



# Patient Blood Management PBM



CONGRÈS TOLOSIADÉ 2022 - 19 Novembre 2022

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@POpARToulouse

# PBM

## Introduction

British Journal of Anaesthesia 109 (1): 55–68 (2012)  
Advance Access publication 24 May 2012 · doi:10.1093/bja/aes139

BJA

### Patient blood management in Europe

A. Shander<sup>1\*</sup>, H. Van Aken<sup>2</sup>, M. J. Colomina<sup>3</sup>, H. Gombotz<sup>4</sup>, A. Hofmann<sup>5</sup>, R. Krauspe<sup>6</sup>, S. Lasocki<sup>7</sup>,  
T. Richards<sup>8</sup>, R. Slappendel<sup>9</sup> and D. R. Spahn<sup>10</sup>



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patient blood management

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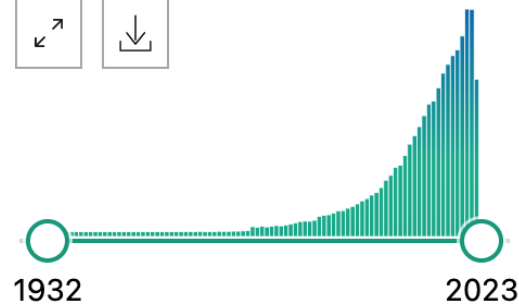
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#### RESULTS BY YEAR



# PBM

## Introduction



HAUTE AUTORITÉ DE SANTÉ

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**RECOMMANDER**  
LES BONNES PRATIQUES

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**RECOMMANDATION**

Gestion du capital  
sanguin en pré, per  
et postopératoire et  
en obstétrique

**Recommandations Juin 2022**

# PBM

## Introduction

**PBM**  
= **Préserver la masse sanguine des patients**

**PBM**  
= **Pilier de la RAAC**

P  
a  
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p  
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t

	Optimiser Hb	Diminuer pertes	Améliorer tolérance
Preoperative	<ul style="list-style-type: none"> <li>• Screen for anaemia</li> <li>• Identify underlying disorder(s) causing anaemia</li> <li>• Manage underlying disorder(s)</li> <li>• Refer for further evaluation if necessary</li> <li>• Treat iron deficiency, anaemia of chronic disease, iron-restricted erythropoiesis</li> <li>• Note: anaemia is a contraindication for elective surgery</li> </ul>	<ul style="list-style-type: none"> <li>• Identify and manage bleeding risk (past/family history, current medications, etc)</li> <li>• Minimise iatrogenic blood loss</li> <li>• Procedure planning and rehearsal</li> <li>• Preoperative autologous blood donation (in selected cases or when patient choice)</li> </ul>	<ul style="list-style-type: none"> <li>• Assess/optimize patient's physiological reserve and risk factors</li> <li>• Compare estimated blood loss with patient-specific tolerable blood loss</li> <li>• Formulate patient-specific management plan using appropriate blood-conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia</li> <li>• Restrictive evidence-based transfusion strategies</li> </ul>
Intraoperative	<ul style="list-style-type: none"> <li>• Timing surgery with haematological optimisation</li> </ul>	<ul style="list-style-type: none"> <li>• Meticulous haemostasis and surgical techniques</li> <li>• Blood-sparing surgical techniques</li> <li>• Anaesthetic blood-conserving strategies</li> <li>• Autologous blood options</li> <li>• Pharmacological/haemostatic agents</li> </ul>	<ul style="list-style-type: none"> <li>• Optimise cardiac output</li> <li>• Optimise ventilation and oxygenation</li> <li>• Restrictive evidence-based transfusion strategies</li> </ul>
Postoperative	<ul style="list-style-type: none"> <li>• Treat anaemia/iron deficiency</li> <li>• Stimulate erythropoiesis</li> <li>• Be aware of drug interactions that can cause/increase anaemia</li> </ul>	<ul style="list-style-type: none"> <li>• Vigilant monitoring and management of post-operative bleeding</li> <li>• Avoid secondary haemorrhage</li> <li>• Rapid warming – maintain normothermia (unless hypothermia specifically indicated)</li> <li>• Autologous blood salvage</li> <li>• Minimising iatrogenic blood loss</li> <li>• Haemostasis/anticoagulation management</li> <li>• Prophylaxis of upper gastrointestinal haemorrhage</li> <li>• Avoid/treat infections promptly</li> <li>• Be aware of adverse effects of medication</li> </ul>	<ul style="list-style-type: none"> <li>• Optimise tolerance of anaemia</li> <li>• Treat anaemia</li> <li>• Maximise oxygen delivery</li> <li>• Minimise oxygen consumption</li> <li>• Avoid/treat infections promptly</li> <li>• Restrictive, evidence-based transfusion strategies</li> </ul>

# PBM

## Pourquoi?

**Anémie = Fréquente = Augmentation des complications**



**Homme < 13 g/dl**

**Femme < 12 g/dl**

# PBM

## Pourquoi?

Prévalence d'une anémie préopératoire en chirurgie orthopédique majeure

Auteur/année

Intervention

Nb cas

Prévalence

**Anémie préopératoire = fréquente**

# PBM

## Pourquoi?

Pre-operative haemoglobin levels and iron status in a large multicentre cohort of patients undergoing major elective surgery\*

M. Muñoz,<sup>1</sup> M. J. Laso-Morales,<sup>2</sup> S. Gómez-Ramírez,<sup>3</sup> M. Cadellas,<sup>4</sup> M. J. Núñez-Matas<sup>5</sup> and J. A. García-Erce<sup>6</sup> Anaesthesia 2017, 72, 826-834

**Anémie = fréquente**

**Tout type de chirurgie majeure**

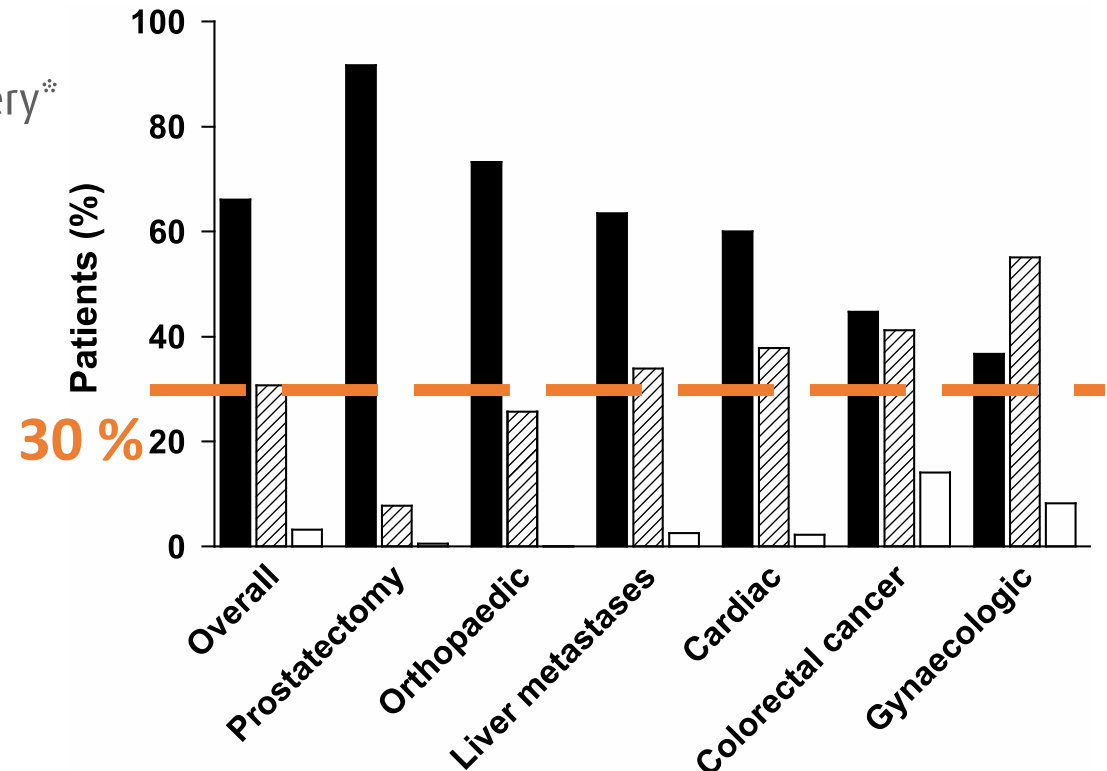


Figure 1 Distribution of pre-operative haemoglobin levels according to type of surgery. ■ Haemoglobin  $\geq 130$  g.l<sup>-1</sup>; ▨ Haemoglobin 100-129 g.l<sup>-1</sup>; □ Haemoglobin  $< 100$  g.l<sup>-1</sup>; p = 0.001 between groups.

# PBM

## Pourquoi?

### *Risk Associated with Preoperative Anemia in Noncardiac Surgery*

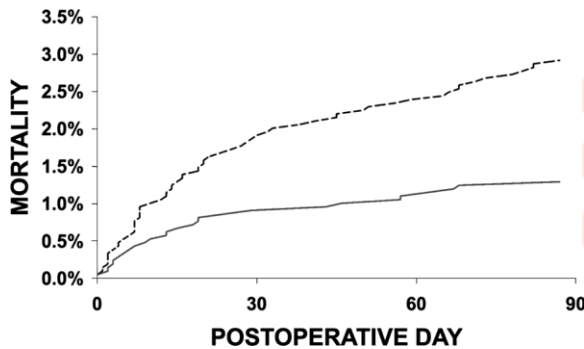
Anesthesiology 2009; 110:574-81

#### *A Single-center Cohort Study*

W. Scott Beattie, M.D., Ph.D., F.R.C.P.C.,\* Keyvan Karkouti, M.D., M.Sc., F.R.C.P.C.,†  
Duminda N. Wijesundera, M.D., F.R.C.P.C.,‡ Gordon Tait, Ph.D.§

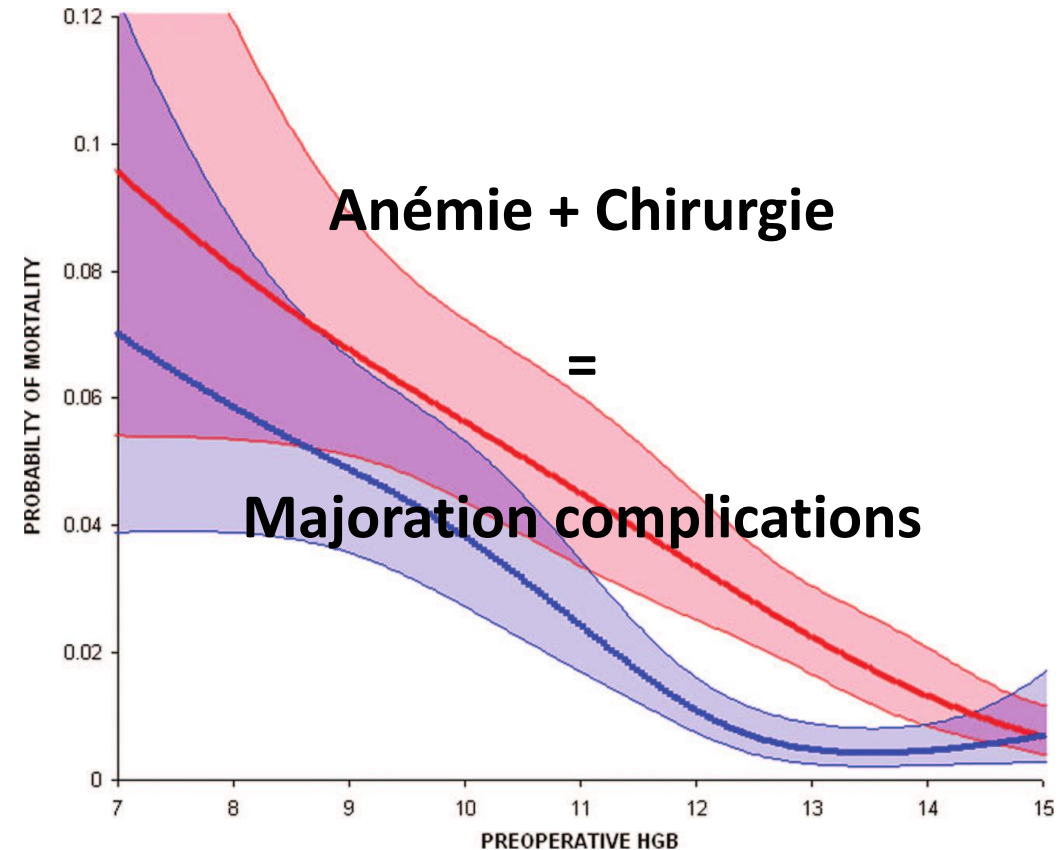
**Table 5. Causes of Death\***

	Anemia, n (%)	No Anemia, n (%)	Total %
Cardiac†	29 (32.5)	10 (30.3)	(31.9)
Cerebrovascular	1 (1.1)	1 (3.0)	(1.6)
Respiratory‡	6 (6.7)	4 (12.0)	(8.2)
Pulmonary embolism	1 (1.1)	0	(0.8)
Septic	22 (24.7)	6 (18.1)	(22.9)
Hemorrhagic	8 (8.9)	0	(6.6)
Multiorgan failure	15 (16.8)	6 (18.1)	(17.1)
Cancer-related	6 (6.7)	6 (18.1)	(9.8)



**Table 3. Effect of Transfusions**

	No Transfusions*	1-2 Units	3-4 Units	5-9 Units	10+ Units
Total population (percent mortality)	88/6,161 (1.41)	35/885 (3.95)	21/337 (6.23)	12/153 (7.84)	4/55 (7.27)
No anemia (percent mortality)	25/4,129 (0.61)	11/314 (3.50)	2/128 (1.56)	4/61 (6.6)	
Anemic (percent mortality)	63/2,102 (2.97)	24/571 (4.20)	19/209 (9.09)	12/147 (8.2)	
Relative risk (95% CI) of transfusion (anemia vs. no anemia)		1.94 (1.84-2.05)	1.77 (1.65-1.89)	1.86 (1.67-2.03)	





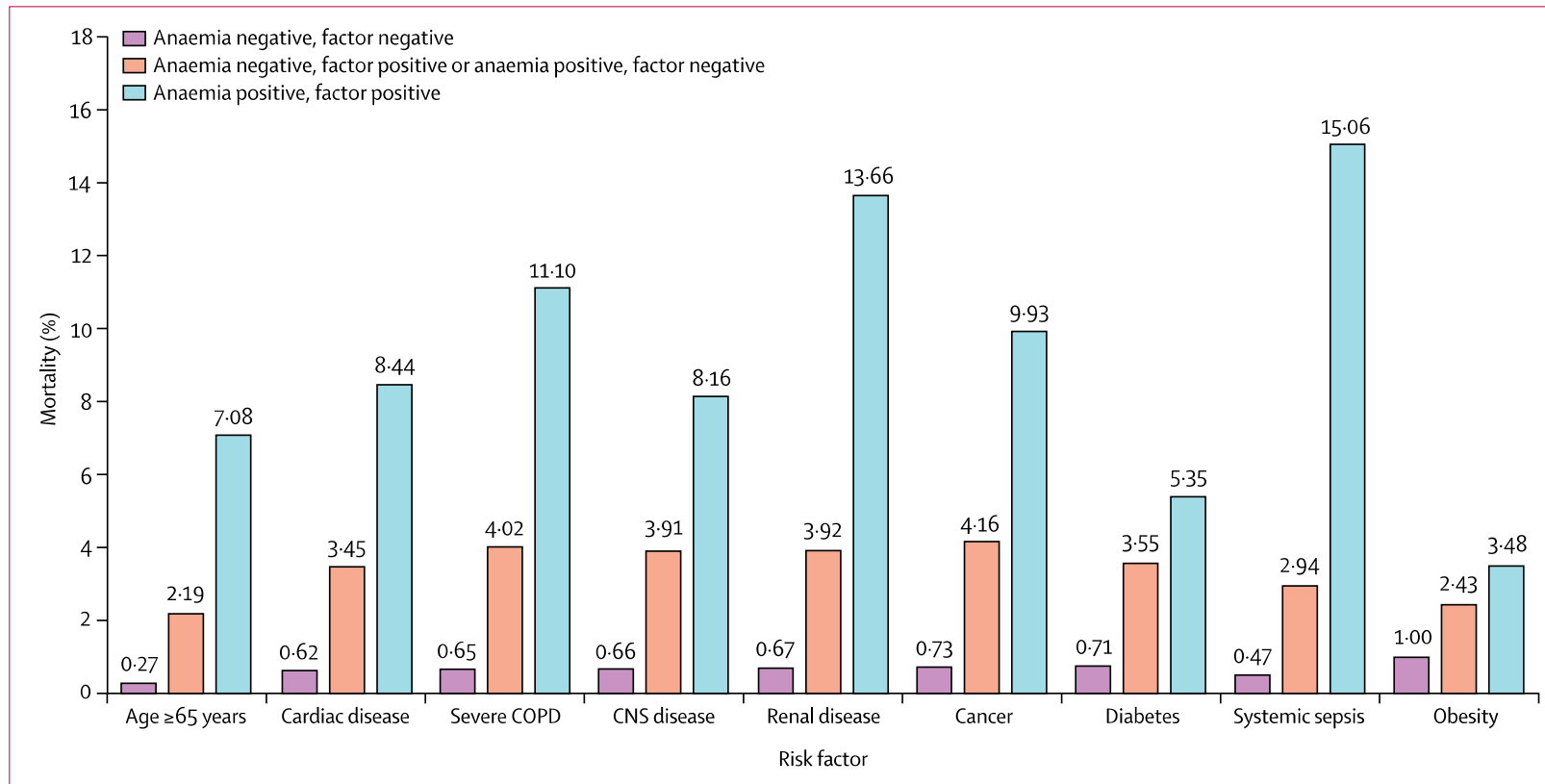
# PBM

## Pourquoi?

### Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study

*Khaled M Musallam, Hani M Tamim, Toby Richards, Donat R Spahn, Frits R Rosendaal, Aida Habbal, Mohammad Khreiss, Fadi S Dahdaleh, Kaivan Khavandi, Pierre M Sfeir, Assaad Soweid, Jamal J Hoballah, Ali T Taher, Faek R Jamali*

Vol 378 October 15, 2011



# PBM

## Pourquoi?

### Pre- and postoperative anemia, acute kidney injury, and mortality after coronary artery bypass grafting surgery: a retrospective observational study

Can J Anesth/J Can Anesth (2018) 65:46–59

Adriana D. Oprea, MD ·

**N = 6130**

**Etude monocentrique rétrospective**

**Table 2** Time-varying anemia patterns as univariable and multivariable predictors of postoperative acute kidney injury

Time-varying anemia pattern	Univariable model		Multivariable model	
	Hazard ratio (95% CI)	<i>P</i> value	Hazard ratio (95% CI)	<i>P</i> value
No anemia	1.00		1.00	
Preoperative anemia	1.60 (1.49 to 1.72)	< 0.001	1.23 (1.13 to 1.33)	< 0.001
Postoperative anemia	1.06 (0.93 to 1.20)	0.38	1.01 (0.89 to 1.15)	0.84
Preoperative and postoperative anemia	1.64 (1.47 to 1.85)	< 0.001	1.24 (1.09 to 1.40)	< 0.001



**Table 4** Time-varying anemia patterns as univariable and multivariable predictors of long-term mortality

Time-varying anemia pattern	Univariable model		Multivariable model	
	Hazard ratio (95% CI)	<i>P</i> value	Hazard ratio (95% CI)	<i>P</i> value
No anemia	1.00		1.00	
Preoperative anemia	2.02 (1.83 to 2.22)	< 0.001	1.29 (1.15 to 1.44)	< 0.001
Postoperative anemia	0.66 (0.54 to 0.81)	< 0.001	0.83 (0.67 to 1.02)	0.08
Preoperative and postoperative anemia	1.78 (1.50 to 2.10)	< 0.001	1.50 (1.25 to 1.79)	< 0.001



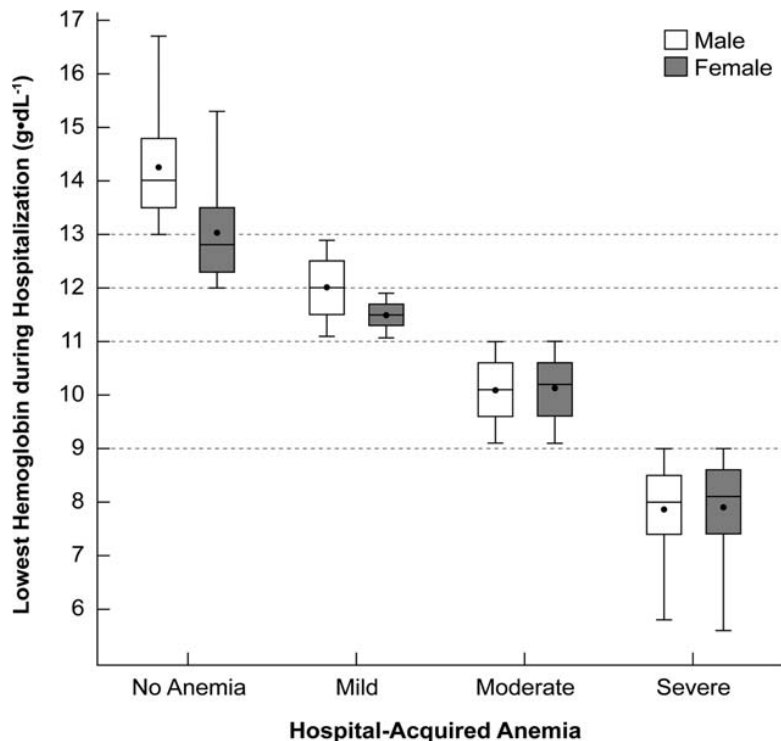
# PBM

## Pourquoi?

### Hospital-Acquired Anemia: Prevalence, Outcomes, and Healthcare Implications

Colleen G. Koch, MD<sup>1,2\*</sup>, Liang Li, PhD<sup>3</sup>, Zhiyuan Sun, MS<sup>3</sup>, Eric D. Hixson, PhD<sup>4</sup>, Anne Tang, MS<sup>3</sup>, Shannon C. Phillips, MD<sup>2</sup>, Eugene H. Blackstone, MD<sup>3,5</sup>, J. Michael Henderson, MD<sup>2,6</sup>

*Journal of Hospital Medicine* Vol 8 | No 9 | September 2013

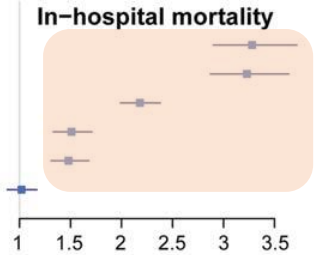


N = 188 447  
41 % de patients chirurgicaux

74 % d'anémie acquises  
80 % d'anémie dans le groupe chirurgie

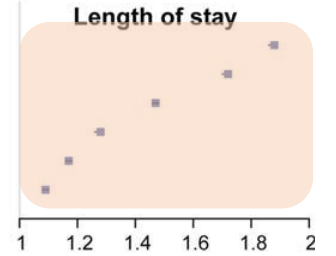
HAA	Ratio
Severe vs. none	3.28 (2.90, 3.72)
Severe vs. mild	3.23 (2.87, 3.64)
Severe vs. moderate	2.18 (1.99, 2.38)
Moderate vs. none	1.51 (1.33, 1.71)
Moderate vs. mild	1.48 (1.31, 1.68)
Mild vs. none	1.02 (0.88, 1.17)

A



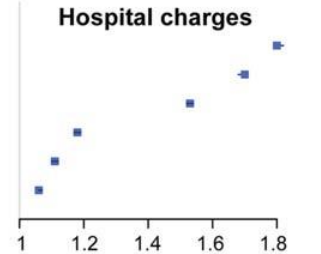
HAA	Ratio
Severe vs. none	1.88 (1.86, 1.89)
Severe vs. mild	1.72 (1.70, 1.73)
Severe vs. moderate	1.47 (1.46, 1.48)
Moderate vs. none	1.28 (1.26, 1.29)
Moderate vs. mild	1.17 (1.16, 1.18)
Mild vs. none	1.09 (1.08, 1.10)

B



HAA	Ratio
Severe vs. none	1.80 (1.79, 1.82)
Severe vs. mild	1.70 (1.68, 1.71)
Severe vs. moderate	1.53 (1.52, 1.54)
Moderate vs. none	1.18 (1.17, 1.19)
Moderate vs. mild	1.11 (1.10, 1.12)
Mild vs. none	1.06 (1.06, 1.07)

C



**FIG. 5.** Forest plots of adjusted outcomes and hospital-acquired anemia (HAA). Squares represent the effect size (ratio), and lines represent confidence intervals.

# PBM

## Pourquoi?

### Risque de réadmission

#### **Magnitude of Anemia at Discharge Increases 30-Day Hospital Readmissions**

Colleen Koch;Liang Li;Zhiyuan Sun;Eric Hixson;Anne Tang;Kevin Chagin;Michael Kattan;Shannon Phillips;Eugene Blackstone;J. Henderson;  
Journal of Patient Safety. 13(4):202–206, DECEMBER 2017

N = 152 757 séjours hospitaliers

**72 % des patients = anémiques :**

- 21 % minime (11g – 12-13g/dl)
- 35 % modérée (9g – 11g/dl)
- 17 % sévère ( $\leq$  9g/dl)

### **Résultats :**

#### **Risque de ré-hospitalisation augmenté**

Anémie minime : OR = 1,74 (1,65 – 1,82)

Anémie modérée : OR = 2,76 (2,64 – 2,89)

Anémie sévère : OR = 3,47 (3,30 – 3,65)



# PBM

## Pourquoi?

### Récupération postopératoire

#### Postoperative Anemia and Quality of Life After Primary Hip Arthroplasty in Patients Over 65 Years Old

Niamh P. Conlon, FCARCSI\*

Vol. 106, No. 4, April 2008

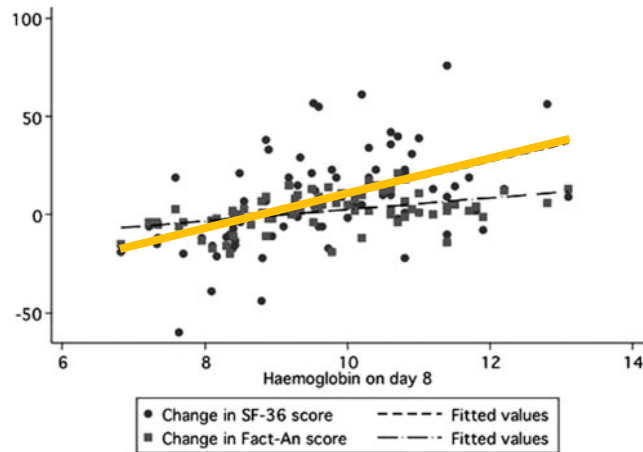
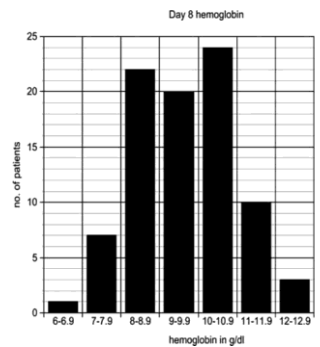
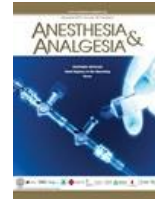


Figure 2. The correlation between Day 8 hemoglobin and changes in Sf-36 and Fact-An scores.

N = 87

SF36 à J8

#### Anaemia impedes functional mobility after hip fracture surgery *Age and Ageing* 2008; 37: 173–178

NICOLAI B. FOSS<sup>1,2</sup>, MORTEN TANGE KRISTENSEN<sup>3</sup>, HENRIK KEHLET<sup>4</sup>

Table 3. Multivariate analysis of factors impeding functional mobility and the ability to walk independently or with human assistance on the third post-operative day (n= 430)

	Ability to walk on the third post-operative day			
	Univariate analysis		Multivariate analysis	
	Odds ratio (95% CI)	P	Odds ratio (95% CI)	P
> 75 years	0.16 (0.07–0.35)	< 0.001	0.28 (0.12–0.67)	0.004
Prefracture NMS 0–5	0.19 (0.12–0.32)	< 0.001	0.35 (0.20–0.63)	< 0.001
Dementia	0.21 (0.13–0.34)	< 0.001	0.36 (0.20–0.64)	< 0.001
ASA 3–4	0.37 (0.23–0.60)	< 0.001	0.69 (0.39–1.22)	0.20
Post-operative medical complication	0.28 (0.17–0.44)	< 0.001	0.39 (0.23–0.67)	0.001
Operation is arthroplasty <sup>a</sup>	0.92 (0.57–1.49)	0.73	0.53 (0.17–1.60)	0.26
Operation is sliding hip screw <sup>a</sup>	0.78 (0.50–1.23)	0.29	0.37 (0.13–1.09)	0.07
Operation is intramedullary hip screw <sup>a</sup>	0.52 (0.25–1.09)	0.08	0.25 (0.07–0.91)	0.04
Hb < 100 g/l 1st post-operative day	0.47 (0.29–0.75)	0.002	0.41 (0.23–0.73)	0.002

# PBM

## Pourquoi?

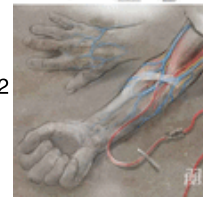
### Récupération postopératoire

Postoperative anemia does not impede functional outcome and quality of life early after hip and knee arthroplasties

TRANSFUSION

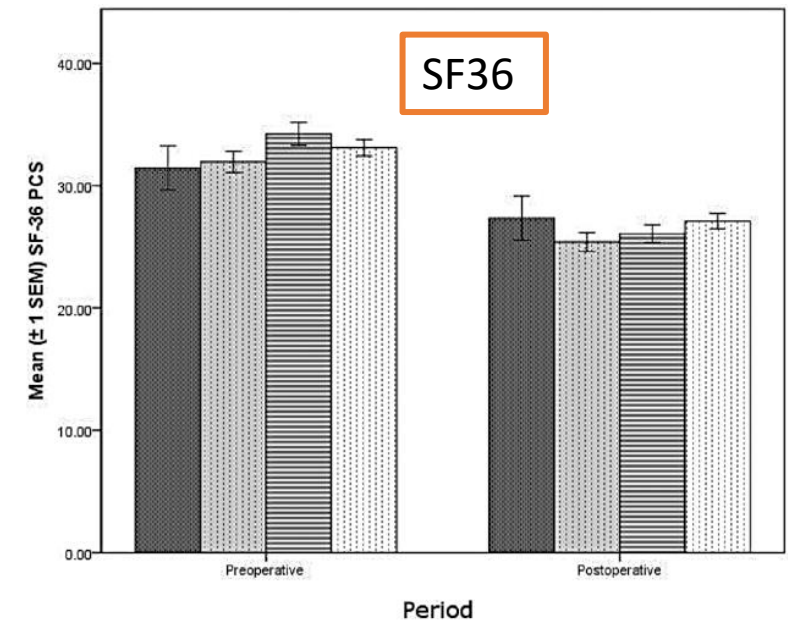
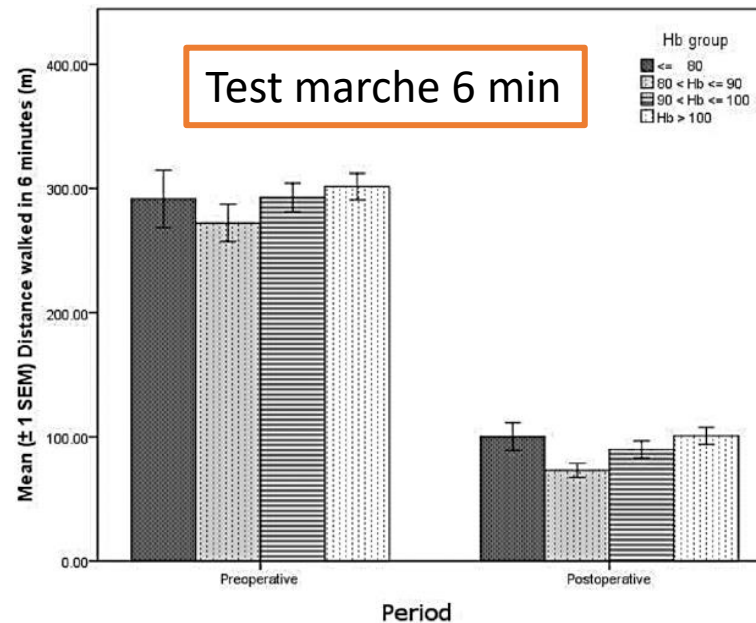
Volume 52, February 2012

Élise Vuille-Lessard, Daniel Boudreault, François Girard, Monique Ruel, Miguel Chagnon, and Jean-François Hardy



N = 305  
Age > 60 ans  
Postop PTH - PTG

Différences = NS



# PBM

## Pourquoi?

### Récupération postopératoire

Postoperative anemia and early functional outcomes after fast-track hip arthroplasty: a prospective cohort study

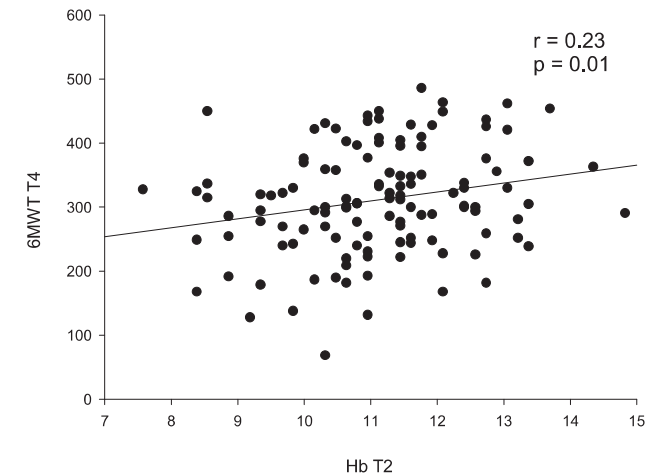


Volume 56, April 2016

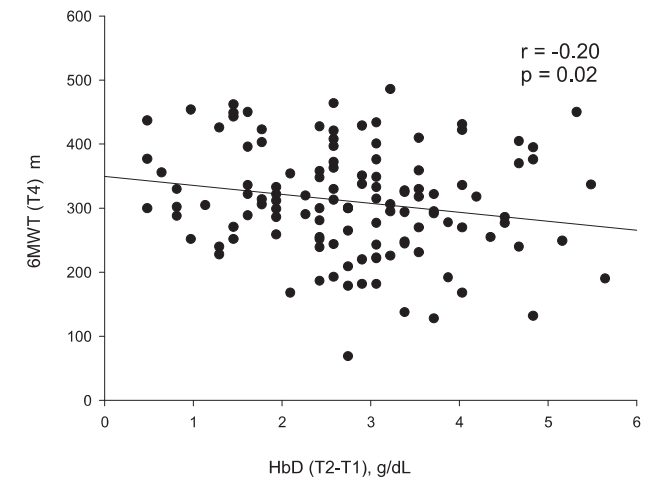
Øivind Jans,<sup>1,2</sup> Thomas Bandholm,<sup>3</sup> Sorel Kurbegovic,<sup>1</sup> Søren Solgaard,<sup>4</sup>  
Per Kjærsgaard-Andersen,<sup>5</sup> Pär I. Johansson,<sup>6</sup> and Henrik Kehlet<sup>1,2</sup>  
on behalf of the Lundbeck Foundation Centre for Fast-Track Hip and Knee  
Replacement Collaborative Group

N = 122  
Age > 65 ans  
PTH

Hémoglobine le jour de la sortie  
Test de marche 6 min à 16 jours postop



Tendance NS



# PBM

## Pourquoi?

**Anémie = Fréquente = Augmentation des complications**

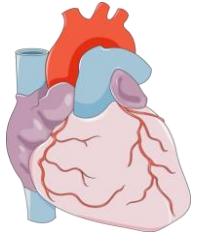
**Transfusion = FRD de complications**



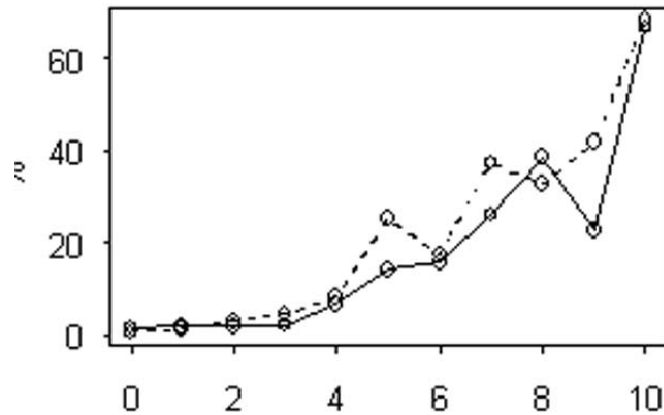


# PBM

## Pourquoi?



### Intubation Morbidity



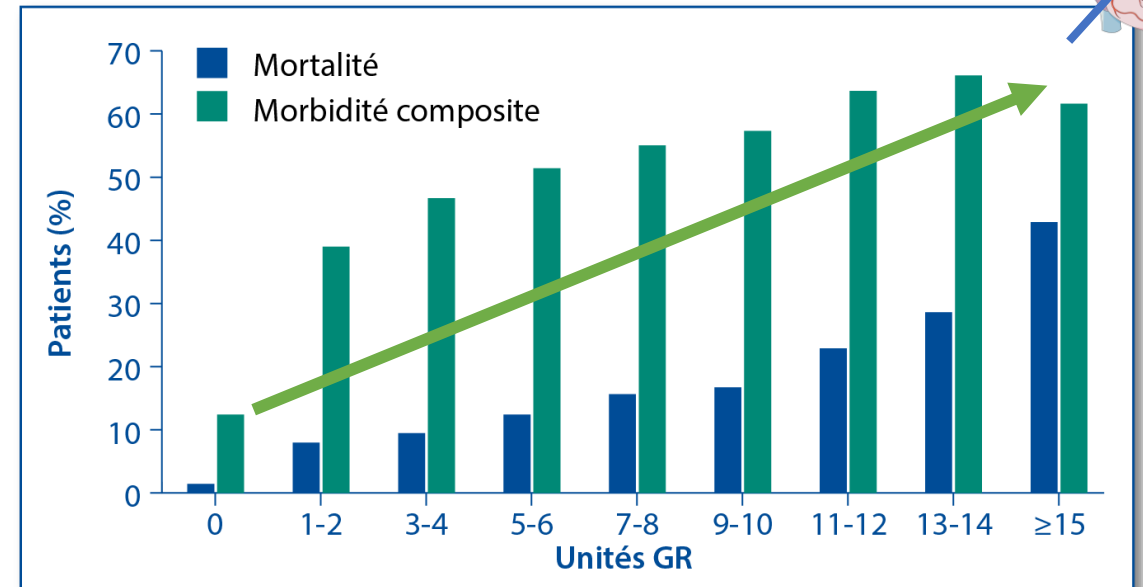
**Table 3 Observed and adjusted ORs of postoperative adverse outcomes after cardiac surgery, according to the presence or absence of anemia**

Outcome	Crude OR (95% CI)	Adjusted* OR (95%)
Mortality	2.81 (2.06-3.84)	1.44 (1.02-2.03)
Atrial fibrillation	1.18 (1.06-1.31)	0.96 (0.85-1.08)
Renal dysfunction	3.26 (2.8-3.8)	1.73 (1.43-2.1)
Stroke	1.77 (1.17-2.67)	0.95 (0.61-1.47)
Myocardial infarction	0.967 (0.66-1.4)	0.79 (0.53- 1.19)
Length of hospital stay >7 days	2.03 (1.82-2.25)	1.3 (1.15-1.47)

\*Adjusted for baseline characteristics and propensity score.

Crit Care Med 2006 Vol. 34, No. 6

Miceli et al. Journal of Cardiothoracic Surgery 2014, 9:137



**Le volume transfusé = FDR de morbi-mortalité**

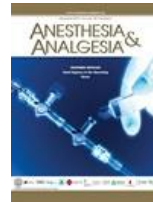
Ferraris, V. et al., Arch Surg, 2012

# PBM Pourquoi?

## Transfusion of Red Blood Cells, Fresh Frozen Plasma, or Platelets Is Associated With Mortality and Infection After Cardiac Surgery in a Dose-Dependent Manner

Yue Ming, MMed,\* Jing Liu, MMed,† Fengjiang Zhang, MD, PhD,\* Changwei Chen, MMed,† Li Zhou, MD, PhD,† Lei Du, MD, PhD,† and Min Yan, MD, PhD\*

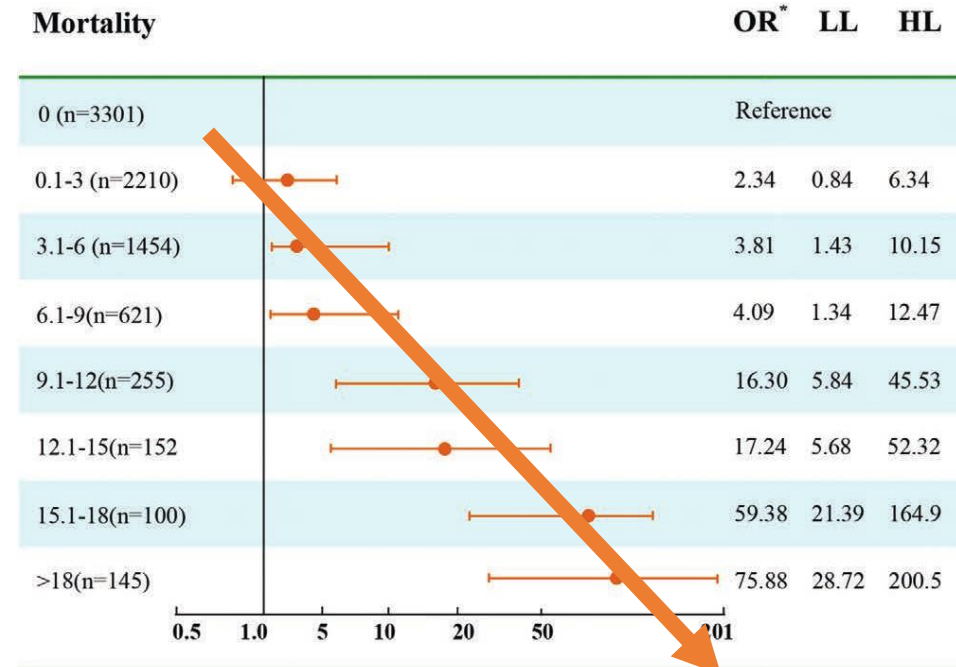
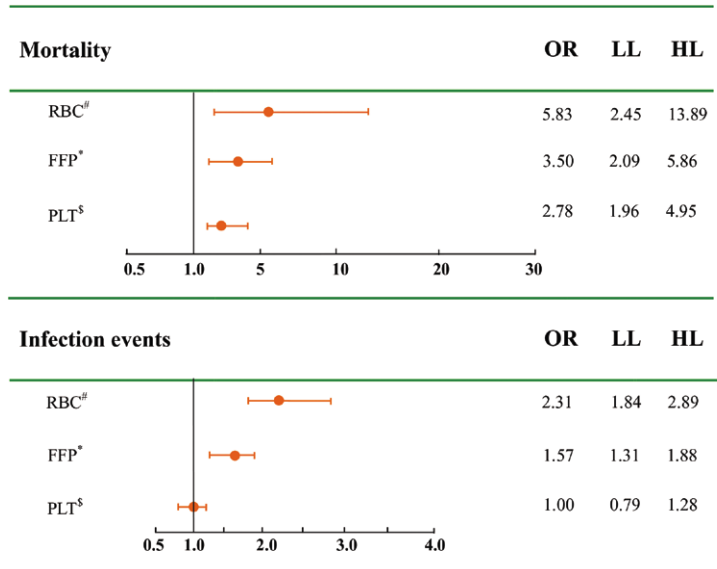
On line



N = 8238

Etude rétrospective, bicentrique

Chirurgie cardiaque



# PBM

## Pourquoi?

### Association between Intraoperative Blood Transfusion and Mortality and Morbidity in Patients Undergoing Noncardiac Surgery

Laurent G. Glance, M.D.,\* Andrew W. Dick, Ph.D.,† Dana B. Mukamel, Ph.D.,‡  
 Fergal J. Fleming, M.D.,§ Raymond A. Zollo, M.D.,\* Richard Wissler, M.D.,\* Rabih Salloum, M.D.,||  
 U. Wayne Meredith, M.D.,# Turner M. Osler, M.D.\*\*



**N = 10100**

Etude rétrospective

Chirurgie générale – Vasculaire - Orthopédique

**Table 3.** Impact of Intraoperative Transfusion on 30-Day Mortality and 30-Day Complications

Outcome	Transfusion Group, Outcome Rate (%)	No Transfusion Group, Outcome Rate (%)	Unadj OR Txf vs. No Txf (95% CI)	Adj OR Txf vs. No Txf (95% CI)
→ Mortality	6.44	4.26	1.55 (1.24, 1.90)	1.29 (1.03, 1.62)
→ Cardiac complications	2.08	1.40	1.50 (1.06, 2.12)	1.40 (0.97, 2.03)
→ Pulmonary complications	12.6	6.03	2.24 (1.92, 2.63)	1.76 (1.48, 2.09)
Renal complications	2.69	1.85	1.46 (1.08, 1.99)	1.32 (0.93, 1.88)
CNS complications	0.69	0.58	1.20 (0.67, 2.15)	0.84 (0.43, 1.64)
→ Sepsis complications	16.4	9.81	1.81 (1.58, 2.07)	1.43 (1.21, 1.68)
Wound complications	9.17	4.65	2.07 (1.73, 2.48)	1.87 (1.47, 2.37)
Thromboembolic complications	4.07	1.89	2.20 (1.69, 2.88)	1.77 (1.32, 2.38)

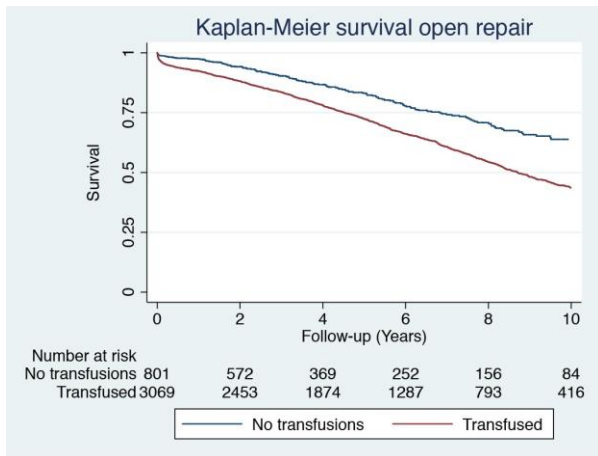
# PBM

## Pourquoi?

Red blood cell transfusion associated with increased morbidity and mortality in patients undergoing elective open abdominal aortic aneurysm repair

July 11, 2019

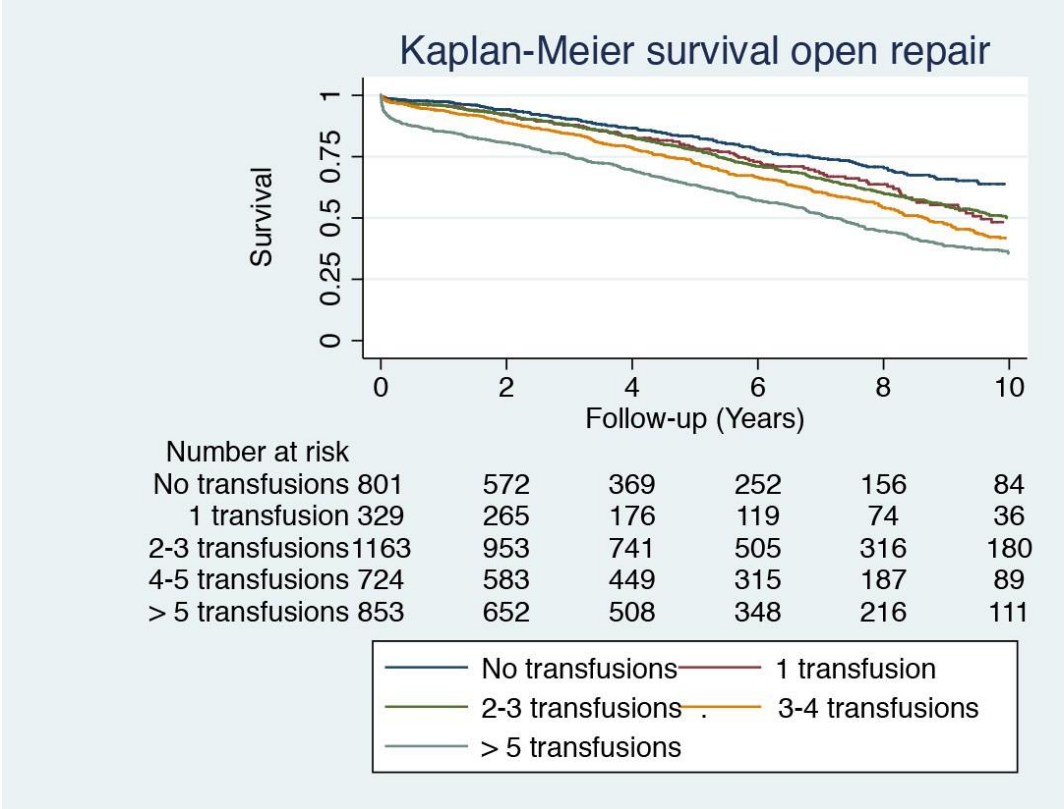
Charlotte Wedel<sup>1\*</sup>, Cecilie M. Møller<sup>1</sup>, Jacob Budtz-Lilly<sup>1</sup>, Nikolaj Eldrup<sup>1,2</sup>



N = 3 876 patients

Etude prospective – Multicentrique

Anévrismes aorte abdo programmés



# PBM

## Que faut-il proposer?

**1<sup>ier</sup> Etape**

=

**Corriger l'anémie**

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	Optimiser Hb	Diminuer pertes	Améliorer tolérance
Preoperative	<ul style="list-style-type: none"><li>• Screen for anaemia</li><li>• Identify underlying disorder(s) causing anaemia</li><li>• Manage underlying disorder(s)</li><li>• Refer for further evaluation if necessary</li><li>• Treat iron deficiency, anaemia of chronic disease, iron-restricted erythropoiesis</li><li>• Note: anaemia is a contraindication for elective surgery</li></ul>	<ul style="list-style-type: none"><li>• Identify and manage bleeding risk (past/family history, current medications, etc)</li><li>• Minimise iatrogenic blood loss</li><li>• Procedure planning and rehearsal</li><li>• Preoperative autologous blood donation (in selected cases or when patient choice)</li></ul>	<ul style="list-style-type: none"><li>• Assess/optimize patient's physiological reserve and risk factors</li><li>• Compare estimated blood loss with patient-specific tolerable blood loss</li><li>• Formulate patient-specific management plan using appropriate blood-conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia</li><li>• Restrictive evidence-based transfusion strategies</li></ul>
Intraoperative	<ul style="list-style-type: none"><li>• Timing surgery with haematological optimisation</li></ul>	<ul style="list-style-type: none"><li>• Meticulous haemostasis and surgical techniques</li><li>• Blood-sparing surgical techniques</li><li>• Anaesthetic blood-conserving strategies</li><li>• Autologous blood options</li><li>• Pharmacological/haemostatic agents</li></ul>	<ul style="list-style-type: none"><li>• Optimise cardiac output</li><li>• Optimise ventilation and oxygenation</li><li>• Restrictive evidence-based transfusion strategies</li></ul>
Postoperative	<ul style="list-style-type: none"><li>• Treat anaemia/iron deficiency</li><li>• Stimulate erythropoiesis</li><li>• Be aware of drug interactions that can cause/increase anaemia</li></ul>	<ul style="list-style-type: none"><li>• Vigilant monitoring and management of post-operative bleeding</li><li>• Avoid secondary haemorrhage</li><li>• Rapid warming – maintain normothermia (unless hypothermia specifically indicated)</li><li>• Autologous blood salvage</li><li>• Minimising iatrogenic blood loss</li><li>• Haemostasis/anticoagulation management</li><li>• Prophylaxis of upper gastrointestinal haemorrhage</li><li>• Avoid/treat infections promptly</li><li>• Be aware of adverse effects of medication</li></ul>	<ul style="list-style-type: none"><li>• Optimise tolerance of anaemia</li><li>• Treat anaemia</li><li>• Maximise oxygen delivery</li><li>• Minimise oxygen consumption</li><li>• Avoid/treat infections promptly</li><li>• Restrictive, evidence-based transfusion strategies</li></ul>

# PBM : Que faut-il proposer? Corriger l'anémie



HAUTE AUTORITÉ DE SANTÉ

**Chirurgie programmée**  
**=**  
**Dépistage ET prise en charge de l'anémie**

# PBM : Que faut-il proposer? Corriger l'anémie

Detection, evaluation, and management of preoperative anaemia in the elective orthopaedic surgical patient: NATA guidelines *British Journal of Anaesthesia* 106 (1): 13–22 (2011)

BJA

L. T. Goodnough<sup>1\*</sup>, A. Maniatis<sup>2</sup>, P. Earnshaw<sup>3</sup>, G. Benoni<sup>4</sup>, P. Beris<sup>5</sup>, E. Bisbe<sup>6</sup>, D. A. Fergusson<sup>7</sup>, H. Gombotz<sup>8</sup>, O. Habler<sup>9</sup>, T. G. Monk<sup>10</sup>, Y. Ozier<sup>11</sup>, R. Slappendel<sup>12</sup> and M. Szpalski<sup>13</sup>

## 1<sup>ère</sup> Etape = Dépistage

### Bilan simple

#### Hémoglobine

**Bilan martial** : Ferritinémie – Taux de saturation de la transferrine

**Bilan inflammatoire** : CRP

**Bilan rénal** : clairance de la créatinémie

Hb < 12 g dl<sup>-1</sup> for females  
Hb < 13 g dl<sup>-1</sup> for males

No

No action required

Yes

Evaluation necessary

### GUIDELINES

#### Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology

First update 2016

Sibylle A. Kozek-Langenecker, Aamer B. Ahmed, Arash Afshari, Pierre Albaladejo, Cesar Aldecoa, Guidrius Barauskas, Edoardo De Robertis, David Faraoni, Daniela C. Filipescu, Dietmar Fries, Thorsten Haas, Matthias Jacob, Marcus D. Lancé, Juan V.L. Pitarch, Susan Mallett, Jens Meier, Zsolt L. Molnar, Niels Rahe-Meyer, Charles M. Samama, Jakob Stensballe, Philippe J.F. Van der Linden, Anne J. Wikkelse, Patrick Wouters, Piet Wyffels and Kai Zacharowski

*Eur J Anaesthesiol* 2017; 34:332–395

We recommend that patients at risk of bleeding are assessed for anaemia 3 to 8 weeks before surgery. **1C**

If anaemia is present, we recommend identifying the cause (iron deficiency, renal insufficiency or inflammation). **1C**

**Evaluation = nécessité de reporter l'intervention**

# PBM : Que faut-il proposer? Corriger l'anémie

## Bilan simple

Hémoglobine

**Bilan martial** : Ferritinémie – Taux de saturation de la transferrine

**Bilan inflammatoire** : CRP

**Bilan rénal** : clairance de la créatinémie

## 2<sup>ème</sup> Etape = Traiter

**Stimuler l'érythropoïèse : EPO**

**Corriger une carence martiale**



# PBM : Que faut-il proposer? Corriger l'anémie

## Stimuler l'érythropoïèse : EPO

The effectiveness and safety of preoperative use of erythropoietin in patients scheduled for total hip or knee arthroplasty

A systematic review and meta-analysis of randomized controlled trials

Yan Zhao (MD), Chao Jiang (MD), Huiming Peng (MD), Bin Feng (MD), Yulong Li (MD), Xisheng Weng (MD)\*

Medicine®

## Méta-analyse

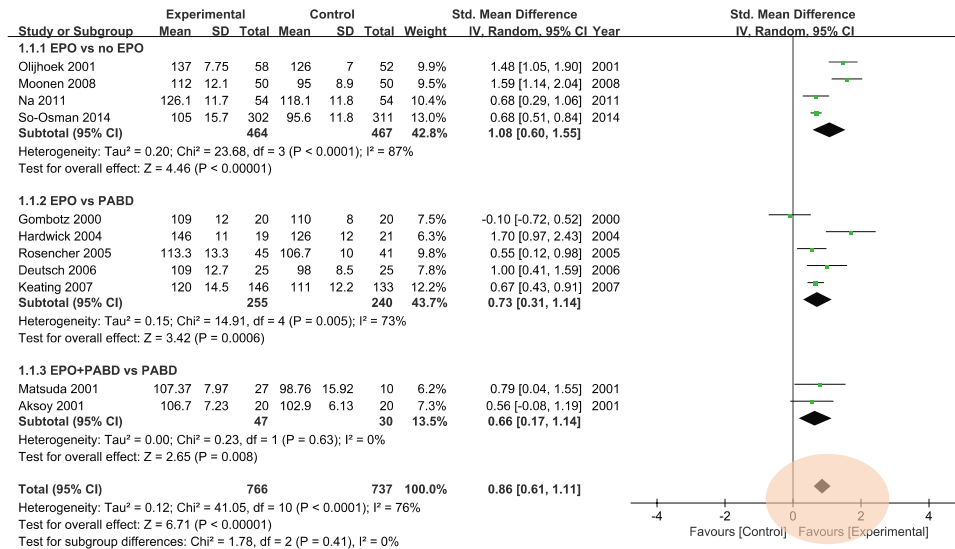


Figure 5. Forest plot of hemoglobin level at discharge.

Hb à la sortie

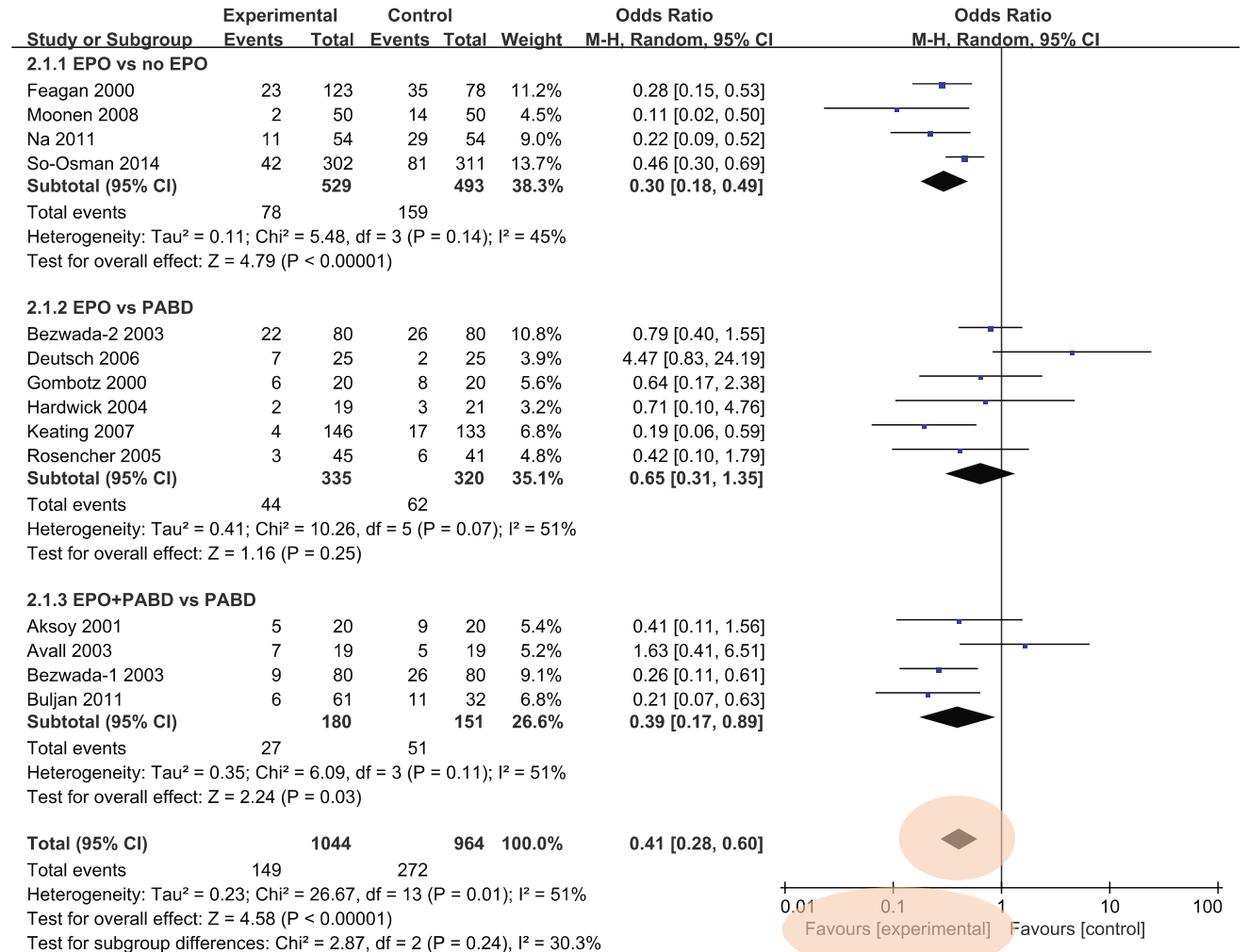


Figure 3. Forest plot of total number of patients who needed allogeneic transfusion.

CGR

# PBM : Que faut-il proposer? Corriger l'anémie

## Stimuler l'érythropoïèse : EPO

Use of erythropoietin reduces perioperative transfusions in cardiac surgery: results of a prospective single-blind randomized controlled trial

Luca Weltert,<sup>1</sup> Beatrice Rondinelli,<sup>2</sup> Ricardo Bello,<sup>3</sup> Mauro Falco,<sup>4</sup> Alessandro Bellisario,<sup>1</sup> Daniele Maselli,<sup>1</sup> Franco Turani,<sup>4</sup> Ruggero De Paulis,<sup>1</sup> and Luca Pierelli<sup>2,5</sup>

N = 600 patients

Administration de **80000 UI d'EPO**  
**2 jours** avant la chirurgie

Fer PO

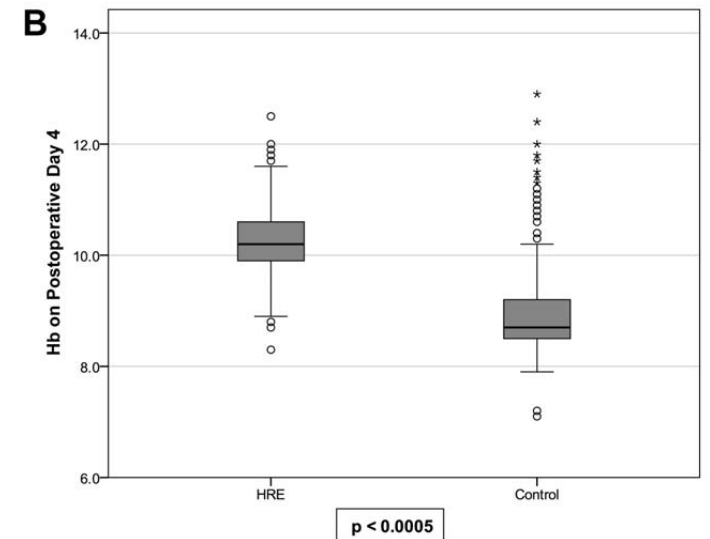
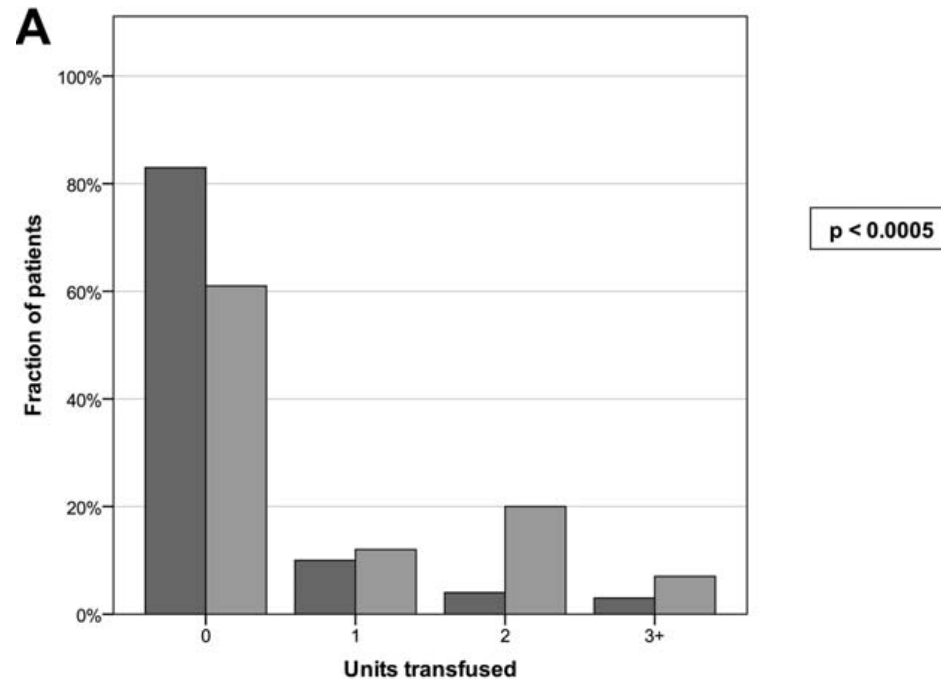
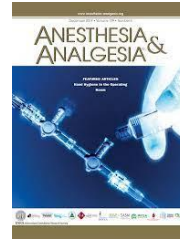


Fig. 3. (A) Distribution of number of units of aRBC units transfused per patient in the first 4 days after surgery in HRE (■) versus control (□;  $p < 0.0005$ ). (B) Box plot of Hb level (g/dL) on Day 4 after operation in HRE versus control ( $p = 0.0005$ ). The central box represents the interquartile range. Open circles (○) and asterisks (\*) indicate outliers.

# PBM : Que faut-il proposer? Corriger l'anémie

Stimuler l'érythropoïèse : EPO



## Impact of Preoperative Erythropoietin on Allogeneic Blood Transfusions in Surgical Patients: Results From a Systematic Review and Meta-analysis

Brian C. Cho, MD,\* Jessica Serini, MD,† Andres Zorrilla-Vaca, BS,‡ Michael J. Scott, MBChB,§ Eric A. Gehrie, MD,||¶ Steve M. Frank, MD,\* and Michael C. Grant, MD\*

May 2019 • Volume 128 • Number 5

**Table 2. Results of Subgroup Analysis of Preoperative Erythropoietin Administration and Whole Hospitalization Allogeneic Transfusions**

Subgroup	Control (N)	Control Events	Erythropoietin (N)	Erythropoietin Events	No. Trials	Risk Ratio <sup>a</sup>	I <sup>2</sup>
Cardiac	755	324	765	184	9	0.55 (0.37–0.81); <i>P</i> = .003	84% ( <i>P</i> < .001)
Elective orthopedic	733	278	921	113	5	0.37 (0.28–0.46); <i>P</i> < .001	41% ( <i>P</i> = .15)
Gastrointestinal	356	150	350	116	7	0.78 (0.55–1.10); <i>P</i> = .16	54% ( <i>P</i> = .04)

<sup>a</sup>Risk ratios (95% CIs).

**Pas d'impact sur le risque thrombo-embolique**

# PBM : Que faut-il proposer? Corriger l'anémie

## Corriger une carence martiale

Déficit en fer = fréquent



Pre-operative haemoglobin levels and iron status in a large multicentre cohort of patients undergoing major elective surgery\*

M. Muñoz,<sup>1</sup> M. J. Laso-Morales,<sup>2</sup> S. Gómez-Ramírez,<sup>3</sup> M. Cadellas,<sup>4</sup> M. J. Núñez-Matas<sup>5</sup> and J. A. García-Erce<sup>6</sup>

Patients analysed for iron deficiency (n = 2884)

**N = 3342**

Chirurgie cardiaque et non cardiaque



87 % de déficit en fer

69 % de déficit en fer

# PBM : Que faut-il proposer? Corriger l'anémie

## Corriger une carence martiale

International consensus statement on the peri-operative management of anaemia and iron deficiency

M. Muñoz,<sup>1</sup> A. G. Acheson,<sup>2</sup> M. Auerbach,<sup>3</sup> M. Besser,<sup>4</sup> O. Habler,<sup>5</sup> H. Kehlet,<sup>6</sup> G. M. Liubruno,<sup>7</sup> S. Lasocki,<sup>8</sup> P. Meybohm,<sup>9</sup> R. Rao Baikady,<sup>10</sup> T. Richards,<sup>11</sup> A. Shander,<sup>12</sup> C. So-Osman,<sup>13</sup> D. R. Spahn<sup>14</sup> and A. A. Klein<sup>15</sup>

Anaesthesia 2017, 72, 233–247

### Carence martiale absolue

Ferritinémie  
< 30 µg/l  
< 100 µg/l

#### Iron status

Normal

Low iron stores (for surgery with moderate-to-high blood losses)

Iron deficiency

#### Laboratory findings

Ferritin 30–300 µg.l<sup>-1</sup>  
TSAT 20–50%  
CRP < 5 mg.l<sup>-1</sup>  
Ferritin < 100 µg.l<sup>-1</sup>

Ferritin < 30 µg.l<sup>-1</sup>

Fer

Inflammation → ↑ Hepsidine → Diminution absorption + séquestration macrophage

Mais ferritinémie normale ou augmentée

Fer

# PBM : Que faut-il proposer? Corriger l'anémie

## Corriger une carence martiale



**Safety and efficacy of intravenous iron therapy in reducing requirement for allogeneic blood transfusion: systematic review and meta-analysis of randomised clinical trials** *BMJ* 2013;347:f4822 doi: 10.1136/bmj.f4822 (Published 15 August 2013)

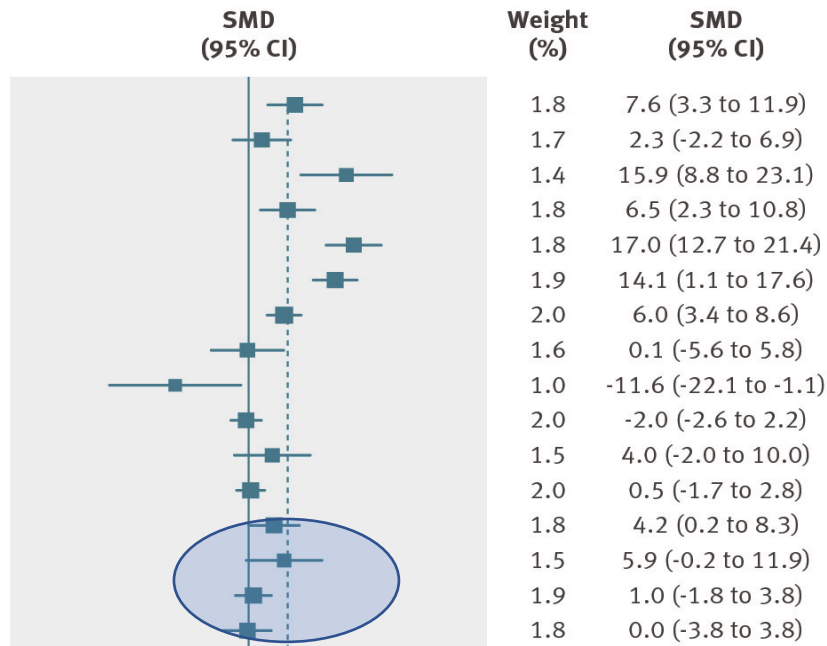
OPEN ACCESS

Edward Litton *staff specialist clinical senior lecturer*<sup>1,2</sup>, Jing Xiao *registrar*<sup>1</sup>, Kwok M Ho *staff specialist associate professor*<sup>1,3</sup>

### Study

#### IV iron v oral iron

Adhikary 2011<sup>15</sup>  
 Agarwal 2006<sup>16</sup>  
 Aggarwal 2003<sup>17</sup>  
 Al 2005<sup>18</sup>  
 Al-Momen 1996<sup>19</sup>  
 Auerbach 2004<sup>22</sup>  
 Auerbach 2010<sup>23</sup>  
 Bayoumeu 2002<sup>25</sup>  
 Beck-da-Silva 2103<sup>26</sup>  
 Bencaiova 2009<sup>27</sup>  
 Bhandal2006<sup>28</sup>  
 Breymann 2008<sup>30</sup>  
 Charytan 2005<sup>31</sup>  
 Dangsuan 2010<sup>33</sup>  
 Froessler 2013<sup>37</sup>  
 Garrido-Martin 2012<sup>38</sup>



72 études

10 605 patients

**Fig 2** Standardised mean difference in haemoglobin (g/L) in patients who received intravenous iron compared with oral iron and no iron. Weights are from random effects analysis

# PBM : Que faut-il proposer? Corriger l'anémie

## Corriger une carence martiale

**Preoperative Epoetin- $\alpha$  with Intravenous or Oral Iron for Major Orthopedic Surgery**

*A Randomized Controlled Trial*

Philippe Biboulet, M.D., Sophie Bringuier, Pharm.D., Ph.D., Pierre Smilevitch, M.D., Thibault Loupec, M.D., Caroline Thuile, M.D., Mathieu Pencole, M.D., Guillaume Maissiat, M.D., Gaëtan Dangelser, M.D., Xavier Capdevila, M.D., Ph.D.

ANESTHESIOLOGY

**N = 100**

Etude Randomisée

**EPO = 40 000 UI**

**Fer PO 160 mg vs Fer IV 1g**

**Table 2.** Results the Day before Surgery

## IV vs PO ?

	Oral Group, n = 50	IV Group, n = 50	P Value
Iron received, tablets or mg	52 (42–56)	1,000 (1,000–1,000)	—
Duration of iron treatment, day	26 (22–28)	—	
Ratio prescribed iron/received	1 (0.95–1)	1 (1–1)	< 0.001
Morisky questionnaire	0 (0–1)	—	
Adherence to treatment VAS	10 (9–10)	—	
Pichot's scale	9.5 (4.5–15.5)	9 (4–14)	0.848
Fitness VAS	6 (5–7.5)	6.5 (5–8)	0.389
Digestive complications	26 (52)	1 (2)	< 0.0001
Blood assessment at day -1			
Hemoglobin, g/dl	13.9 (13.2–15.1)	14.9 (14.1–15.6)	0.017
Increase in hemoglobin	1.9 (1.4–2.5)	2.6 (2.1–3.2)	< 0.001
Hematocrit, %	43.1 (40.9–46.8)	44.7 (42.3–47)	0.043
Mean cell volume, $\mu\text{m}^3$	95 (92–99)	95 (91–99)	0.840
Ferritin level, $\mu\text{g/l}$	64.5 (44–107)	325 (217–476)	< 0.001
Serum iron, $\mu\text{mol/l}$	10.2 (6.8–21.9)	9.3 (6.2–11.3)	0.095
Transferrin, g/l	2.5 (2.3–2.7)	2 (1.8–2.3)	< 0.001
Transferrin saturation, %	15.5 (11–34)	17 (13–21)	0.837
Erythrocyte mass, ml	1,952 (1,823–2,137)	2,015 (1,833–2,169)	0.514
Produced erythrocyte mass, ml	298 (217–357)	353 (294–450)	< 0.001

# PBM : Que faut-il proposer? Corriger l'anémie

## Corriger une carence martiale

Preoperative Epoetin- $\alpha$  with Intravenous or Oral Iron  
for Major Orthopedic Surgery

A Randomized Controlled Trial

Philippe Biboulet, M.D., Sophie Bringuier, Pharm.D., Ph.D., Pierre Smilevitch, M.D.,  
Thibault Loupec, M.D., Caroline Thuile, M.D., Mathieu Pencole, M.D., Guillaume Maissiat, M.D.,  
Gaëtan Dangelser, M.D., Xavier Capdevila, M.D., Ph.D.

ANESTHESIOLOGY

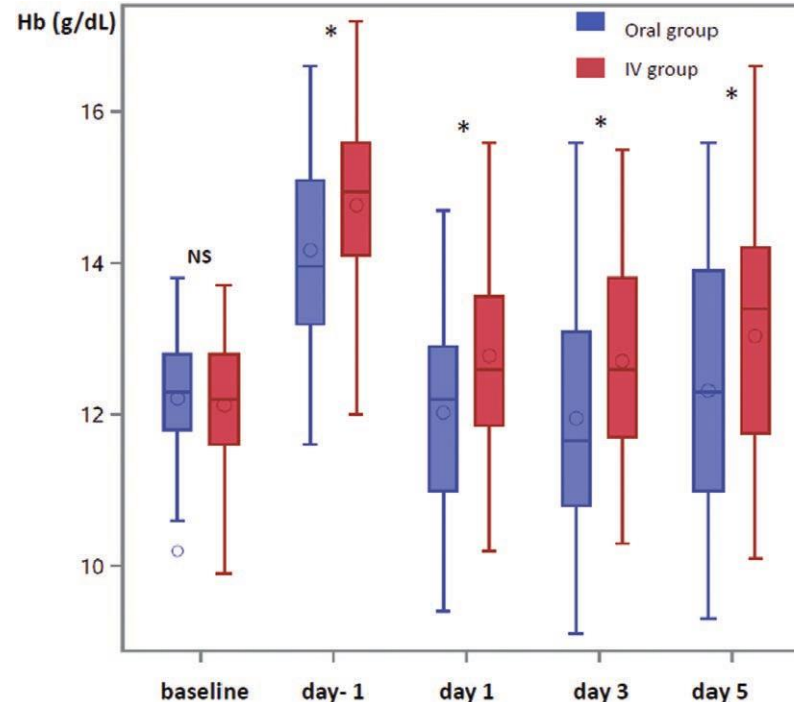
N = 100

Etude Randomisée

EPO = 40 000 UI

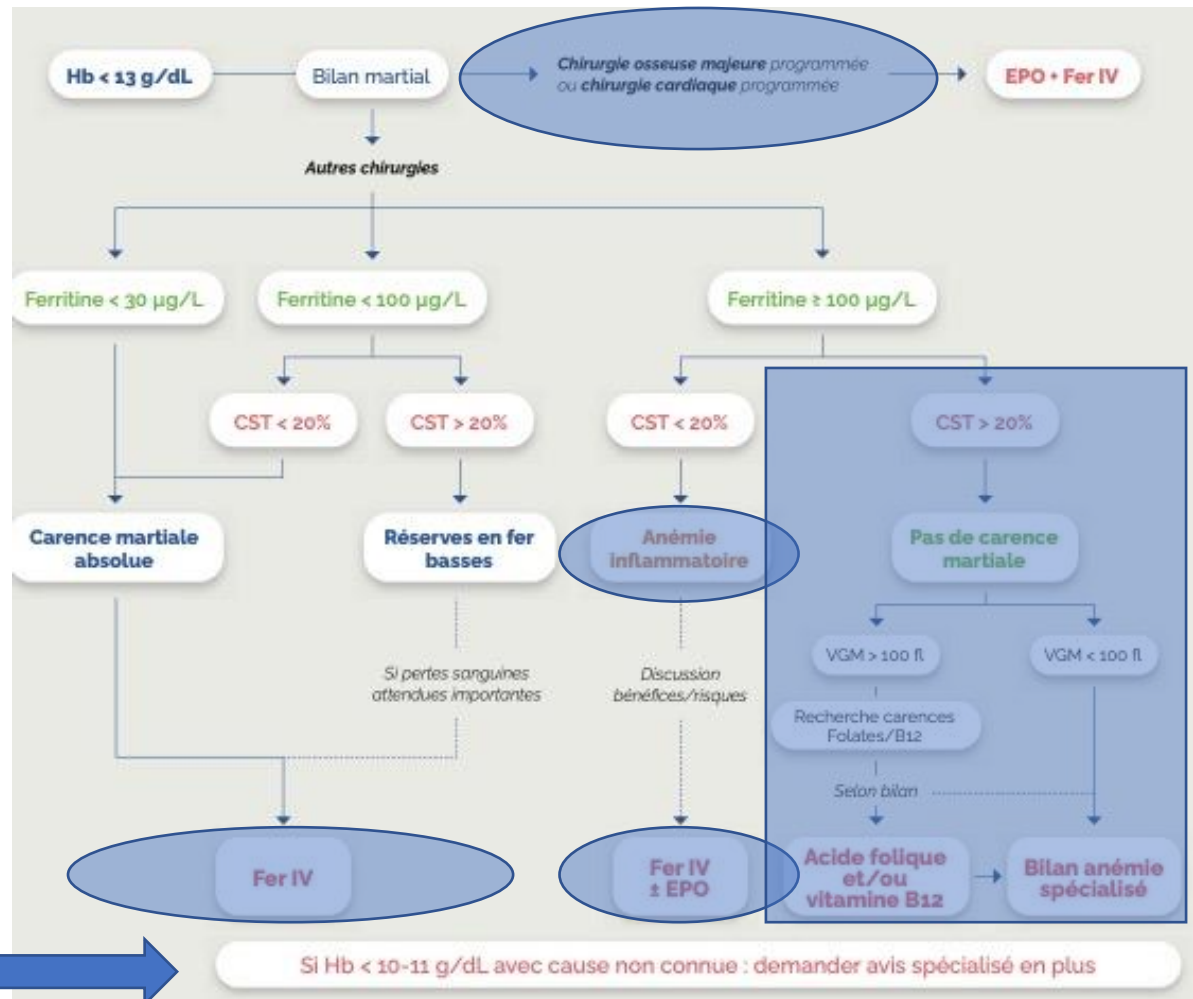
Fer PO 160 mg vs Fer IV 1g

### IV vs PO ?





# PBM : Que faut-il proposer? Corriger l'anémie



# PBM : Que faut-il proposer? Corriger l'anémie



## Fer + EPO

**EPO**  
=  
**Mobilisation du fer**  
=  
**Induction d'une carnce**

# PBM : Que faut-il proposer?

## Corriger l'anémie

**1<sup>ier</sup> Etape**  
 =  
**Corriger l'anémie**

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	Optimiser Hb	Diminuer pertes	Améliorer tolérance
Preoperative	<ul style="list-style-type: none"> <li>• Screen for anaemia</li> <li>• Identify underlying disorder(s) causing anaemia</li> <li>• Manage underlying disorder(s)</li> <li>• Refer for further evaluation if necessary</li> <li>• Treat iron deficiency, anaemia of chronic disease, iron-restricted erythropoiesis</li> <li>• Note: anaemia is a contraindication for elective surgery</li> </ul>	<ul style="list-style-type: none"> <li>• Identify and manage bleeding risk (past/family history, current medications, etc)</li> <li>• Minimise iatrogenic blood loss</li> <li>• Procedure planning and rehearsal</li> <li>• Preoperative autologous blood donation (in selected cases or when patient choice)</li> </ul>	<ul style="list-style-type: none"> <li>• Assess/optimize patient's physiological reserve and risk factors</li> <li>• Compare estimated blood loss with patient-specific tolerable blood loss</li> <li>• Formulate patient-specific management plan using appropriate blood-conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia</li> <li>• Restrictive evidence-based transfusion strategies</li> </ul>
Intraoperative	<ul style="list-style-type: none"> <li>• Timing surgery with haematological optimisation</li> </ul>	<ul style="list-style-type: none"> <li>• Meticulous haemostasis and surgical techniques</li> <li>• Blood-sparing surgical techniques</li> <li>• Anaesthetic blood-conserving strategies</li> <li>• Autologous blood options</li> <li>• Pharmacological/haemostatic agents</li> </ul>	<ul style="list-style-type: none"> <li>• Optimise cardiac output</li> <li>• Optimise ventilation and oxygenation</li> <li>• Restrictive evidence-based transfusion strategies</li> </ul>
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# PBM : Que faut-il proposer? Corriger l'anémie

## Anémie postopératoire :

- **Perte sanguines per-opératoire :**

- Métabolisme du fer :

- **Faible absorption : 7mg/jour**

- 70 % : hème → recyclage



- 1ml de sang = 0,5mg de fer

- 500ml de sang → 250 mg de fer

**Carence martiale postopératoire = quasi - systématique**

# PBM : Que faut-il proposer? Corriger l'anémie

## Recherche du déficit en fer

- **Bilan habituel :**
  - Ferritinémie < 100 µg/l
  - Coefficient de saturation de la transferrine : < 20%
- **Optimisation préopératoire**
- Augmentation ferritinémie avec l'inflammation
- MAIS mécanisme au-delà des 1<sup>ères</sup> 24 heures
- MAIS carence martiale quasi systématique

## Review Article

### **An international consensus statement on the management of postoperative anaemia after major surgical procedures**

M. Muñoz,<sup>1</sup> A. G. Acheson,<sup>2</sup> E. Bisbe,<sup>3</sup> A. Butcher,<sup>4</sup> S. Gómez-Ramírez,<sup>5</sup> A. A. Khalafallah,<sup>6,7</sup> H. Kehlet,<sup>8</sup> S. Kietaibl,<sup>9</sup> G. M. Liembruno,<sup>10</sup> P. Meybohm,<sup>11</sup> R. Rao Baikady,<sup>12</sup> A. Shander,<sup>13,14</sup> C. So-Osman,<sup>15,16</sup> D. R. Spahn<sup>17,18</sup> and A. A. Klein<sup>19</sup>

Anaesthesia 2019, 73, 1418-1431

been treated in the pre-operative period. As ferritin levels will not be elevated by inflammation immediately after surgery, a postoperative ferritin concentration < 100 µg.l<sup>-1</sup> within 24 h after surgery indicates insufficient iron stores to support erythropoiesis with the potential for significant falls in postoperative haemoglobin [8].

# PBM : Que faut-il proposer? Corriger l'anémie

JAMA | Original Investigation

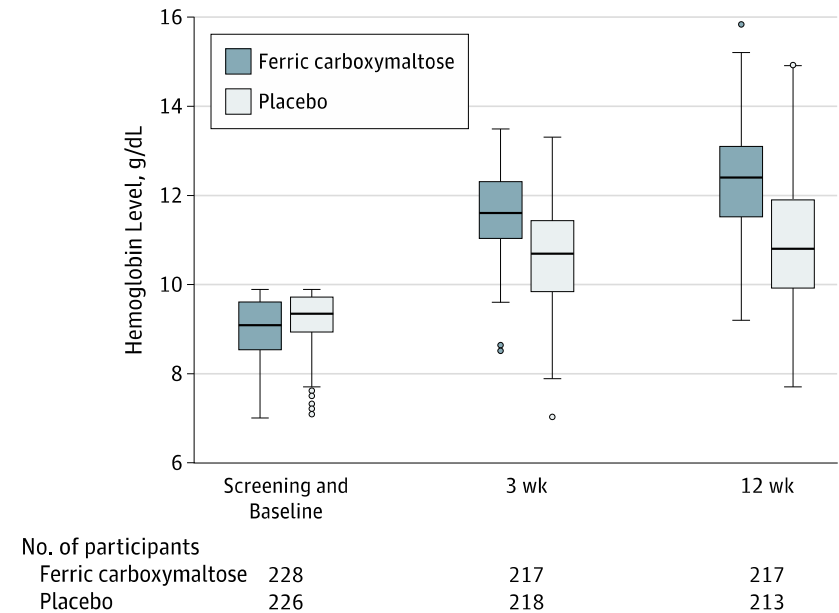
## Effect of Intravenous Ferric Carboxymaltose on Hemoglobin Response Among Patients With Acute Isovolemic Anemia Following Gastrectomy The FAIRY Randomized Clinical Trial

Young-Woo Kim, PhD; Jae-Moon Bae, PhD; Young-Kyu Park, PhD; Han-Kwang Yang, PhD; Wansik Yu, PhD; Jeong Hwan Yook, PhD; Sung Hoon Noh, PhD;

**Table 2. Primary Analysis of Patients With Acute Isovolemic Anemia Following Gastrectomy Receiving Ferric Carboxymaltose vs Placebo By Week 12**

	Total Patients in Primary Analysis, No. (%) (N = 430) <sup>a</sup>	Hb Responders, No. (%) <sup>b</sup>		Absolute Difference, % (95% CI)
		Ferric Carboxymaltose (n = 217)	Placebo (n = 213)	
Hb increase of $\geq 2$ g/dL from baseline, Hb level of $\geq 11$ g/dL, or both (primary outcome)	315 (73.3)	200 (92.2)	115 (54.0)	38.20 (33.6-42.8)
Hb increase of $\geq 2$ g/dL from baseline	277 (64.4)	191 (88.0)	86 (40.4)	47.60 (42.9-52.4)
Hb level of $\geq 11$ g/dL	291 (67.7)	191 (88.0)	100 (46.0)	41.10 (36.4-45.7)

**Figure 2. Hemoglobin Levels Among Patients Receiving Ferric Carboxymaltose vs Placebo Over Time**



# PBM : Que faut-il proposer? Corriger l'anémie

Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial

THE LANCET  
Haematology

Alhossain A Khalafallah, Carl Yan, Raghad Al-Badri, Ella Robinson, Brooke E Kirkby, Emily Ingram, Zara Gray, Vinod Khelgi, Iain K Robertson, Brian P Kirkby  
Vol 3 September 2016

**Fer IV 1g en J1**

**Chirurgie lourde : Ortho – abdo – gynéco**

Etude prospective randomisée

Anémie 7g – 12g/dl

+ carence (ferritinémie < 100 ou coef < 20%)

	Standard care (control; n=98)	Intravenous ferric carboxymaltose (intervention; n=103)	Treatment effect*	p value
<b>Haemoglobin (g/L)</b>				
Preoperative	134.40 (13.10)	134.50 (11.10)	-0.61 (-4.31 to 3.09)	0.094
Postoperative (day 1)	105.50 (13.80)	106.20 (11.90)	0.00	
4 weeks	121.50 (14.50)	130.10 (11.30)	7.84 (3.79 to 11.9)	<0.0001
12 weeks	133.60 (11.30)	137.50 (11.10)	3.07 (-0.99 to 7.14)	0.24

	Standard care (control; n=73)	Intravenous ferric carboxymaltose (intervention; n=97)	Treatment effect*	p value
<b>Physical component scale</b>				
Postoperative (day 1)	48.8 (18.5)	46.7 (23.9)	0.00	
4 weeks	40.1 (17.4)	44.9 (19.5)	6.93 (-1.16 to 15.00)	0.093
12 weeks	56.7 (22.8)	60.1 (20.6)	5.51 (-3.43 to 14.40)	0.23
<b>Mental component scale</b>				
Postoperative (day 1)	59.7 (19.2)	57.8 (22.0)	0.00	
4 weeks	56.6 (20.7)	58.1 (20.2)	3.53 (-4.56 to 11.60)	0.39
12 weeks	69.6 (19.7)	71.1 (20.9)	3.41 (-4.33 to 11.10)	0.39
<b>SF36</b>				
Postoperative (day 1)	54.0 (16.5)	52.2 (21.5)	0.00	
4 weeks	48.3 (16.7)	51.5 (18.6)	5.04 (-2.41 to 12.50)	0.19
12 weeks	63.1 (20.0)	65.6 (18.6)	4.38 (-3.11 to 11.90)	0.25

Data are mean (SD) or mean (95% CI). \*We estimated treatment effect of intravenous iron (ferric carboxymaltose) using repeated measures mixed effects linear regression with time from operation as a random factor, adjusted for sex (p values corrected for multiple comparisons by the Holm method).

**Table 5: Summary quality of life assessment scales (SF36) in standard care or intravenous ferric carboxymaltose infusion groups after major surgical procedures**

# PBM : Que faut-il proposer? Corriger l'anémie

Single-dose intravenous iron infusion or oral iron for treatment of fatigue after postpartum haemorrhage: a randomized controlled trial

**VoxSanguinis**

The International Journal of Transfusion Medicine

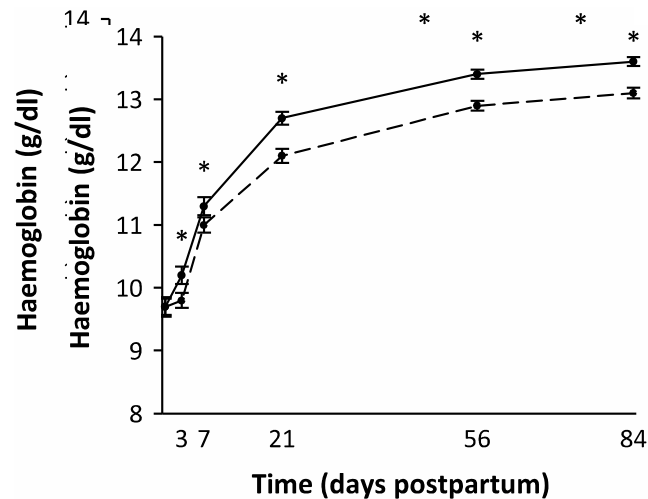
C. Holm,<sup>1,2</sup> L. L. Thomsen,<sup>2</sup> A. Norgaard<sup>3</sup> & J. Langhoff-Roos<sup>1</sup>

<sup>1</sup>Department of Obstetrics, Juliane Marie Centre, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark

<sup>2</sup>Pharmacosmos A/S, Holbæk, Denmark

<sup>3</sup>Section for Transfusion Medicine, Capital Region Blood Bank, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark

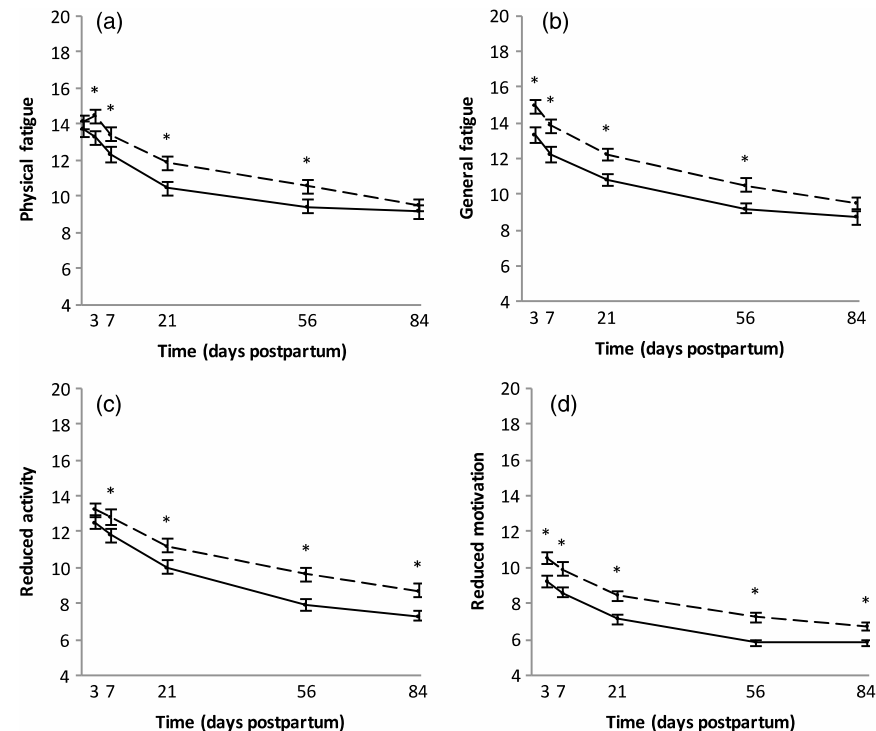
**Fer IV 1,2g en J1**



Etude prospective, randomisée, monocentrique  
Postpartum

**Inclusion :**

- Pertes sanguines entre 700 et 1000 ml
- > 1000 ml + Hb > 6,5g/dl





# PBM : Que faut-il proposer? Corriger l'anémie

**Fer postopératoire = Fer IV**

**Inflammation postop → synthèse d'Hepcidine → Inhibition absorption intestinale**

Therefore, should postoperative iron therapy be indicated, i.v. formulations are recommended. This is in line with recent management guidelines in surgical patients experiencing severe bleeding (GRADE 2C for i.v. iron

Review Article

## **An international consensus statement on the management of postoperative anaemia after major surgical procedures**

M. Muñoz,<sup>1</sup> A. G. Acheson,<sup>2</sup> E. Bisbe,<sup>3</sup> A. Butcher,<sup>4</sup> S. Gómez-Ramírez,<sup>5</sup> A. A. Khalafallah,<sup>6,7</sup> H. Kehlet,<sup>8</sup> S. Kietaihl,<sup>9</sup> G. M. Liumbruno,<sup>10</sup> P. Meybohm,<sup>11</sup> R. Rao Baikady,<sup>12</sup> A. Shander,<sup>13,14</sup> C. So-Osman,<sup>15,16</sup> D. R. Spahn<sup>17,18</sup> and A. A. Klein<sup>19</sup>

Anaesthesia 2019, 73, 1418-1431

**Dose = déficit en fer**

**Déficit en fer = (Delta Hb g/dl) x 2,4 x poids (kg)**

# PBM : Que faut-il proposer? Corriger l'anémie

## Intérêts contrastés

**Ferric carboxymaltose with or without erythropoietin in anemic patients with hip fracture: a randomized clinical trial**

*Máximo Bernabeu-Wittel,<sup>1</sup> Manuel Romero,<sup>2</sup> Manuel Ollero-Baturone,<sup>1</sup> Reyes Aparicio,<sup>3</sup> José Murcia-Zaragoza,<sup>4</sup> Manuel Rincón-Gómez,<sup>1</sup> Rafael Monte-Secades,<sup>5</sup> María Melero-Bascones,<sup>6</sup> Clara M. Rosso,<sup>1</sup> and Alberto Ruiz-Cantero,<sup>7</sup> on behalf of the PAHFRAC-01 Investigators*



Etude randomisée - multicentrique  
Anémie + Fracture du col du fémur

EPO + Fer vs Fer + Placebo  
40 000 UI + 1g 1g

**TABLE 4. Intention-to-treat main outcome measures of patients included in the PAHFRAC-01 clinical trial\***

Endpoint	Arm		
	EPOFE (n = 100)	FE (n = 103)	Placebo (n = 100)
Patients transfused	52 (52)	53 (51.5)	54 (54)
Number of RBC transfusions/patient	1.18 (1.2)	1.26 (1.3)	1.28 (1.4)
Survival			
Hospital discharge	95 (95)	99 (96)	96 (96)
60 days after discharge	88 (88)	91 (88)	90 (90)
Hb level (g/L)			
24 hr postoperative	93.91 (13)	92.78 (13.2)	93.53 (12.2)
72 hr postoperative	93.63 (13)	92.17 (11)	91.13 (11.5)
Discharge	102.6 (11)†	100 (10.7)	97.2 (12)
60 days after discharge	124.8 (13)‡	123.6 (15)	119 (11.3)



# PBM : Que faut-il proposer? Corriger l'anémie



HAUTE AUTORITÉ DE SANTÉ

## 3.2. Supplémentation en fer

En cas d'anémie postopératoire avec un taux d'hémoglobine inférieur à 12 g/dL lié à des pertes sanguines importantes et/ou à une carence martiale préopératoire non traitée, une administration précoce de fer est recommandée, de préférence par voie intraveineuse (Grade B) .

La dose d'un gramme de carboxymaltose ferrique est à privilégier (en cas de poids supérieur à 35 kg) puisqu'elle peut être réalisée en une seule injection de 15 min (AE) .

# PBM

## Que faut-il proposer?

2<sup>ème</sup> Etape

=

Diminuer les pertes

P  
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p  
a  
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t

	Optimiser Hb	Diminuer pertes	Améliorer tolérance
Preoperative	<ul style="list-style-type: none"><li>• Screen for anaemia</li><li>• Identify underlying disorder(s) causing anaemia</li><li>• Manage underlying disorder(s)</li><li>• Refer for further evaluation if necessary</li><li>• Treat iron deficiency, anaemia of chronic disease, iron-restricted erythropoiesis</li><li>• Note: anaemia is a contraindication for elective surgery</li></ul>	<ul style="list-style-type: none"><li>• Identify and manage bleeding risk (past/family history, current medications, etc)</li><li>• Minimise iatrogenic blood loss</li><li>• Procedure planning and rehearsal</li><li>• Preoperative autologous blood donation (in selected cases or when patient choice)</li></ul>	<ul style="list-style-type: none"><li>• Assess/optimize patient's physiological reserve and risk factors</li><li>• Compare estimated blood loss with patient-specific tolerable blood loss</li><li>• Formulate patient-specific management plan using appropriate blood-conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia</li><li>• Restrictive evidence-based transfusion strategies</li></ul>
Intraoperative	<ul style="list-style-type: none"><li>• Timing surgery with haematological optimisation</li></ul>	<ul style="list-style-type: none"><li>• Meticulous haemostasis and surgical techniques</li><li>• Blood-sparing surgical techniques</li><li>• Anaesthetic blood-conserving strategies</li><li>• Autologous blood options</li><li>• Pharmacological/haemostatic agents</li></ul>	<ul style="list-style-type: none"><li>• Optimise cardiac output</li><li>• Optimise ventilation and oxygenation</li><li>• Restrictive evidence-based transfusion strategies</li></ul>
Postoperative	<ul style="list-style-type: none"><li>• Treat anaemia/iron deficiency</li><li>• Stimulate erythropoiesis</li><li>• Be aware of drug interactions that can cause/increase anaemia</li></ul>	<ul style="list-style-type: none"><li>• Vigilant monitoring and management of post-operative bleeding</li><li>• Avoid secondary haemorrhage</li><li>• Rapid warming – maintain normothermia (unless hypothermia specifically indicated)</li><li>• Autologous blood salvage</li><li>• Minimising iatrogenic blood loss</li><li>• Haemostasis/anticoagulation management</li><li>• Prophylaxis of upper gastrointestinal haemorrhage</li><li>• Avoid/treat infections promptly</li><li>• Be aware of adverse effects of medication</li></ul>	<ul style="list-style-type: none"><li>• Optimise tolerance of anaemia</li><li>• Treat anaemia</li><li>• Maximise oxygen delivery</li><li>• Minimise oxygen consumption</li><li>• Avoid/treat infections promptly</li><li>• Restrictive, evidence-based transfusion strategies</li></ul>

# PBM : Que faut-il proposer?

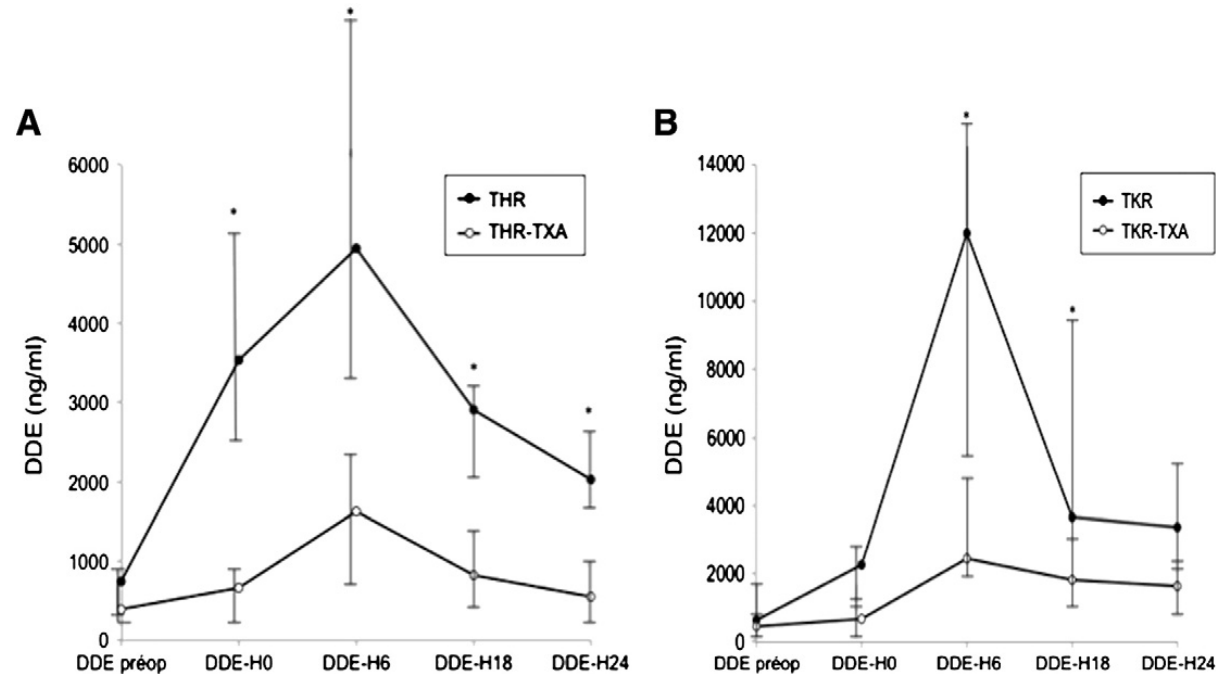
## Diminuer les pertes

### Duration of Postoperative Fibrinolysis after Total Hip or Knee Replacement: A Laboratory Follow-up Study

Thrombosis Research 131 (2013) e6–e11



Antonia Blanié <sup>a,\*</sup>, Lorenn Bellamy <sup>a</sup>, Yara Rhayem <sup>b</sup>, Claire Flaujac <sup>b</sup>, Charles Marc Samama <sup>a</sup>,  
Michaela Fontenay <sup>b</sup>, Nadia Rosencher <sup>a</sup>



**Fig. 2.** D dimers ELISA (DDE, ng/ml, median) dosage measured before surgery and 0, 6, 18 and 24 hours after surgery (respectively, préop, H0, H6, H18 and H24) in THR group and THR with TXA group (A) and in TKR group and TKR with TXA group (B). \*:  $p < 0.05$  between *THR* and *THR-TXA* groups.

# PBM : Que faut-il proposer?

## Diminuer les pertes

### Tranexamic acid reduces blood loss and financial cost in primary total hip and knee replacement surgery

E. Irsson<sup>a,\*</sup>, Y. Hémon<sup>a</sup>, V. Pauly<sup>b</sup>, S. Parratte<sup>c</sup>, J.-N. Argenson<sup>c</sup>,  
F. Kerbaul<sup>a,d</sup>

Orthopaedics & Traumatology: Surgery & Research (2012) 98, 477–483



N = 451

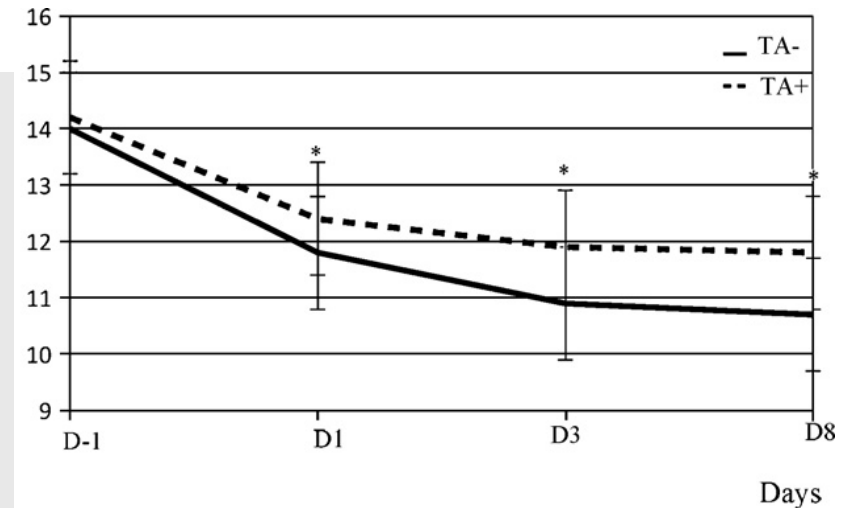
Acide tranexamique 1g  
puis toutes les 6h pendant 24h

**Table 2** Effect of tranexamic acid therapy in decreasing blood losses and blood transfusion requirements. The data are mean  $\pm$  SD, number, or percentage.

	TA- (n = 241)	TA+ (n = 210)
Hb D1 (g/dL)	14.0 $\pm$ 1	14.2 $\pm$ 1
Hb D8 (g/dL)	10.7 $\pm$ 1.2	11.8 $\pm$ 1.2*
Total blood losses (mL)	1900 $\pm$ 690	1260 $\pm$ 620*
Homologous blood transfusions, n of patients	10	0*
N (1, 2, or 3) of RBC packs in homologous blood transfusions, n of patients	3/6/1	0
Autologous blood transfusion rate (%)	97	59*
Volume of autologous blood transfusions (mL)	350 $\pm$ 190	110 $\pm$ 125*

TA-: group managed without tranexamic acid; TA+: group managed with tranexamic acid; Hb: haemoglobin; D: day; RBC: red blood cell.

\*P < 0.001 versus the group managed without tranexamic acid.



# PBM : Que faut-il proposer?

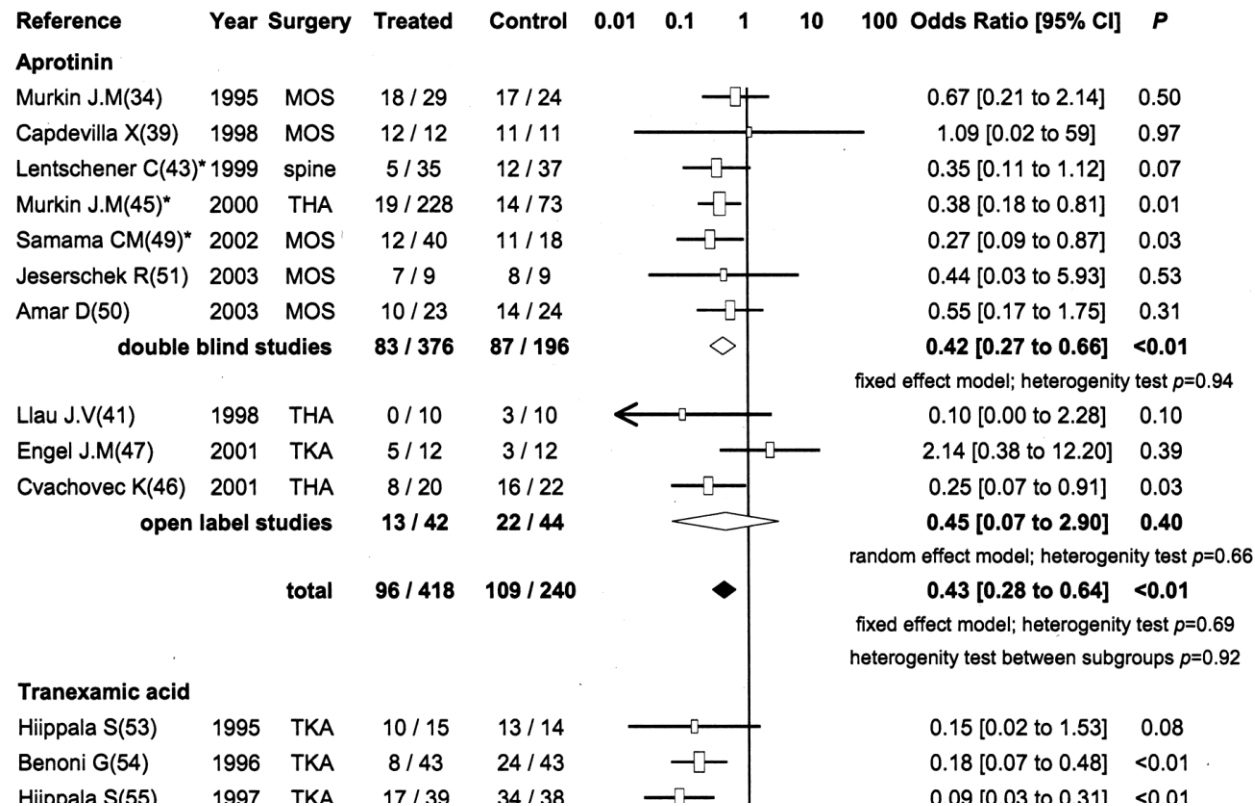
## Diminuer les pertes

### *Do Antifibrinolytics Reduce Allogeneic Blood Transfusion in Orthopedic Surgery?*

Anesthesiology, V 105, No 5, Nov 2006

ANESTHESIOLOGY

Paul Zufferey, M.D.,\* Fanette Merquiol, M.D.,† Silvy Laporte, M.Sc., Ph.D.,‡ Hervé Decousus, M.D.,§  
Patrick Mismetti, M.D., Ph.D.,§ Christian Auboyer, M.D.,|| Charles Marc Samama, M.D., Ph.D.,# Serge Molliex, M.D., Ph.D.||

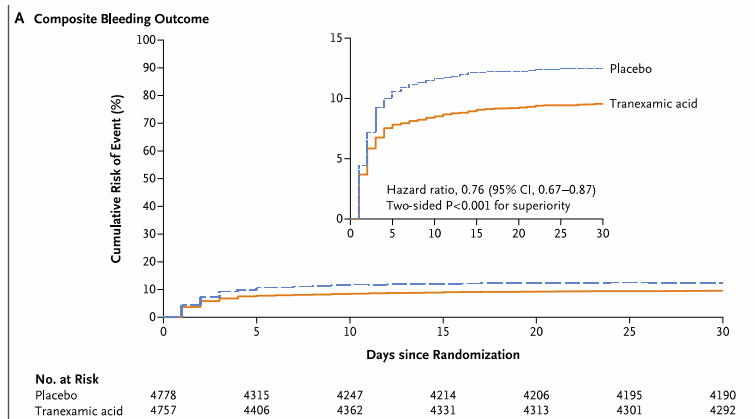
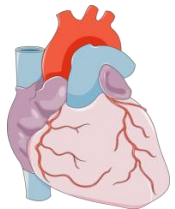


# PBM : Que faut-il proposer? Diminuer les pertes

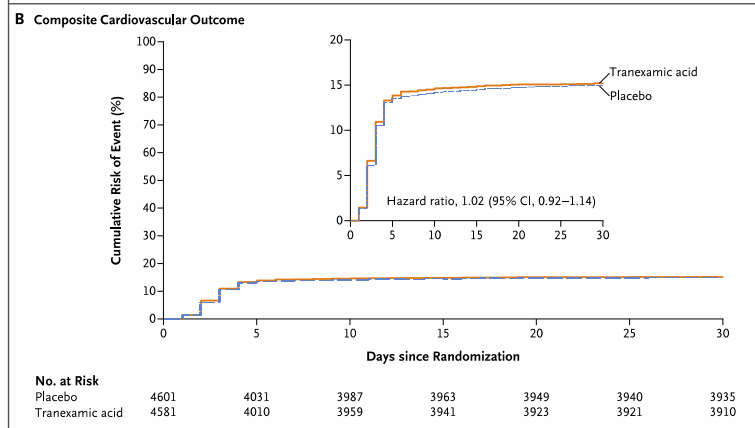
ORIGINAL ARTICLE

## Tranexamic Acid in Patients Undergoing Noncardiac Surgery

P.J. Devereaux, M. Marcucci, T.W. Painter, D. Conen, V. Lomivorotov,



$p < 0,0001$



NS



Surgery — no./total no. (%)	Placebo	Tranexamic acid
Any procedure	4729/4757 (99.4)	4740/4778 (99.2)
General†	1769/4729 (37.4)	1773/4740 (37.4)
Orthopedic	1083/4729 (22.9)	1063/4740 (22.4)
Vascular	699/4729 (14.8)	700/4740 (14.8)
Urologic	598/4729 (12.6)	624/4740 (13.2)
Spinal	237/4729 (5.0)	206/4740 (4.3)
Gynecologic	162/4729 (3.4)	171/4740 (3.6)
Thoracic	127/4729 (2.7)	146/4740 (3.1)
Low-risk	39/4729 (0.8)	34/4740 (0.7)
Plastic	14/4729 (0.3)	23/4740 (0.5)
Data missing on type of procedure performed	1/4729 (<0.1)	0/4740

**1g x 2 vs Placebo**

**DFG > 30 ml/min/1,73m2**



# PBM : Que faut-il proposer?

## Diminuer les pertes



HAUTE AUTORITÉ DE SANTÉ

L'utilisation prophylactique de l'acide tranexamique est recommandée pour diminuer le saignement et la transfusion en chirurgie cardiaque et en chirurgie osseuse majeure (Grade A).

Pour les autres types de chirurgie, il est possible d'utiliser l'acide tranexamique en cas de risque hémorragique à visée prophylactique ou curative (Grade B).

En cas d'utilisation prophylactique, il est recommandé d'utiliser l'acide tranexamique préférentiellement par voie intraveineuse lente en début d'intervention à la dose de 1 g (ou 10 à 20 mg/kg) (Grade B).

Elle peut être complétée par des réinjections ou une perfusion continue, en particulier en cas d'hémorragie (Grade B).

L'application locale d'acide tranexamique peut être utilisée en complément de la voie intraveineuse, en particulier en chirurgie osseuse (Grade B).

En cas d'hémorragie sévère ou de choc hémorragique, il est recommandé d'utiliser l'acide tranexamique dès que possible (Grade A).

# PBM : Que faut-il proposer?

## Diminuer les pertes

- Ne pas oublier les bonnes pratiques

### Patient blood management in Europe

A. Shander<sup>1\*</sup>, H. Van Aken<sup>2</sup>, M. J. Colomina<sup>3</sup>, H. Gombotz<sup>4</sup>, A. Hofmann<sup>5</sup>, R. Krauspe<sup>6</sup>, S. Lasocki<sup>7</sup>, T. Richards<sup>8</sup>, R. Slappendel<sup>9</sup> and D. R. Spahn<sup>10</sup> *British Journal of Anaesthesia* 109 (1): 55-68 (2012)

BJA

Intraoperative

- Timing surgery with haematological optimisation

- Meticulous haemostasis and surgical techniques
- Blood-sparing surgical techniques
- Anaesthetic blood-conserving strategies
- Autologous blood options
- Pharmacological/haemostatic agents

- Optimise cardiac output
- Optimise ventilation and oxygenation
- Restrictive evidence-based transfusion strategies

# PBM : Que faut-il proposer?

## Diminuer les pertes

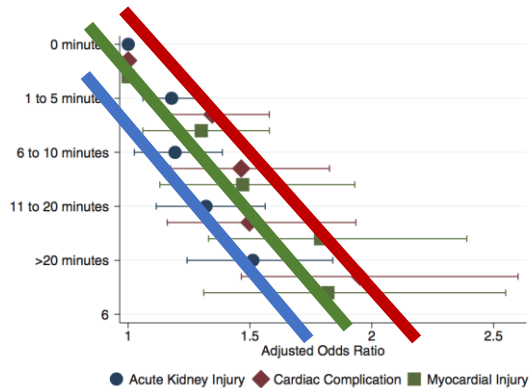
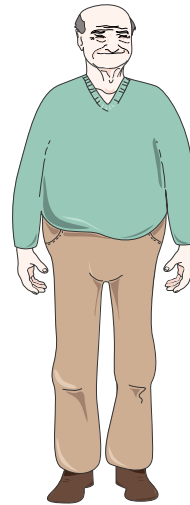


Fig. 4. Adjusted odds ratios for acute kidney injury, cardiac complications, and myocardial injury by time spent with a mean arterial pressure <55 mmHg.

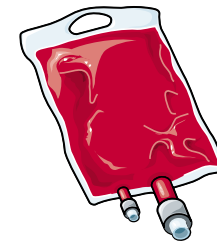
Anesthesiology 2013; 119:507-15

Remplissage titré

PAM



Température

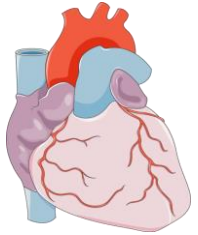


Monitoring

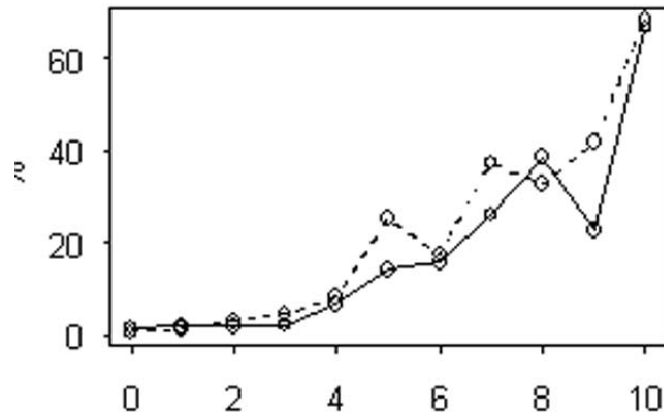


# PBM : Que faut-il proposer?

## Limiter la transfusion



Intubation Morbidity



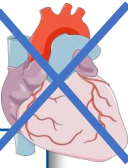
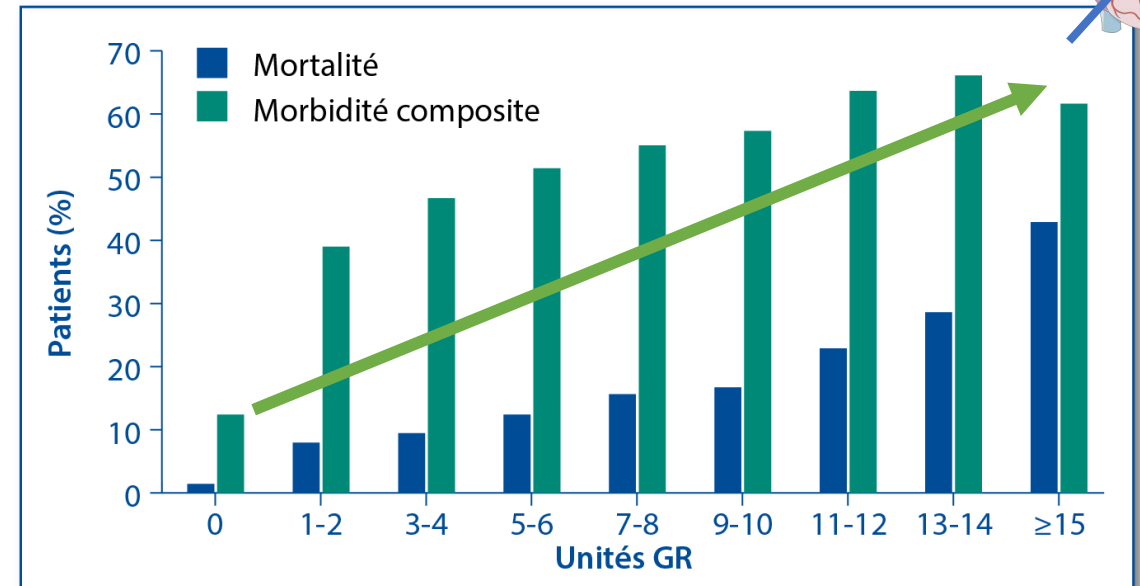
Crit Care Med 2006 Vol. 34, No. 6

**Table 3 Observed and adjusted ORs of postoperative adverse outcomes after cardiac surgery, according to the presence or absence of anemia**

Outcome	Crude OR (95% CI)	Adjusted* OR (95%)
Mortality	2.81 (2.06-3.84)	1.44 (1.02-2.03)
Atrial fibrillation	1.18 (1.06-1.31)	0.96 (0.85-1.08)
Renal dysfunction	3.26 (2.8-3.8)	1.73 (1.43-2.1)
Stroke	1.77 (1.17-2.67)	0.95 (0.61-1.47)
Myocardial infarction	0.967 (0.66-1.4)	0.79 (0.53- 1.19)
Length of hospital stay >7 days	2.03 (1.82-2.25)	1.3 (1.15-1.47)

\*Adjusted for baseline characteristics and propensity score.

Miceli et al. Journal of Cardiothoracic Surgery 2014, 9:137



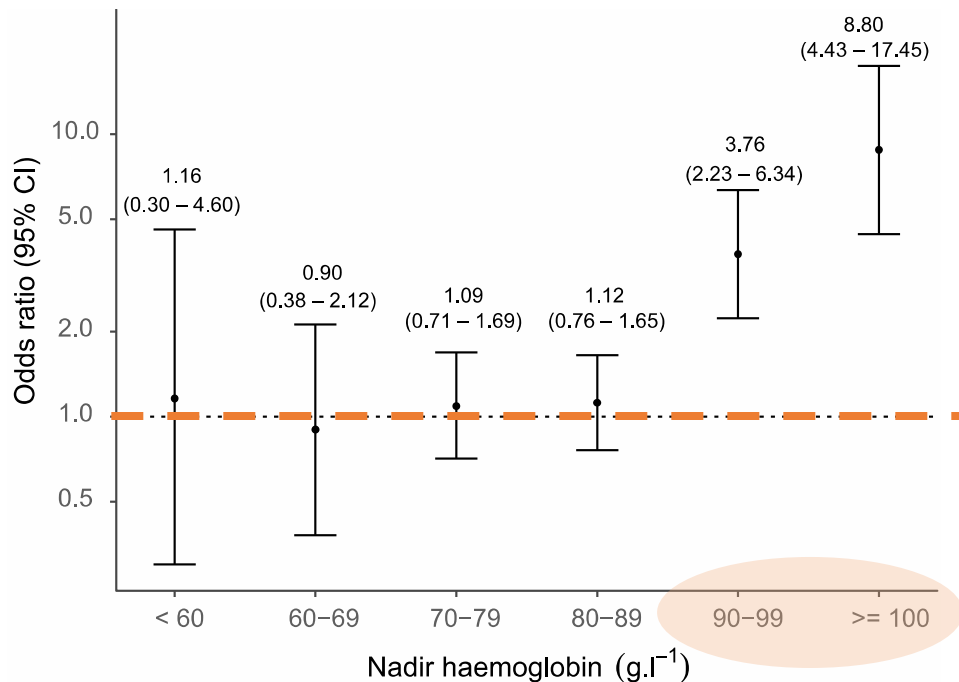
Le volume transfusé = FDR de morbi-mortalité

Ferraris, V. et al., Arch Surg, 2012

# PBM : Que faut-il proposer? Limiter la transfusion

**Associations of nadir haemoglobin level and red blood cell transfusion with mortality and length of stay in surgical specialties: a retrospective cohort study**

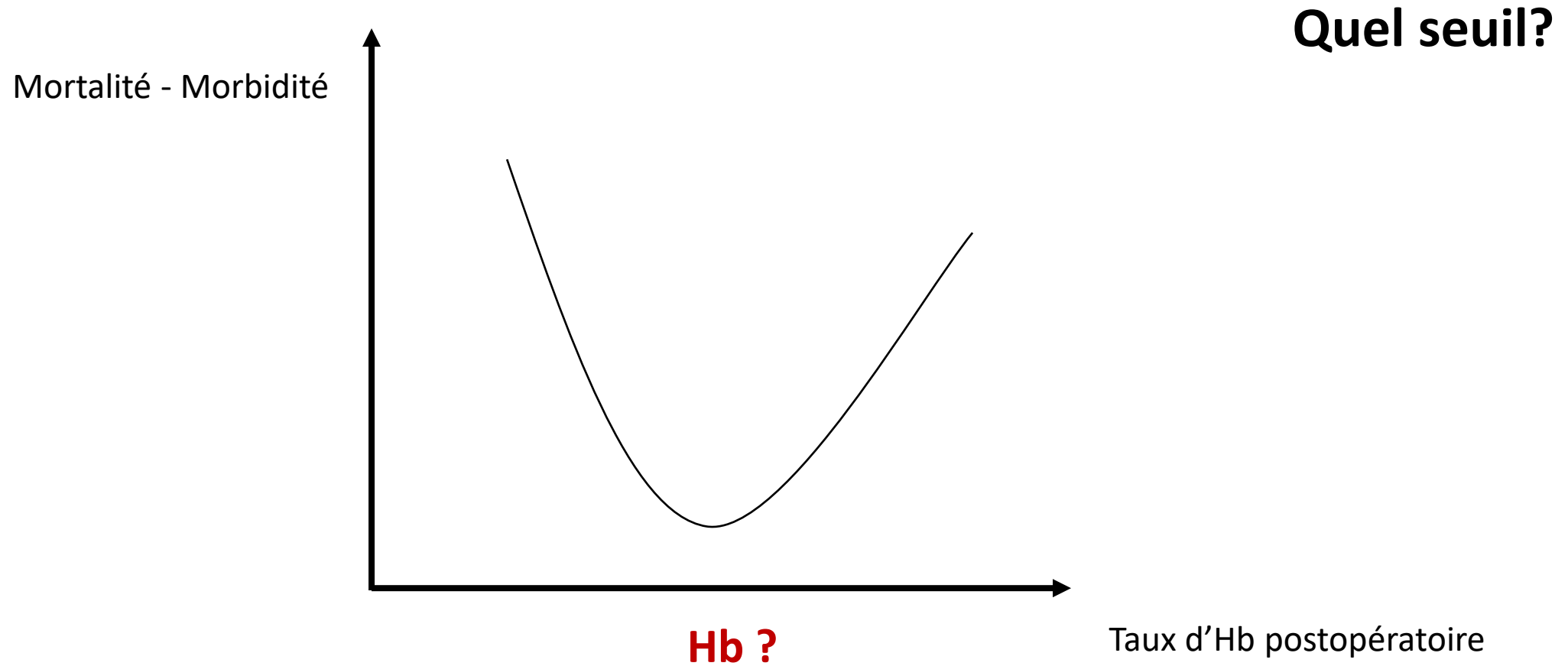
Anaesthesia 2019, 74, 726-734



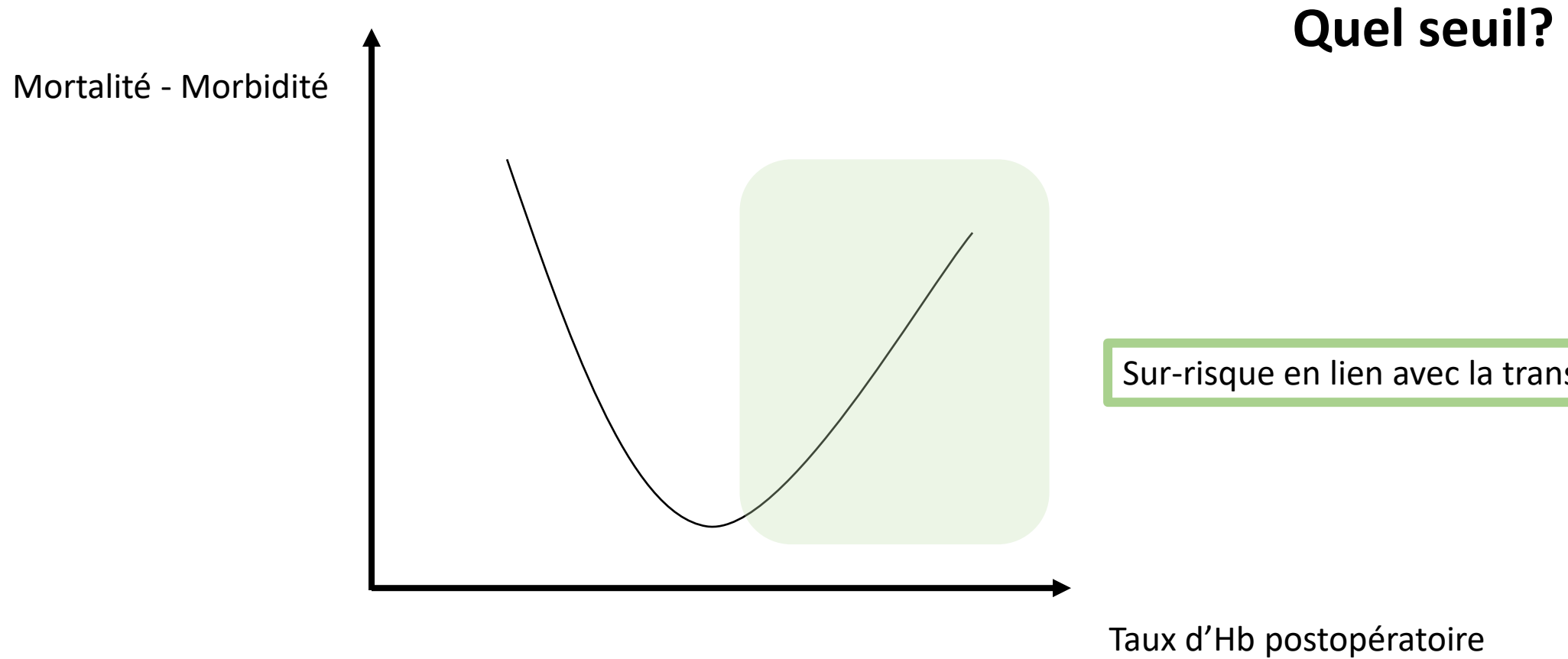
Etude rétrospective  
N = 60 955 patients  
Chirurgie majeure cardiaque et non cardiaque

	No red cell transfusion n = 54,685	Red cell transfusion n = 6270	Total patients n = 60,955	p value
Nadir haemoglobin; g.l <sup>-1</sup>				<0.001
< 60	100 (0.2%)	231 (3.7%)	331 (0.5%)	
60-69	249 (0.5%)	1073 (17.1%)	1322 (2.2%)	
70-79	1440 (2.6%)	2731 (43.6%)	4171 (6.8%)	
80-89	4181 (7.6%)	1680 (26.8%)	5861 (9.6%)	
90-99	6595 (12.1%)	369 (5.9%)	6964 (11.4%)	
>= 100	42,120 (77.0%)	186 (3.0%)	42,306 (69.4%)	

# PBM : Que faut-il proposer? limiter la transfusion



# PBM : Que faut-il proposer? limiter la transfusion

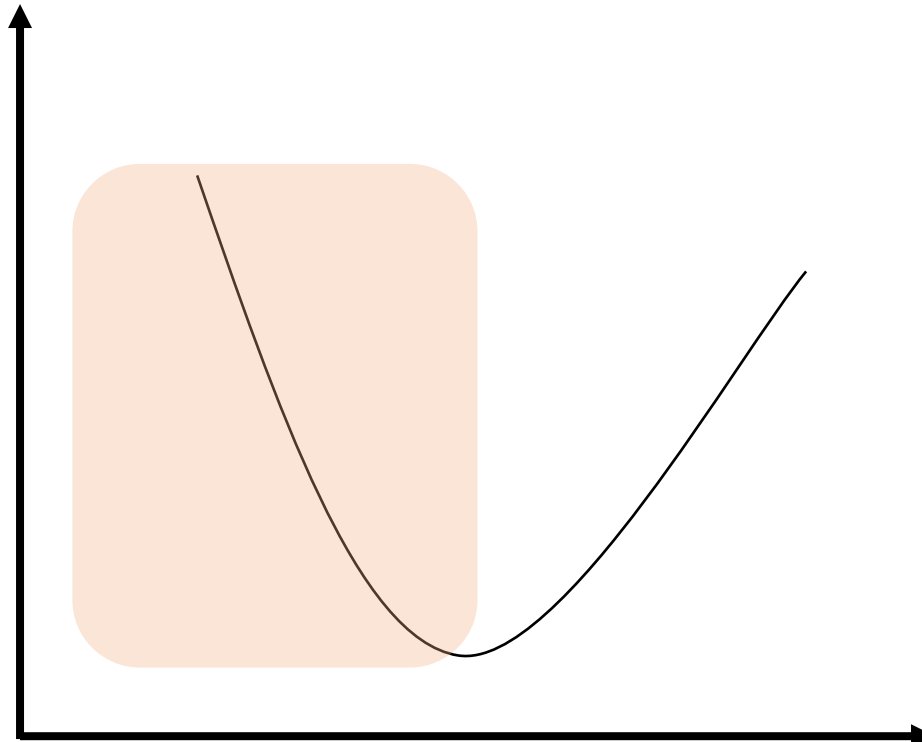


# PBM : Que faut-il proposer? limiter la transfusion

Quel seuil?

Mortalité - Morbidité

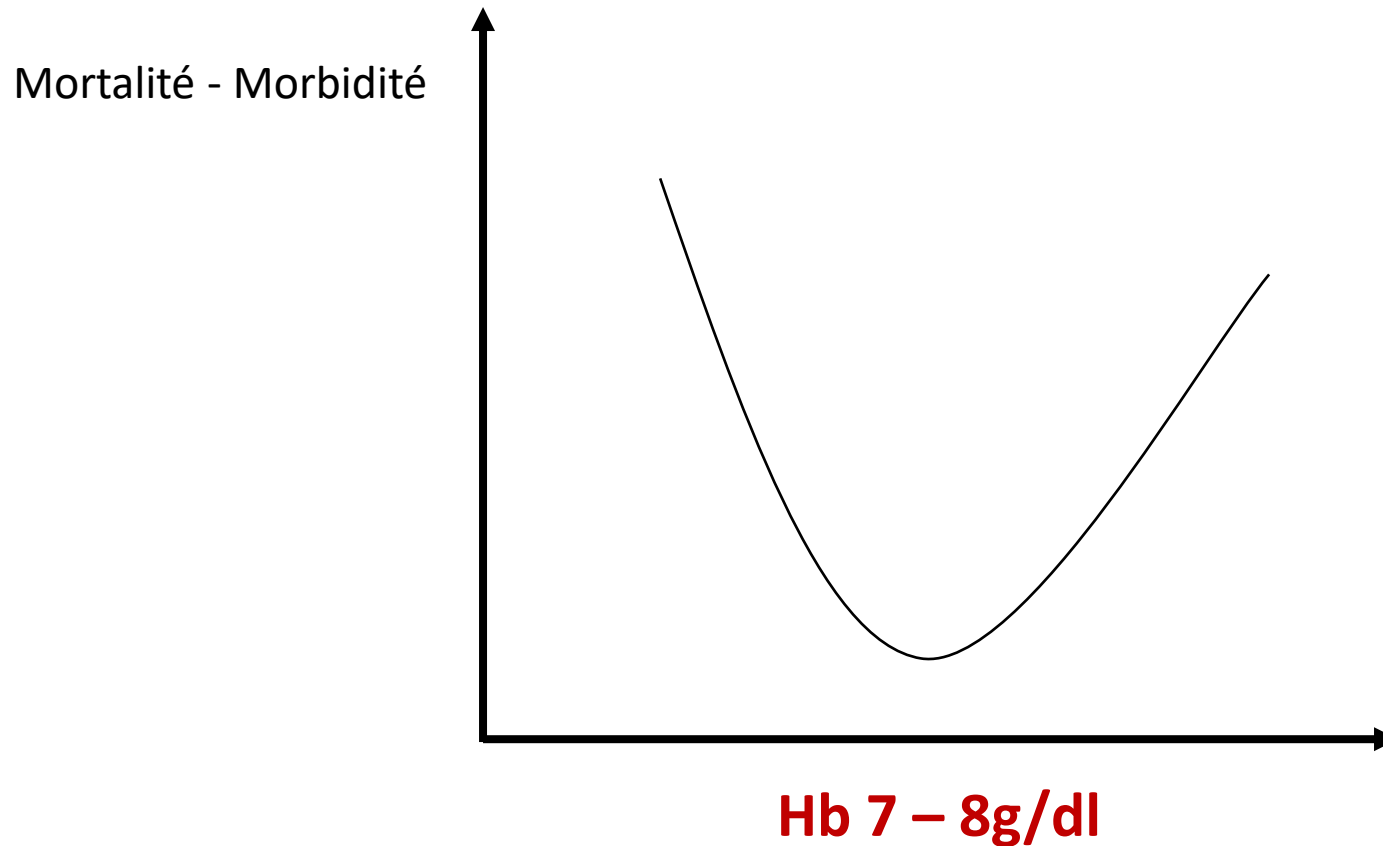
Sur-risque en lien avec  
 l'absence de transfusion



Taux d'Hb postopératoire



# PBM : Que faut-il proposer? Limiter la transfusion



## Quel seuil?

**An international consensus statement on the management of postoperative anaemia after major surgical procedures** *Anaesthesia* 2019, 73, 1418-1431

M. Muñoz,<sup>1</sup> A. G. Acheson,<sup>2</sup> E. Bisbe,<sup>3</sup> A. Butcher,<sup>4</sup> S. Gómez-Ramírez,<sup>5</sup>  
A. A. Khalafallah,<sup>6,7</sup> H. Kehlet,<sup>8</sup> S. Kietai,<sup>9</sup> G. M. Liembruno,<sup>10</sup> P. Meybohm,<sup>11</sup>  
R. Rao Baikady,<sup>12</sup> A. Shander,<sup>13,14</sup> C. So-Osman,<sup>15,16</sup> D. R. Spahn<sup>17,18</sup> and A. A. Klein<sup>19</sup>



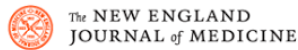
# PBM : Que faut-il proposer?

## Limiter la transfusion

ORIGINAL ARTICLE

### Six-Month Outcomes after Restrictive or Liberal Transfusion for Cardiac Surgery

C.D. Mazer, R.P. Whitlock, D.A. Fergusson, J. Hall, E. Belley-Cote, K. Connolly,



Patients à risques modérés ou élevés  
N = 4860 patients  
2 groupes

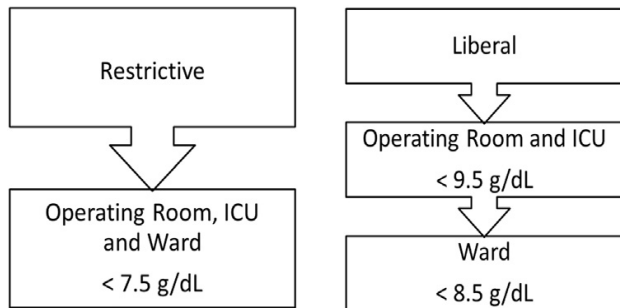
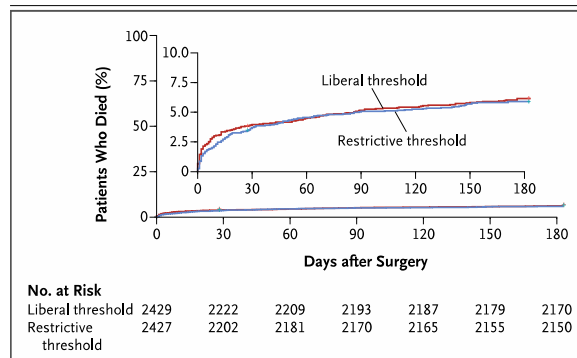


Fig 1. Transfusion triggers for TRICS III.



NS

REVIEW

### Effects of restrictive red blood cell transfusion on the prognoses of adult patients undergoing cardiac surgery: a meta-analysis of randomized controlled trials

## Quel seuil?

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Méta-analyse  
8886 patients

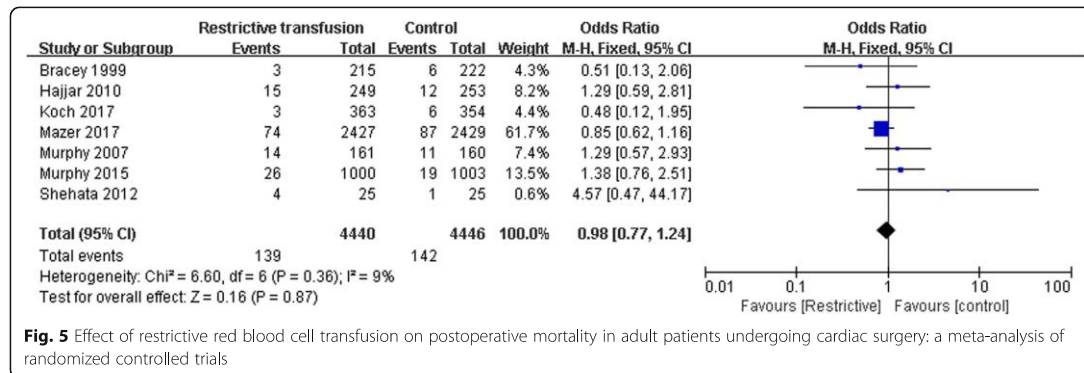


Fig. 5 Effect of restrictive red blood cell transfusion on postoperative mortality in adult patients undergoing cardiac surgery: a meta-analysis of randomized controlled trials

NS

# PBM : Que faut-il proposer? Limiter la transfusion



**Cochrane  
Library**

Cochrane Database of Systematic Reviews

27 May 2016.

## Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion (Review)

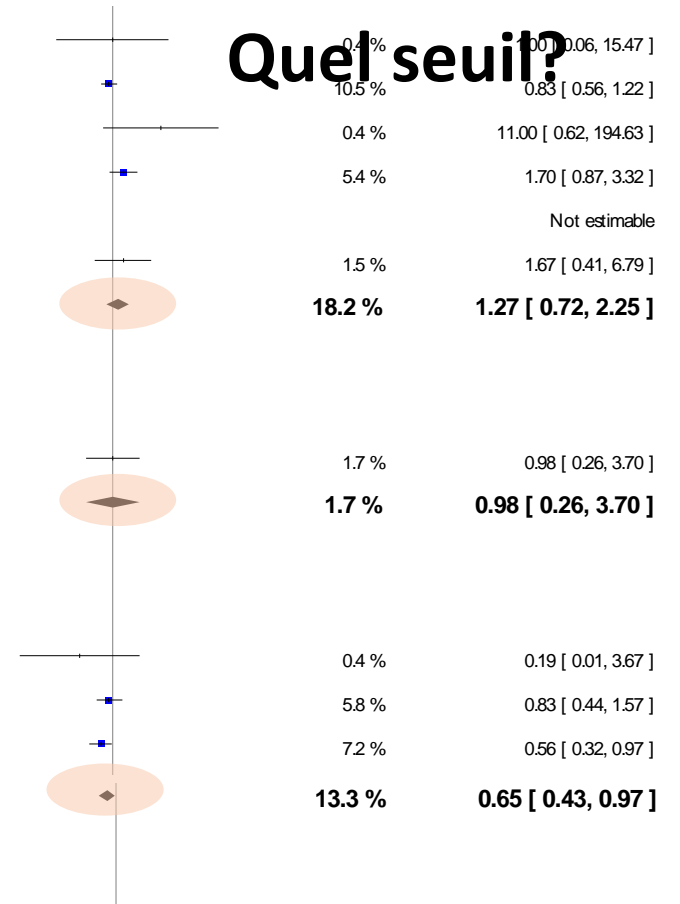
Carson JL, Stanworth SJ, Roubinian N, Fergusson DA, Triulzi D, Doree C, Hebert PC

**Pas de d'augmentation avec  
les stratégies restrictives**

Study	Restrictive	Liberal
<b>2 Orthopaedic surgery</b>		
Carson 1998	1/42	1/42
Carson 2011	43/1009	52/1007
Massaro 2009	5/60	0/60
Wagner 2015	21/144	12/140
Wagner 1999	0/62	0/65
Parker 2013	5/100	3/100
<b>Subtotal (95% CI)</b>	<b>1417</b>	<b>1414</b>
Total events: 75 (Restrictive), 68 (Liberal)		
Heterogeneity: Tau <sup>2</sup> = 0.14; Chi <sup>2</sup> = 6.46, df = 4 (P = 0.17); I <sup>2</sup> = 38%		
Test for overall effect: Z = 0.82 (P = 0.41)		
<b>3 Vascular</b>		
Bush 1997	4/50	4/49
<b>Subtotal (95% CI)</b>	<b>50</b>	<b>49</b>
Total events: 4 (Restrictive), 4 (Liberal)		
Heterogeneity: not applicable		
Test for overall effect: Z = 0.03 (P = 0.98)		
<b>4 Acute blood loss/trauma</b>		
Blair 1986	0/26	2/24
Jairath 2015	14/257	25/382
Villanueva 2013	19/416	34/417
<b>Subtotal (95% CI)</b>	<b>699</b>	<b>823</b>
Total events: 33 (Restrictive), 61 (Liberal)		
Heterogeneity: Tau <sup>2</sup> = 0.0; Chi <sup>2</sup> = 1.55, df = 2 (P = 0.46); I <sup>2</sup> = 0.0%		
Test for overall effect: Z = 2.08 (P = 0.037)		



## Quel seuil?



# PBM

## Conclusions

**PBM une affaire commune qui doit impliquer tout le monde**

**L'anémie pré-opératoire ne doit plus exister en chirurgie programmée**

**Utilisation de l'acide tranéxamique si risque**

**Transfusion restrictive – CG par CG**