JARCA

Journées d'Anesthésie Réanimation Chirurgicale d'Aquitaine

Nouveautés dans la prise en charge du traumatisme crânien

Pr Thomas GEERAERTS

Pôle Anesthésie Réanimation

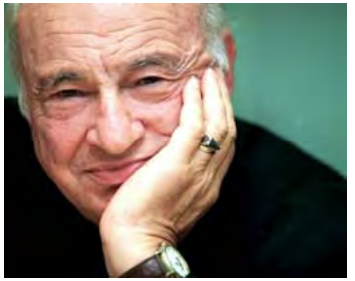
CHU de Toulouse

UNIVERSITÉ TOULOUSE III PAUL SABATIER

Université de Toulouse

Hôpitaux de Toulouse

Edgar Morin



« La vraie *nouveauté* naît toujours

dans le retour aux sources »

Guidelines for the Management of Severe Traumatic Brain Injury

3rd Edition

B. Level II

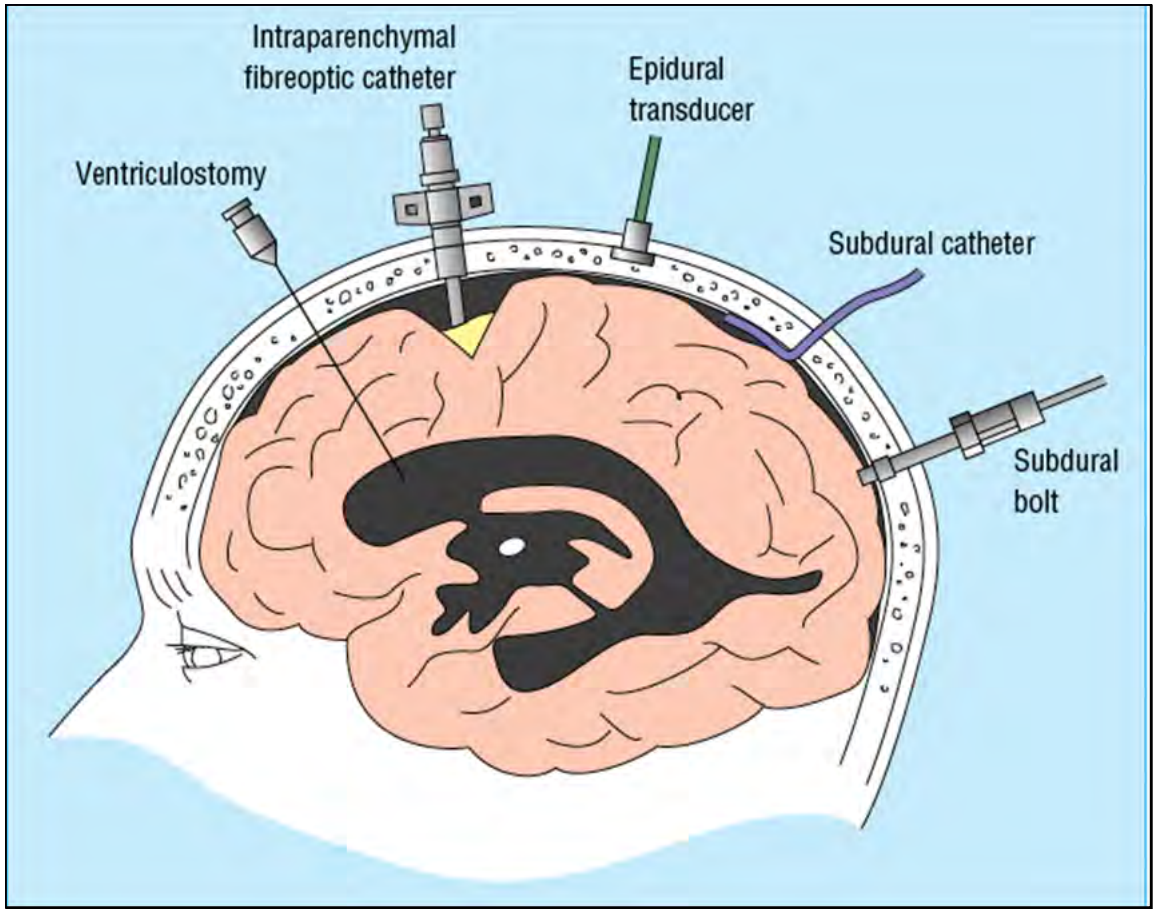
Intracranial pressure (ICP) should be monitored in all salvageable patients with a severe traumatic brain injury (TBI; Glasgow Coma Scale [GCS] score of 3–8 after resuscitation) and an abnormal computed tomography (CT) scan. An abnormal CT scan of the head is one that reveals hematomas, contusions, swelling, herniation, or compressed basal cisterns.

Journal of Neurotrauma

(ISSN: 0897-7151)

VOLUME 24 SUPPLEMENT 1 2007

Méthode de référence
Capteur invasif



Regardons la réalité…

Suivi des recommandations

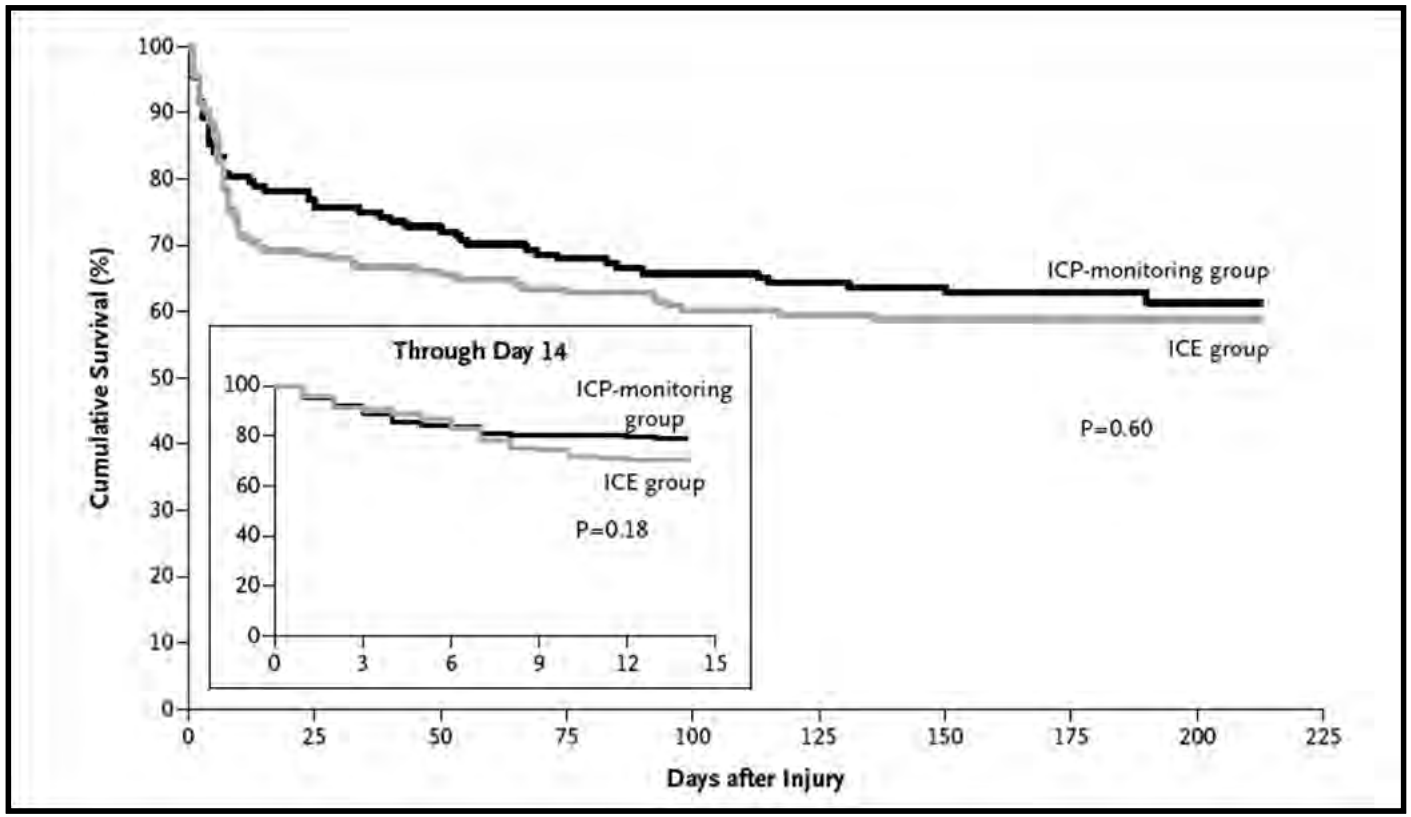
Intracranial pressure monitoring in severe head injury: compliance with Brain Trauma Foundation guidelines and effect on outcomes: a prospective study

J Neurosurg / August 23, 2013

- 216 TC graves
- Suivi des recommandations pour monitorage de la PIC **46,8%**
- Paris, 2008, TC grave (B Vigué)
  - **49%** sans PIC

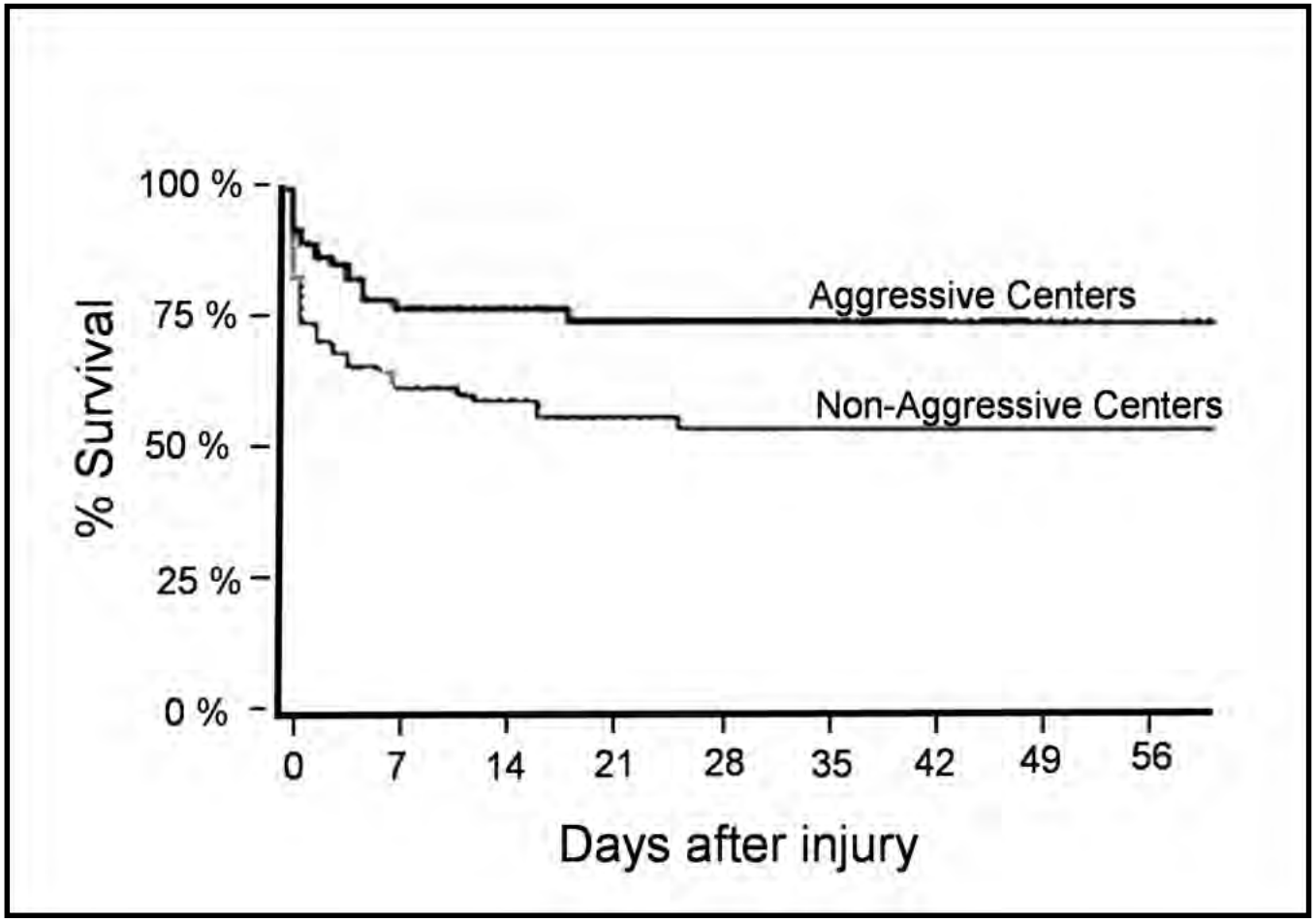
A Trial of Intracranial-Pressure Monitoring in Traumatic Brain Injury

Randall M. Chesnut, M.D., Nancy Temkin, Ph.D., Nancy Carney, Ph.D., Sureyya Dikmen, Ph.D., Carlos Rondina, M.D., Walter Videtta, M.D., Gustavo Petroni, M.D., Silvia Lujan, M.D., Jim Pridgeon, M.H.A., Jason Barber, M.S., Joan Machamer, M.A., Kelley Chaddock, B.A., Juanita M. Celix, M.D., Marianna Cherner, Ph.D., and Terence Hendrix, B.A.



N Engl J Med 2012;367:2471-81.

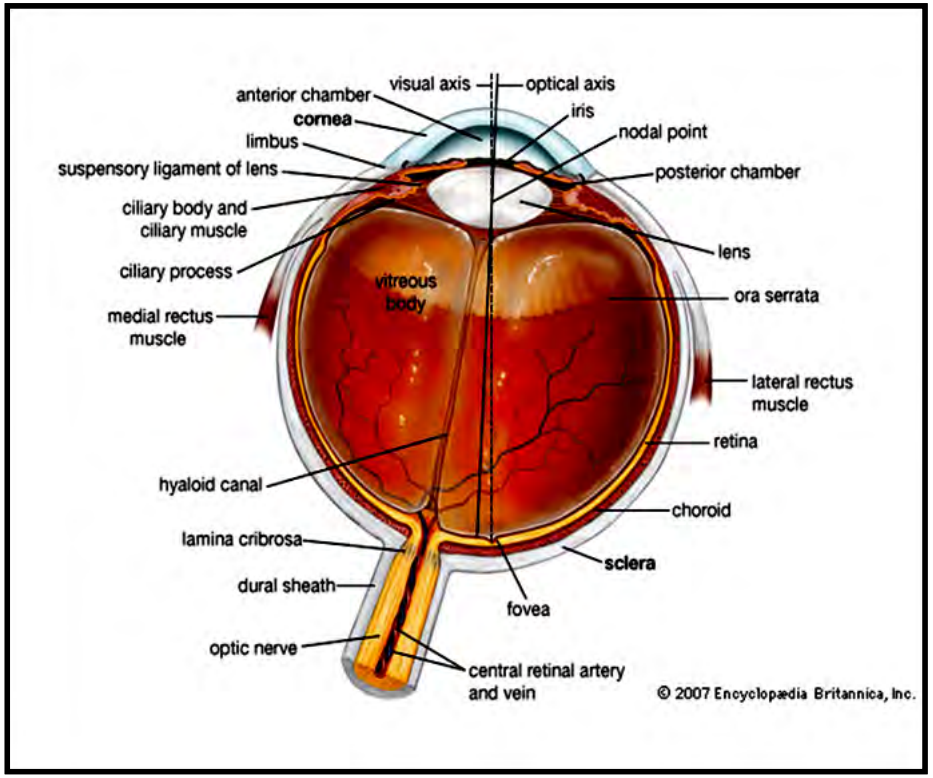
Le monitorage de la PIC améliore le pronostic !

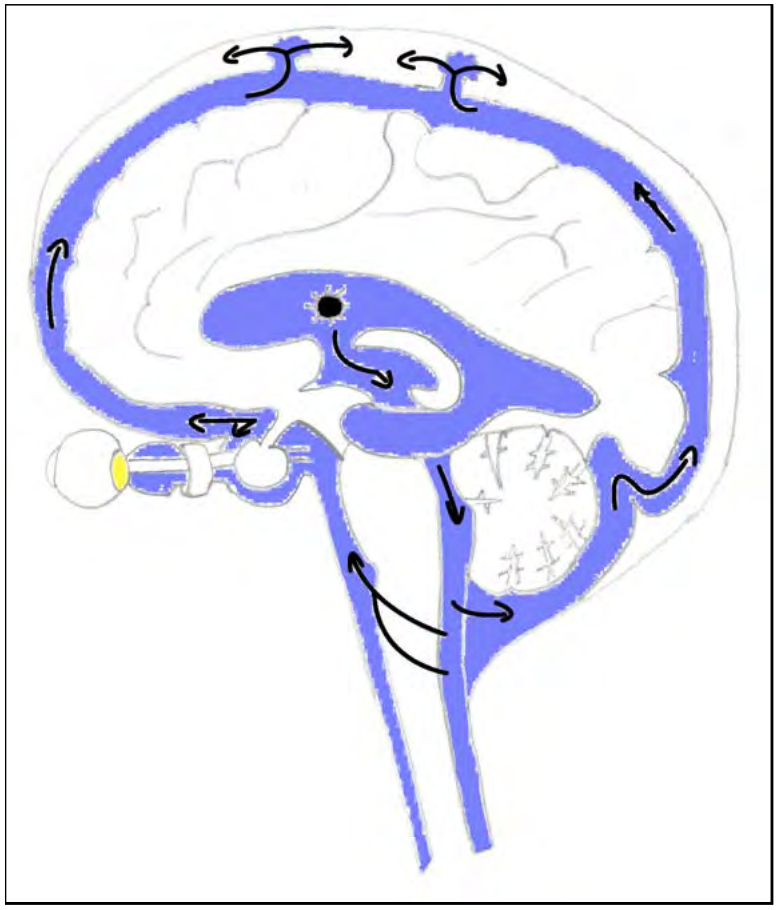


Bulger EM, *Crit Care Med*, 2002

Peut-on mesurer la PIC sans capteur ?

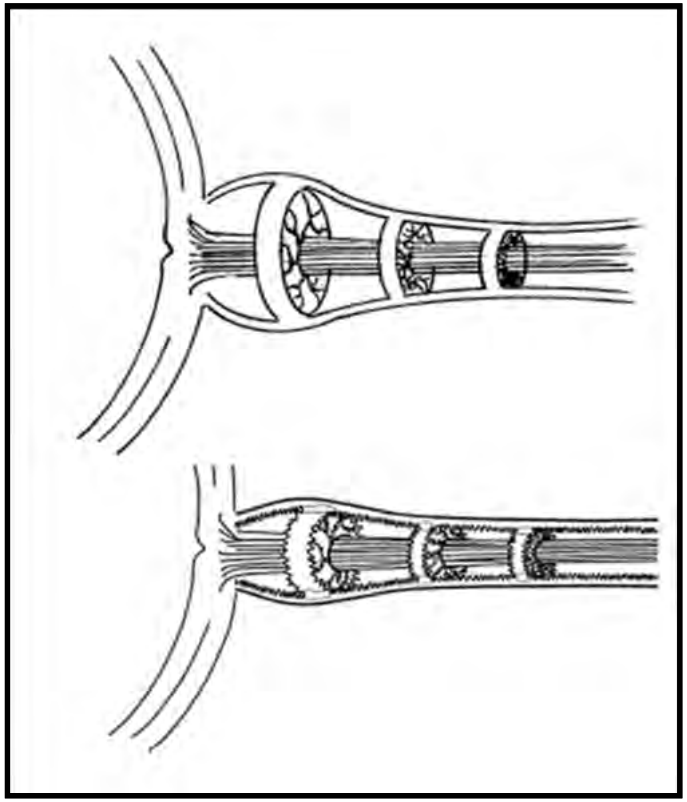
Enveloppe du nerf optique





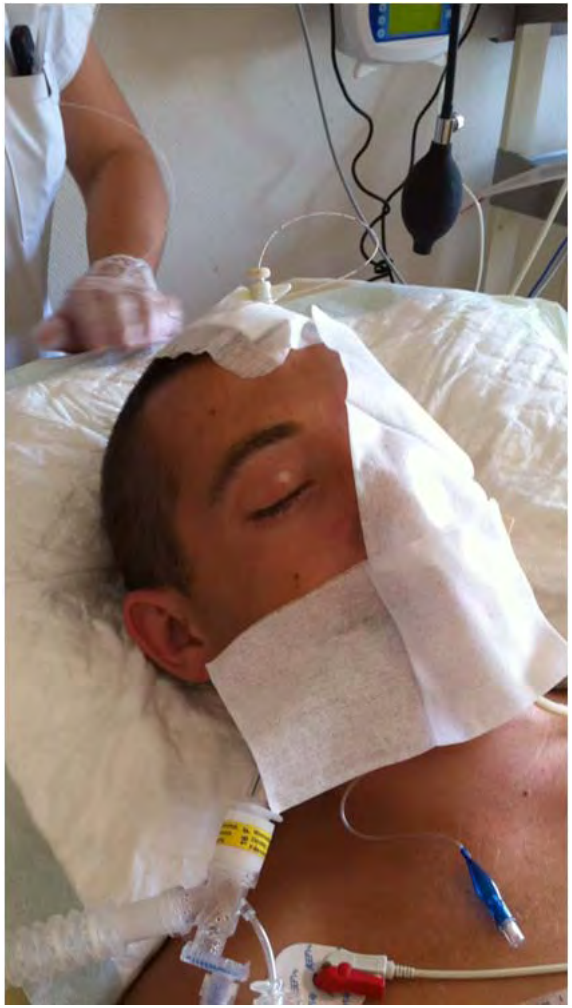
Dependence of the optic nerve sheath diameter on acutely applied subarachnoidal pressure – an experimental ultrasound study

Hans-Christian Hansen,[1] Wolf Lagrèze,[2] Oswald Krueger[3] and Knut Helmke[4]



Acta Ophthalmologica 2011

Echographie oculaire

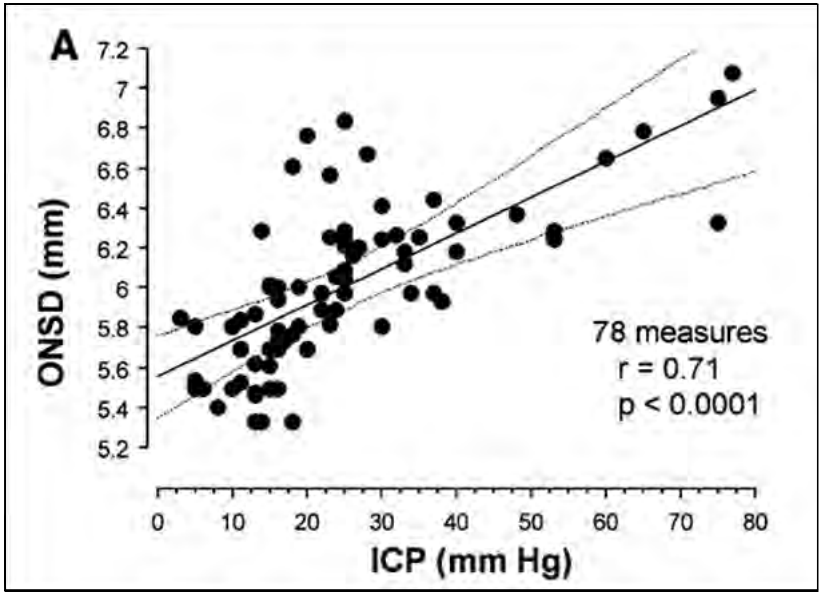


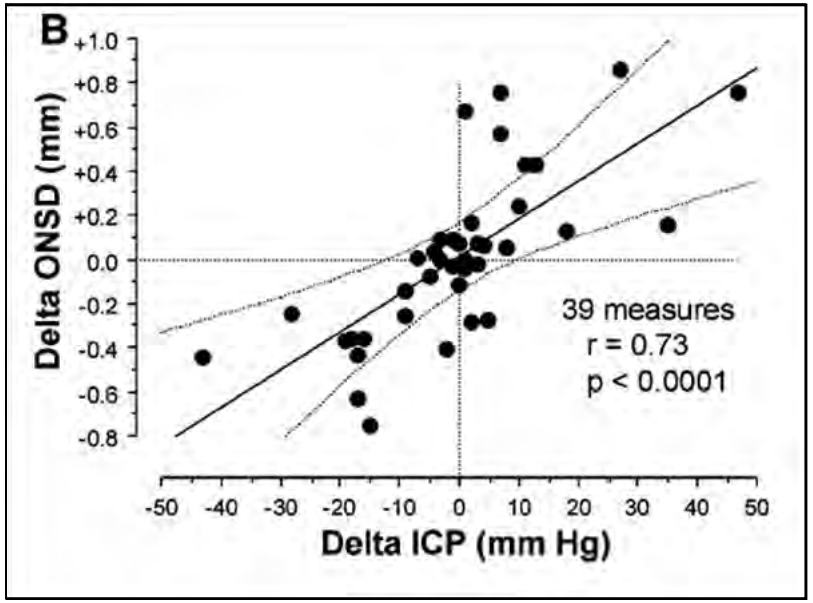
Intensive Care Med
DOI 10.1007/s00134-008-1149-x

ORIGINAL

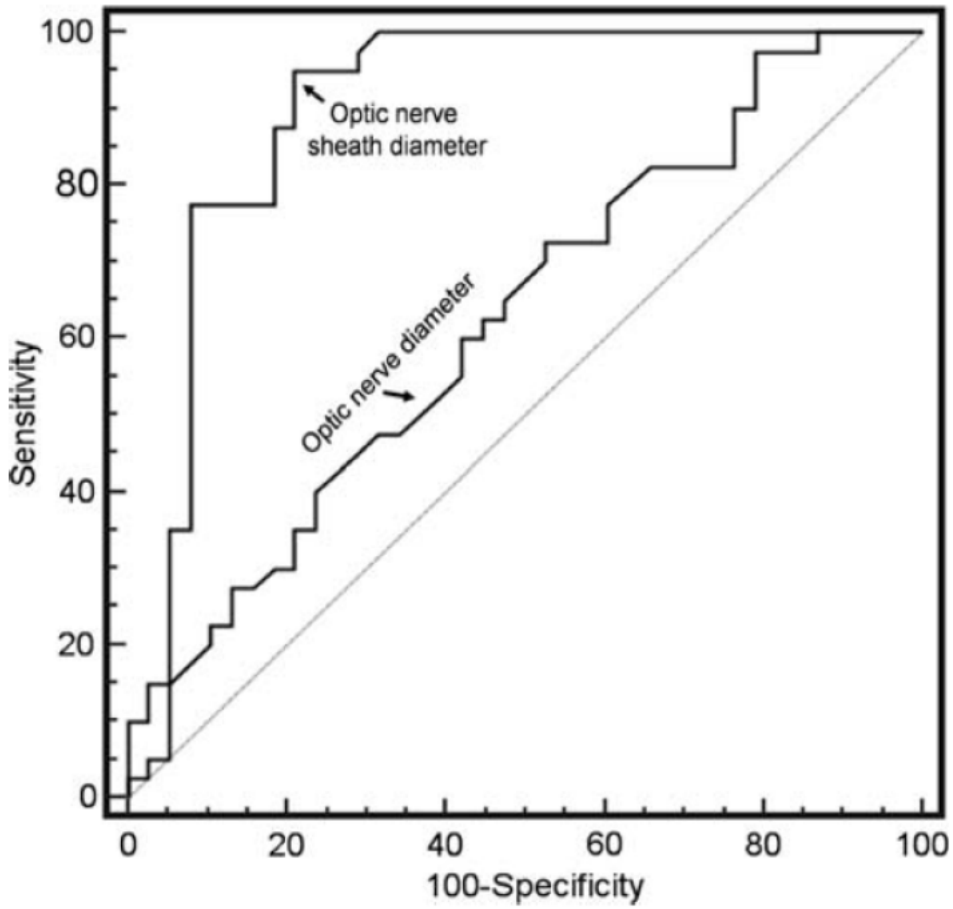
Thomas Geeraerts
Sybille Merceron
Dan Benhamou
Bernard Vigué
Jacques Duranteau

Non-invasive assessment of intracranial pressure using ocular sonography in neurocritical care patients





Courbe ROC pour PIC > 20 mmHg

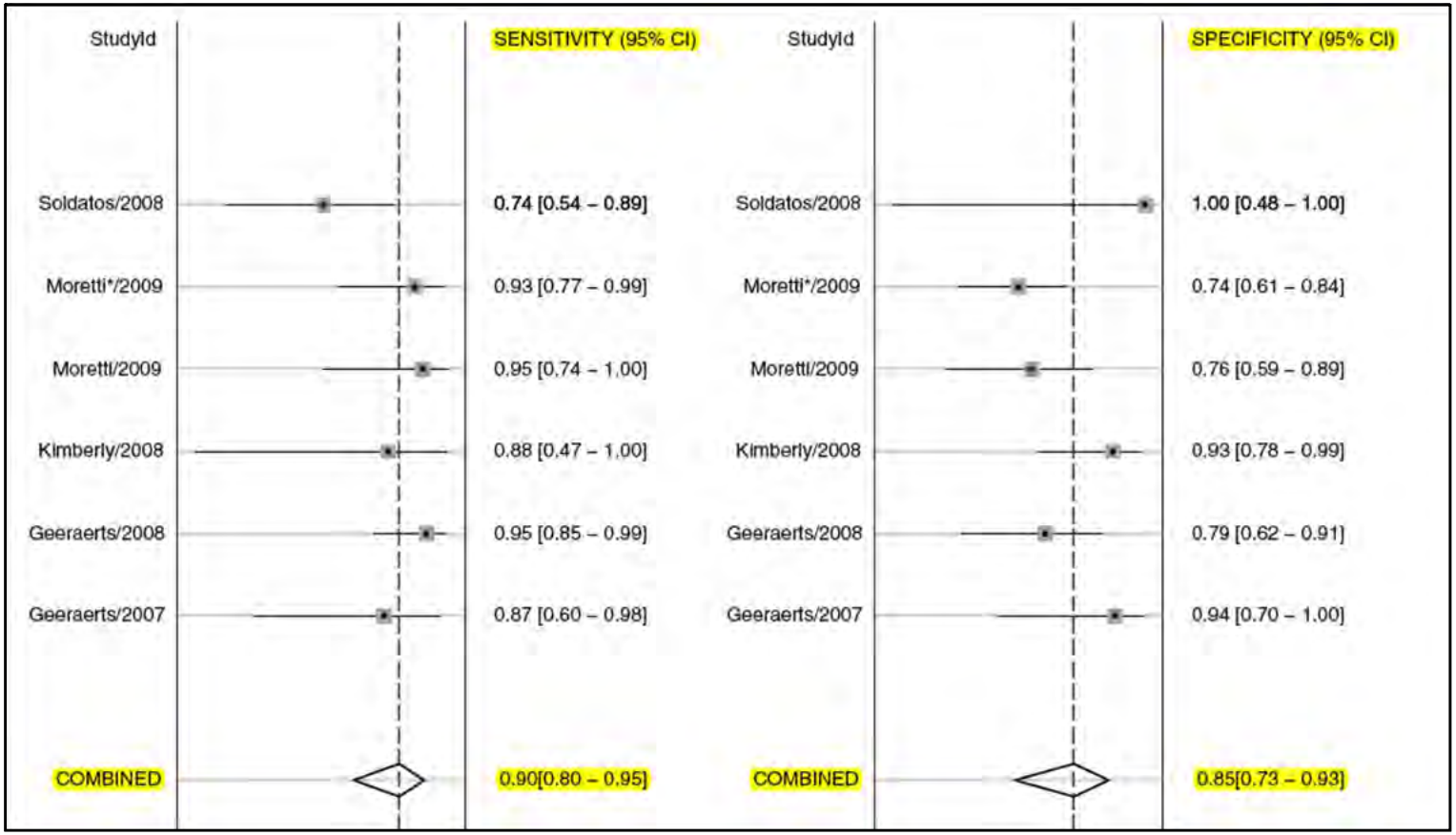


Intensive Care Med
DOI 10.1007/s00134-011-2224-2

REVIEW

Julie Dubourg
Etienne Javouhey
Thomas Geeraerts
Mahmoud Messerer
Behrouz Kassai

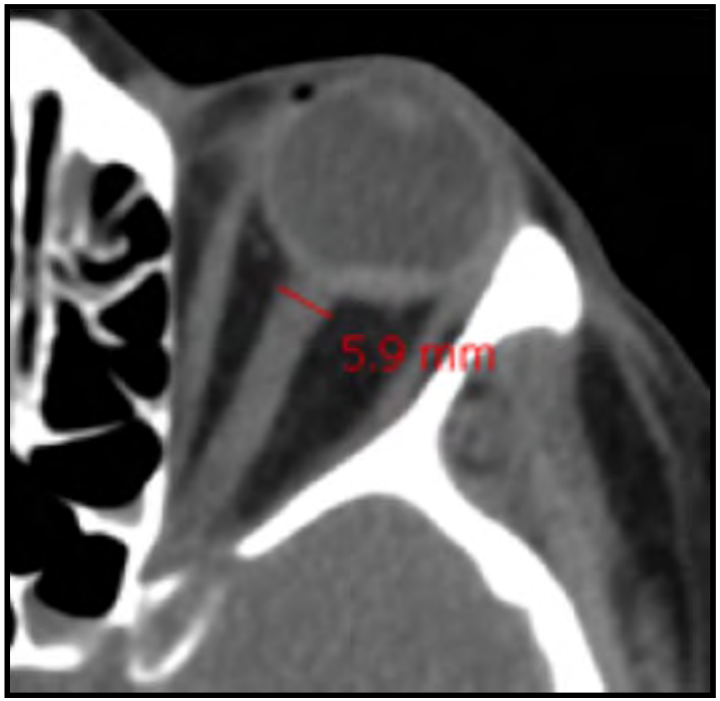
Ultrasonography of optic nerve sheath diameter for detection of raised intracranial pressure: a systematic review and meta-analysis

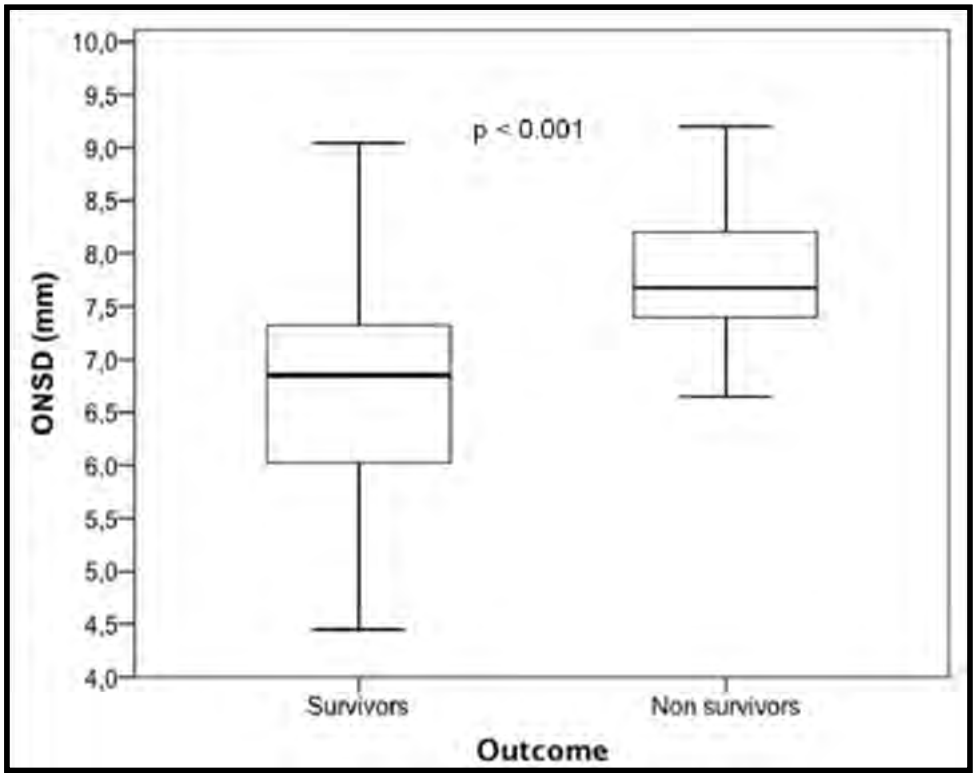


Estimation of optic nerve sheath diameter on an initial brain computed tomography scan can contribute prognostic information in traumatic brain injury patients

Aurélien Legrand[1], Patrick Jeanjean[1], Fanny Delanghe[1], Johann Peltier[2], Benoit Lecat[1] and Hervé Dupont[1,3*]

CRITICAL CARE





Critical Care 2013, **17**:R61

Guidelines for the Management of Severe Traumatic Brain Injury

3rd Edition

A. Level I

There are insufficient data to support a Level I recommendation for this topic.

B. Level II

Blood pressure should be monitored and hypotension (systolic blood pressure < 90 mm Hg) avoided.

Journal of Neurotrauma

(ISSN: 0897-7151)

VOLUME 24 SUPPLEMENT 1 2007

Redefining hypotension in traumatic brain injury

Cherisse Berry, Eric J. Ley, Marko Bukur, Darren Malinoski, Daniel R. Margulies, James Mirocha, Ali Salim *

Age (years)	SBP cut-off (mmHg)		Mortality rate below SBP cut-off
5–49 (n = 10,284)			
	<60	admission SBP	9/24 (37.5%)
	<70		34/47 (47.9%)
	<80		62/150 (41.3%)
	<90		120/333 (36.0%)
	<100		179/618 (29.0%)
	<110		**258/1205 (21.4%)**
	<120		361/2375 (15.2%)
	<130		484/4070 (11.9%)
	<140		624/6062 (10.3%)
	<150		759/7744 (9.8%)

Injury, Int. J. Care Injured 43 (2012) 1833–1837

Guidelines for the Management of Severe Traumatic Brain Injury

3rd Edition

B. Level II

Aggressive attempts to maintain cerebral perfusion pressure (CPP) above 70 mm Hg with fluids and pressors should be avoided because of the risk of adult respiratory distress syndrome (ARDS).

C. Level III

CPP of <50 mm Hg should be avoided.

The CPP value to target lies within the range of 50–70 mm Hg. Patients with intact pressure autoregulation tolerate higher CPP values.

Journal of Neurotrauma

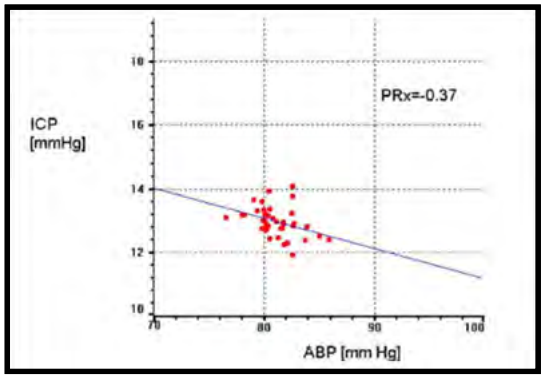
(ISSN: 0897-7151)

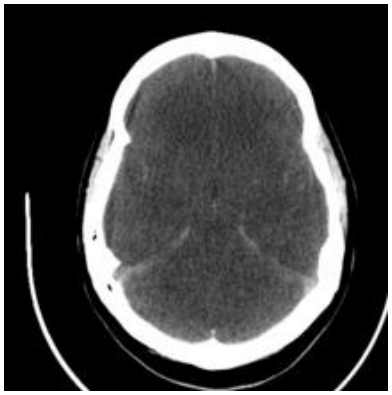
VOLUME 24 SUPPLEMENT 1 2007

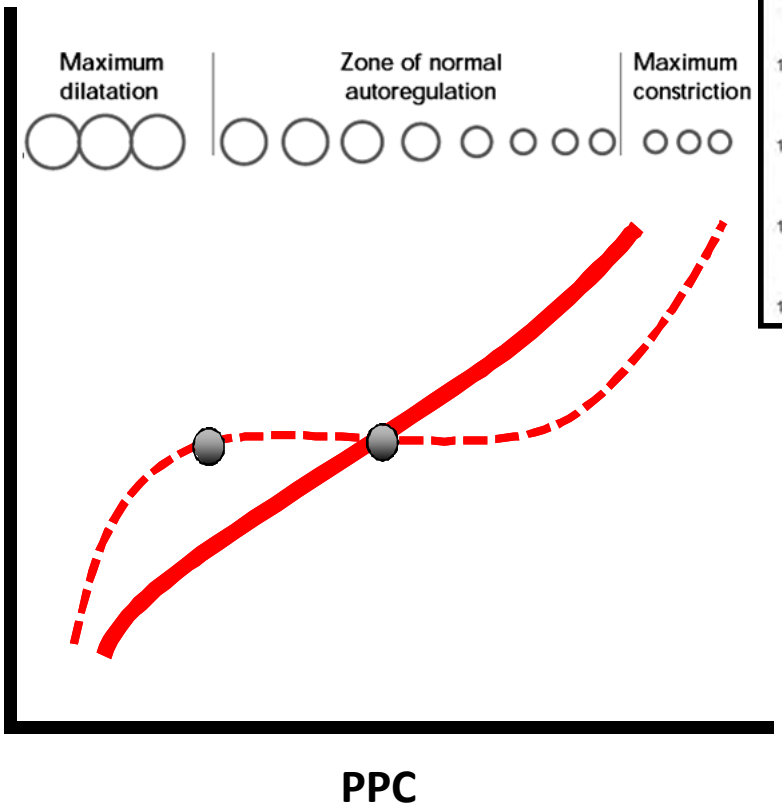
La PIC ou la PPC
ce n’est pas qu’un chiffre

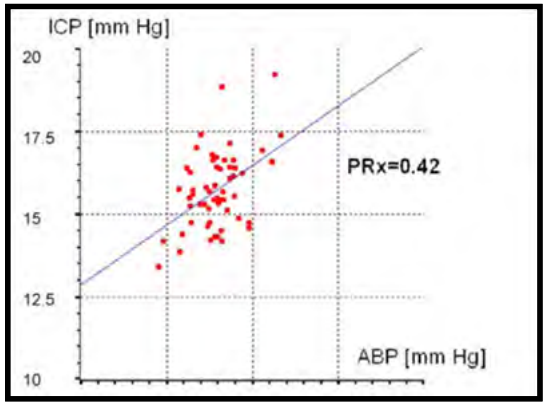
C ’est aussi un paramètre dynamique

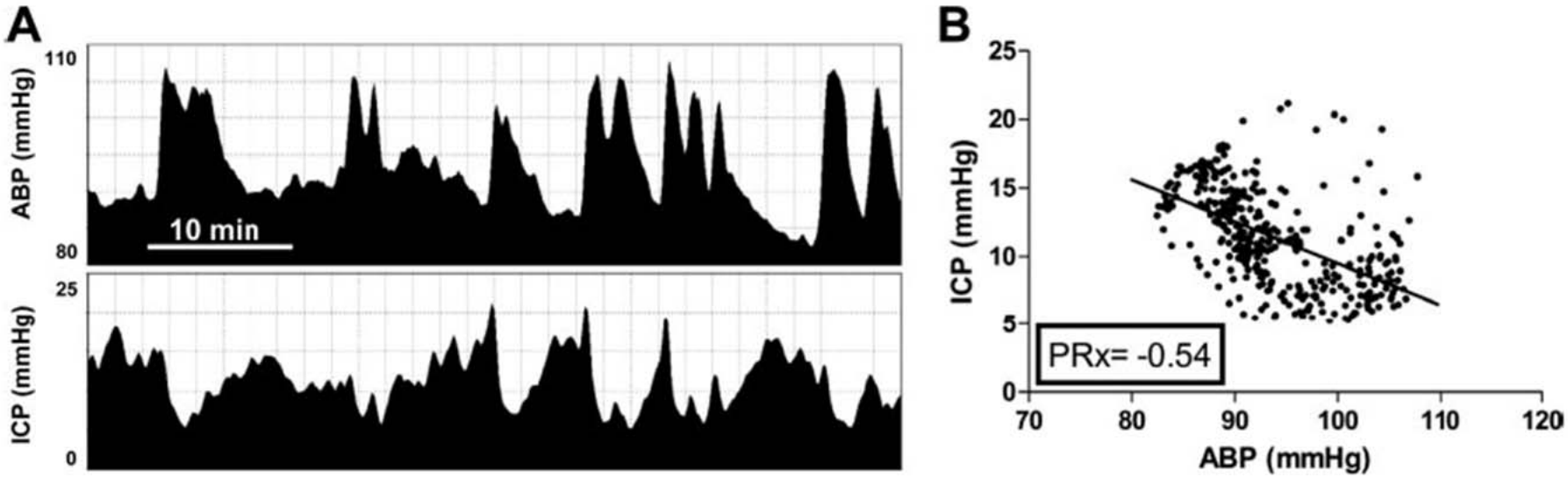
Mesure dynamique de la réactivité pour la pression

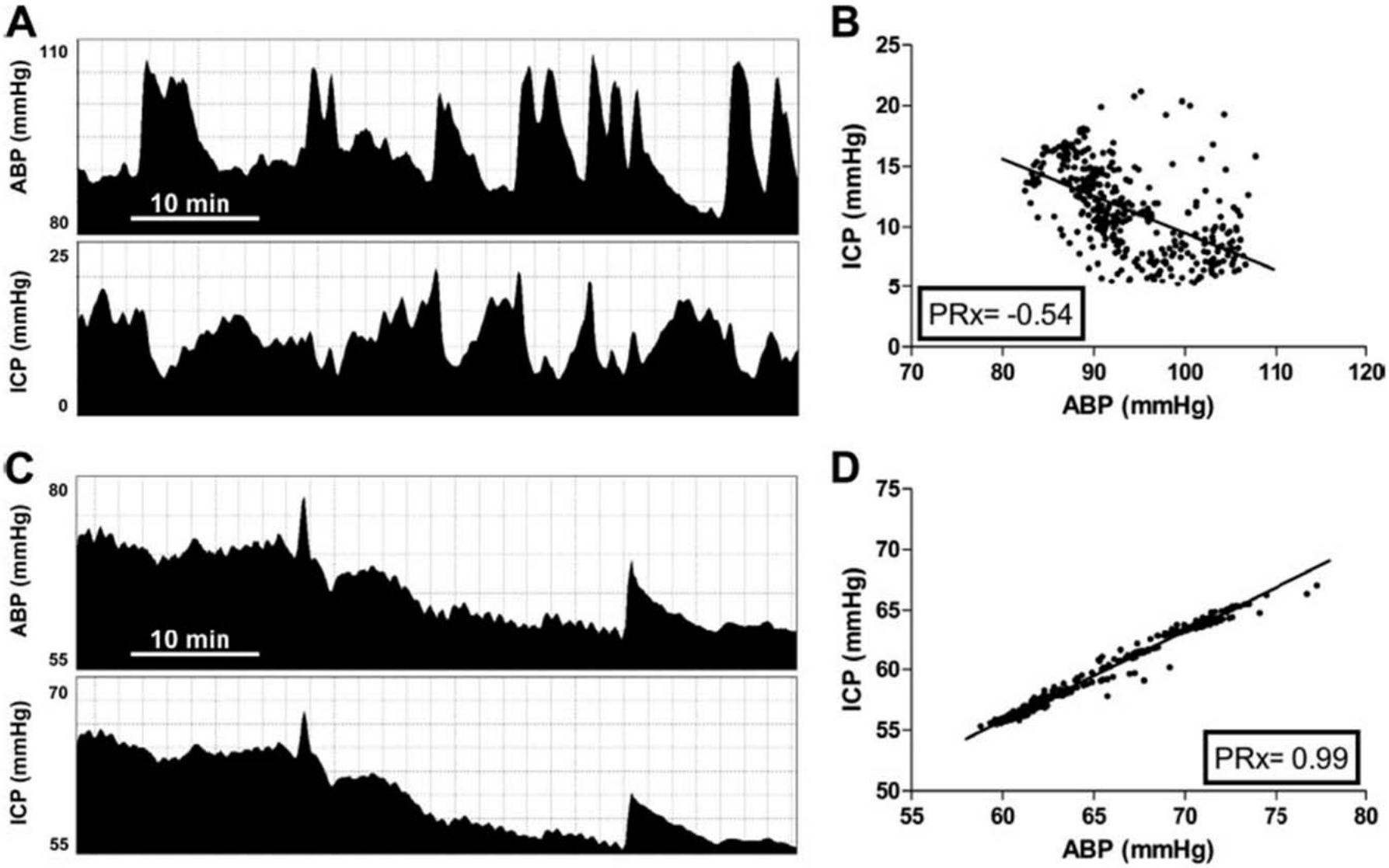






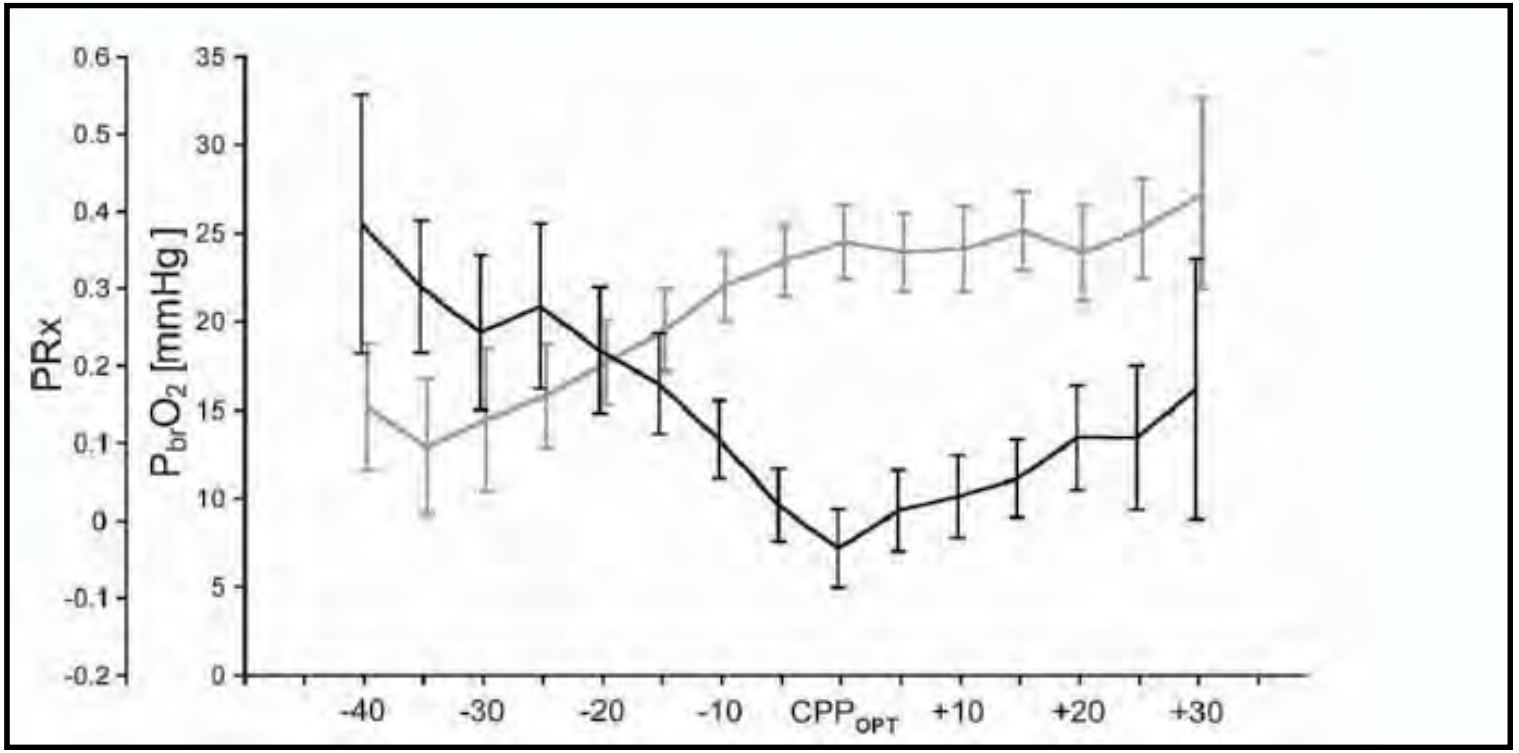



A
ABP (mmHg)
110
80
10 min
ICP (mmHg)
25
0
B
ICP (mmHg)
25
20
15
10
5
0
PRx= -0.54
70
80
90
100
110
120
ABP (mmHg)


A
ABP (mmHg)
110
80
10 min
ICP (mmHg)
25
0
B
ICP (mmHg)
25
20
15
10
5
0
PRx= -0.54
70
80
90
100
110
120
ABP (mmHg)
C
ABP (mmHg)
80
55
10 min
ICP (mmHg)
70
55
D
ICP (mmHg)
75
70
65
60
55
50
PRx= 0.99
55
60
65
70
75
80
ABP (mmHg)

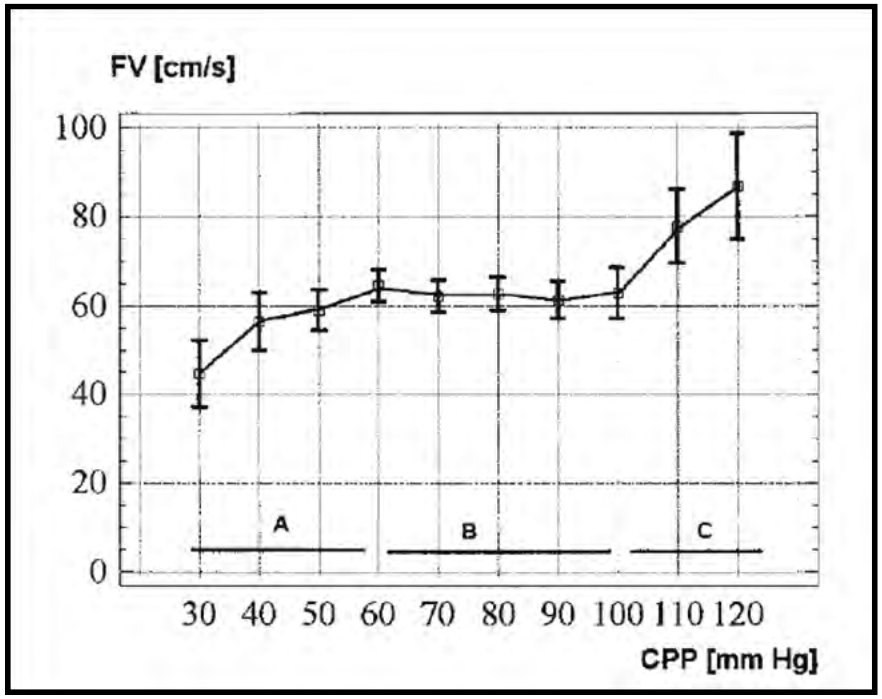
Effects of cerebrovascular pressure reactivity-guided optimization of cerebral perfusion pressure on brain tissue oxygenation after traumatic brain injury*

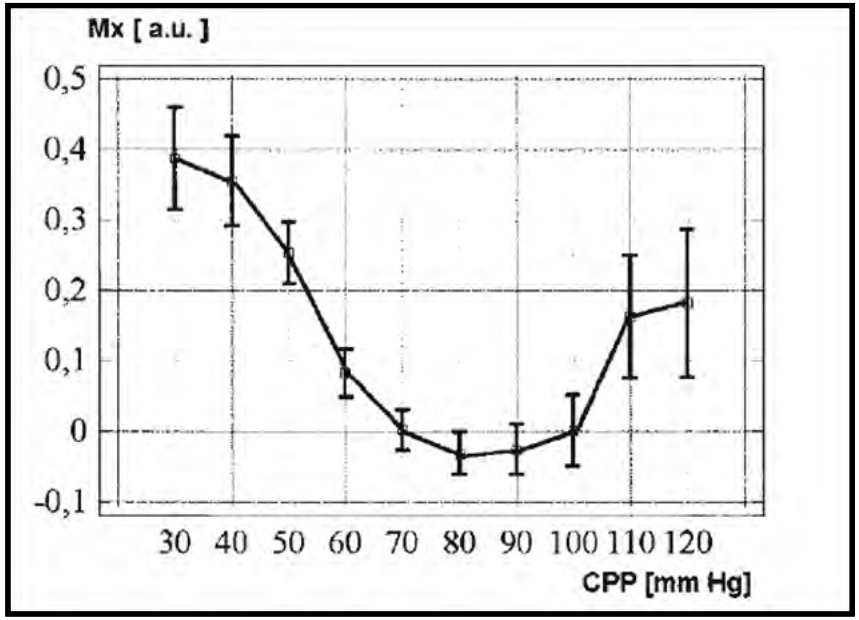
Matthias Jaeger, MD; Markus Dengl, MD; Jürgen Meixensberger, MD, PhD;
Martin U. Schuhmann, MD, PhD



Cerebral autoregulation following head injury

MAREK CZOSNYKA, PH.D., PIOTR SMIELEWSKI, PH.D., STEFAN PIECHNIK, PH.D., LUZIUS A. STEINER, M.D., AND JOHN D. PICKARD, M.CHIR., F.MED.SCI.





J Neurosurg 95:756–763, 2001

Comment dépister les PPC trop basses ?

Celles qui entrainent une ischémie cérébrale

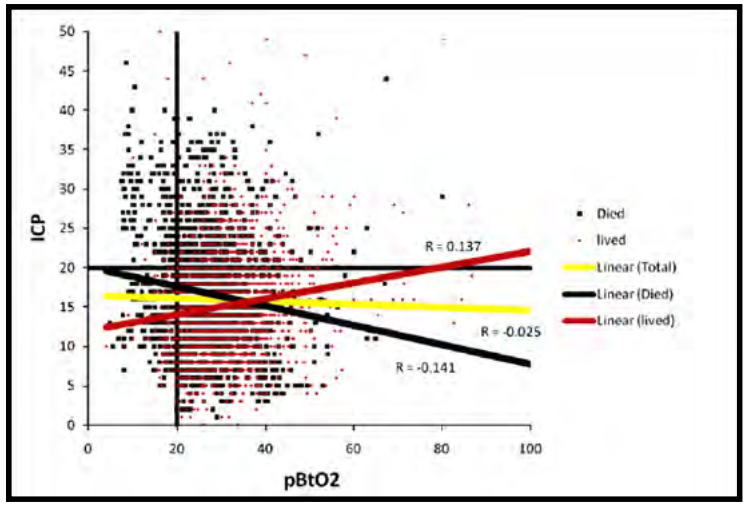
$PtiO_2$

- Évalue l'adéquation entre apports et besoins en oxygène

Photos: brochure commerciale

Cerebral perfusion pressure and intracranial pressure are not surrogates for brain tissue oxygenation in traumatic brain injury ☆

Evert A. Eriksson [a,*], Jeffrey F. Barletta [b], Bryan E. Figueroa [c], Bruce W. Bonnell [d], Wayne E. Vanderkolk [e], Karen J. McAllen [f], Mickey M. Ott [g]



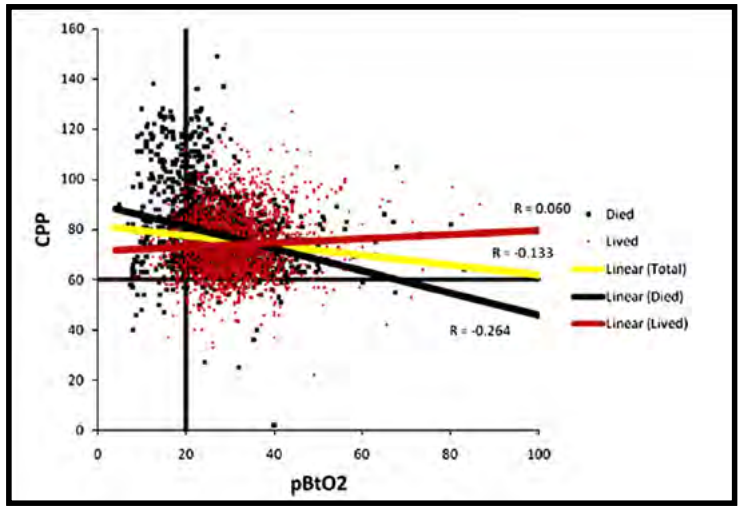


Table 5
Physiologic parameters occurring during normoxic ($pBtO_2 \geqslant 20$ mmHg) and hypoxic ($pBtO_2 < 20$ mmHg).

	Mean	Standard deviation	*p*
Intracranial pressure			
Normoxic	15.6	6.7	<0.001
Hypoxic	18.4	8.6	
Cerebal perfusion pressure			
Normoxic	75.2	12.4	<0.001
Hypoxic	81.7	19.0	
Mean arterial pressure			
Normoxic	90.9	12.7	<0.001
Hypoxic	100.1	17.7	

Clinical Neurophysiology 123 (2012) 1255–1260

Même si on réanime correctement

- PPC > 60 mmHg
- Agressions cérébrales contrôlées
- Il peut persister des épisodes d'hypoxie cérébrale
- 10 à 20% des cas…
- Non détectées par PIC/PPC

Reduced mortality rate in patients with severe traumatic brain injury treated with brain tissue oxygen monitoring

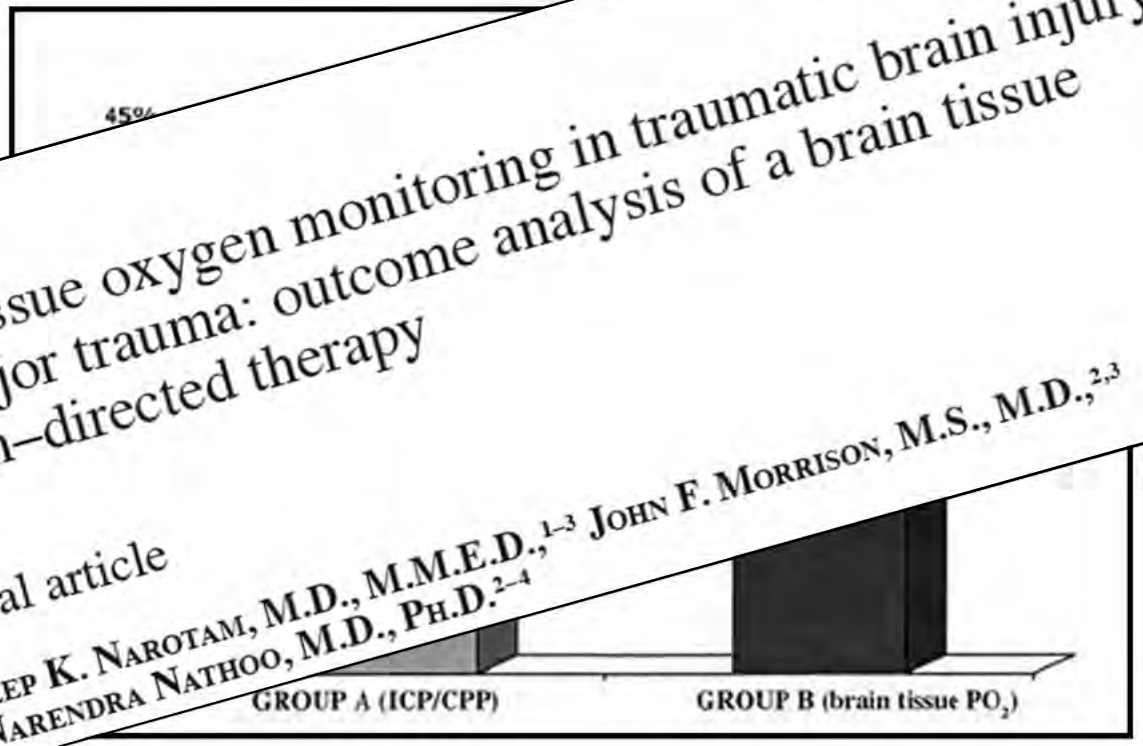
MICHAEL F. STIEFEL, M.D., PH.D., ALEJANDRO SPIOTTA, M.D., VINCENT H. GRACIAS, M.D., ALICIA M. GARUFFE, M.S.N., OSCAR GUILLAMONDEGUI, M.D., EILEEN MALONEY-WILENSKY, M.S.N., STEPHANIE BLOOM, M.S.N., M. SEAN GRA[illegible]D., AND PETER D. LEROUX, M.D.

J Neurosurg 111:672–682, 2009

Brain tissue oxygen monitoring in traumatic brain injury and major trauma: outcome analysis of a brain tissue oxygen–directed therapy

Clinical article

PRADEEP K. NAROTAM, M.D., M.M.E.D.,[1–3] JOHN F. MORRISON, M.S., M.D.,[2,3] AND NARENDRA NATHOO, M.D., PH.D.[2–4]



J Neurosurg 103:805–811, 2005

Le dogme du sérum salé 0,9%

PRISE EN CHARGE DES TRAUMATISÉS CRÂNIENS GRAVES À LA PHASE PRÉCOCE

RECOMMANDATIONS POUR LA PRATIQUE CLINIQUE

TEXTE DES RECOMMANDATIONS

Janvier 1998

Les solutés à utiliser sont (grade B) :

- soluté vecteur : sérum salé isotonique à 0,9 % ;
- soluté de remplissage vasculaire : sérum salé isotonique à 0,9 % ou colloïdes isotoniques ;
- en excluant tout soluté hypotonique (soluté glucosé, Ringer lactate) ;

Association Between a Chloride-Liberal vs Chloride-Restrictive Intravenous Fluid Administration Strategy and Kidney Injury in Critically Ill Adults

Table 3. Incidence of Acute Kidney Injury Stratified by Risk, Injury, Failure, Loss, and End-Stage (RIFLE) Serum Creatinine Criteria

	No. (%) [95% CI] of Patients[a]		
	Control Period (n = 760)	Intervention Period (n = 773)	*P* Value
RIFLE class			
Risk	71 (9.0) [7.2-11.0]	57 (7.4) [5.5-9.0]	.16
Injury	48 (6.3) [4.5-8.1]	23 (3.0) [1.8-4.2]	.002
Failure	57 (7.5) [5.6-9.0]	42 (5.4) [3.8-7.1]	.10
Injury and failure	105 (14) [11-16]	65 (8.4) [6.4-10.0]	<.001

[a] The control period was from February 18 through August 17, 2008, and the intervention period was from February 18 through August 17, 2009.

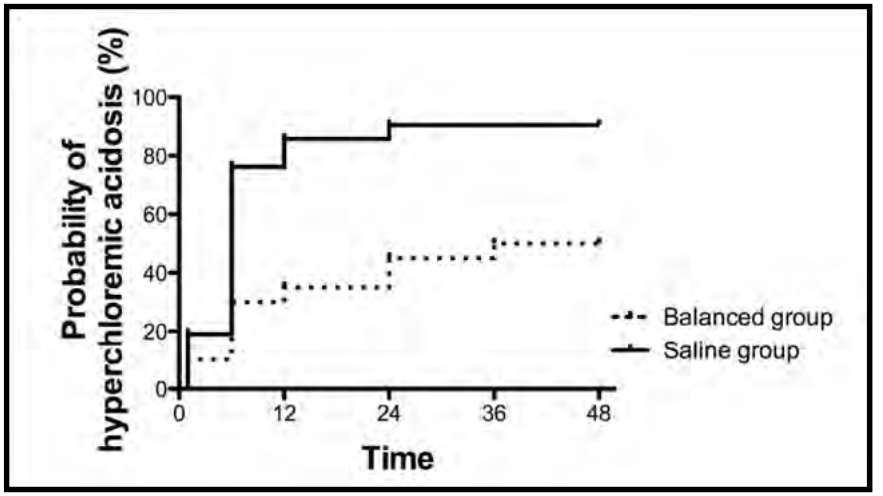
JAMA. 2012;308(15):1566-1572

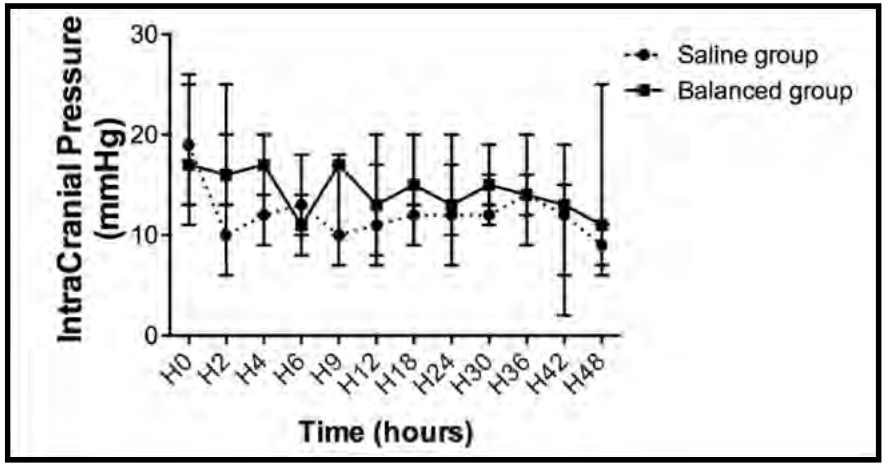
Balanced versus chloride-rich solutions for fluid resuscitation in brain-injured patients: a randomized double-blind pilot study

Critical Care 2013, **17**:R77 doi:10.1186/cc12686

Antoine Roquilly
Olivier Loutrel
Raphael Cinotti
Elise Rosenczweig
Laurent Flet
Pierre Joachim Mahe
Romain Dumont
Anne Marie Chupin
Catherine Peneaux
Corinne Lejus
Yvonnick Blanloeil
Christelle Volteau
Karim Asehnoune

	Saline group	Balanced group
Crystalloid solutions	**0.9% saline solution**	**Isofundine ®**
Sodium - *mmol/l*	153	140
Potassium - *mmol/l*	0	4.0
Calcium - *mmol/l*	0	2.5
Magnesium - *mmol/l*	0	1.0
Chloride - *mmol/l*	153	127
Acetate - *mmol/l*	0	24
Malate - *mmol/l*	0	5.0
pH	4-7	4.6-5.4
Theoretical osmolarity - *mOsmol/l*	306	304
Acide titre	< 2	< 2
Hydroxyethyl starch solutions	**HEAfusine ®**	**Tetraspan ®**
Poly(O-2-hydroxyethyl) starch- *g/l*	60.0	60.0
Molar substitution	0.5	0.42
Average molecular weight - *Da*	200.000	130.000
Sodium - *mmol/l*	153	140
Potassium - *mmol/l*	0	4.0
Calcium - *mmol/l*	0	2.5
Magnesium - *mmol/l*	0	1.0
Chloride - *mmol/l*	153	118
Acetate - *mmol/l*	0	24
Malate - *mmol/l*	0	5.0
pH	4-7	5.6□6.4
Theoretical osmolarity - *mOsmol/l*	310	296
Acide titre	< 2	< 2





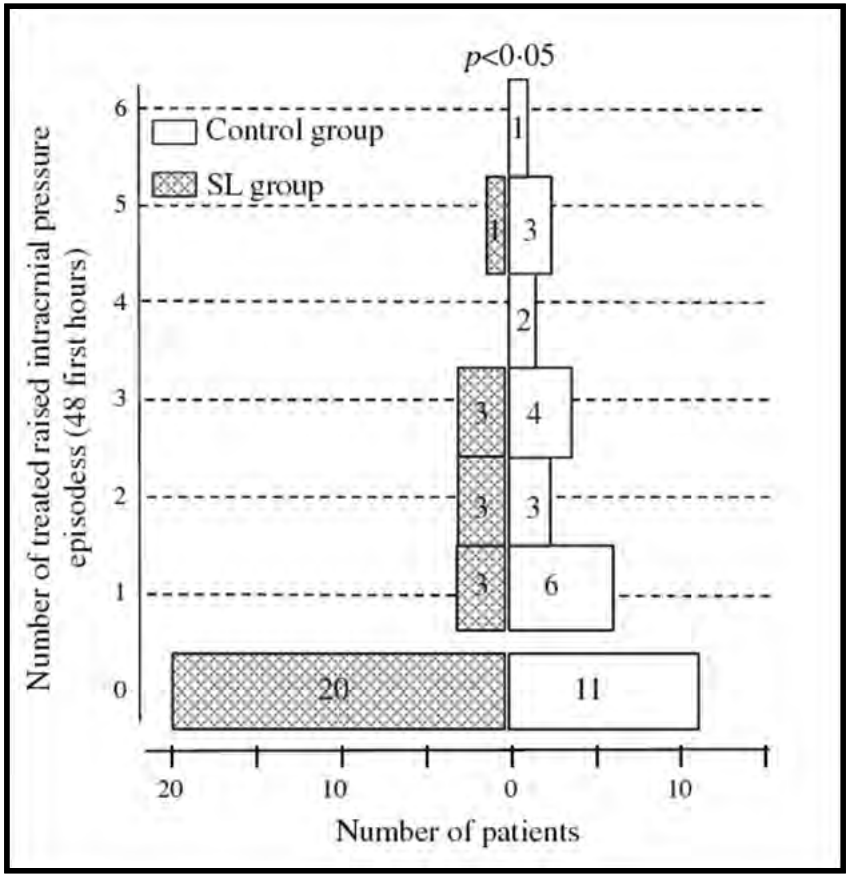
Intensive Care Med (2013) 39:1413–1422
DOI 10.1007/s00134-013-2978-9

ORIGINAL

Carole Ichai
Jean-François Payen
Jean-Christophe Orban
Hervé Quintard
Hubert Roth
Robin Legrand
Gilles Francony
Xavier M. Leverve

Half-molar sodium lactate infusion to prevent intracranial hypertensive episodes in severe traumatic brain injured patients: a randomized controlled trial

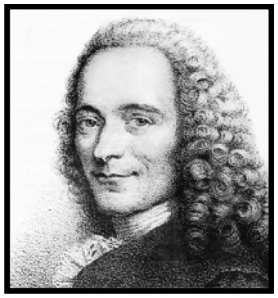
ods: This was a double-blind, randomized controlled trial including 60 patients with severe TBI requiring ICP monitoring. Patients were randomly allocated to receive a 48-h continuous infusion at 0.5 ml/kg/h of either SL (SL group) or isotonic saline solution (control group) within the first 12 h post-trauma. Serial mea-



Les nouveautés…

- Vers une individualisation des traitements
  - PIC
  - PPC
  - Indice d'autorégulation
- Mesure de l'oxygénation cérébrale
- Solutés pauvres en chlore
- Neuroprotection (études en cours)
  - Progestérone
  - EPO

Voltaire (1694-1778)



« ***L'art de la médecine*** *consiste à distraire le malade pendant que la nature le guérit* »

Je vous remercie de votre attention

geeraerts.t@chu-toulouse.fr

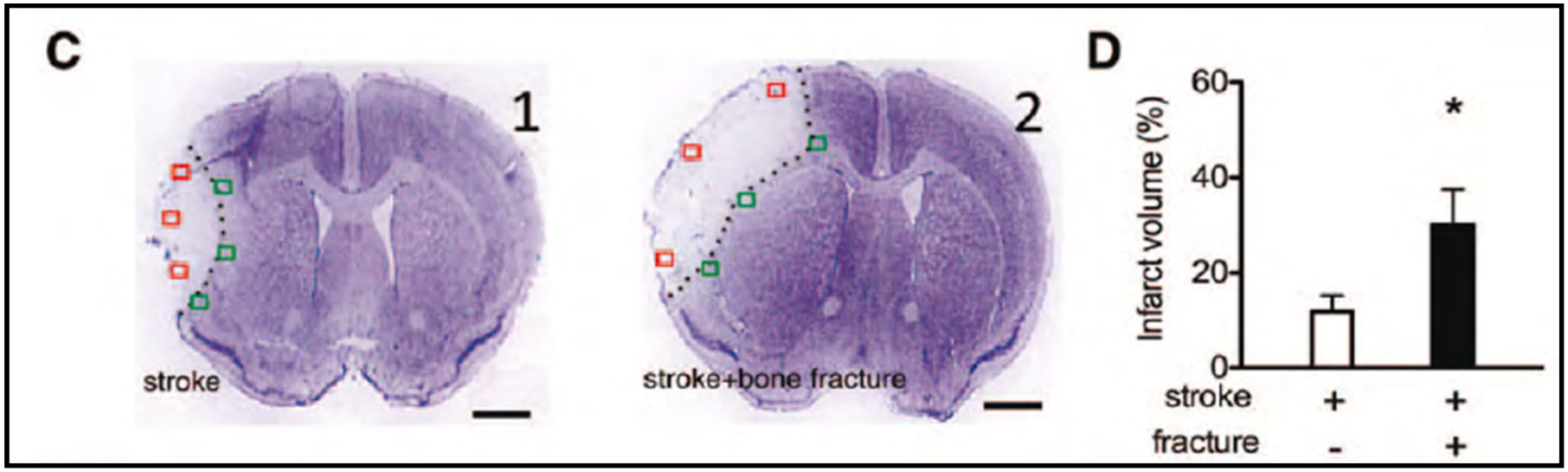
Et le fémur

Le délai

La méthode

Bone Fracture Exacerbates Murine Ischemic Cerebral Injury

Vincent Degos, M.D., Ph.D.,* Mervyn Maze, M.B., Ch.B.,† Susana Vacas, M.D.,‡ Jan Hirsch, M.D.,§
Yi Guo, M.D.,‖ Fanxia Shen, M.D.,# Kristine Jun, B.S.,# Nico van Rooijen, Ph.D.,**
Pierre Gressens, M.D., Ph.D.,†† William L. Young, M.D.,‡‡ Hua Su, M.D.§§



Anesthesiology 2013; 118:1362-72

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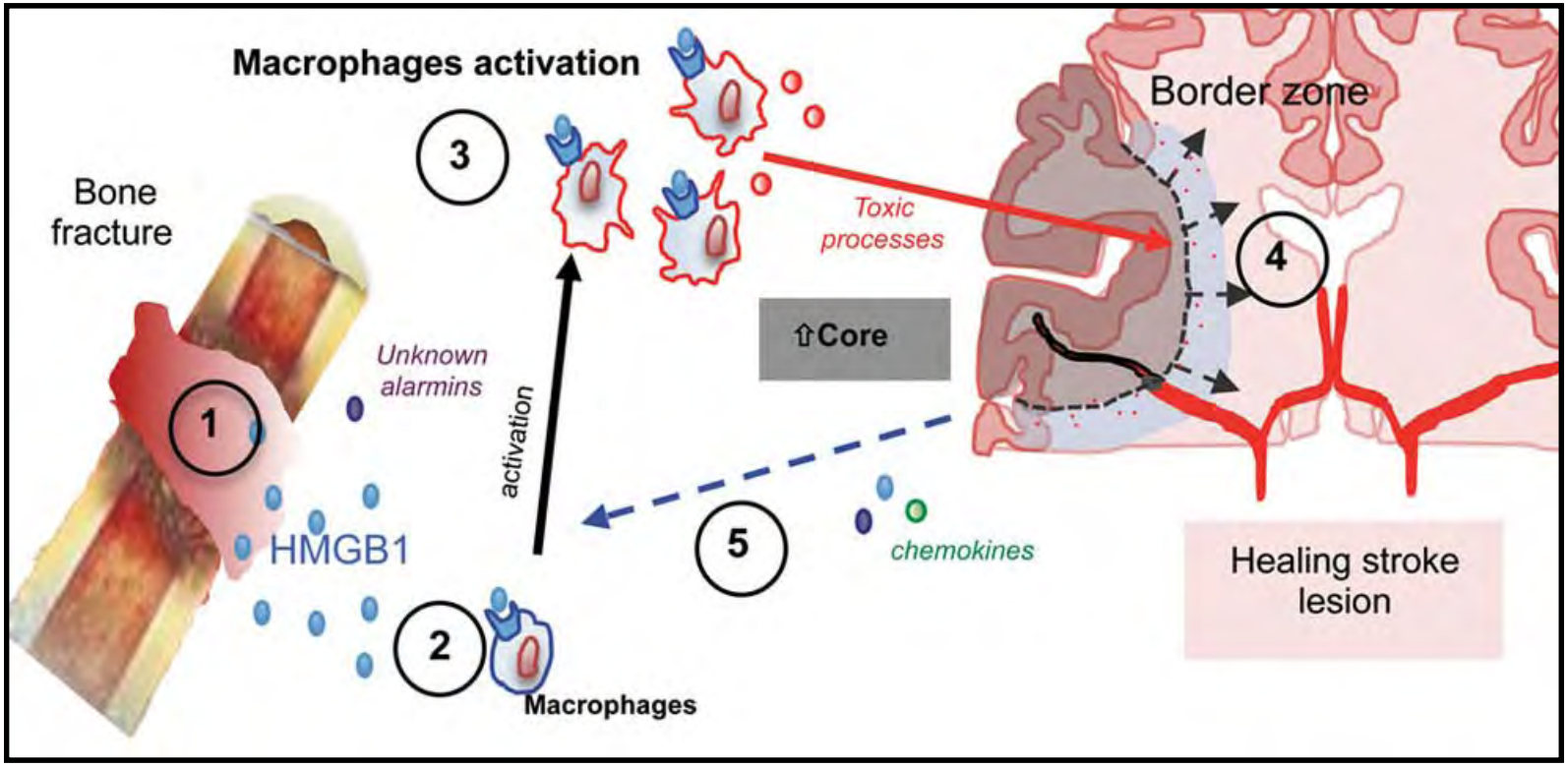

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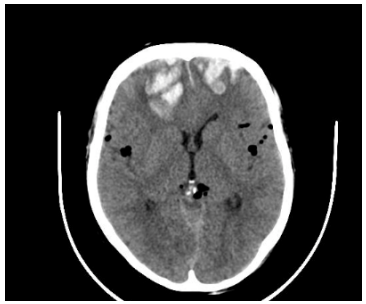
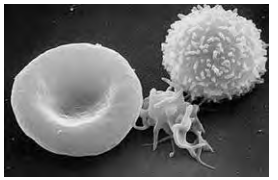
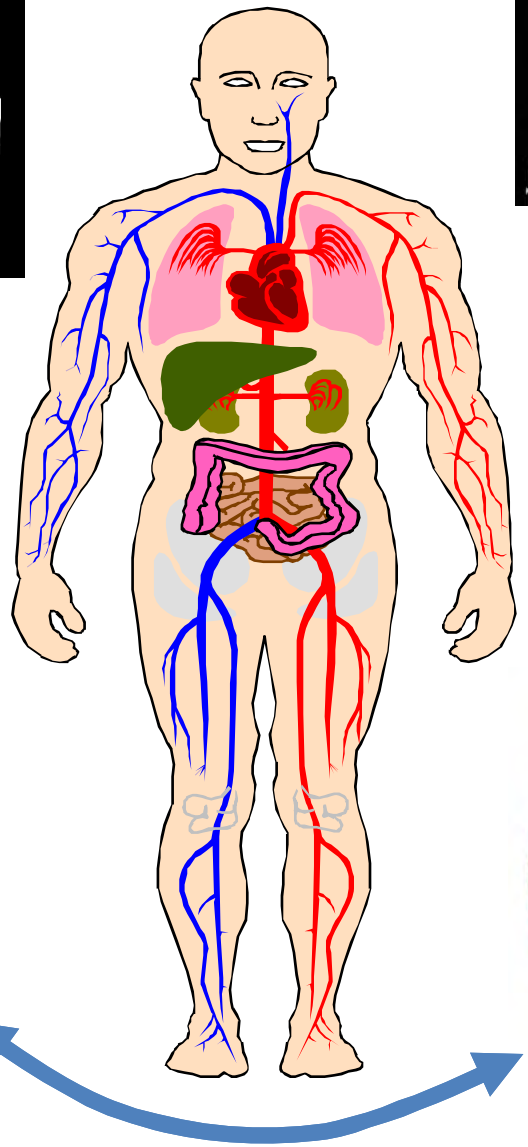
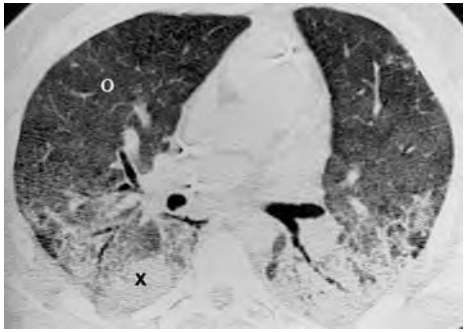
- Contusion
- Lésions axonales diffuses
- Ischémie cérébrale
- Neuro-inflammation



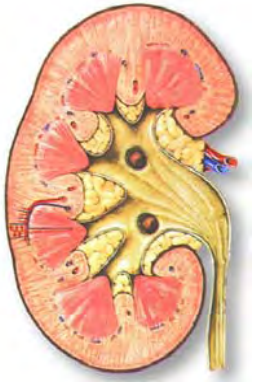


First hit



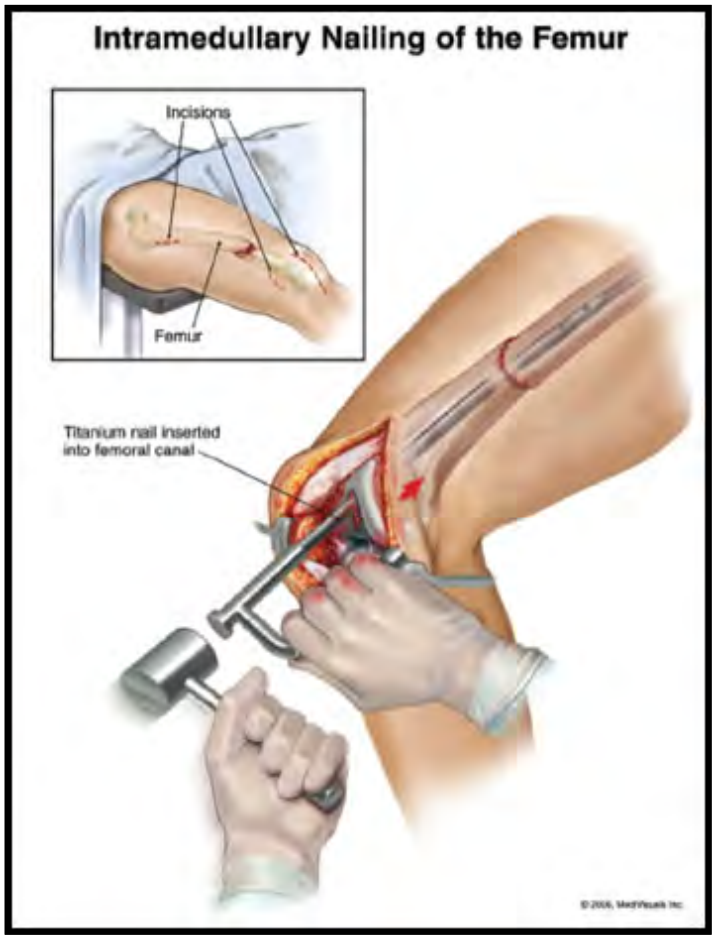


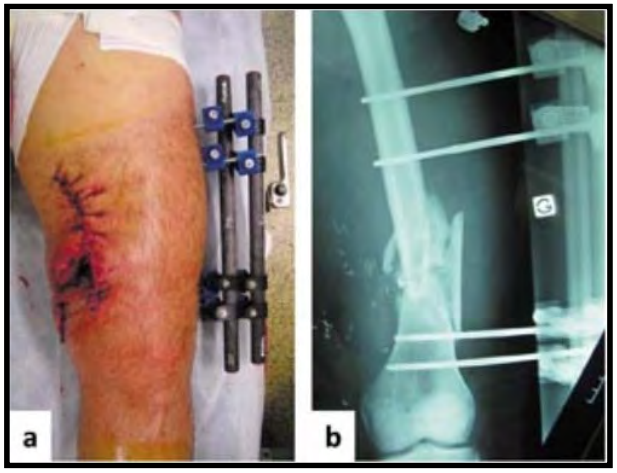
Second hit

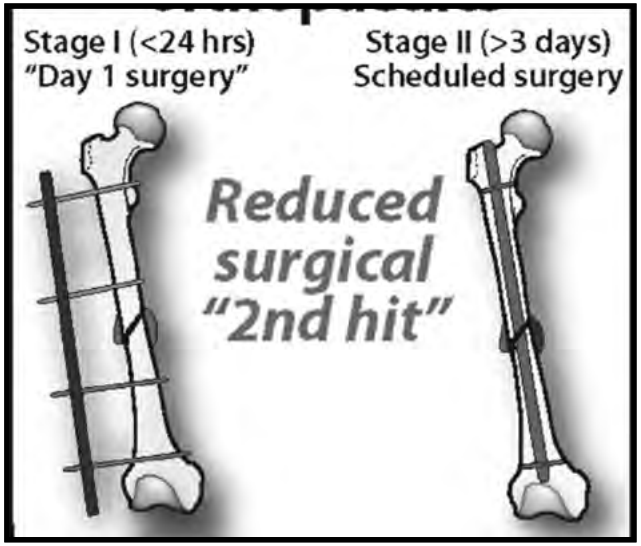


- Perte sanguine
- Activation inflammation
- Activation coagulation

Early Total Care vs. Damage control orthopedics







Safety and Efficacy of Damage Control External Fixation Versus Early Definitive Stabilization for Femoral Shaft Fractures in the Multiple-Injured Patient

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retrospective review

TABLE 1. Demographic and ISS Data for ETC and DCO Groups

	ETC	DCO	*p*
Total subjects	42	55	
Male	27	38	0.252
Female	15	17	0.126
Mean age (yr)	28.8	31.7	0.312
Mean ISS	36.8	39.1	0.265

TABLE 2. ETC vs. DCO Outcome Measurements and Statistical Significance per Group

	ETC	DCO	*p*
Initial OR time (min)	125	22	<0.005
Initial estimated blood loss (mL)	330	37	<0.005
Total OR time (min)	125	152	0.754
Total estimated blood loss (mL)	330	348	0.811
ICU LOS (d)	13.2	12.1	0.580
Hospital LOS (d)	20.9	17.2	0.745
Transfusion requirements (PRBC units)	3.2	3.7	0.582
Ventilator days	11.4	10.8	0.671
MOF score	2.78	3.08	0.371
ARDS score	1.81	1.79	0.232

PRBC, packed red blood cells.

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Femur Shaft Fracture Fixation in Head-Injured Patients: When Is the Right Time?

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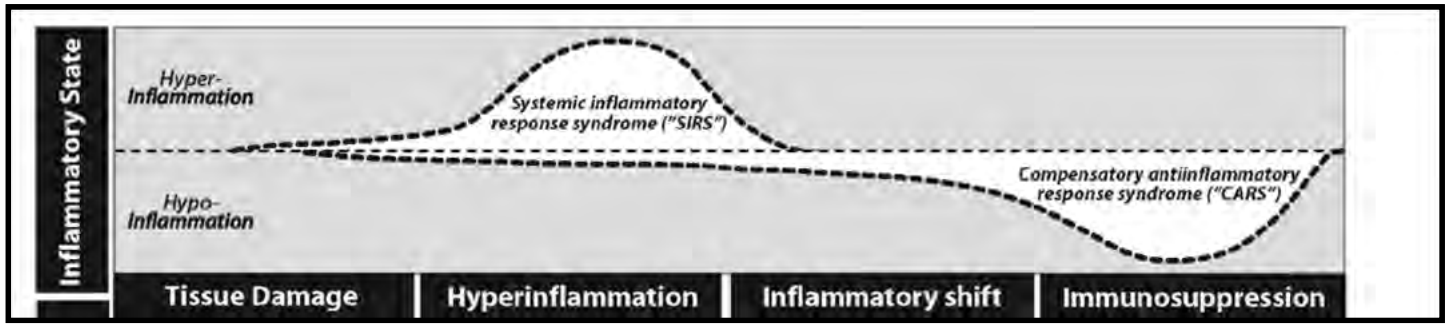

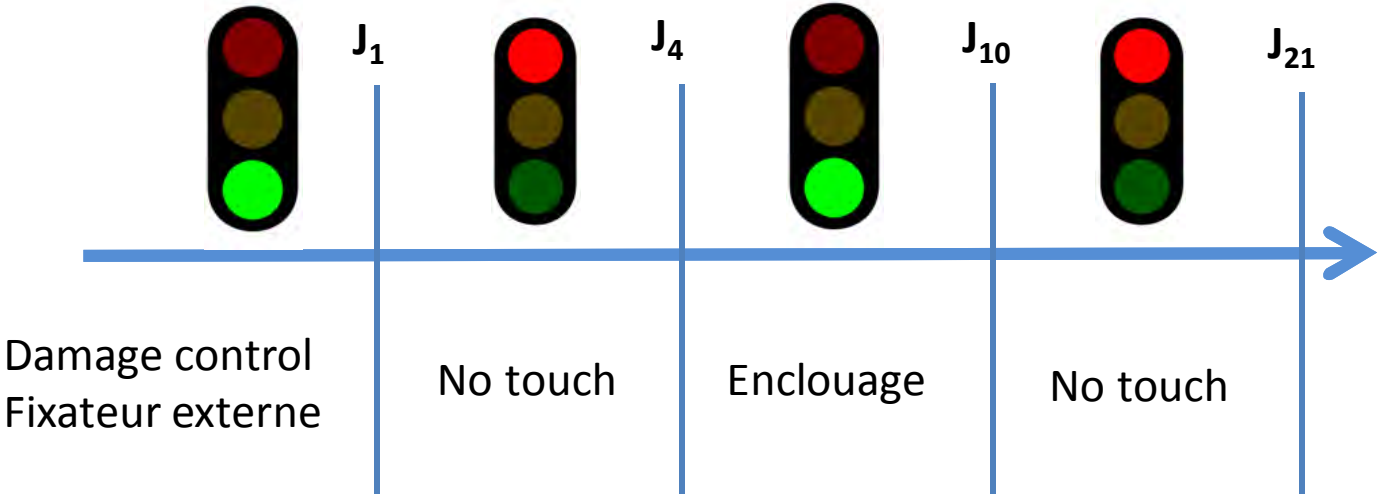

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