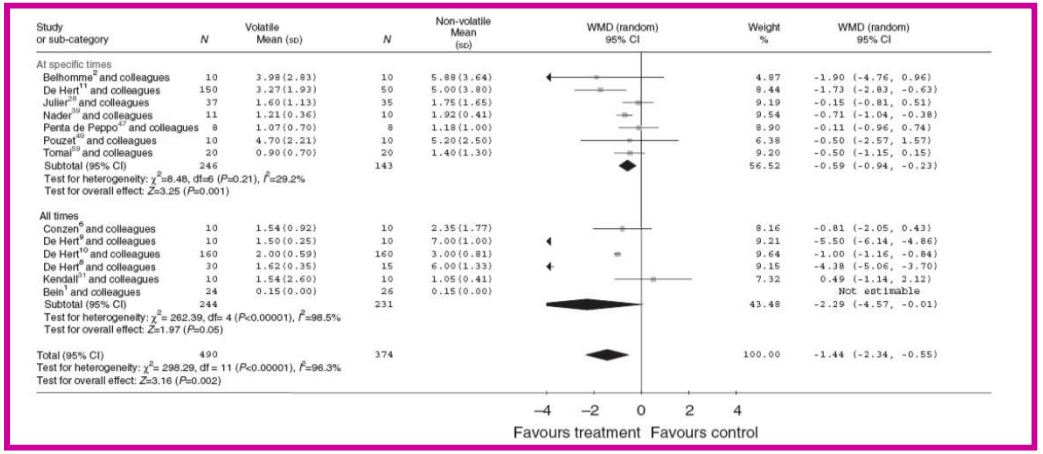
Cardioprotection Périopératoire - HALOGENES

Myocardial protection with volatile anaesthetic agents during coronary artery bypass surgery: a meta-analysis

Chirurgie CARDIAQUE

27 études – 2979 patients

↓ TROPONINE I



Symons et al. Br J Anaesth 2006;97:127-36

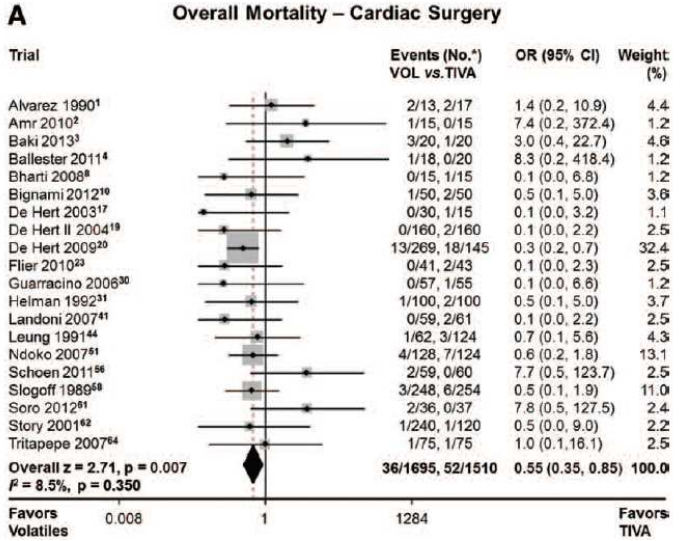
Effects of Volatile Anesthetics on Mortality and Postoperative Pulmonary and Other Complications in Patients Undergoing Surgery

A Systematic Review and Meta-analysis

Chirurgie CARDIAQUE

45 études – 4890 patients

↓ MORTALITE



Uhlig et al. Anesthesiology 2016;124:1230-45

Halogénés – Cardioprotection – Chirurgie Cardiaque

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association®
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2011 ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery : A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Writing Committee Members, L. David Hillis, Peter K. Smith, Jeffrey L. Anderson, John A. Bittl, Charles R. Bridges, John G. Byrne, Joaquin E. Cigarroa, Verdi J. DiSesa, Loren F. Hiratzka, Adolph M. Hutter, Jr, Michael E. Jessen, Ellen C. Keeley, Stephen J. Lahey, Richard A. Lange, Martin J. London, Michael J. Mack, Manesh R. Patel, John D. Puskas, Joseph F. Sabik, Ola Selnes, David M. Shahian, Jeffrey C. Trost and Michael D. Winniford

2. Procedural Considerations

2.1. Intraoperative Considerations

2.1.8. Preconditioning/Management of Myocardial Ischemia: Recommendations

Class IIa

1. **Volatile-based anesthesia can be useful in reducing the risk of perioperative myocardial ischemia and infarction.[178–181] *(Level of Evidence: A)***

Circulation 2011;124:e652-e735

Halogénés – Cardioprotection – Chirurgie Non Cardiaque

European Heart Journal (2009) **30**, 2769–2812
doi:10.1093/eurheartj/ehp337

ESC GUIDELINES

Guidelines for pre-operative cardiac risk assessment and perioperative cardiac management in non-cardiac surgery

The Task Force for Preoperative Cardiac Risk Assessment and Perioperative Cardiac Management in Non-cardiac Surgery of the European Society of Cardiology (ESC) and endorsed by the European Society of Anaesthesiology (ESA)

Intraoperative anaesthetic management

The choice of the anaesthetic agent has been considered to be of little importance with regard to patients' outcome provided the vital functions are adequately supported. There is conflicting evidence from cardiac surgery over whether a specific method is advantageous in cardiac disease, but there is no evidence of superiority of any specific anaesthetic agent in non-cardiac surgery.[224,225]

Eur Heart J 2009;30:2769-812

Halogénés – Cardioprotection – Chirurgie Non Cardiaque

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association. Learn and Live.
Practice Guidelines: Full Text

2009 ACCF/AHA Focused Update on Perioperative Beta Blockade Incorporated Into the ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery

A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

Lee A. Fleisher, MD, FACC, FAHA, Chair; Joshua A. Beckman, MD, FACC*; Kenneth A. Brown, MD, FACC, FAHA†; Hugh Calkins, MD, FACC, FAHA‡; Elliot L. Chaikof, MD§; Kirsten E. Fleischmann, MD, MPH, FACC; William K. Freeman, MD, FACC‖; James B. Froehlich, MD, MPH, FACC; Edward K. Kasper, MD, FACC; Judy R. Kersten, MD, FACC¶; Barbara Riegel, DNSc, RN, FAHA; John F. Robb, MD, FACC#

8.1. Choice of Anesthetic Technique and Agent

Recommendations for Use of Volatile Anesthetic Agents

Class IIa

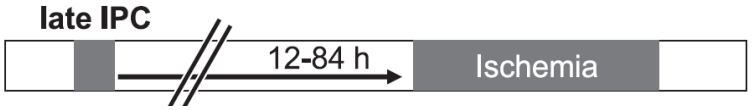
1. It can be beneficial to use volatile anesthetic agents during noncardiac surgery for the maintenance of general anesthesia in hemodynamically stable patients at risk for myocardial ischemia. (*Level of Evidence: B*)

Fleisher et al. Circulation 2009;120:e169-276

Halogénés – Cardioprotection – Chirurgie Non Cardiaque

Randomized Comparison of Sevoflurane Versus Propofol to Reduce Perioperative Myocardial Ischemia in Patients Undergoing Noncardiac Surgery

Giovanna A.L. Lurati Buse, MD; Philippe Schumacher, MD; Esther Seeberger, CCRN; Wolfgang Studer, MD; Regina M. Schuman, MD; Jens Fassl, MD; Jorge Kasper, MD; Miodrag Filipovic, MD; Daniel Bolliger, MD; Manfred D. Seeberger, MD



Etude randomisée, multicentrique, 385 patients à risque CV, en chirurgie non cardiaque

Etude « **PRAGMATIQUE** » = pas d'information sur les gestions per et post-op.
analgésie, perfusions, seuils transfusionnels, gestion HD, réintroduction ttt…

Table 2. Study End Points and 12-Month Outcome by Treatment

	Sevoflurane (n=184)	Propofol (n=201)	RR or HR (95% CI)
Primary end point			
Myocardial ischemia (cECG and troponin)	75 (40.8)	81 (40.3)	RR=1.01 (0.78–1.30)
Secondary end points			
Cardiac mortality	5 (2.7)	5 (2.5)	HR=1.09 (0.32–3.77)
All-cause mortality	25 (13.6)	23 (11.4)	HR=1.19 (0.67–2.09)

Editorial

A Recipe for Perioperative Cardioprotection
What Matters Most? The Ingredients or the Chef?

Judy R. Kersten, MD

Lurati Buse et al. Circulation 2012;126:2696-704

Halogénés – Cardioprotection – Chirurgie Non Cardiaque

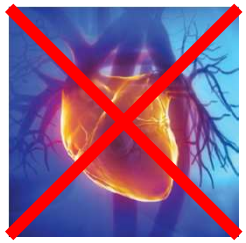
CLINICAL PRACTICE GUIDELINE

2014 ACC/AHA Guideline on Perioperative Cardiovascular Evaluation and Management of Patients Undergoing Noncardiac Surgery

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American College of Surgeons, American Society of Anesthesiologists, American Society of Echocardiography, American Society of Nuclear Cardiology, Heart Rhythm Society, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Vascular Medicine

Endorsed by the Society of Hospital Medicine



CLASS IIa

1. Use of either a volatile anesthetic agent or total intravenous anesthesia is reasonable for patients undergoing noncardiac surgery, and the choice is determined by factors other than the prevention of myocardial ischemia and MI (340,341). *(Level of Evidence: A)*

Fleisher et al. JACC 2014;64:e77-137

Cardioprotection péri-opératoire

Stratégie Globale = Stratégie Multimodale

Hyperglycémie - Cardio-Protection - Chirurgie cardiaque

8727 patients opérés d'une chirurgie cardiaque, 1996 – 2004

Highest blood glucose control (BGC)
H0 → H60 post-op.

- **Good** < **200 mg/dL**
- **Moderate** **200 – 250 mg/dL**
- **Poor** > **250 mg/dL**

15% des patients = hyperglycémie (HPG) > **200 mg/dL**

> **50%** des HPG modérées ou sévères = patients **non** diabétiques

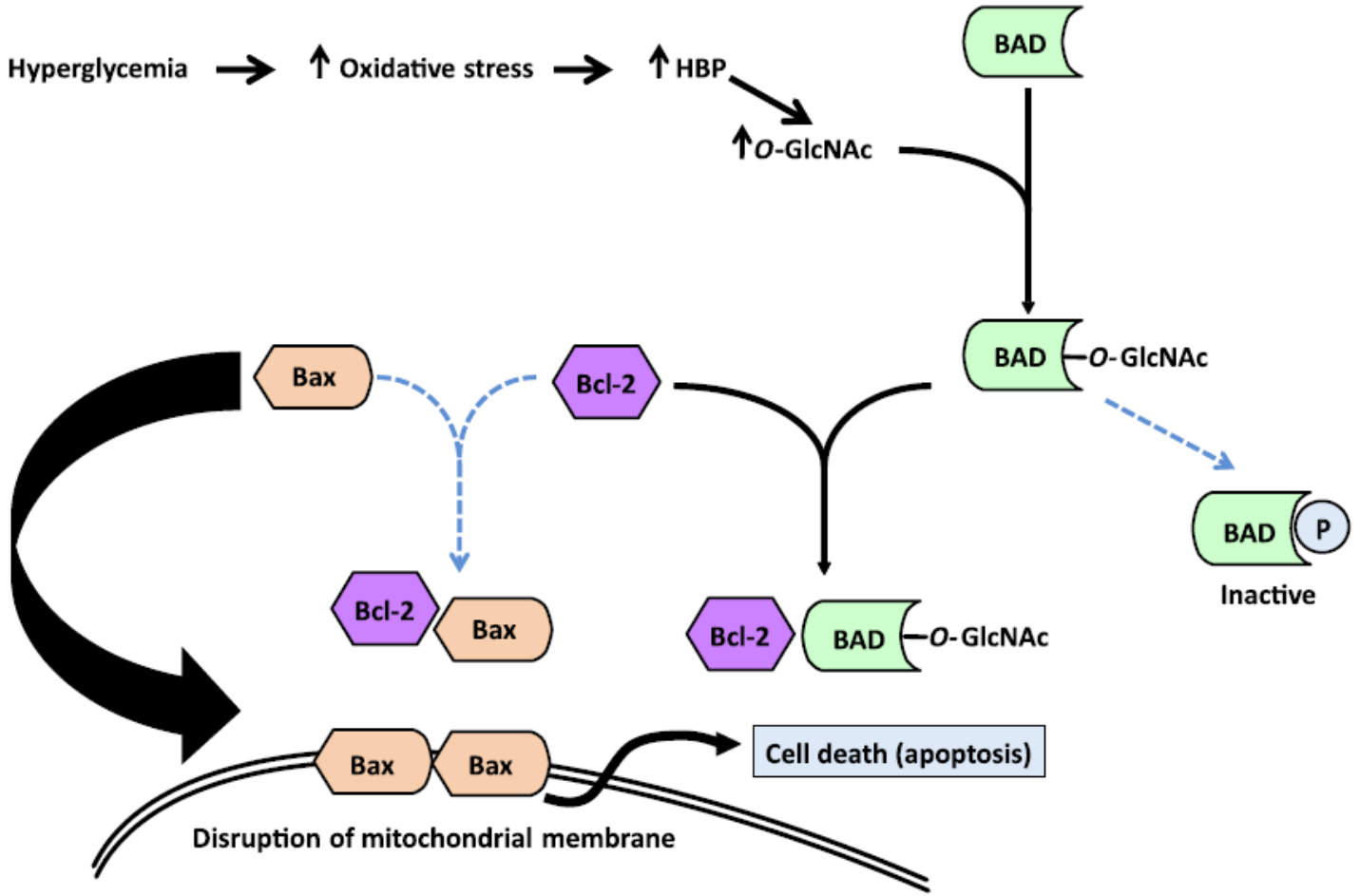
IDM post-opératoire →

Moderate / Good **OR = 1,62** (1,15 – 2,29)

Poor / Good **OR = 2,73** (1,74 – 4,26)

Ascione et al. Circulation 2008;118:113-23

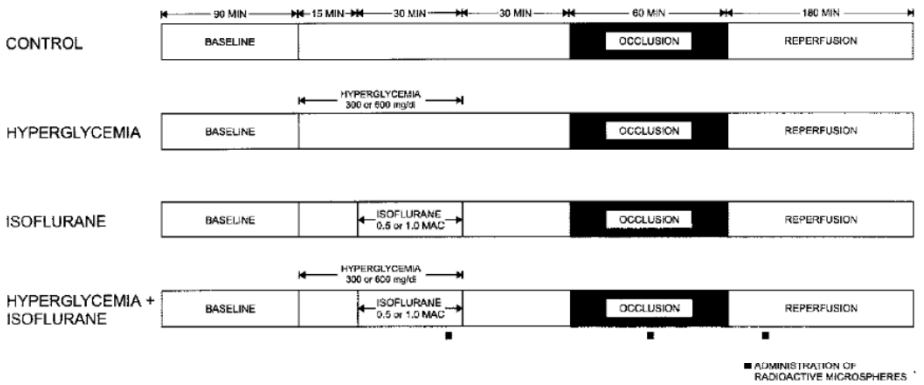
Hyperglycémie – Lésions Cardio-Vasculaires

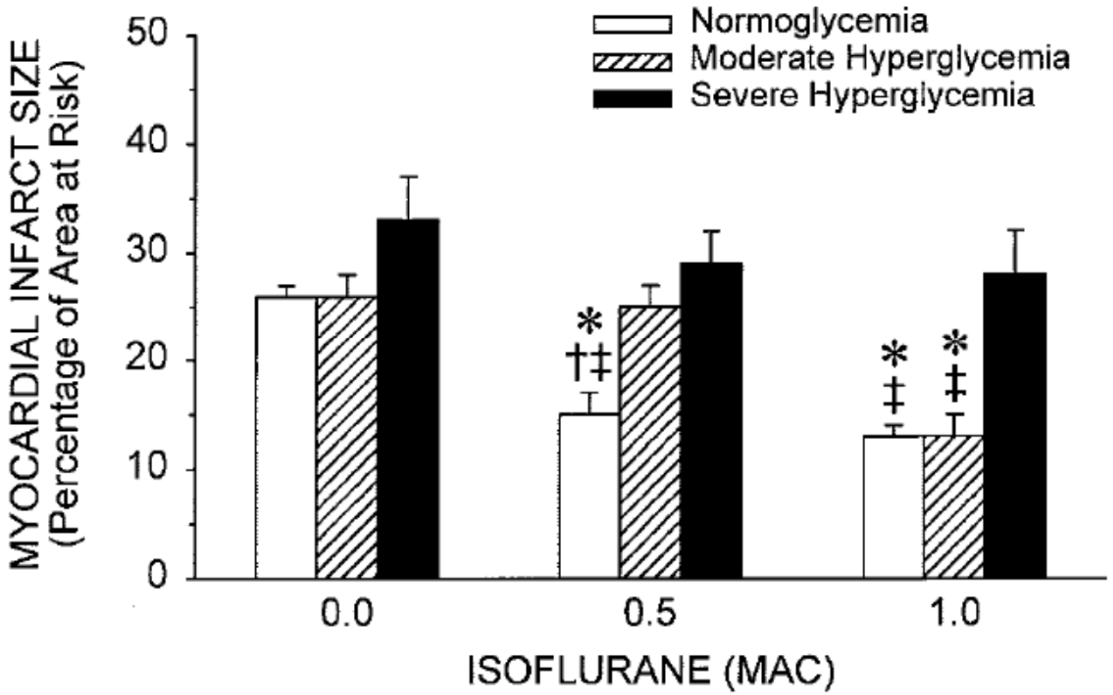


Mapanga et al. Am J Physiol 2016;310:H153-73

Hyperglycémie – PRE-conditionnement / Isoflurane

Isch + Reperf
± **Isoflurane** 0.5 ou 1 MAC
± **HPglycémie** 300 ou 600 mg/dl





Kehl et al. Anesthesiology 2002;96:183-8

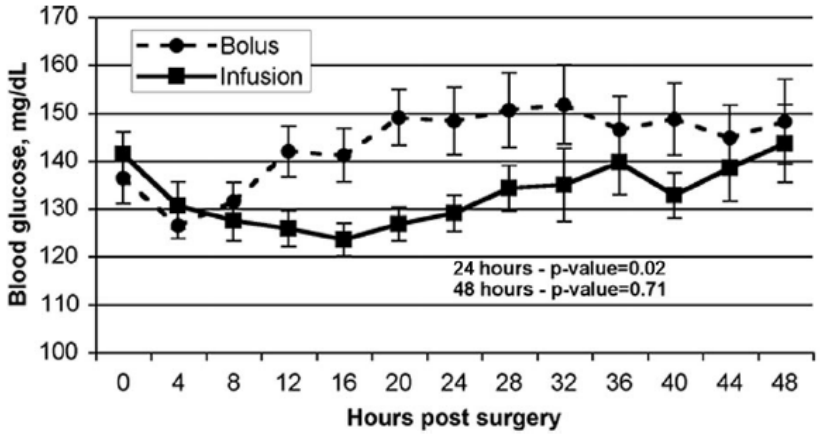
Hyperglycémie - Insuline - Chirurgie non Cardiaque

Continuous Perioperative Insulin Infusion Decreases Major Cardiovascular Events in Patients Undergoing Vascular Surgery

A Prospective, Randomized Trial

Balachundhar Subramaniam, M.B.B.S., M.D., Peter J. Panzica, M.D.,† Victor Novack, M.D., Ph.D.,‡ Feroze Mahmood, M.D.,† Robina Matyal, M.B.B.S.,† John D. Mitchell, M.D.,† Eswar Sundar, M.B.B.S.,† Ruma Bose, M.B.B.S.,† Frank Pomposelli, M.D.,§ Judy R. Kersten, M.D.,‖ Daniel S. Talmor, M.D., M.P.H.#*

- 236 patients
- Traitement: per-op. – 48 h post-op.
- Objectif glucose < 150 mg/dl



Intermittent **I**nsulin **B**olus

Continuous **I**nsulin **I**nfusion

Table 3. Clinical Outcomes

	IIB Group, n = 122	CII Group, n = 114	Relative Risk for Continuous Infusion (95% CI)	*P* Value
Composite (MI and CHF), n (%)	15 (12.3)	4 (3.5)	0.29 (0.10–0.83)	0.013*
MI, n (%)	7 (5.7)	0 (0)	—	0.015*
CHF decompensation, n (%)	9 (7.4)	4 (3.5)	0.48 (0.15–1.50)	0.19
Wound infection, n (%)	29 (23.8)	35 (30.7)	1.29 (0.85–1.97)	0.23
Graft failure or need for reintervention, n (%)	18 (14.8)	14 (12.3)	0.83 (0.43–1.59)	0.58
Creatinine increase > 25% above baseline, n (%)	22 (18.2)	23 (20.5)	0.89 (0.52–1.50)	0.65
Hypoglycemia (level < 60 mg/dl) recorded at least once, n (%)	5 (4.1)	10 (8.8)	2.14 (0.75–6.07)	0.14
Glucose level > 150 mg/dl, No. of events (IQR)	1.0 (0.0–3.0)	1.0 (0.0–2.0)	—	0.11
Total No. of events	235	167		
Hospital duration of stay, median (IQR), days	7.0 (5.0–9.0)	6.0 (4.0–8.0)	—	0.06

Subramaniam et al. Anesthesiology 2009;110:970-7

Hyperglycémie - Insuline - Chirurgie cardiaque

4302 patients, Cleveland Clinic, 2005 – 2007. TTT protocolisé:

Insuline si Gly. > 150 mg/dl

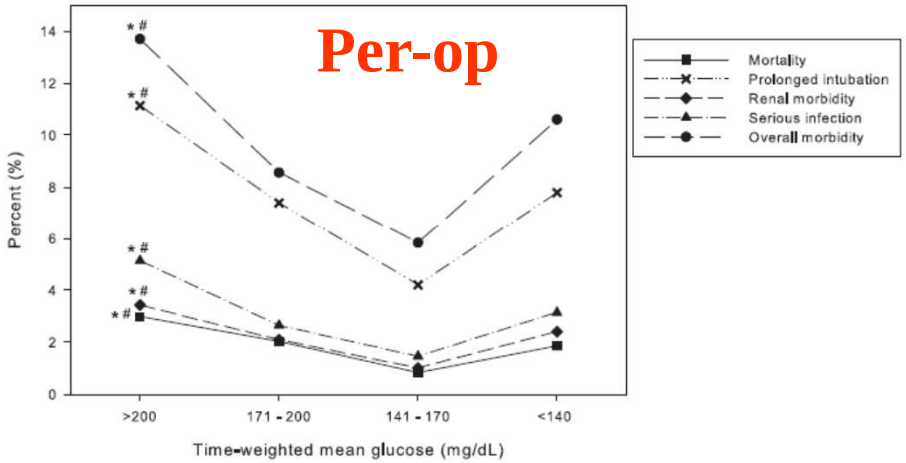
Objectif Per-op: 70 – 150 mg/dl Post-op: 80 – 150 mg/dl

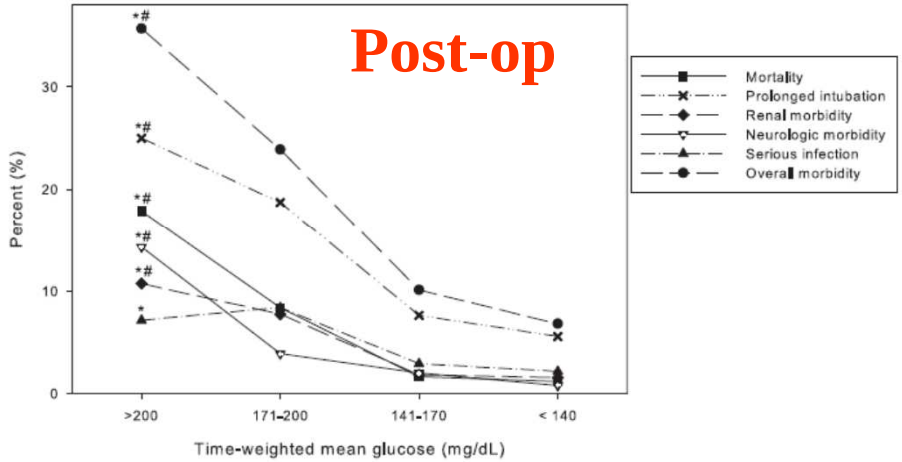
Gly. > 200 mg/dl

vs

Gly. < 200 mg/dl

Outcome	Per-op Glc_{OR}, Odds Ratio (95% CI)	Coefficient of $Variation_{OR}$, Odds Ratio (95% CI)	Post-op Glc_{ICU}, Odds Ratio (95% CI)	Coefficient of $Variation_{ICU}$, Odds Ratio (95% CI)
Mortality	1.92 (1.01–3.70)*	1.15 (0.78–1.69)	10.0 (2.86–33.3)†	1.49 (1.05–2.11)*
Cardiac morbidity	1.05 (0.46–2.22)	1.03 (0.66–1.60)	0.17 (0.001–2.22)	1.23 (0.81–1.84)
Prolonged intubation	1.64 (1.18–2.33)*	1.17 (0.96–1.41)	2.08 (0.68–6.25)	1.08 (0.90–1.31)
Renal morbidity	1.45 (0.81–2.63)	0.84 (0.59–1.18)	2.04 (0.38–11.11)	1.45 (1.05–1.99)*
Serious infection	1.85 (1.14–2.94)*	1.01 (0.76–1.35)	0.94 (0.15–5.88)	1.62 (1.23–2.13)†
Neurologic morbidity	1.15 (0.57–2.27)	0.91 (0.62–1.33)	10.0 (2.86–33.33)†	1.23 (0.86–1.75)
Overall morbidity	1.49 (1.09–2.05)*	1.09 (0.91–1.29)	3.57 (1.39–9.09)*	1.33 (1.13–1.58)†





Duncan et al. Anesthesiology 2010;112:860-71

Hyperglycémie - Insuline - Intraopératoire

CLINICAL PRACTICE

Glycaemic control in the perioperative period

J. J. Sebranek[1*], A. Kopp Lugli[2] and D. B. Coursin[1]

Insulinothérapie si:
Glycémie > 10 mmol/l
180 mg/dl

Objectif:
Glycémie: 8 – 10 mmol/l
140 – 180 mg/dl

Treatment goals

Intraoperative IIT is currently not recommended because of conflicting data and the risk of hypoglycaemia. The Society for Ambulatory Anesthesia (SAMBA) and several authors suggest following guidelines published by the American Association of Clinical Endocrinologists (AACE) and the ADA in their Consensus Statement on Inpatient Glycemic Control.[58 79] This group suggests initiating treatment with an insulin infusion in critically ill patients at a BG no greater than 10 mM (180 mg dl^{-1}). Once treatment has begun, they suggest a target BG of 7.7–10 mM (140–180 mg dl^{-1}), recognizing that greater benefit might be realized at the lower end of this range. Finally, they admit that even lower targets might be beneficial in some patient populations, but suggest never setting a BG target below 6.1 mM (110 mg dl^{-1}).[79] There are slight variations in suggested treatment thresholds and target glucose levels when looking at recommendations from other prominent medical societies; most, however, mirror those of the ADA.[20 80 81]

Sebranek et al. Br J Anaesth 2013;111:i18-34

Hyperglycémie - Insuline - SCA

ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation

ESC GUIDELINES

Table 19 Management of hyperglycaemia in ST-segment elevation myocardial infarction

Recommendations	Class[a]	Level[b]	Ref[c]
Measurement of glycaemia is indicated at initial evaluation in all patients, and should be repeated in patients with known diabetes or hyperglycaemia.	I	C	-
Plans for optimal outpatient glucose control and secondary prevention must be determined in patients with diabetes before discharge.	I	C	-
The goals of glucose control in the acute phase should be to maintain glucose concentrations ≤11.0 mmol/L (200 mg/dL) while avoiding fall of glycaemia <5 mmol/L (<90 mg/dL). In some patients, this may require a dose-adjusted insulin infusion with monitoring of glucose, as long as hypoglycaemia is avoided.	IIa	B	202, 204, 207

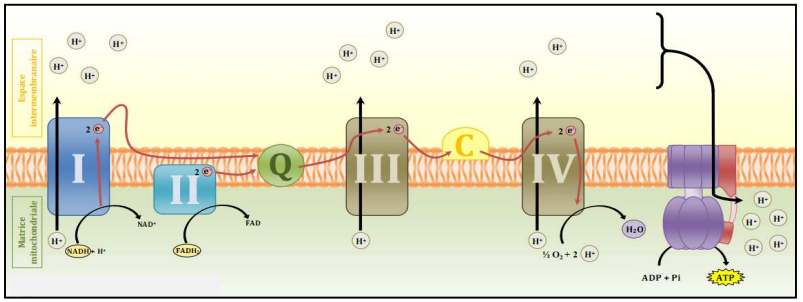
Objectif:

Glycémie: < 11 mmol/l
< 200 mg/dl

ESC Guidelines Eur Heart J 2012;33:2569-619

Toxicité O_2 - Ischémie - Reperfusion

Production de Radicaux Libres



◆ **Pendant l'ischémie :**

- altération de la chaîne respiratoire (CR)

◆ **A la reperfusion :**

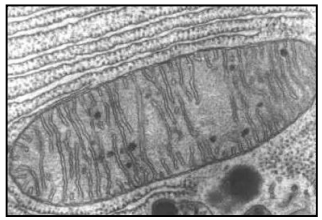
- apport massif d'oxygène qui capte les électrons de la CR

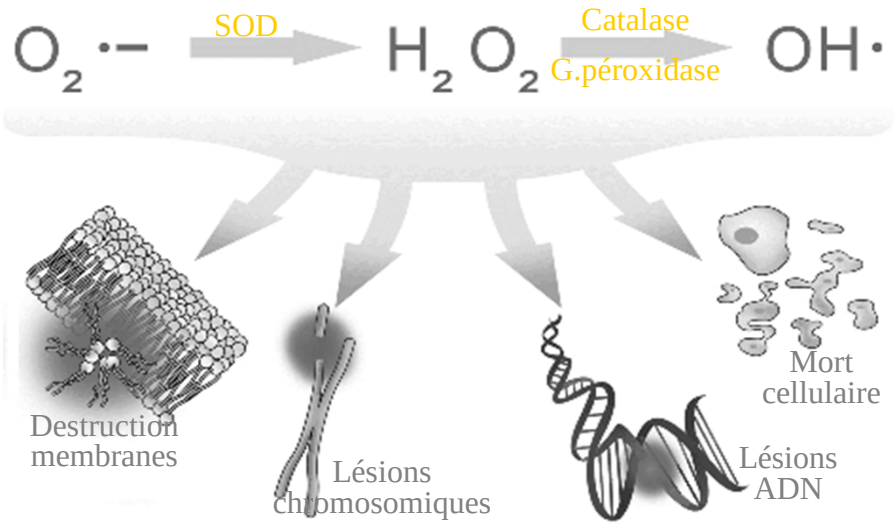
→ production de RL :

- O_2° (anion superoxyde)

- H_2O_2 (peroxyde d'hydrogène)

- OH° (radical hydroxyle)





Oxygénation - STEMI

Air Versus Oxygen in ST-Segment–Elevation Myocardial Infarction

Dion Stub, MBBS, PhD; Karen Smith, BSc, PhD; Stephen Bernard, MBBS, MD; Ziad Nehme, BEmergHlth(Pmedic); Michael Stephenson, RN, BHlthSc, Grad Dip (MICA); Janet E. Bray, RN, PhD; Peter Cameron, MBBS, MD; Bill Barger, MACAP; Andris H. Ellims, MBBS, PhD; Andrew J. Taylor, MBBS, PhD; Ian T. Meredith, BSc, MBBS, PhD; David M. Kaye, MBBS, PhD; on behalf of the AVOID Investigators*

Etude :

prospective, multicentrique, randomisée

441 patients STEMI

SpO2 basal: 98% *versus* 98%

O2: 8 l/min *versus* 0 l/min

SpO2 final: 100% *versus* 98%

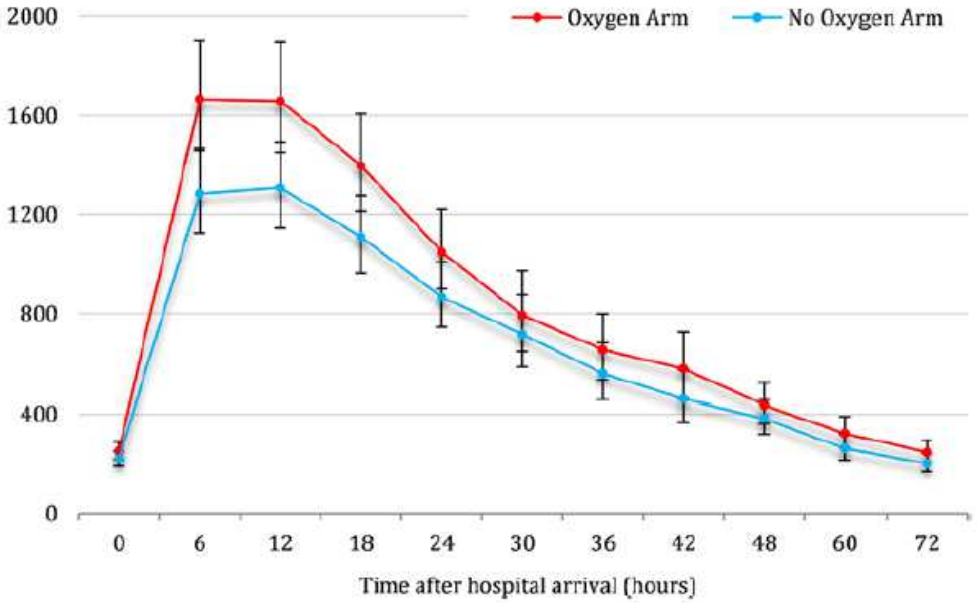


Figure 3. Geometric mean (95% confidence interval) for creatine kinase release (U/L) over 72 hours in patients with confirmed ST-segment–elevation myocardial infarction. A repeated-

Stub et al. Circulation 2015;131:2143-50

Oxygénation - ICU

Effect of Conservative vs Conventional Oxygen Therapy on Mortality Among Patients in an Intensive Care Unit
The Oxygen-ICU Randomized Clinical Trial

Massimo Girardis, MD; Stefano Busani, MD; Elisa Damiani, MD; Abele Donati, MD; Laura Rinaldi, MD; Andrea Marudi, MD; Andrea Morelli, MD; Massimo Antonelli, MD; Mervyn Singer, MD, FRCA

Etude :

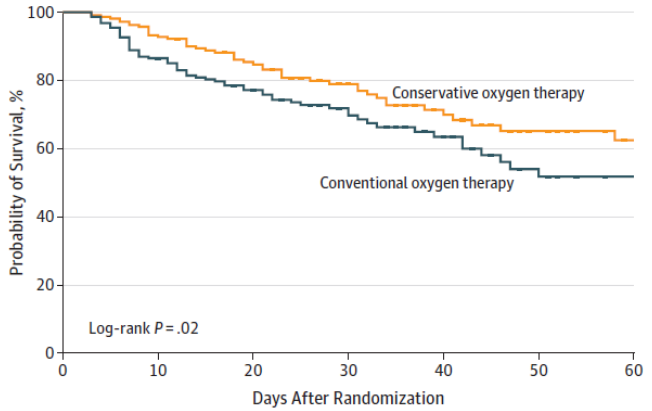
prospective, monocentrique, randomisée

480 patients admis en ICU

PaO2: **>150** *versus* **70-100** mmHg

SpO2: **>97** % *versus* **94-98** %

Figure 2. Probability of Survival From Study Inclusion (Day 0) Through Day 60 for Patients in the Conservative and Conventional Oxygen Strategy Groups



No. at risk

Conservative oxygen therapy	216	201	188	181	173	170	169
Conventional oxygen therapy	218	189	172	163	158	152	152

Girardis et al. JAMA 2016;316:1583-9

Cardioprotection péri-opératoire

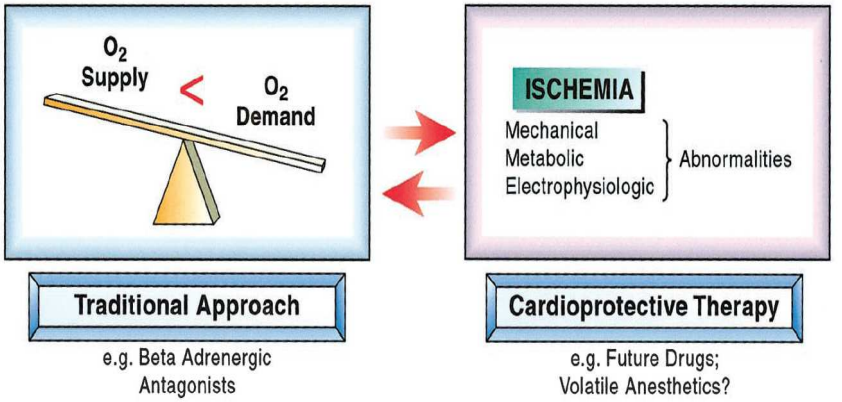
Evaluation et stratification **PRE**-opératoire

\+

Gestion **PER**-opératoire

\+

Gestion **POST**-opératoire



Stratégie Globale = Stratégie Multimodale