IML

Institut du Mouvement et de l'appareil Locomoteur

EPARGNE SANGUINE EN CHIRURGIE ORTHOPEDIQUE

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Vifor Pharma

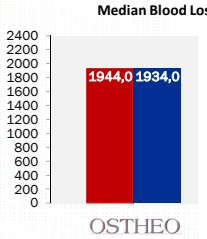
La Chirurgie Orthopédique : Hémorragique???

1992

2006

2010

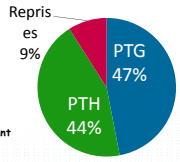
Évolution des pertes sanguines



N. Rosencher Transfusion. 2003 Apr;43(4):459-69

Résultats Orchidée
Description de la population

1. Au total **623/642 patients inclus dans 40 centres en France** sont retenus en ITT :
   - L'âge moyen est de 75 ans [56-87]
2. Les patients ont reçu **3 injections** (1 - 4) d'epoétine zêta.
3. **17% sont sous AAP** (aspirine), et **6,4% sous anticoagulant** AVK ou AOD repris en postopératoire
4. L'EPO est associée à du **fer oral (70%) ou à fer IV (24%)**



IMPORTANT

La Chirurgie Orthopédique prothétique réglée, même primaire, reste une chirurgie à risque hémorragique **modéré voire élevé** (>800ml)

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Anémie : Incidence ???

© Can Stock Photo - csp42894798 © Can Stock Photo - csp42894762

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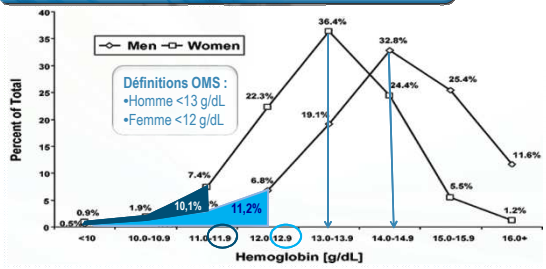
Distribution des concentrations d'Hb : + 65ans



n = 26372

Guralnik JM, et al., Blood 2004;104:2263-8.

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Prevalence of anemia in persons 65 years and older in the United States: evidence for a high rate of unexplained anemia

Jack M. Guralnik, Richard S. Eisenstaedt, Luigi Ferrucci, Harvey G. Klein, and Richard C. Woodman

Blood 2004

Table 2. Distribution of types of anemia in persons 65 years and older, United States: NHANES III, phase 2, 1991 to 1994

Anemia	No. in the United States	Type, %	All anemia, %
With nutrient deficiency			
Iron only	447 000	48.3	16.6
Folate only	181 000	18.8	6.4
B_{12} only	166 000	17.2	5.9
Folate and B_{12}	56 000	5.8	2.0
Iron with folate or B_{12} or both	95 000	9.9	3.4
Total	965 000	100.0	34.3
Without nutrient deficiencies			
Renal insufficiency only	230 000	12.4	8.2
ACI, no renal insufficiency	554 000	30.0	19.7
Renal insufficiency and ACI	120 000	6.5	4.3
UA	945 000	51.1	33.6
Total	1 849 000	100.0	65.7
Total, all anemia	2 814 000	NA	100.0

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Prévalence d'une anémie préopératoire en chirurgie orthopédique majeure

Auteur/année	Intervention	Nb cas	Prévalence
Saleh 2007	PTH/PTG	1142	20%
Basora 2006	PTH/PTG	218	39%
Myers 2004	PTH	225	15%
Rosencher 2003	PTH	2 346	30%
Su 2004	Fr. hanche	844	44%
Halm 2004	Fr. hanche	550	46%
Gruson 2002	Fr. hanche	395	46%

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En péri-opératoire d'orthopédie

- Revue systématique : 19 études
  - ***13 études (n = 29.068) PTH/PTG***
  - *6 études (n = 6.366) Fractures hanches*
- Anémie préopératoire : **24 ± 9** et 44 ± 9 %
- Anémie postopératoire : **51** et 87 ± 10 %
- Taux de Transfusion : **45 ± 25** et 44 ± 15 %

Spahn DR. Anesthesiology 2010;113:482-95

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PREPARE: the prevalence of perioperative anaemia and need for patient blood management in elective orthopaedic surgery

A multicentre, observational study

Sigismond Lasocki, Rüdiger Krauspe, Christian von Heymann, Anna Mezzacasa, Suki Chainey and Donat R. Spahn

Eur J Anaesthesiol 2015; **32:**160–167

Étude observationnelle PREPARE
17 centres,
6 pays européens
n = 1534 patients
PTH/PTG

11

All patients
1534(100%)

Hip 765 (49.9%)
Knee 570 (37.2%)
Spine 199 (13.0%)

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RESULTS Anaemia prevalence increased from 14.1% preoperatively to 85.8% postoperatively. Mean Hb decrease was 1.9 (1.5) and 3.0 (1.3) g dl^{-1} in preoperatively anaemic and nonanaemic patients, respectively ($P < 0.001$). In PBM (n = 7) vs. non-PBM centres, preoperative anaemia was less frequent (8.0 vs. 18.5%; $P < 0.001$) and iron status was assessed more frequently (ferritin 11.0 vs. 2.6%, transferrin saturation 11.0 vs. 0.1%; $P < 0.001$). Perioperative anaemia correction (mainly transfusion) was given to 34.3%. Intraoperatively, 14.8% of preoperatively anaemic and 2.8% of nonanaemic patients received transfusions [units per patient: 2.4 (1.5) and 2.2 (1.4), median time to first intraoperative transfusion: 130 (88, 158) vs. 179 (135, 256) min; $P < 0.001$]. Postoperative complications in preoperatively anaemic vs. nonanaemic 22.2%; $P = 0.009$).

CONCLUSION Most patients who underwent elective orthopaedic surgery had normal preoperative Hb levels but became anaemic after the procedure. Those who were anaemic prior to surgery had an increased intraoperative transfusion risk and postoperative complication rate. PBM measures such as iron status assessment and strategies to avoid transfusion are still underused in Europe.

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Orthopedic Surgery Transfusion Hemoglobin European Overview (OSTHEO) study: blood management in elective knee and hip arthroplasty in Europe

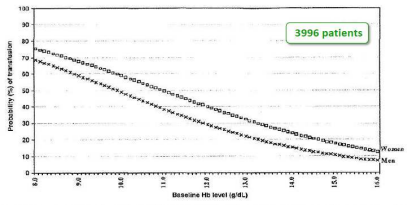

Fig. 2. Probability of allogeneic transfusion only in knee and hip replacements unilateral, nonrevision, no erythropoietin. (×) Men; (□) women.

N. Rosencher, *et al.* Transfusion 2003;43:459-69

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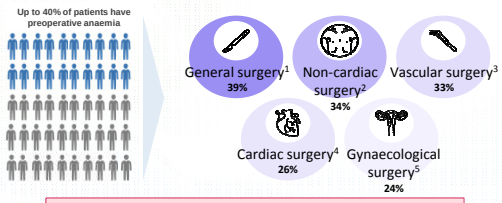
Pour les autres chirurgies…



- [1] Fowler AJ et al. Br J Surg. 2015;102(11):1314–24
- [2] Muñoz M et al. Anaesthesia. 2017;72(2):233–47
- [3] Dunkelgrun M et al. Am J Cardiol. 2008;101:1196–200
- [4] Karkouti K et al. Circulation. 2008;117:478–84
- [5] Richards T et al. PLoS One. 2015;10(7):e0130861

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IMPORTANT

L'anémie est **fréquente** en péri opératoire de chirurgie prothétique réglée.
L'anémie augmente l'incidence de la **transfusion**

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L'anémie : Impact sur la morbi-mortalité ???

.... et l'Anémie ?

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Anémie pré-op FDR indépendant de mortalité

Risk Associated with Preoperative Anemia in Noncardiac Surgery

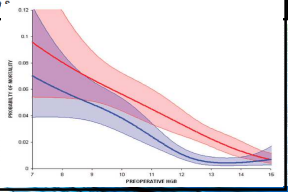
A Single-center Cohort Study

Anesthesiology 2009; 110:574–81

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. Wijeysundera, M.D., F.R.C.P.C.,‡ Gordon Tait, Ph.D.**

Table 5. Causes of Death*

	Anemia, n (%)	No Anemia, n (%)	Total %
Cardiac	20 (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)



Anémie pré-op FDR indépendant de mortalité

- Registre américain (211 hôpitaux)
- 227.425 patients opérés de chir majeure en 2008
- FdR indépendant de morbi-mortalité à J30.
- Indépendant de la transfusion

	No anaemia (n=158 196)	Mild anaemia (n=57 870)	Moderate-to-severe anaemia (n=11 359)	Any anaemia (n=69 229) 30%
Mortality				
n	1240 (0·78%)	2037 (3·52%)	1155 (10·17%)	3192 (4·61%)
$OR_{unadjusted}$	Reference	4·62 (4·30–4·96)	14·33 (13·19–15·56)	6·12 (5·73–6·54)
$OR_{adj\,1}$	Reference	1·67 (1·54–1·80)	2·40 (2·18–2·65)	1·83 (1·70–1·97)
$OR_{adj\,2}$	Reference	1·41 (1·30–1·53)	1·44 (1·29–1·60)	1·42 (1·31–1·54)

Musallam KM, et al. Lancet 2011;378:1396-407.

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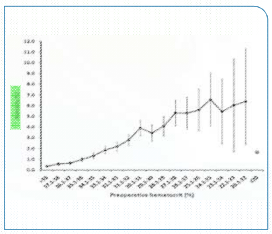
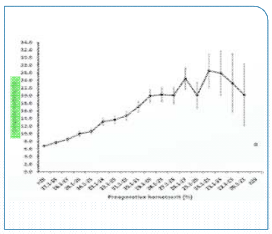
Lien inverse entre hématocrite pré-op et morbi- mortalité





Musallam KM, et al. Lancet 2011;378:1396-407.

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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

Lancet 2011; 378: 1396–407

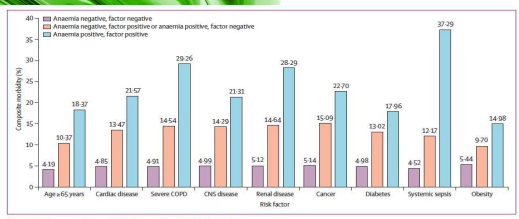

Figure 2: 30-day composite morbidity, by anaemia and risk factor status
COPD=chronic obstructive pulmonary disease.

Role of preoperative anemia for risk of transfusion and postoperative morbidity in fast-track hip and knee arthroplasty

Øivind Jans, Christoffer Jørgensen, Henrik Kehlet, and Pär I. Johansson on behalf of the Lundbeck Foundation Centre for Fast-track Hip and Knee Replacement Collaborative Group*

TRANSFUSION 2014;54:717-726.

In conclusion, we found that preoperative anemia was prevalent (12.8%) in elective fast-track THA or TKA and was associated with increased risk of transfusion, prolonged LOS, and readmission within 90 days. Measures to optimize preoperative Hb are required.

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Preoperative Anemia Increases Postoperative Complications and Mortality Following Total Joint Arthroplasty

Jessica Viola, BS, Miguel M. Gomez, MD, Camilo Restrepo, MD, Mitchell G. Maltenfort, PhD, Javad Parvizi, MD, FRCS
The Rothman Institute at Thomas Jefferson University, Philadelphia, Pennsylvania

The Journal of Arthroplasty 30 (2015) 846–848

Variable	Reference Patients n: 10,987	Anemic Patients, n: 2576	OR (CI)	P-Value
LOS mean (range)	3.33 (1–19)	4.04 (1–192)	–	0.0001
All complications %	33.2	15.4	2.11 (1.79–2.50)	0.0001
Cardiovascular complication %	11.8	26.5	2.2 (1.83–2.63)	0.0001
Genitourinary complications %	0.9	3.9	2.38 (1.3–3.98)	0.0009
Rate of infections %	1.12	4.5	2.83 (1.78–4.51)	0.0001
Primary vs revision %	0.79 vs 6.07	1.14 vs 16.6		
Transfusion %	4.89	14.55		
Mortality %	8.00%	0.2	–	0.08

Charlson comorbidity index

Fig. 1. Higher incidence of complications as CCI increased.

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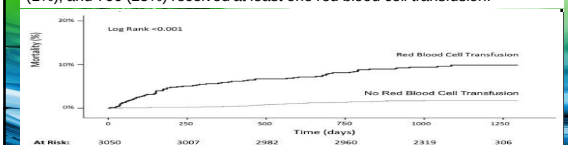
Association Between Anemia, Bleeding, and Transfusion with Long-term Mortality Following Noncardiac Surgery

The American Journal of Medicine®
The American Journal of Medicine (2016) 129, 315-323

Nathaniel R. Smilowitz, MD,[a] Brandon S. Oberweis, MD,[b] Swetha Nukala, MBBS,[c] Andrew Rosenberg, MD,[d] Sibo Zhao, MS,[e] Jinfeng Xu, PhD,[e] Steven Studvin, MD,[a] Richard Iorio, MD,[a] Thomas Errico, MD,[a] Martha J. Radford, MD,[a,f,g] Jeffrey S. Berger, MD, MS[a,h]

There were 3050 subjects who underwent orthopedic surgery. Preoperative anemia was present in 17.6% (537) of subjects, hemorrhage occurred in 33 (1%), and 766 (25%) received at least one red blood cell transfusion.



At Risk:	3050	3007	2982	2960	2319	306
RBCT:	766	728	716	706	542	68
No RBCT:	2284	2279	2266	2254	1777	238

Figure 2 Red blood cell transfusion (RBCT) and long-term mortality following surgery.

La transfusion est également un FDR de morbi-mortalité

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)	Adj OR Txf vs. No Txf (PS Method) (95% CI)
Mortality	6.44	4.26	1.55 (1.24, 1.90)	1.29 (1.03, 1.62)	1.21 (0.96, 1.52)
Cardiac complications	2.08	1.40	1.50 (1.06, 2.12)	1.40 (0.97, 2.03)	1.31 (0.88, 1.95)
Pulmonary complications	12.6	6.03	2.24 (1.92, 2.63)	1.76 (1.48, 2.09)	1.75 (1.47, 2.08)
Renal complications	2.69	1.85	1.46 (1.08, 1.99)	1.32 (0.93, 1.88)	1.29 (0.91, 1.84)
CNS complications	0.69	0.58	1.20 (0.67, 2.15)	0.84 (0.43, 1.64)	0.68 (0.34, 1.36)
Sepsis complications	16.4	9.81	1.81 (1.58, 2.07)	1.43 (1.21, 1.68)	1.48 (1.24, 1.72)
Wound complications	9.17	4.65	2.07 (1.73, 2.48)	1.87 (1.47, 2.37)	1.89 (1.49, 2.41)
Thromboembolic complicatioins	4.07	1.89	2.20 (1.69, 2.88)	1.77 (1.32, 2.38)	1.81 (1.34, 2.45)

Adj = adjusted; CI = confidence interval; CNS = central nervous system; OR = odds ratio; PS method = propensity score method; Txf = transfusion; Unadj = unadjusted.

Glance LG, et al. Anesthesiology 2011;114:283-92.

Harms associated with single unit perioperative transfusion: retrospective population based analysis

BMJ 2015;350:h3037

Elizabeth L Whitlock,[1] Helen Kim,[1] Andrew D Auerbach[2]

1 583 819 adults

Table 4 | Surgical subgroup analyses with primary hierarchical logistic regression model for stroke/myocardial infarction. Odds ratios are adjusted for age, sex, race, insurance payor, cardiovascular risk factors,* cerebrovascular disease, coronary artery disease, obesity, smoking status, anemia, and interactions between transfusion and cardiovascular risk factors or cerebrovascular disease, as well as random effects by hospital

Subgroup variable	Colectomy (partial and total)	Small bowel resection	Hip/knee replacement or revision	Spine, including fusion and laminectomy	Hysterectomy
No of patients	37 989	16 179	432 419	196 802	112 960†
No (%) transfused	1748 (4.6)	647 (4.0)	35 546 (7.4)	3903 (2.0)	1747 (1.6)
No (%) with stroke/MI (%)	689 (1.8)	309 (1.9)	1447 (0.33)	670 (0.34)	115 (0.10)
Odds ratio for stroke/myocardial infarction (95% CI)					
pRBC use (units) (reference: 0 units):					
1	2.36 (1.33 to 4.19)	2.05 (0.66 to 6.30)	1.24 (0.79 to 3.03)	1.43 (0.65 to 3.14)	5.21 (1.15 to 23.7)
2	2.21 (1.38 to 3.54)	2.84 (1.32 to 6.11)	1.77 (1.22 to 2.54)	1.73 (0.90 to 3.33)	7.57 (3.33 to 17.2)
3	2.56 (1.06 to 6.17)	1.80 (0.23 to 13.9)	2.29 (1.01 to 6.24)	3.87 (1.46 to 10.3)	4.79 (1.45 to 15.8)
≥4	1.96 (0.84 to 4.54)	4.37 (1.45 to 13.1)	3.26 (1.29 to 7.21)	4.27 (1.73 to 10.5)	9.46 (2.29 to 39.0)

WHAT THIS STUDY ADDS

There is an association between perioperative transfusion of as little as one unit of blood and ischemic stroke or myocardial infarction

L'anémie et la transfusion sont des **facteurs de risque indépendant de morbi-mortalité**

Ca SAIGNE

C'est FREQUENT

ELEMENTAIRE

MON CHER WATSON

C'est GRAVE

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Il faut anticiper !

DEMANDEZ LE PROGRAMME

« Patient Blood Management »
Programme !

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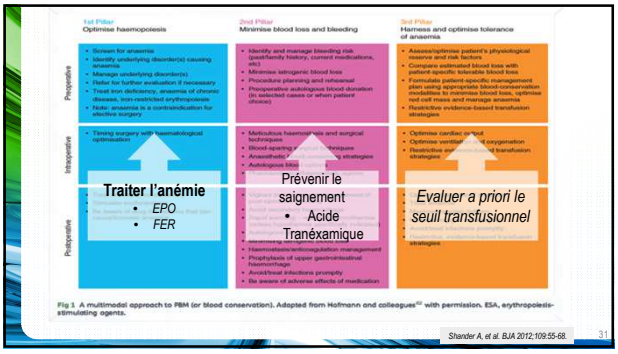

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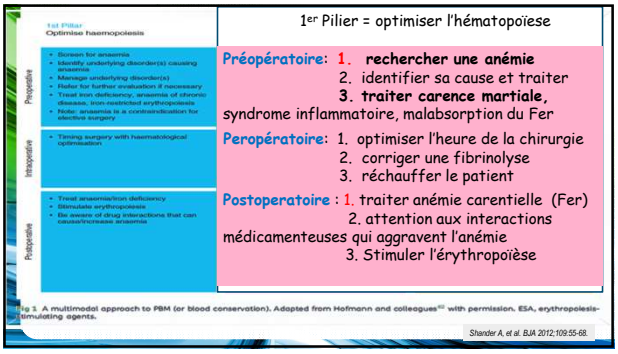

1er Pilier = optimiser l'hématopoïese

Préopératoire: 1. **rechercher une anémie**
2. identifier sa cause et traiter
3. **traiter carence martiale,**
syndrome inflammatoire, malabsorption du Fer

Peropératoire: 1. optimiser l'heure de la chirurgie
2. corriger une fibrinolyse
3. réchauffer le patient

Postoperatoire : 1. traiter anémie carentielle (Fer)
2. attention aux interactions médicamenteuses qui aggravent l'anémie
3. Stimuler l'érythropoïèse

British Journal of Anaesthesia **106** (1): 13–22 (2011)
doi:10.1093/bja/aeq361

BJA

Detection, evaluation, and management of preoperative anaemia in the elective orthopaedic surgical patient: NATA guidelines

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

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[3] Department of Orthopaedics, Guy's and St Thomas' Hospital, London, UK
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[5] Department of Hematology, Geneva University Hospital, Geneva, Switzerland
[6] Department of Anesthesiology, University Hospital Mar-Esperança, Barcelona, Spain
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[10] Department of Anesthesiology, Duke University Medical Center, Durham, NC, USA
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[13] Department of Orthopedics, IRIS South Teaching Hospitals, Free University of Brussels, Brussels, Belgium

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NATA Guidelines

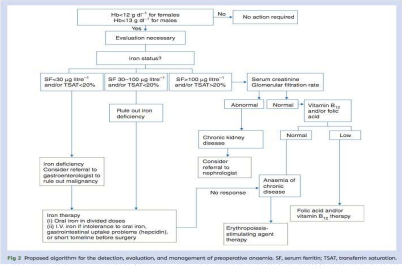

Fig 2 Proposed algorithm for the detection, evaluation, and management of preoperative anaemia. SF, serum ferritin; TSAT, transferrin saturation.

Goodnough LT, *et al.BJA 2011;106:13-22.*

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SFAR

Société Française d'Anesthésie et de Réanimation

Examens pré interventionnels systématiques

Lors d'une intervention à risque intermédiaire ou élevé, quel que soit l'âge, il est recommandé de prescrire un hémogramme avant l'acte pour son caractère pronostique ou d'aide à l'élaboration d'une stratégie transfusionnelle. (GRADE 1+)

SFAR. Recommandations formalisées d'experts - 2012

EJA

Eur J Anaesthesiol 2013; **30**:1–112

GUIDELINES

Management of severe perioperative bleeding
Guidelines from the European Society of Anaesthesiology

Preoperative correction of anaemia

We recommend that patients at risk of bleeding are assessed for anaemia 4–8 weeks before surgery. **1C**

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

We recommend treating iron deficiency with iron supplementation (oral or intravenous). **1B**

If iron deficiency has been ruled out, we suggest treating anaemic patients with erythropoietin-stimulating agents. **2A**

If autologous blood donation is performed, we suggest treatment with erythropoietin-stimulating agents in order to [illegible] anaemia and [illegible] overall transfusion rates. **2B**

HAS
HAUTE AUTORITÉ DE SANTÉ

RAPPORT D'EVALUATION

CHOIX DES EXAMENS DU METABOLISME DU FER EN CAS DE SUSPICION DE CARENCE EN FER

Mars 2011

Quelles que soient les recommandations, rapports d'évaluation et consensus, aucun ne préconise la réalisation d'un dosage du fer sérique seul.

Quand le dosage du fer sérique est recommandé, il l'est avec celui de la transferrine.

Le dosage conjoint du fer sérique et de la ferritine, sans la transferrine, n'est pas non plus préconisé.

La ferritine semble être le dosage le plus préconisé :
- seule
- en combinaison avec le coefficient de saturation de la transferrine (fer sérique + transferrine) ou des paramètres hématologiques, dans le cas de contextes pathologiques particuliers (cancers, maladies inflammatoires chroniques intestinales, insuffisance rénale chronique) ou quand la ferritine n'est pas informative.

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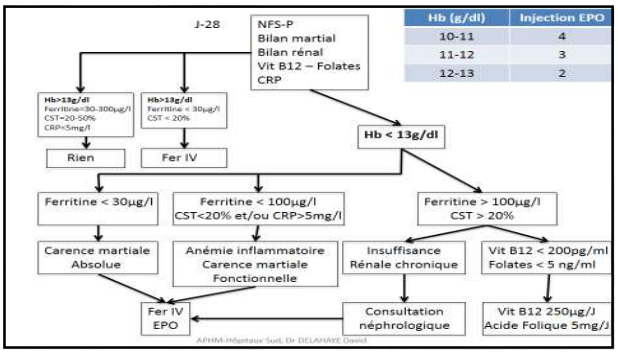
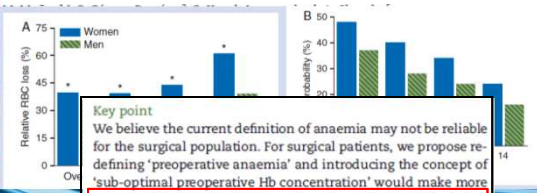


REVIEW ARTICLES

'Fit to fly': overcoming barriers to preoperative haemoglobin optimization in surgical patients†



Key point

We believe the current definition of anaemia may not be reliable for the surgical population. For surgical patients, we propose re-defining 'preoperative anaemia' and introducing the concept of 'sub-optimal preoperative Hb concentration' would make more sense. While waiting for more physiologically-sensible definitions, patients presenting with preoperative Hb <13 g dl^{-1} irrespective of gender should be considered anaemic. Therefore,

Intérêt du Fer

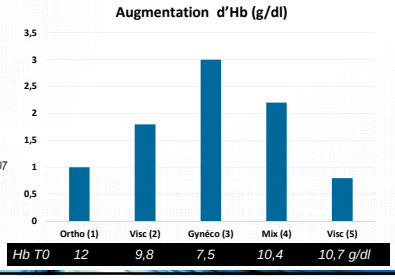
Qui a mangé des clous se torche de tenailles.

François Cavanna

www.citation-celebre.com

Le fer IV est efficace en préopératoire

Traitement pré-op,
de 4 à 21 jours
Doses entre 900 mg
et 1,2g



1. Theusinger Anesthesiology 2007
2. Keeler Colorectal Dis 2014
3. Kim Acta Haematol 2009
4. Bisbe BJA 2011
5. Froessler Ann Surg 2016

Intérêt du fer IV Pré-op

British Journal of Anaesthesia 100 (5): 599–604 (2008)
doi:10.1093/bja/aen054 Advance Access publication March 27, 2008
BJA

REVIEW ARTICLE

Perioperative anaemia management: consensus statement on the role of intravenous iron

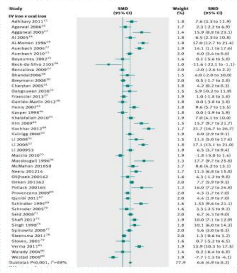
P. Beris[1*†], M. Muñoz[2], J. A. García-Erce[3], D. Thomas[4], A. Maniatis[5†] and P. Van der Linden[6]

A recommendation on the perioperative use of i.v. iron to increase haemoglobin levels and reduce allogenic blood transfusion can only be made for orthopaedic surgical

42

Fer IV *vs* Oral

Litton et al. BMJ 2013



- 72 études
- 10.605 patients
- Efficacy
  - **Delta Hb 6,5[5,1-7,9] g/L (59 études)**
  - **Transfusion 0,74[0,62-0,88] (22 études)**
- Safety (22 études) :
  - Mortalité : 1,1[0,8-1,5]
  - EIG 0,9 [0,8-1,1]
  - **Risque infection : 1,34 [1,1-1,64]**

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Fer Oral *vs* Fer IV

Fer Oral

- Beaucoup moins cher
- Tolérance limitée
  - 30-60% effets II^{aires}
- Observance ?
- Doses effectivement ingérées très faibles, compensation lente
- Intérections médicamenteuses
- Non réabsorbé si S inflammatoire.

Fer IV

- Coût
- Effets secondaires sévères mais rares
  - Anaphylaxie (*dextran*)
- Nécessite une voie veineuse / HdJ / Doses répétées
- Efficace, Compensation rapide
- Pas d'intéractions médicamenteuses
- A utiliser en priorité en cas de S inflammatoire.

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Et l'EPO ? Demandez au spécialiste

Pourquoi de l'EPO en pré-opératoire ?

Si l'Hb pré-opératoire augmente,

- **le saignement toléré sans transfusion augmente,**
- **on évite toute transfusion** (autologue et homologue)

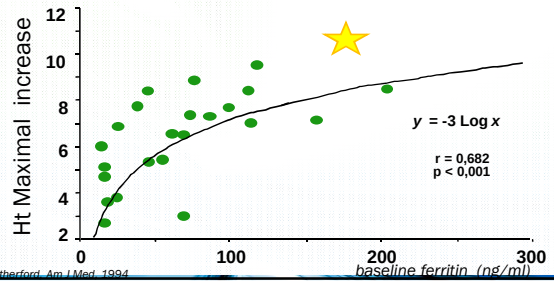
et donc on diminue les risques de :

1. **Pénurie de sang homologue**
2. **Risque émergent, résiduel, inconnu**
3. **Problème infectieux**
4. **Erreur transfusionnelle**

EPO
Données expérimentales et cliniques

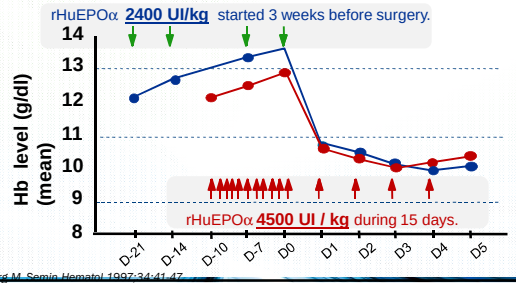
- L' efficacité de l'érythropoïétine :
  - Dépend des **réserves en fer**
  - Dépend de la **dose**
  - **Requiert du temps**

Réserves en Fer



Rutherford, Am J Med, 1994

Combined effect of delay and dose



Goldberg M. Semin Hematol 1997;34:41-47

AMM de l'EPO en péri-chirurgie

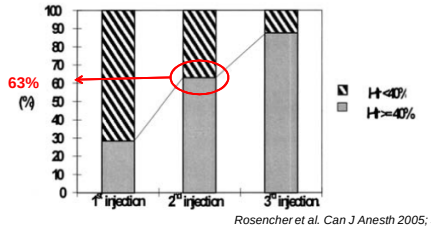
- Chirurgie « **orthopédique** » et **saignement > 800 ml**
- **10 g/dl ≤ Hb ≤ 13 g/dl, sans carence martiale**
- **600 UI /kg/semaine** en SC
- Injections : **J-21, J-15, J-7, J0 ou sans dépasser une Hb = 15 g/dl** (Hte = 45 %)
- **Surveiller PA** avant l'injection

Contre-indications et Précautions d'emploi de l'EPO

- HTA sévère mal contrôlée
- IDM récent
- AVC récent
- Artérite sévère
- Sténose carotidienne sévère
- Prudence quand ATCD EP et TVP

RCP ASE

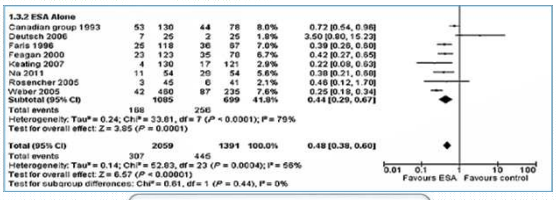
Two injections of erythropoietin correct moderate anemia in most patients awaiting orthopedic surgery



Rosencher et al. Can J Anesth 2005; 52:160-5

EPO Pré-opératoire : une méta-analyse

26 études
3450 patients



1.3.2 ESA Alone						
Canadian group 1993	53	130	44	78	8.0%	0.72 [0.54, 0.96]
Deutsch 2006	7	25	2	25	1.8%	3.50 [0.80, 15.23]
Faris 1996	25	118	36	87	7.0%	0.39 [0.25, 0.58]
Feagan 2000	23	123	35	78	6.7%	0.42 [0.27, 0.65]
Keating 2007	4	130	17	121	2.9%	0.22 [0.08, 0.63]
Na 2011	11	54	20	54	5.6%	0.38 [0.21, 0.68]
Rosencher 2005	3	45	6	41	2.1%	0.46 [0.12, 1.70]
Weber 2005	42	480	87	235	7.6%	0.25 [0.19, 0.34]
Subtotal (95% CI)		1085		699	41.8%	0.44 [0.29, 0.67]
Total events	168		256			
Heterogeneity: Tau² = 0.24; Chi² = 33.81, df = 7 (P < 0.0001); I² = 79%						
Test for overall effect: Z = 3.85 (P = 0.0001)						
Total (95% CI)		2059		1391	100.0%	0.48 [0.38, 0.60]
Total events	307		445			
Heterogeneity: Tau² = 0.14; Chi² = 52.63, df = 23 (P = 0.0004); I² = 56%						
Test for overall effect: Z = 6.57 (P < 0.00001)						
Test for subgroup differences: Chi² = 0.61, df = 1 (P = 0.44), I² = 0%						

RR de transfusion = 0,44
(15 *vs* 37% de patients transfusés)

Alaaleh K, et al. J Arthroplasty 2013;28:1463-72.

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Optimisation Bénéfice / Coût

Editorials CAN J ANESTH 2005 / 52:4 / pp 347–351

The health(y) cost of erythropoietin in orthopedic surgery

Dean A. Fergusson MHA PhD, Paul Hébert MD MHSc

L'éditorial pose la question de la sous prescription de l'EPO malgré son efficacité reconnue et validée : **problème de coût essentiellement** et **délais avant chirurgie**

Comment **optimiser le rapport bénéfice/coût ?**

Preoperative Erythropoietin Alpha Reduces Postoperative Transfusions in THA and TKA but May Not Be Cost-effective

Hany Bedair MD, Judy Yang MD, Maureen K. Dwyer PhD, ATC, Joseph C. McCarthy MD

Clin Orthop Relat Res (2015) 473:590–596

Table 3. Postoperative data

Postoperative blood management measure	Control	EPO	p value
Transfused (%)	23 (41)	0 (0)	< 0.001
Units transfused*	0.41 ± 0.07	0	< 0.01
Postoperative Day 1 preoperative Hgb (g/dL)*	9 ± 0.1	10.5 ± 0.3	< 0.001
Postoperative Day 2 preoperative Hgb (g/dL)*	9 ± 0.1	10 ± 0.3	< 0.001
Postoperative Day 3 preoperative Hgb (g/dL)*	9 ± 0.1	10 ± 0.3	< 0.01
Length of stay (days)*	3 ± 0.1	3 ± 0.1	0.14
Percent discharged home	59	62.5	0.77

* Mean ± SD; EPO = erythropoietin alpha; Hgb = hemoglobin.

Optimiser la prescription d'EPO

1. **L'efficacité de l'EPO augmente avec**
   - **La dose (600 UI /kg/semaine)**
   - **Le délai entre la première injection et l'intervention**
   - **Association au traitement martial**
2. **Adapter le nombre d'injections d'EPO à l'Hb en consultation, efficacité démontrée si 10≤Hb≤13g/dl**

N Rosencher et al./transfusion clinique et biologique 15 (2008) 294-302

Pourquoi associer du fer à l'EPO ?

1. Stimulation de l' érythropoïèse = **augmentation des besoins en fer**
2. Le **fer fixé sur la transferrine est très vite épuisé** et le fer de réserve (sous forme de ferritine) sera mobilisé
3. La **mobilisation ne peut se faire que lentement** (même si les réserves sont suffisantes)
4. Le **fer n'est pas délivré assez vite** pour cette érythropoïèse accélérée par l' EPO et induit **une carence fonctionnelle**

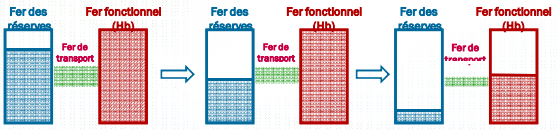
La carence fonctionnelle en fer entraîne une diminution de la réponse érythrocytaire

La persistance d'une anémie chez un patient traité par EPO peut donc être la conséquence d'un **déficit en fer, fonctionnel ou absolu, issu de l'accélération de l'érythropoïèse**

Carence martiale fonctionnelle
➔ CST < 20 %

Carence martiale absolue

Baisse des réserves en fer et biodisponibilité du fer insuffisante pour assurer une érythropoïèse normale

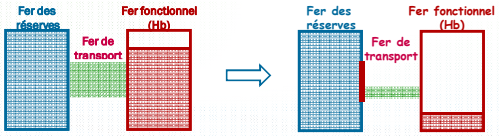


↘ de la ferritine

↘ de la ferritine puis ↘ du CST

Carence martiale fonctionnelle

Insuffisance de mobilisation du fer pour l'érythropoïèse à partir des lieux de stockage et de transport, quel que soit l'état des réserves tissulaires



Ferritine normale voire élevée

Étude EFOR : Fer IV *vs* Oral + EPO

- Étude Avant – Après
- **367** patients opérés de PTH & PTG
  - *PHASE 1 (183 pts) :* ***EPO + Fer Oral*** *si Hb<13g/dL*
  - *PHASE 2 (184 pts) :* ***EPO + carboxymaltose ferrique (FCM) 1g*** *si Hb<13g/dL*
- EPO *si Hb<13 g/dL*, 40.000 UI /sem (3ème injection si Hb<15 g/dL)

Rineau, Lasocki BJA 2014

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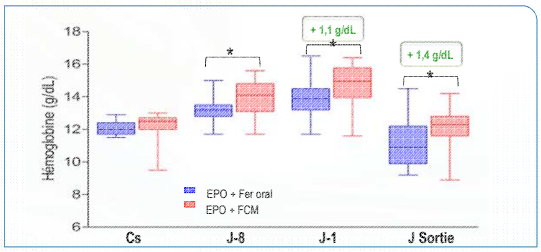
Amélioration de la réponse à l'EPO



Rineau, Lasocki BJA 2014

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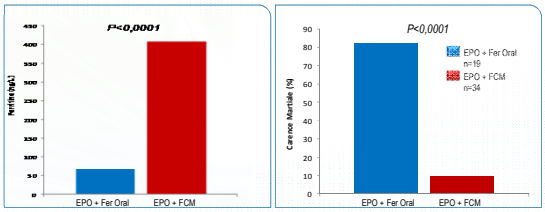
Réduction de la Carence Martiale



CM pré-opératoire 10 vs 82 %

Rineau, Lasocki BJA 2014

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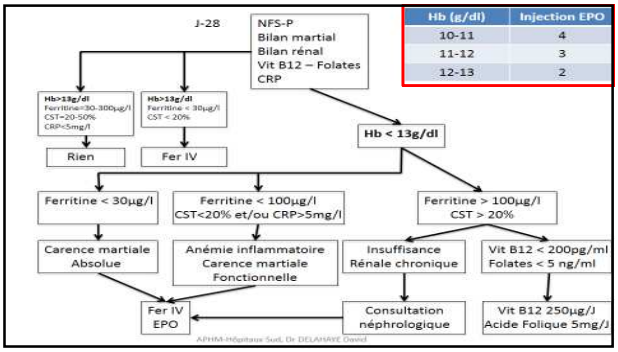

PBM et prothèses

1186 PTH ou PTG

Parameter	All patients Control	Iron ± rHuEPO
Patients	648	538
Age (years)	68 ± 10	70 ± 8*
Sex (male/female)	253/395	185/354
ASA II/III (n, %)	630 (97.2)	511 (94.8)
Treatment, n (%)		
IV iron	0	477
IV iron + rHuEPO	0	61
Hb (g/dL)		
Preoperative	13.7 ± 1.3	13.8 ± 1.3
POD 1	9.7 ± 1.8	10.7 ± 1.4*
POD 7	10.1 ± 1.1	10.3 ± 1.3
Patients transfused, n (%)	196 (30.2)	48 (8.9)*
Transfusion index (U/patient)	0.7 ± 1.2	0.2 ± 0.6*
Postoperative infection, n (%)	24 (3.7)	15 (2.8)
UTI	11	12
RTI	2	1
SWI	7	1
Other	4	1
LHS (days)	10.7 ± 5.3	8.4 ± 2.9†

Muñoz M, et al. Transfusion 2014;54:289-99.

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PBM : Étude avant-après

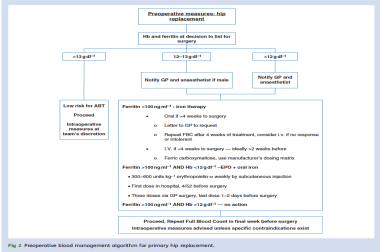

Fig 2 Preoperative blood management algorithm for primary hip replacement.

Kotzé A, et al. BJA 2012;108:943-52.

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Table 6 Before-and-after comparisons. Continuous data expressed as median (IQR). †P=0.02; *P<0.01; **P<0.001

	Before	After
Female:male ratio	412:305	155:126
TKR:THR ratio	356:361	123:158
ASA score	2 (2–2)	2 (2–3)
Age (yr)	72 (65–78)	74* (66–80)
Anaemia prevalence at decision for surgery	166/684	73/281
Nadir Hb in transfused patients (g dl^{-1})	7.8 (7.2–8.7)	7.6 (7.3–9.2)
Discharge Hb (g dl^{-1})	10.4 (9.5–11.4)	10.4 (9.4–11.0)
Hb loss: THR (g dl^{-1})	3.8 (2.9–4.9)	3.1** (1.9–4.6)
Hb loss: TKR (g dl^{-1})	3.1 (1.9–4.6)	2.6* (2.0–3.3)
Received ABT: THR	83/361	12**/158
Received ABT: TKR	24/356	0**/123
Length of stay (days): THR	6 (5–8)	5** (3–7)
Length of stay (days): TKR	6 (5–8)	4** (3–6)
Readmitted within 30 days	49/717	12/281
Readmitted within 90 days	97/717	23†/281

↓ Transfusion
- PTH : 23 → 7%
- PTG : 7 → 0%

Kotzé A, et al. BJA 2012;108:943-52

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Implementing a blood management protocol during the entire perioperative period allows a reduction in transfusion rate in major orthopedic surgery: a before–after study

Emmanuel Rineau,[1] Aurélie Chaudet,[1] Claire Chassier,[1] Pascal Bizot,[2] and Sigismond Lasocki[1]

TRANSFUSION 2016;56;673–681

STUDY DESIGN AND METHODS: In a two-phase prospective observational study, all patients admitted for total hip or knee arthroplasty were included the day before surgery. In Phase 1, use of EPO, iron, and tranexamic acid was left to the discretion of the anesthesiologists. In Phase 2, a protocol combining these treatments was implemented in the perioperative period. Perioperative hemoglobin levels and transfusion rates were recorded.

RESULTS: A total of 367 patients were included (184 and 183 in Phase 1 and 2, respectively). During Phase 2, implementing a PBM protocol allowed an increase in preoperative EPO prescription in targeted patients (i.e., with Hb < 13 g/dL; 18 [38%] vs. 34 [62%], p = 0.03) and in postoperative use of intravenous iron (12 [6%] vs. 32 [18%], p = 0.001) and tranexamic acid (157 [86%] vs. 171 [94%] patients, p = 0.02). In Phase 2, the number of patients who received transfusions (24 [13%] vs. 5 [3%], p = 0.0003) and of patients with a Hb level of less than 10 g/dL at discharge (46 [25%] vs. 26 [14%], p = 0.01) were reduced.

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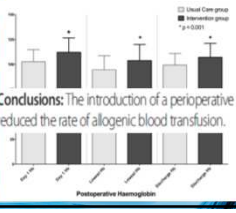
Perioperative blood management programme reduces the use of allogenic blood transfusion in patients undergoing total hip and knee arthroplasty

Paul Kopanidis[1], Andrew Hardidge[1], Larry McNicol[2-4], Stanley Tay[3], Peter McCall[4] and Laurence Weinberg[2,4,5*]

Journal of Orthopaedic Surgery and Research (2016) 11:28



Conclusions: The introduction of a perioperative blood optimisation programme improved postoperative Hb levels and reduced the rate of allogenic blood transfusion.

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Anaesthesia 2017, 72, 233–247 doi:10.1111/anae.13773

Consensus Statement

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

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

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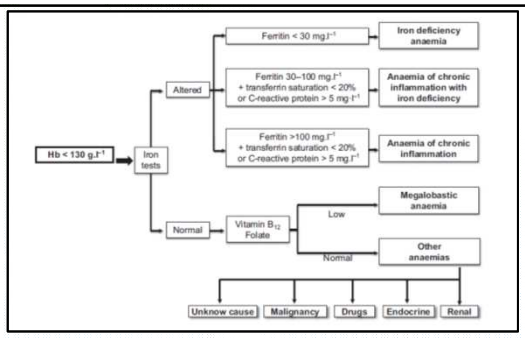

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Table 2 Characteristics of the different stages of iron deficiency in surgical patients.

Iron status	Laboratory findings	Initial treatment	Adjuvant treatment
Normal	Ferritin 30–300 μg.l⁻¹ TSAT 20–50% CRP < 5 mg.l⁻¹	None	None
Low iron stores (for surgery with moderate-to-high blood losses)	Ferritin < 100 μg.l⁻¹	Low dose oral iron (40–60 mg iron per day or 80–100 mg alternate days, 6–8 weeks)	Intravenous iron, if intolerance, contraindication or no response to oral iron or short time to surgery
Iron deficiency	Ferritin < 30 μg.l⁻¹	Low dose oral iron (40–60 mg iron per day or 80–100 mg alternate days, 6–8 weeks)	Gastro-intestinal/urological investigations Intravenous iron, if intolerance, contraindication or no response to oral iron or short time to surgery
	*Ferritin 30–100 μg.l⁻¹ TSAT < 20% and/or CRP > 5 mg.l⁻¹	Intravenous iron (Calculated dose)†	Treat underlying chronic disease if possible Recombinant erythropoietin in the selected case if anaemia does not respond to i.v. iron alone
Functional iron deficiency*	Ferritin 100–500 μg.l⁻¹ TSAT < 20%	Intravenous iron (Calculated dose)†	Revise erythropoietin dose Check folic acid and vitamin B_{12}
Iron sequestration*	Ferritin > 100 μg.l⁻¹ TSAT < 20% and/or CRP > 5 mg.l⁻¹	Recombinant erythropoietin, if anaemia	Intravenous iron, if functional iron deficiency develops

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ACIDE TRANEXAMIQUE

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Anesthesiology 2006; 105:1034 – 46
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Do Antifibrinolytics Reduce Allogeneic Blood Transfusion in Orthopedic Surgery?

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.‖*

Tranexamic acid						
Hiippala S(53)	1995	TKA	10 / 15	13 / 14	0.15 [0.02 to 1.53]	0.08
Benoni G(54)	1996	TKA	8 / 43	24 / 43	0.18 [0.07 to 0.48]	<0.01
Hiippala S(55)	1997	TKA	17 / 39	34 / 38	0.09 [0.03 to 0.31]	<0.01
Jansen A.J(57)	1999	TKA	2 / 21	13 / 21	0.06 [0.01 to 0.36]	<0.01
Benoni G(58)*	2000	THA	7 / 20	14 / 20	0.23 [0.06 to 0.87]	0.03
Tanaka N(63)	2001	TKA	47 / 73	26 / 26	0.03 [0.00 to 0.58]	<0.01
Benoni G(61)	2001	THA	4 / 20	8 / 20	0.38 [0.09 to 1.54]	0.17
Husted H(66)	2003	THA	2 / 20	7 / 20	0.21 [0.04 to 1.16]	0.06
Good L(65)	2003	TKA	3 / 27	14 / 24	0.09 [0.02 to 0.38]	<0.01
Lemay E(69)*	2004	THA	0 / 20	8 / 19	0.03 [0.00 to 0.63]	<0.01
Johansson T(71)	2005	THA	12 / 59	24 / 60	0.38 [0.17 to 0.87]	0.02
double blind studies			**112 / 357**	**185 / 305**	**0.18 [0.12 to 0.28]**	**<0.01**
					fixed effect model; heterogenity test p=0.39	
Engel J.M(47)	2001	TKA	0 / 12	3 / 12	0.11 [0.00 to 2.36]	0.10
Ellis M(62)	2001	TKA	1 / 10	7 / 10	0.05 [0.00 to 0.56]	0.01
Veien M(64)	2002	TKA	0 / 15	2 / 15	0.17 [0.01 to 3.96]	0.23
Zohar E(70)	2004	TKA	5 / 40	12 / 20	0.10 [0.03 to 0.35]	<0.01
open label studies			**6 / 77**	**24 / 57**	**0.09 [0.03 to 0.25]**	**<0.01**
					fixed effect model; heterogenity test p=0.93	
		total	**118 / 434**	**209 / 362**	**0.17 [0.11 to 0.24]**	**<0.01**
					fixed effect model; heterogenity test p=0.56	
					heterogenity test between subgroups p=0.22	

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

E. Irisson[a,*], Y. Hémon[a], V. Pauly[b], S. Parratte[c], J.-N. Argenson[c], F. Kerbaul[a,d]

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

	TA− (n = 241)	TA+ (n = 210)
Hb D1 (g/dL)	14.0 ± 1	14.2 ± 1
Hb D8 (g/dL)	10.7 ± 1.2	11.8 ± 1.2*
Total blood losses (mL)	1900 ± 690	1260 ± 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 ± 190	110 ± 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.

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

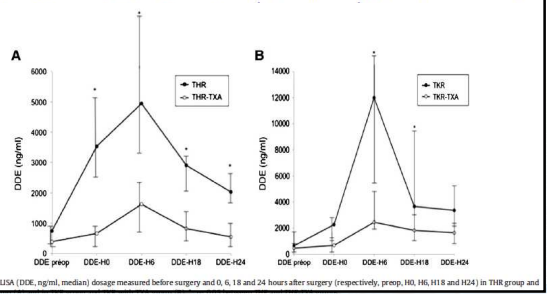

Fig. 2. D dimers ELISA [DDE, ng/ml, median] dosage measured before surgery and 0, 6, 18 and 24 hours after surgery (respectively, preop, H0, H6, H18 and H24) in THR group and

Acide Tranexamique en Orthopédie

- Cohorte rétrospective
- 510 US hospitals – 872.000 THA/TKA pts

Table 4| **Results from multilevel logistic regression model and propensity score analysis for primary outcomes. Values are odds ratios† (95% confidence intervals) unless stated otherwise**

Outcomes	Multilevel logistic regression‡				Propensity score analysis
	Tranexamic acid ≤1000 mg	Tranexamic acid 2000 mg	Tranexamic acid ≥3000 mg	C statistic	Tranexamic acid *v* no tranexamic acid
Allogeneic or autologous transfusion	0.38 (0.35 to 0.42)*	0.31 (0.28 to 0.34)*	0.31 (0.27 to 0.36)*	0.83	0.50 (0.45 to 0.55)*
Allogeneic transfusion only	0.37 (0.33 to 0.41)*	0.29 (0.26 to 0.32)*	0.31 (0.27 to 0.37)*	0.83	0.47 (0.42 to 0.53)*
Thromboembolic complications	1.02 (0.71 to 1.45)	0.99 (0.70 to 1.39)	0.85 (0.53 to 1.35)	0.90	0.86 (0.59 to 1.25)
Acute renal failure	0.90 (0.65 to 1.03)	0.70 (0.55 to 0.89)*	1.11 (0.84 to 1.45)	0.89	0.74 (0.57 to 0.96)*
Combined complications	0.79 (0.65 to 0.96)*	0.75 (0.62 to 0.91)*	0.98 (0.78 to 1.24)	0.86	0.75 (0.61 to 0.92)*
Admission to intensive care unit	0.73 (0.63 to 0.86)*	1.01 (0.88 to 1.16)	0.89 (0.72 to 1.10)	0.89	0.85 (0.74 to 0.99)*

Poeran *BMJ* 2014

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The efficacy of topical tranexamic acid in total hip arthroplasty: a meta-analysis

Shubiao Chen, Kezhou Wu, Gengbin Kong, Weili Feng, Zhihua Deng and Hu Wang*

Chen *et al. BMC Musculoskeletal Disorders* (2016) 17:81

Conclusions

This meta-analysis of the current literature indicates that topical TXA administration leads to a statistically significant reduction in total blood loss, drainage loss, transfusion rate and with less of a drop in haemoglobin level, with no increased risk of thromboembolic complications. Further study is required to elucidate the clinical outcomes and the optimal dose of topical TXA use in THA.

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Which Route of Tranexamic Acid Administration is More Effective to Reduce Blood Loss Following Total Knee Arthroplasty?

Sohrab Keyhani, MD; Ali Akbar Esmailiejah, MD; Mohammad Reza Abbasian, MD; Farshad Safdari, MD

Research performed at Bone Joint Related Tissues Research Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran

Table 2. Comparing the volume of blood loss, postoperative Hb level and frequency and amount of blood transfusion

Group	IV group (n=40)	Topical group (n=40)	Control group (n=40)	*P* value
Blood loss (mL)	406±36	422±51	494±73	<0.001
Hb level at 24 postop. hour	11.3 ± 0.8	11.8 ± 1.6	10.1 ± 1.5	0.031
No. patients required BT	2	3	10	0.013
Total No. of transfused packed cell units	3 (0.075)	3 (0.075)	14 (0.35)	0.002

AB&JS

Topical vs Intravenous Tranexamic Acid in Primary Total Hip Arthroplasty: A Double-Blind, Randomized Controlled Trial

Wayne T. North, MD *, Nima Mehran, MD, Jason J. Davis, MD, Craig D. Silverton, DO, Robb M. Weir, MD, Michael W. Laker, MD

The Journal of Arthroplasty 31 (2016) 1022–1026

Table 3
Primary Patient Outcomes in the Study Population.

Variable	IV (N = 70)	Topical (N = 69)	*P* value
Lowest postop Hgb (g/dL)[a]	10.4 ± 1.6	9.7 ± 1.6	.008
Change in Hgb (g/dL)[a]	−3.1 ± 1.2	−3.5 ± 1.2	.014
Hgb loss (mg)[a]	160.3 ± 63.8	188.4 ± 68.5	.014
Blood loss (mL)[a]	1195.0 ± 485.9	1442.7 ± 562.7	.006
Blood transfusion	8 (11%)	12 (18%)	.300[b]

80

TABLE 1. Co

TABLE 3. Comparison of intraarticular TXA versus IV TXAI

versus control

| Characteristics | | |

CMF Postopératoire

	Reference	Study type and location	Anaemic patient population	Treatments (no of patients)	Key findings
Postoperative	**Bisbe E** *et al. Br J Anaesth* 2014;113:402	Single-centre, single-blinded RCT in Spain	Total knee arthroplasty	FCM (n=60) Oral iron (n=62)	FCM achieved Hb ≥12 g/dL more frequently (42.3% vs 23.5%; P=0.04), achieved greater Hb increase in those patients with postoperative Hb <10 g/dL (2.4 vs 1.1 g/dL; P=0.018) and in those who were iron deficient at enrolment (56.7%) (1.9 vs 1.2 g/dL; P=0.03) vs oral iron
	Khalafallah A *et al Lancet Haematol* 2016;3:415 + **Munoz & Auerbach** *Lancet Haematol* 2016 [online]	Multicentre RCT, open-label in Australia	Elective non-cardiac surgery	FCM (n=103) SoC (n=98)	FCM lead to significantly greater improvement of Hb at week 4 after surgery (p<0.0001), less RBC transfusions (P=0.033) and less perioperative infections (P=0.010) vs standard of care *Munoz & Auerbach (2016) commentary: FCM is a safe, convenient and effective therapy option for treating postoperative anaemia. PBM guidelines should be updated to include the use of postoperative IV iron, to optimize patient outcomes*

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British Journal of Anaesthesia Page 1 of 8
doi:10.1093/bja/aeu092

BJA

Randomized trial comparing ferric carboxymaltose *vs* oral ferrous glycine sulphate for postoperative anaemia after total knee arthroplasty

E. Bisbe[1,3*], L. Moltó[1], R. Arroyo[1], J. M. Muniesa[2] and M. Tejero[2]

Editor's key points

- Anaemia is common after hip and knee arthroplasty and this may impair recovery.
- I.V. iron formulations restore perioperative haemoglobin levels more reliably than oral iron.
- This study identified some evidence that better treatment of postoperative anaemia could improve patient outcomes.
- I.V. iron therapy for pre- or postoperative anaemia is a promising option deserving further study.

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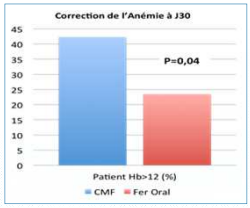
FER IV en post-opératoire

- 122 patients (PTG), anémie post-op (J2) Hb [8.5-12]
- CMF (700-1000 mg)
  vs Fer Oral (100 mg/j)
- Augmentation d'Hb
  - +1.7 *vs* +1.3 (p=0.075)
  - **Si Hb<10 : +2.4 *vs* +1.1 (p=0.018)**
- **Diminution de la Fatigue si Hb<10**



Bisbe E et al., BJA 2014; 113(3):402-9.

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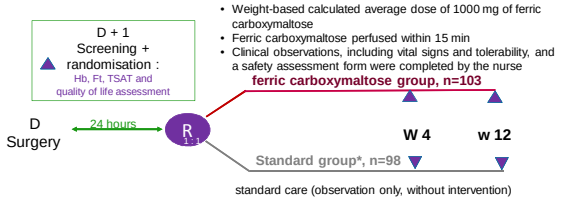
Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial

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

- Objective : to determine the effect of intravenous iron on long-term outcomes following surgery.
- Design : Prospective, open-label, randomised, controlled study of patients at two centres
- Inclusion : Patients undergoing elective surgery with functional iron deficiency anaemia (Hb 70–120 g/L and ferritin ≤100 µg/L or iron saturation ≤20%), measured at day 1 postoperatively.

Khalafallah AA, et al. Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. *Lancet Haematol.* 2016;3:e415-25.

Design



- Weight-based calculated average dose of 1000 mg of ferric carboxymaltose
- Ferric carboxymaltose perfused within 15 min
- Clinical observations, including vital signs and tolerability, and a safety assessment form were completed by the nurse

Hb, Ft, TSAT and quality of life assessment

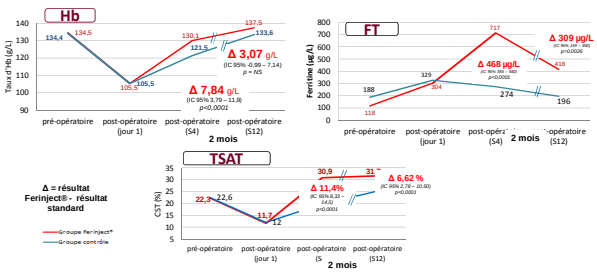
Khalafallah AA, et al. Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. *Lancet Haematol.* 2016;3:e415-25.

Population at inclusion

	Ferric carboxymaltose (n=103)	Standard (n=98)
Age (year)	65 (55-73)	67 (60-76)
Sex	Men : 38 (37%) Women : 65 (63%)	Men : 48 (49%) Women : 50 (51%)
Weight (kg)	82 (70-91)	81 (69-88)
CRP (mg/L)*	85 (17-150)	100 (48-192)
Hb (g/L)*	109 (99-120)	106 (96-117)
Ferritine (µg/L)	170 (108-284)	243 (134-471)
TSAT (%)	10 (7-15)	11 (9-15)
• Orthopedic (knee or hip arthroplasty and spinal surgery)	84 (82 %)	72 (73 %)
• Other	19 (18 %)	26 (27 %)
• Other	19 abdominal surgery, ten gynaecological surgery, eight urological operations, and eight other operations (neck, breast, major plastic, or ear, nose, and throat surgery)	

Khalafallah AA, et al. Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. *Lancet Haematol.* 2016;3:e415-25.

Result primary criteria : Hb, Ferritine, TSAT at 1 month (S4)



Khalafallah AA, et al. Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. *Lancet Haematol.* 2016;3:e415-25.

Results

Blood transfusion (I[ary] criteria)
1% in IV iron vs 6% in standard care
(incident rate ratio 0,10 in favour of the IV group, 95% CI 0,01–0,85; p=0,035).

Lenght of hospital stay
7,8 days (SD 10,3) in ferric carboxymaltose group compared with 11,6 days (15,6) in the standard care group (mean difference – 3,8 days, 95% CI –7,5 to –0,02; p=0,049).

Severe infection requiring intravenous antibiotics
2% patients in IV iron group vs 14% in the standard care group (incidence rate ratio 0,14, 95% CI 0,03–0,63; p=0,010).

Quality of Life
Improvement with IV iron in quality of life as measured by the SF36 questionnaire across most scales except bodily pain, although this did not reach significance.

Safety
No adverse events were observed with ferric carboxymaltose treatment.

Khalafallah AA, et al. Intravenous ferric carboxymaltose versus standard care in the management of postoperative anaemia: a prospective, open-label, randomised controlled trial. *Lancet Haematol*. 2016;3:e415-25.

Postoperative intravenous iron: a simple strategy to improve outcomes

*Manuel Muñoz, *Michael Auerbach*

We are grateful for this well conducted, statistically sound, prospective trial which elucidates another method of administering intravenous iron, and hope that surgeons move forward in adding this safe, effective, and convenient therapy to the current treatment algorithm for postoperative anaemia. We applaud the investigators for not misrepresenting the improved safety of this intravenous iron formulation compared with others,[10] and agree that patient blood management guidelines should be updated, incorporating the use of postoperative intravenous iron to optimise patient outcomes after elective and non-elective procedures.

Dr P Marazzi/Science Photo Library

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August 4, 2016
http://dx.doi.org/10.1016/S2352-3026(16)30083-7

See Articles page e415

EJA

Eur J Anaesthesiol 2017; **34**:332–395

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. Wikkelsø, Patrick Wouters, Piet Wyffels and Kai Zacharowski

Kozek-Langenecker SA, et al. Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol* 2017; 34:332–395.

GUIDELINES UPDATE

1.2. Preoperative and postoperative correction of anaemia

Preoperative anaemia in adults and children appears to be a strong predictor for perioperative blood transfusion across various types of conditions and surgeries and may be associated with adverse events. **B**

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**

We recommend treating iron deficiency with iron supplementation. **1B**

We recommend the use of intravenous iron in preference to oral iron. **1C**

Kozek-Langenecker SA, et al. Management of severe perioperative bleeding: guidelines from the European Society of Anaesthesiology. *Eur J Anaesthesiol* 2017; 34:332–395.

En post-opératoire

- **Perte d'Hb = Perte de FER**
  - *Pas de nécessité de faire un bilan*
  - *Ferritine = protéine inflammation, ne représente plus les réserves en FER*
- **Transfusion**
  - *Seuil 8-9 g/dL si comorbidité ++*
  - *Apporte du fer, mais ne traite pas la CM "cellulaire"*

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SeuilsTransfusionnels

HAS 2014

B	Les seuils transfusionnels suivants d'hémoglobine au cours de la période périopératoire sont recommandés : • 7 g/dl chez les personnes sans antécédents particuliers ; • 10 g/dl chez les personnes ne tolérant pas cliniquement les concentrations d'hémoglobine inférieures ou atteintes d'insuffisance coronarienne aiguë ou d'insuffisance cardiaque avérée ou bêta-bloquées.
AE	Il est recommandé, au cours de la période périopératoire, de privilégier un seuil transfusionnel de 8-9 g/dl chez les personnes ayant des antécédents cardio-vasculaires.

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Restrictive *versus* Liberal Transfusion Strategy in the Perioperative and Acute Care Settings

A Context-specific Systematic Review and Meta-analysis of Randomized Controlled Trials

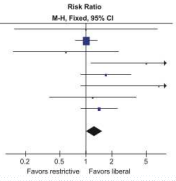
Anesthesiology 2016; 125:46-61

Frédérique Hovaguimian, M.D., M.Clin.Res.Meth., Paul S. Myles, M.B.B.S., M.P.H., M.D., F.C.A.I., F.A.N.Z.C.A., F.R.C.A., F.A.H.M.S.

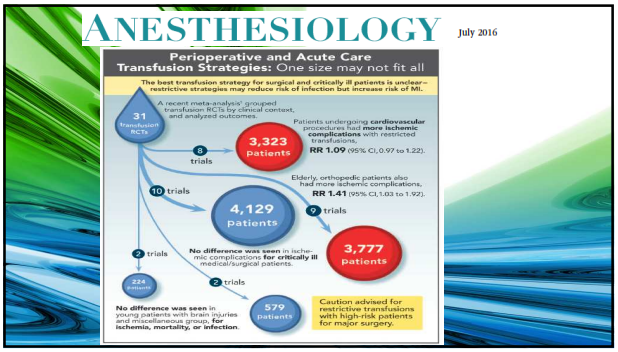
Group 2 studies	Restrictive Events	Restrictive Total	Liberal Events	Liberal Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Carson 1998 [49]	2	42	2	42	1.5%	1.00 [0.15, 6.77]
Carson 2011 [50]	84	1007	83	1005	61.5%	1.01 [0.76, 1.35]
Fan 2014 [52]	3	94	5	92	3.7%	0.59 [0.14, 2.39]
Foss 2009 [8]	10	60	2	60	1.5%	5.00 [1.14, 21.86]
Gregersen 2015 [9]	21	144	12	140	9.0%	1.70 [0.87, 3.32]
Grover 2006 [53]	7	130	1	130	0.7%	7.00 [0.87, 56.15]
Parker 2013 [53]	6	100	5	100	3.7%	1.20 [0.38, 3.81]
So-Osman 2010 [55]	35	299	25	304	18.4%	1.42 [0.87, 2.32]
Total (95% CI)		**1876**		**1873**	**100.0%**	**1.24 [1.00, 1.54]**
Total events	168		135			

Heterogeneity: Chi² = 10.32, df = 7 (P = 0.17); I² = 32%

Test for overall effect: Z = 1.96 (P = 0.05)



Forest plots illustrating the risk of composite events: myocardial infarction, arrhythmia, unstable angina, stroke, acute kidney injury, mesenteric ischemia, peripheral ischemia, and mortality (occurring within 30 days) in elderly patients undergoing orthopedic surgery



SAVE BLOOD, SAVE LIVES

Transfusions are one of the most overused treatments in modern medicine, at a cost of billions of dollars. Researchers are working out how to cut back.

BY EMILY ANTHES

nature
International weekly journal of science

NATURE | VOL 520 | 2 APRIL 2015

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In 2009, a major California hospital was looking for ways to cut costs. Stanford Hospital and Clinics was on track that year to purchase nearly US$6.8 million worth of blood for transfusions. But a growing body of evidence was suggesting that physicians could often forego the procedure.

So, beginning in July 2010, whenever a clinician used the hospital's computerized ordering system to request blood, it would call up the patient's most recent lab results. If the numbers indicated that she or he should be healthy enough to get by without a transfusion, an alert would pop onto the screen gently reminding the doctor of the guidelines and requesting further justification for the order.

The results, detailed in two papers published in the past 18 months[1,2], were dramatic. The number of red-blood-cell transfusions dropped by 24% between 2009 and 2013, representing an annual savings of $1.6 million in purchasing costs alone. And as transfusion rates fell, so did mortality, average length of stay and the number patients who needed to be readmitted within 30 days of a transfusion. By simply asking doctors to think twice about transfusions, the hospital had not only reduced

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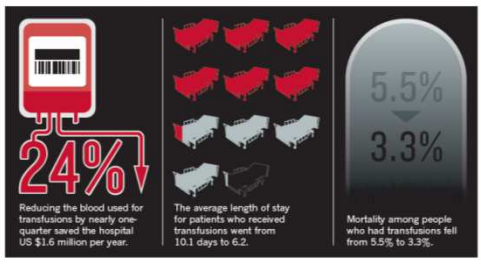
DOCTOR'S ORDERS

By simply reminding doctors of the current guidelines when they order blood, a California hospital was able to save money and lives.



Reducing the blood used for transfusions by nearly one-quarter saved the hospital US $1.6 million per year.

The average length of stay for patients who received transfusions went from 10.1 days to 6.2.

Mortality among people who had transfusions fell from 5.5% to 3.3%.

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En Pratique

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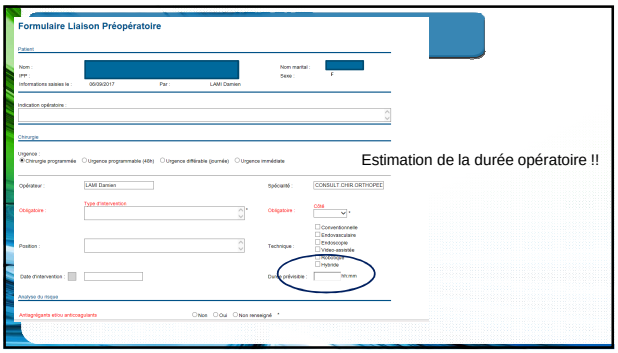
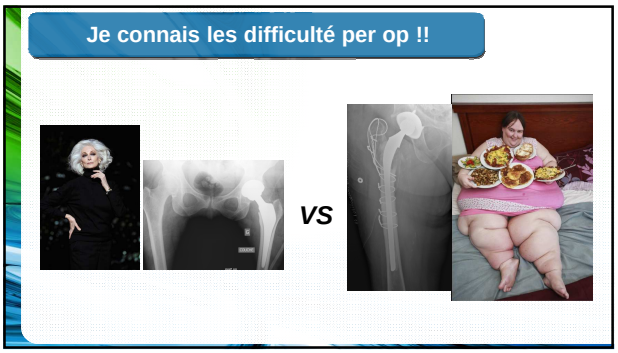
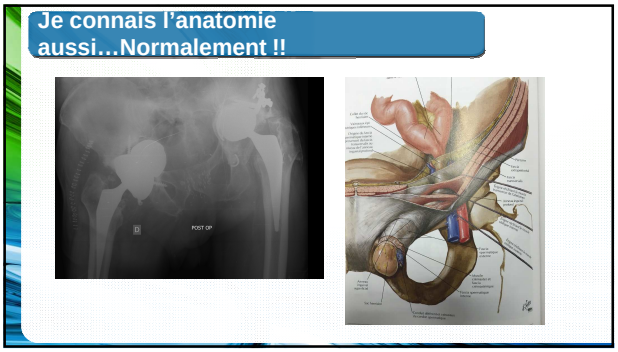
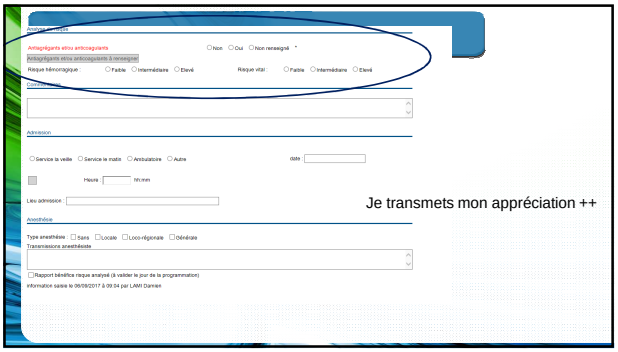

Formulaire Liaison Préopératoire
Estimation de la durée opératoire !!


Je connais les difficulté per op !!
VS


Je connais l'anatomie aussi…Normalement !!


Je transmets mon appréciation ++

Encore un petit effort ….

- On gagnera beaucoup de temps …!!

Je prescrits le premier bilan AVANT la consultation ARE

Il est pré-imprimé dans une pochette ou numérisé

Il suffit d'ajouter le nom du patient et un coup de tampon

~ 45 secondes

Le patient viendra donc à la consultation ARE avec son bilan Sanguin

Et le détail de son traitement personnel

Take home message pré-op

- MISE EN PLACE DU PROTOCOLE
- Fiche de liaison pré –op : risques , temps op estimé, etc ++
- Chirurgien : premier prescripteur : bilan + traitement

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HOPITAUX SUD
Institut du Mouvement et de l'appareil Locomoteur
Service de Chirurgie Orthopédique et Sportive
Centre de Chirurgie de l'Arthrose
Professeur Jean-Noël ARGENSON

Assistance Publique
Hôpitaux de Marseille

Madame G

Marseille, le 03.11.2015

Faire pratiquer par un laboratoire d'analyses médicales :

- Numération Globulaire
- Taux d'Hémoglobine ; Taux d'Hématocrite
- TP ; TCA
- Azotémie ; Créatinémie, débit de filtration glomérulaire
- Dosage vitamine B12
- Dosage des Folates (vitamine B9)
- Dosage de la CRP
- Fer
- Ferritine
- Coefficient de saturation de la transferrine

- E C B U

- Prélèvement nasal à la recherche de staphylocoque doré

À PRATIQUER QUELQUES JOURS AVANT LA CONSULTATION DE PRE-ANESTHESIE ET APPORTER LES RESULTATS A L'ANESTHESISTE

Professeur Jean Noël ARGENSON

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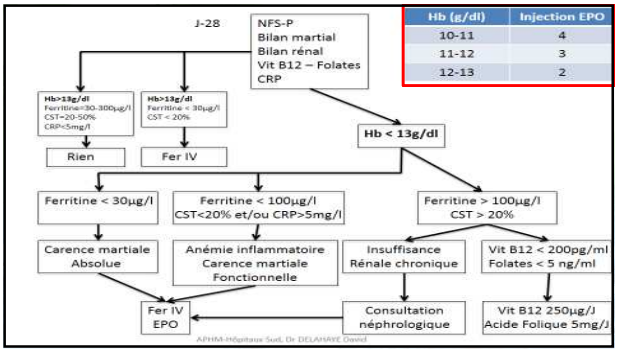
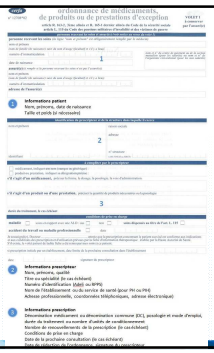


Jusqu'à 2014…

600UI/kg, 1 injection par semaine


ordonnance de médicaments, de produits ou de prestations d'exception

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RÉPUBLIQUE FRANÇAISE

Ministère des affaires sociales et de la santé

CIRCULAIRE N° DGOS/PF2/R3/DGS/PP2/2014/14 du 24 janvier 2014 relative aux modalités d'utilisation des spécialités à base de fer injectable.

Validée par le CNP le 24 janvier 2014 - Visa CNP 2014-14

Date d'application : 1er février 2014

Catégorie :

Résumé : Modalités particulières d'injection et de surveillance des spécialités à base de fer

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Sur la base de l'avis du Comité des médicaments à usage humain (CHMP) de l'EMA (Agence européenne du médicament), la Commission européenne a adopté le 13 septembre 2013 une décision enjoignant les Etats membres à modifier les autorisations de mise sur le marché (AMM) nationales des spécialités à base de fer injectable (IV) afin de renforcer les précautions d'emploi relatives au risque allergique. Cette décision fait suite à des signaux de pharmacovigilance, en particulier la survenue de chocs anaphylactiques, de nature imprévisible.

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Le CHMP préconise désormais que les spécialités à base de fer pour la voie injectable soient administrées aux patients dans les conditions suivantes :

- sous une surveillance médicale attentive pendant et jusqu'à 30 min après chaque administration,
- avec la disponibilité immédiate d'un personnel formé pour évaluer et prendre en charge les réactions anaphylactiques,
- dans un environnement disposant des moyens nécessaires pour assurer une réanimation.

Sur décision de l'ANSM, ce renforcement du dispositif d'administration a notamment pour conséquence une modification des conditions de prescription et de délivrance (CPD) de ces spécialités afin de les classer dans la catégorie des médicaments réservés à l'usage hospitalier (RH) en application des dispositions de l'article R. 5121-82 du code de la santé publique.

Le classement en réserve hospitalière implique que les injections soient faites au sein de structures ayant la qualité d'établissement de santé, incluant l'hospitalisation à domicile, selon les mêmes modalités.

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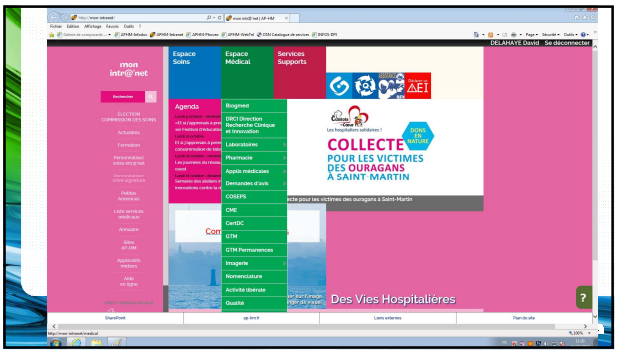
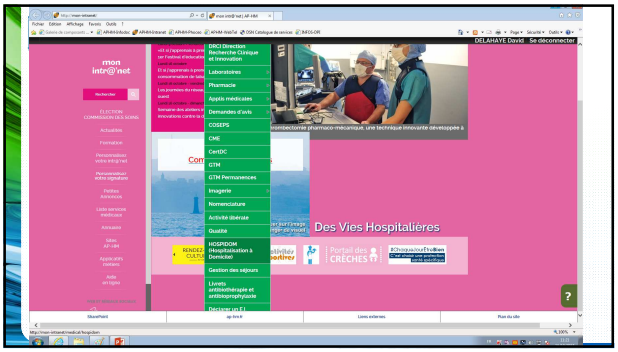
La France vue par les habitants du sud de la France
Groenland
Sibérie
Grand Nord
Nord
Sud

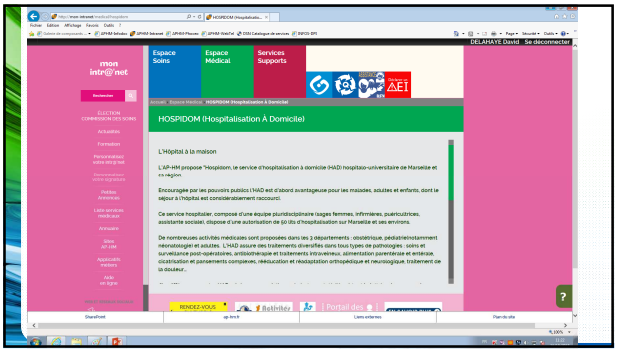
GAP
MANOSQUE
MARTIGUES
BRIGNOLES
St TROPEZ
TOULON
HYERES
CHU
BASTIA
CALVI
CORTE
AJACCIO
Google My Maps

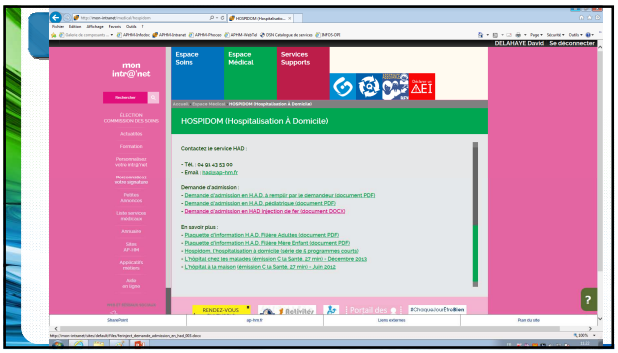
Le classement en réserve hospitalière implique que les injections soient faites au sein de structures ayant la qualité d'établissement de santé, incluant l'hospitalisation à domicile, selon les mêmes modalités.

Dans le cas où les spécialités à base de fer injectable ne pourraient pas administrées directement par un médecin, un protocole de surveillance et de prise en charge du choc anaphylactique doit être établi en application de l'article R. 4311-14 précité. Le personnel infirmier doit être formé à la surveillance et au protocole pour reconnaître et prendre en charge les signes et symptômes du choc anaphylactique et disposer des médicaments et du matériel nécessaire à sa mise en œuvre.



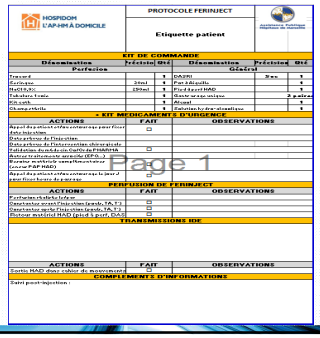


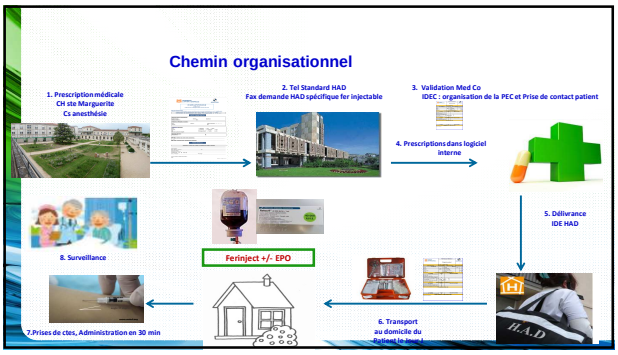


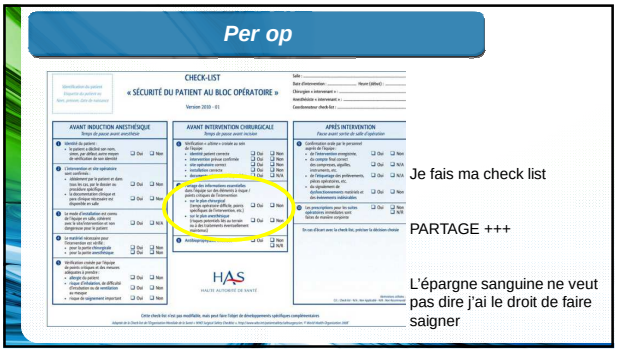


En pratique :

En pratique :







Je fais ma check list

PARTAGE +++

L'épargne sanguine ne veut pas dire j'ai le droit de faire saigner

L'intervention : Pas la peine d'en parler….. mais quand même !

- Hémostases / Garrot
- Temps opératoire

- CHU : médecins en formation …

- SAVOIR DOSER !!

Per op

- GARROT
- Il faut apprendre à s'en passer
- Ce n'est pas de l'épargne …. Au contraire !!

Use of a **Tourniquet** in **Total Knee Arthroplasty** Causes a Paradoxical Increase in **Total** Blood Loss.
Schnettler T, Papilion N, Rees H.
J Bone Joint Surg Am. 2017 Aug 16;99(16):1331-1336. doi: 10.2106/JBJS.16.00750.
PMID: 28816802

Acide tranexamique

- 1 g sur 30min à l'induction et à la fermeture
- 1g peros toutes les 6h pendant 24h

1A 500mg = 0,39€

1cp 500mg = 0,20€

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

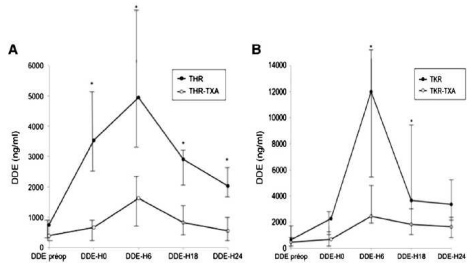


Fig. 2. D dimers ELISA (DDE, ng/ml, median) dosage measured before surgery and 0, 6, 18 and 24 hours after surgery (respectively, preop, H0, H6, H18 and H24) in THR group and

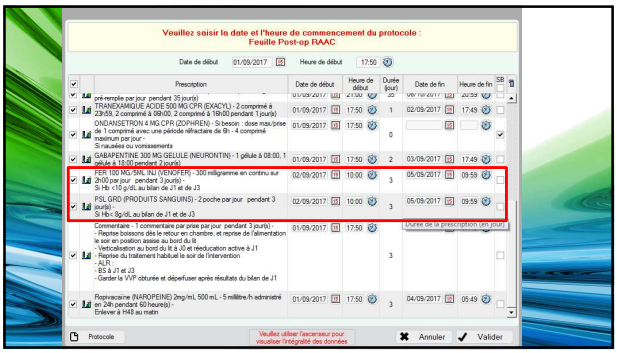
POST OP

✓ Drainage or not drainage !!

✓ Pas de dogme … dans un sens ou dans l'autre

✓ Mais la question est posée

Closed Suction **Drainage** Is Not Necessary for **Total Knee Arthroplasty**: A Prospective Study on Simultaneous Bilateral Surgeries of a Mean Follow-Up of 5.5 Years.
Watanabe T, Muneta T, Yagishita K, Hara K, Koga H, Sekiya I.
J **Arthroplasty**. 2016 Mar;31(3):641-5. doi: 10.1016/j.arth.2015.10.005. Epub 2015 Oct 26.



SeuilsTransfusionnels

HAS 2014

B	Les seuils transfusionnels suivants d'hémoglobine au cours de la période périopératoire sont recommandés : • 7 g/dl chez les personnes sans antécédents particuliers ;
	• 10 g/dl chez les personnes ne tolérant pas cliniquement les concentrations d'hémoglobine inférieures ou atteintes d'insuffisance coronarienne aiguë ou d'insuffisance cardiaque avérée ou bêta-bloquées.
AE	Il est recommandé, au cours de la période périopératoire, de privilégier un seuil transfusionnel de 8-9 g/dl chez les personnes ayant des antécédents cardio-vasculaires.

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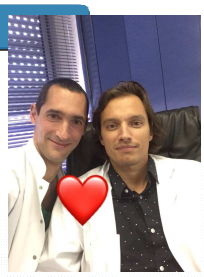
Conclusion

- Organisation Médecin-Chirurgien+++
- Du Temps
- De l'organisation



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MERCI
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