TRAUMATIC BRAIN INJURY

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AER ACTUALITÉS EN RÉANIMATION

CONFLICT OF INTEREST

BD

EUROSETS™ MEDICAL DEVICES

ZOLL®

NIHON KOHDEN

NEUROPTICS

INTEGRA™ LIMIT UNCERTAINTY

CytoSorbents™

50 million people suffer from a TBI worldwide every year—over 80% in developing countries

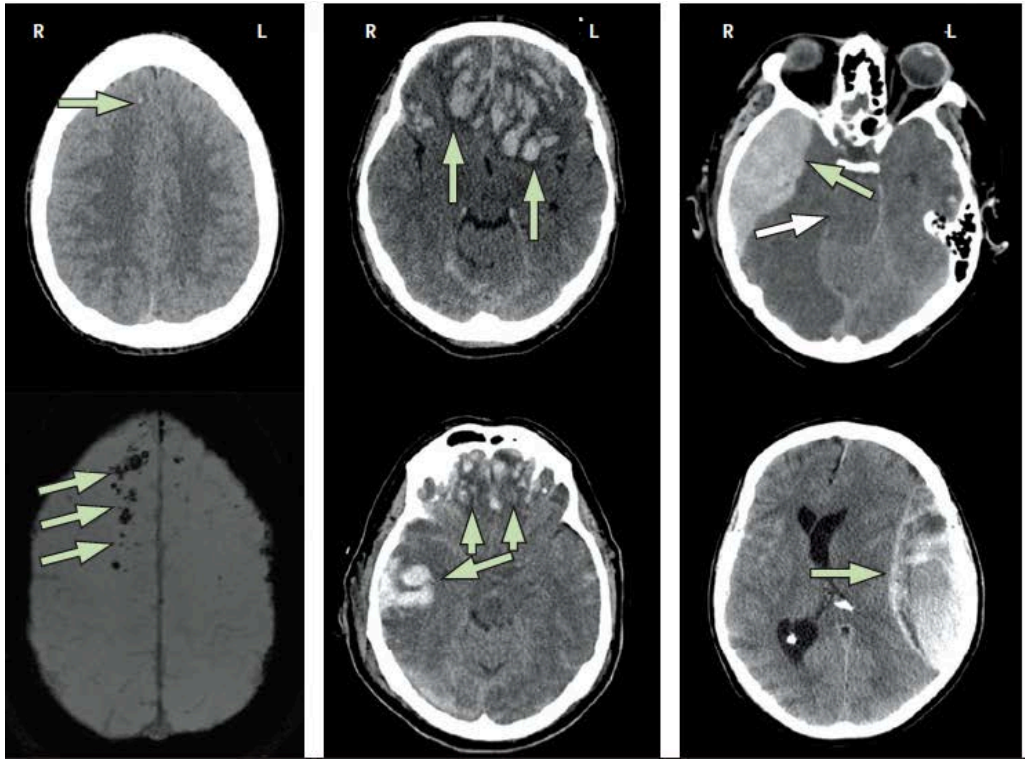
Annual global costs of care and consequences of TBI are up to US$400 billion

57 000 TBI-related deaths and 1·5 million hospitalisations occur in the EU-28 every year

Case-mix, care pathways, and outcomes in patients with traumatic brain injury in CENTER-TBI: a European prospective, multicentre, longitudinal, cohort study

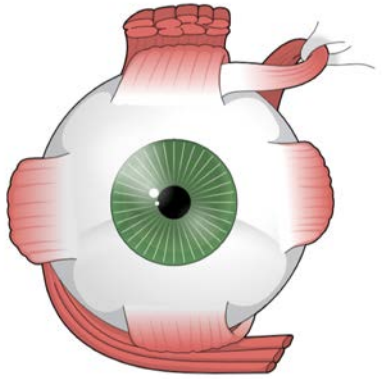
Ewout W Steyerberg, Eveline Wiegers, Charlie Sewalt*, Andras Buki, Giuseppe Citerio, Véronique De Keyser, Ari Ercole, Kevin Kunzmann, Linda Lanyon, Fiona Lecky, Hester Lingsma, Geoffrey Manley, David Nelson, Wilco Peul, Nino Stocchetti, Nicole von Steinbüchel, Thijs Vande Vyvere, Jan Verheyden, Lindsay Wilson, Andrew I R Maas*, David K Menon,* and the CENTER-TBI Participants and Investigators†*

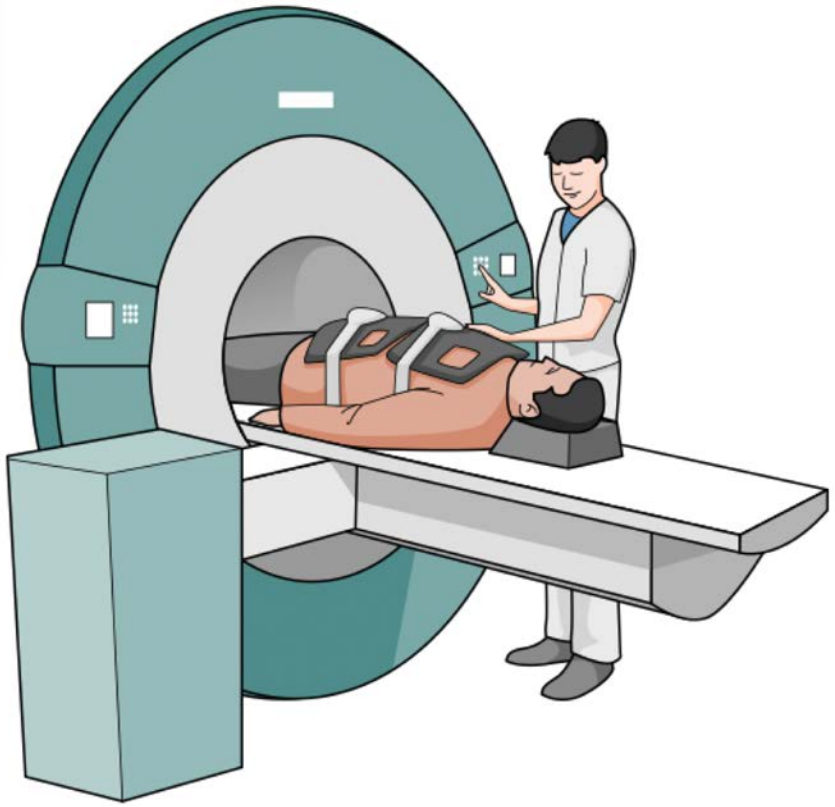
- ✓ **Increasing age (50 years)**
- ✓ **Severe TBI (GCS 3-8): 48%**
- ✓ Abnormal CT-scan: 87%
- ✓ ICP monitoring: 43% (62% if GCS < 9)



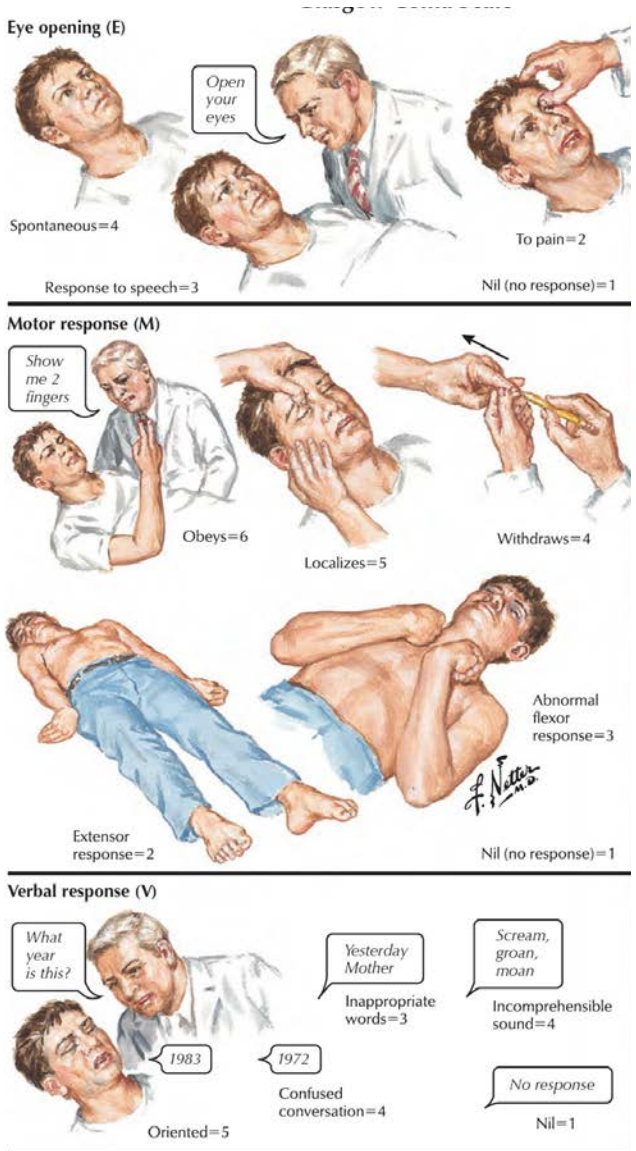
1 FIRST ASSESSMENT

CLINICAL EXAMINATION + **BRAIN IMAGING**





CLINICAL CLASSIFICATION



Glasgow Coma Scale (GCS)

Assess responses in three domains

- Eye (score range 1–4)
- Motor (score range 1–6)
- Verbal (score range 1–5)

Add scores from the three components to give a sum score (3–15)

- GCS 13–15: mild TBI
- GCS 9–12: moderate TBI
- GCS 3–8: severe TBI

Lancet Neurol 2017; 16: 987–1048

THE GLASGOW STRUCTURED APPROACH *to* ASSESSMENT *of the* GLASGOW COMA SCALE

GCS
EYES
VERBAL
MOTOR

GCS-P

* Important changes highlighted in red

	Motor response	Verbal response	Eye opening
1.	None	None	None
2.	Extension	Sounds	To Pressure
3.	Abnormal flexion	Words	To speech
4.	Withdrawal	Confused	Spontaneous
5.	Localizing	Orientated	
6.	Obeying commands		

Pupil Reactivity Score: Subtracted from the calculated GCS

Pupil Reactivity Score

Pupil(s) unreactive to light	Score
Both pupils	2
One Pupil	1
Neither pupil	0

For total GCS, subtract pupil reactivity score from calculated GCS

The neurologic consultation: pointers and takeaways for intensivists

Eelco F. M. Wijdicks*

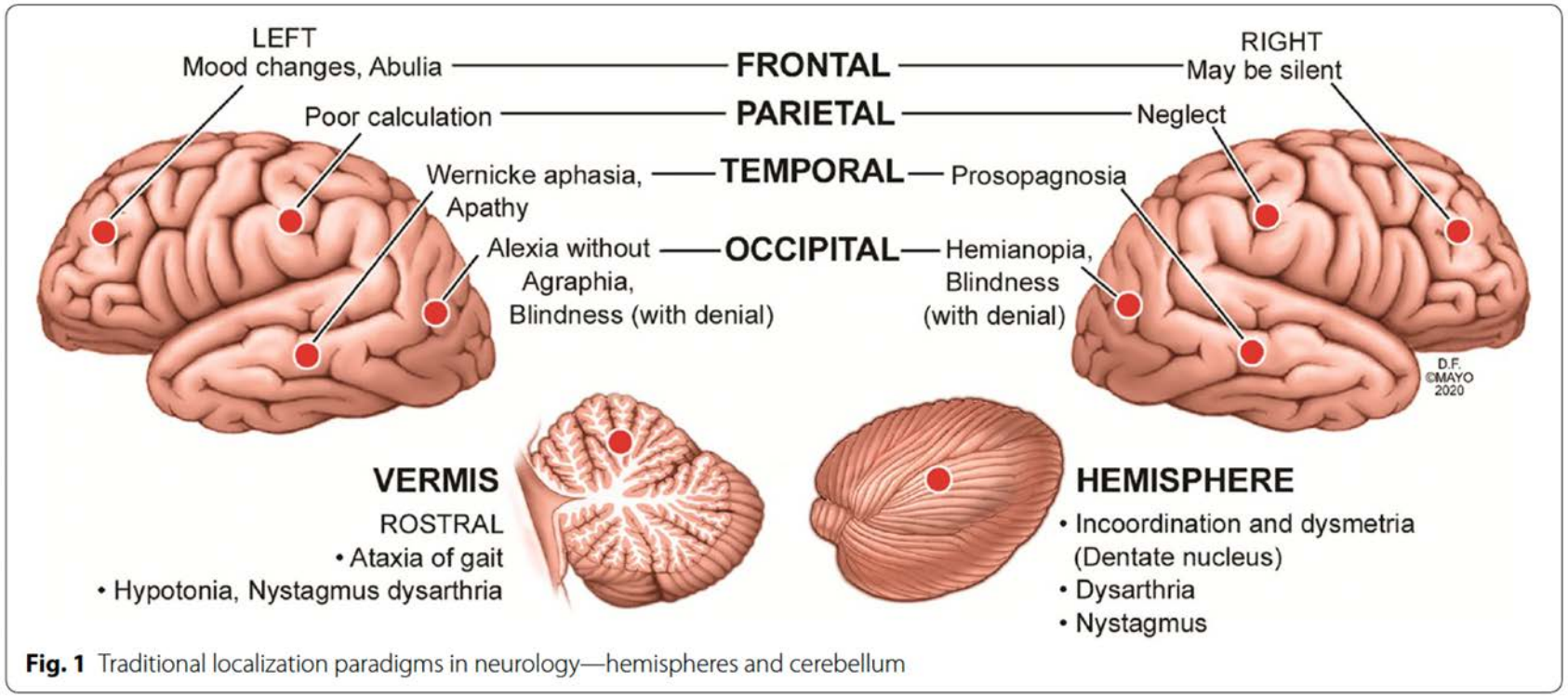
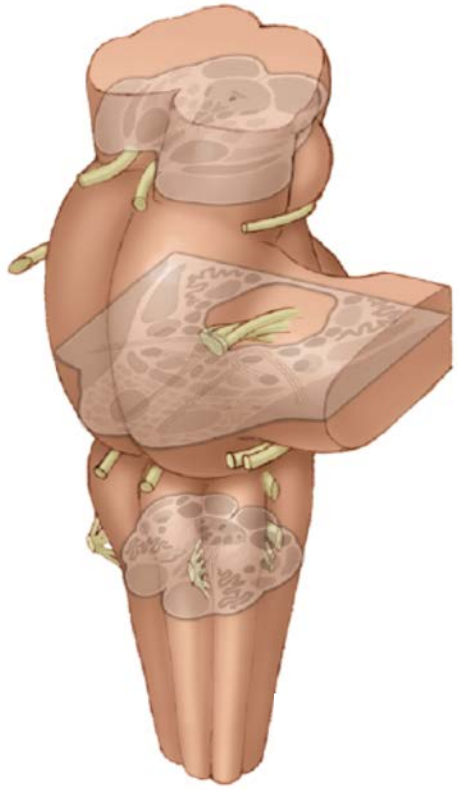


Fig. 1 Traditional localization paradigms in neurology—hemispheres and cerebellum



Intensive Care Med (2020) 46:1267–1270
https://doi.org/10.1007/s00134-020-06055-w

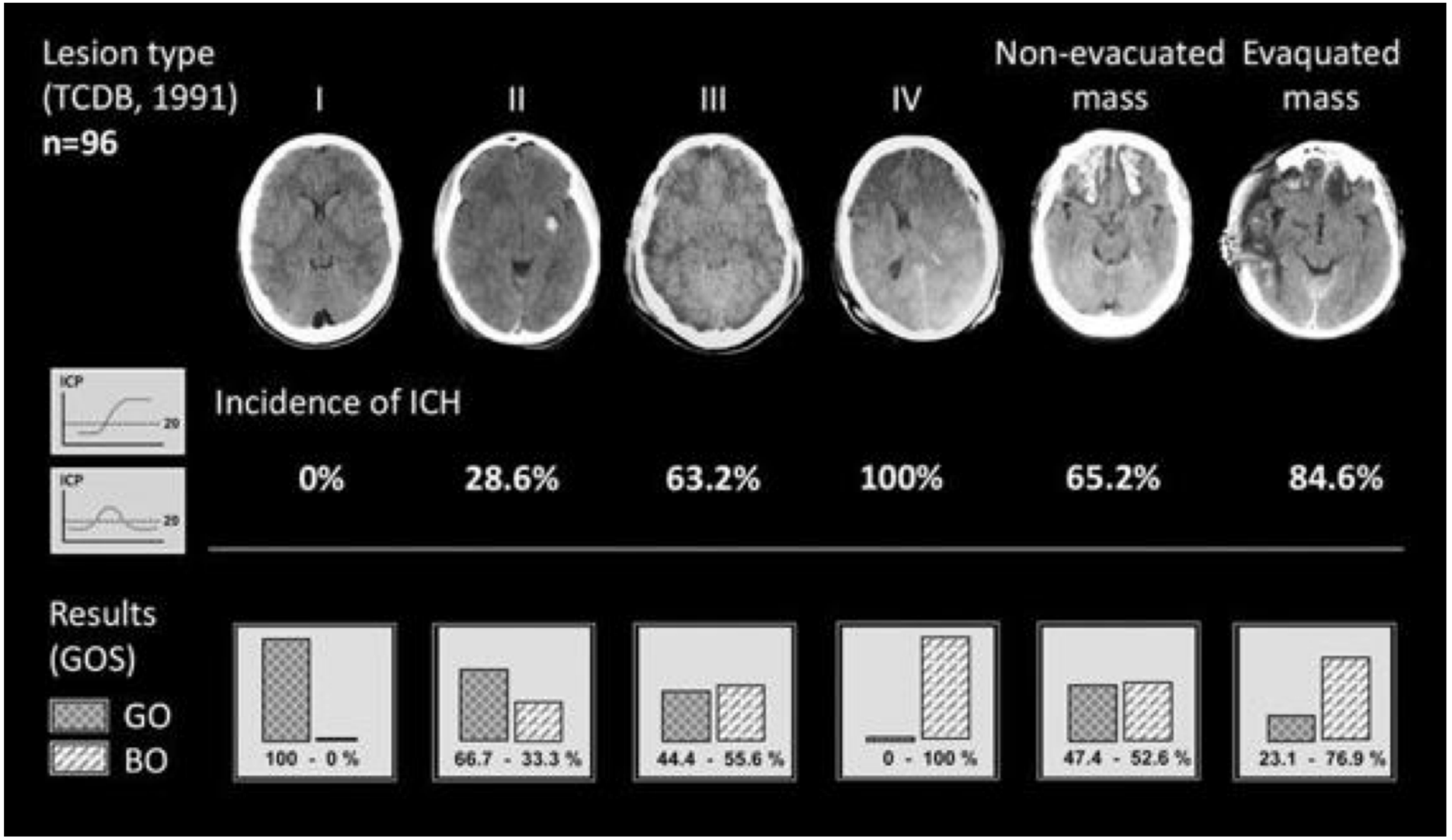
Tarek Sharshar
Giuseppe Citerio
Peter J. D. Andrews
Arturo Chieregato
Nicola Latronico
David K. Menon
Louis Puybasset
Claudio Sandroni
Robert D. Stevens

Neurological examination of critically ill patients: a pragmatic approach. Report of an ESICM expert panel

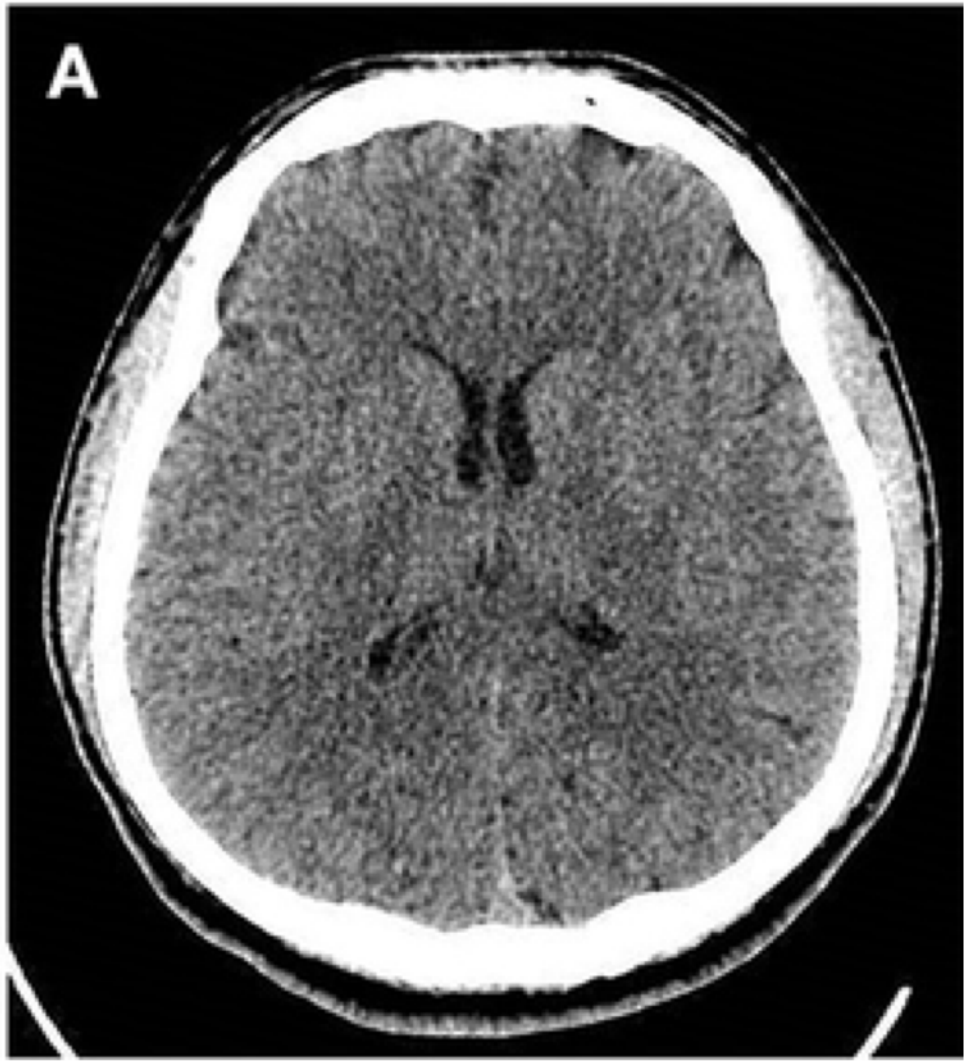
Intensive Care Med (2014) 40:484–495
DOI 10.1007/s00134-014-3214-y

- ✓ Clinical examination is not “specific”
- ✓ Clinical examination can be challenging
- ✓ Subtle alterations are not detectable by non-neurologists
- ✓ What about the “unconscious” patient ?
- ✓ Drug Intoxications
- ✓ Physiological signs can be challenging too

RADIOLOGICAL CLASSIFICATION



Cisterns – Midline Shift – Volume of Lesion – Surgical Evacuation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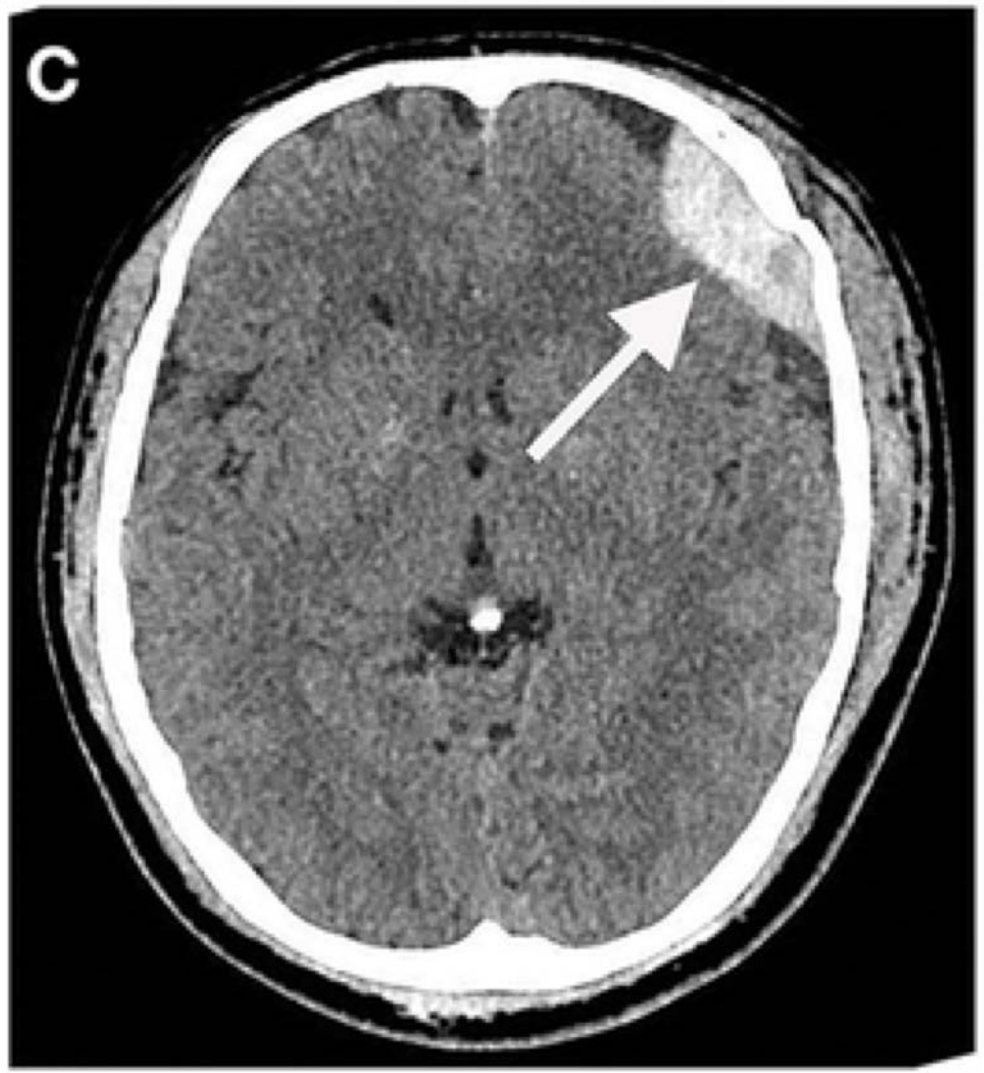
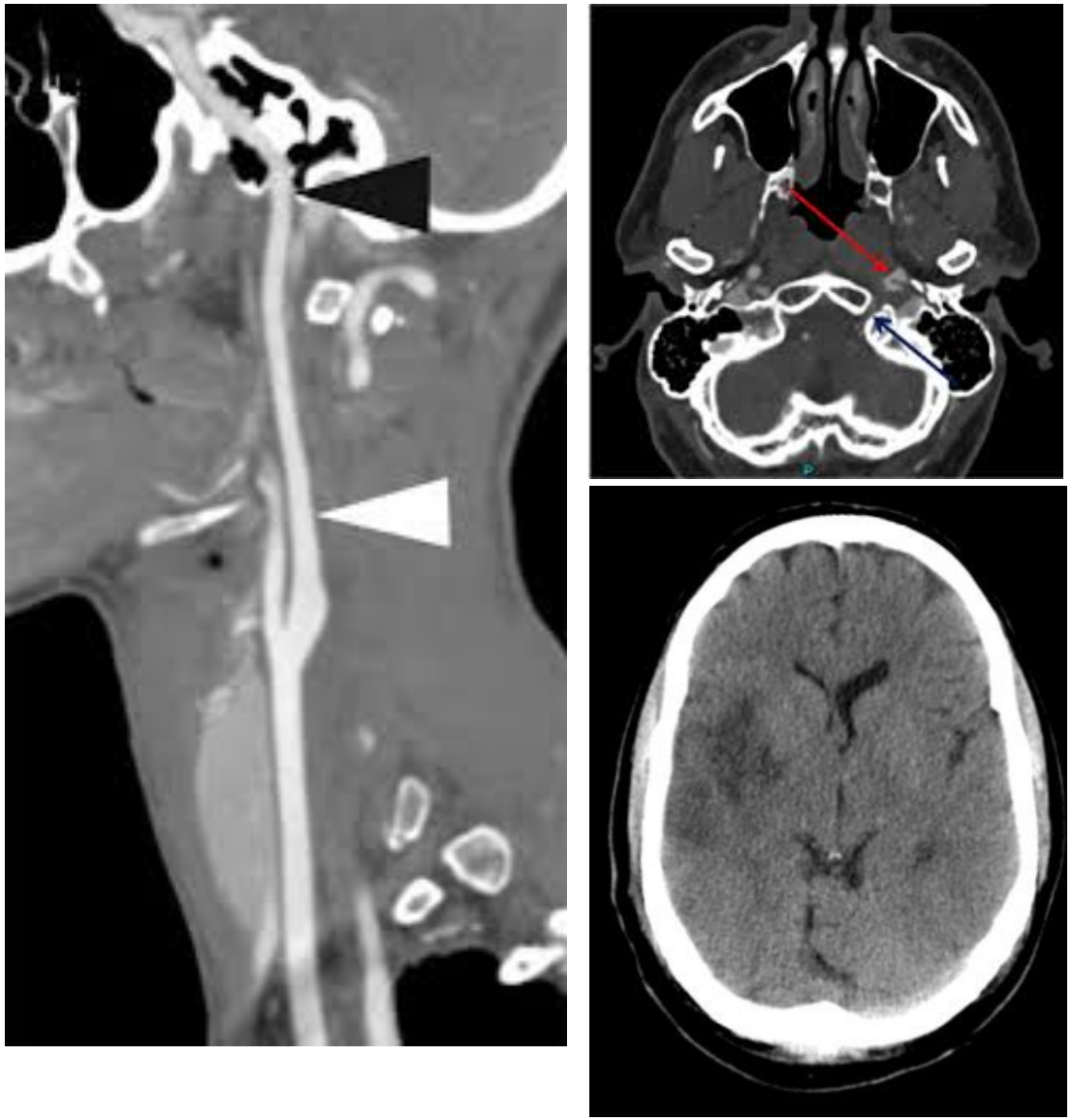
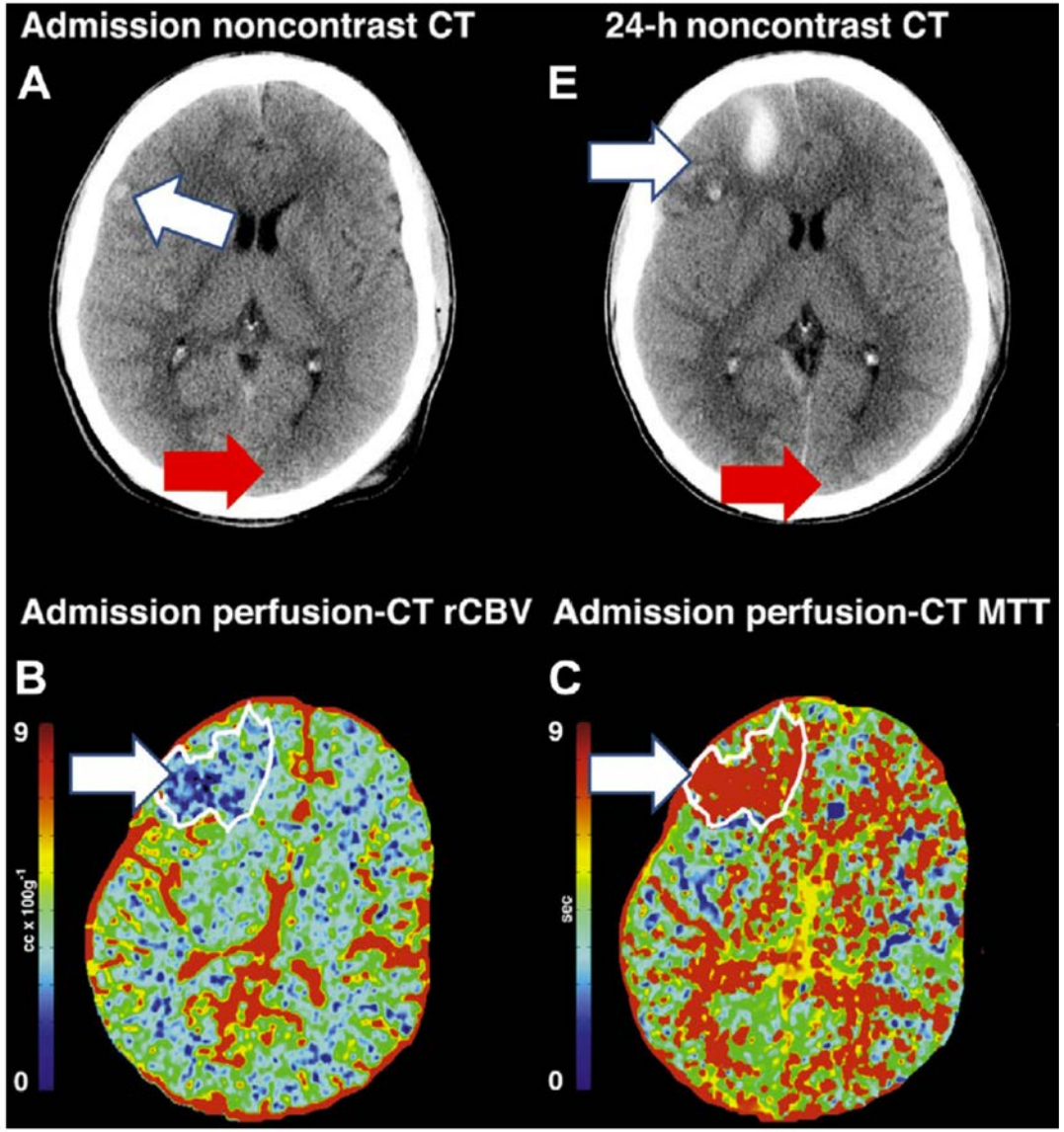

C

CT-ANGIO



Majidi, Neurocrit Care 2014

CT-PERFUSION



Douglas, Neuroimag Clin N Am 2017

2 EARLY PROGNOSIS

Head injury prognosis

CRASH

These prognostic models may be used as an aid to estimate mortality at 14 days and death and severe disability at six months in patients with traumatic brain injury (TBI). The predictions are based on the average outcome in adult patients with Glasgow coma score (GCS) of 14 or less, within 8 hours of injury, and can only support - not replace - clinical judgment. Although individual names of countries can be selected in the models, the estimates are based on two alternative sets of models (high income countries or low & middle income countries).

Country	Indonesia
Age, years	99
Glasgow coma score	3
Pupils react to light	None
Major extra-cranial injury?	Yes
CT scan available?	☑
Presence of petechial haemorrhages	No
Obliteration of the third ventricle or basal cisterns	No
Subarachnoid bleeding	No
Midline shift	No
Non-evacuated haematoma	No

Prediction

Risk of 14 day mortality (95% CI)	93.2% (89.5 - 95.7)
Risk of unfavourable outcome at 6 months	99.8% (99.6 - 99.9)

Reset

IMPACT
International Mission for Prognosis and Analysis of Clinical Trials in TBI

Search: OK

Home | TBI | IMPACT | Publications | References | Links | Contact

You are here: TBI-IMPACT.org » IMPACT » Prognostic calculator

IMPACT

Prognostic calculator

Based on extensive prognostic analysis the IMPACT investigators have developed prognostic models for predicting 6 month outcome in adult patients with moderate to severe head injury (Glasgow Coma Scale <=12) on admission. By entering the characteristics into the calculator, the models will provide an estimate of the expected outcome at 6 months. We present three models of increasing complexity (Core, Core + CT, Core + CT + Lab). These models were developed and validated in collaboration with the CRASH trial collaborators on large numbers of individual patient data (the IMPACT database). The models discriminate well, and are particularly suited for purposes of classification and characterization of large cohorts of patients. Extreme caution is required when applying the estimated prognosis to individual patients.

List of subpages

- Background
- Mission & Aims
- Collaboration
- Investigators
- Advisory Board
- IMPACT database
- Prognostic calculator
- IMPACT recommendations
- Common Data Elements (Draft)
- Data Sharing
- Acknowledgements

IMPACT

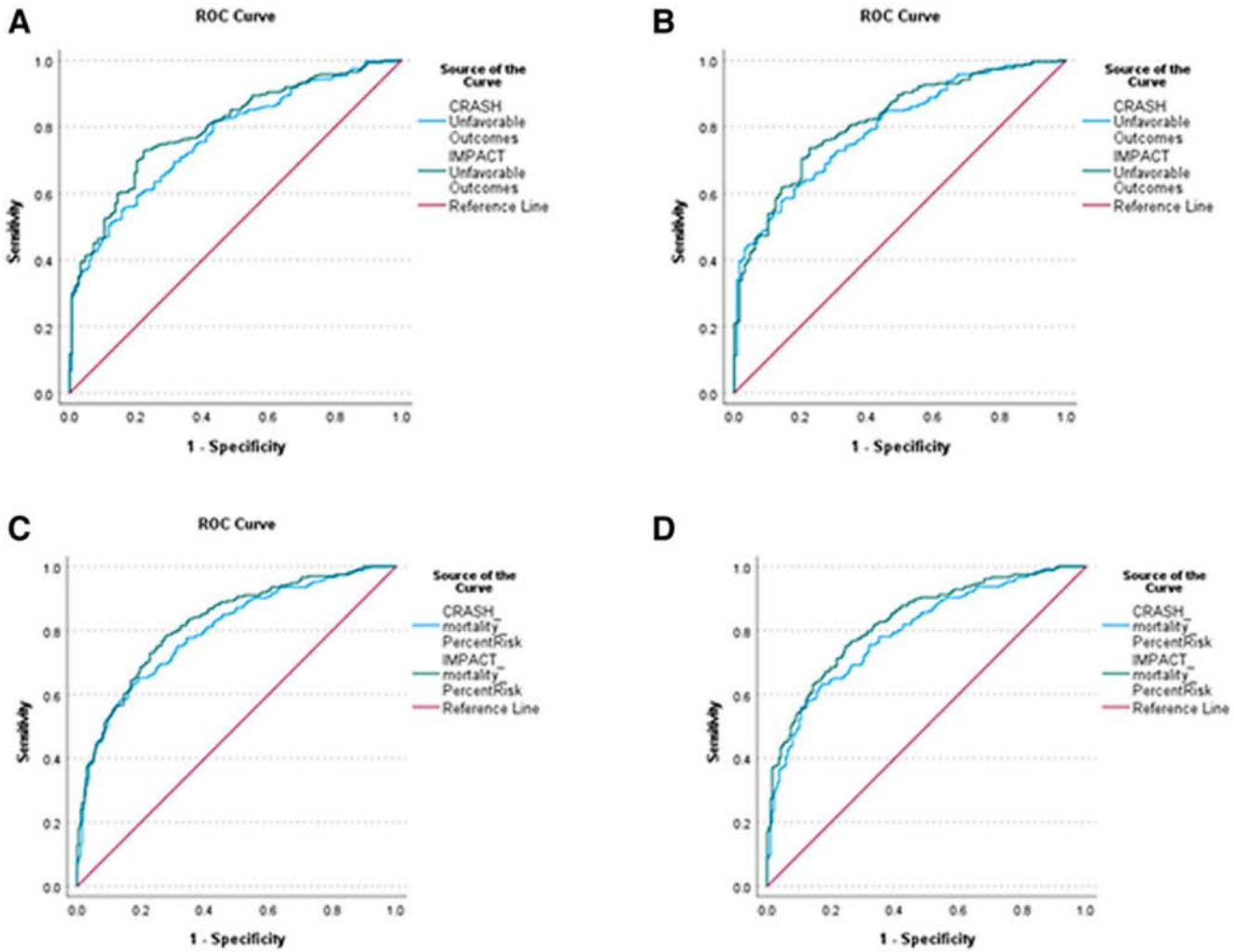
Prognostic models in TBI

1. Clinical Practice
   - informing relatives

ORIGINAL ARTICLE Open Access

Performance of CRASH and IMPACT Prognostic Models for Traumatic Brain Injury at 12 and 24 Months Post-Injury

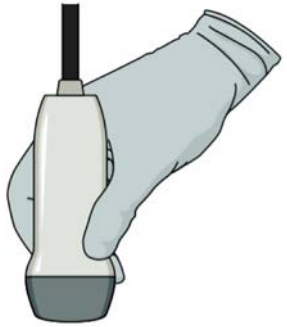
Shawn R. Eagle,[1,*] Enyinna Nwachuku,[2] Jonathan Elmer,[3] Hansen Deng,[1] David O. Okonkwo,[1] and Matthew Pease[4]

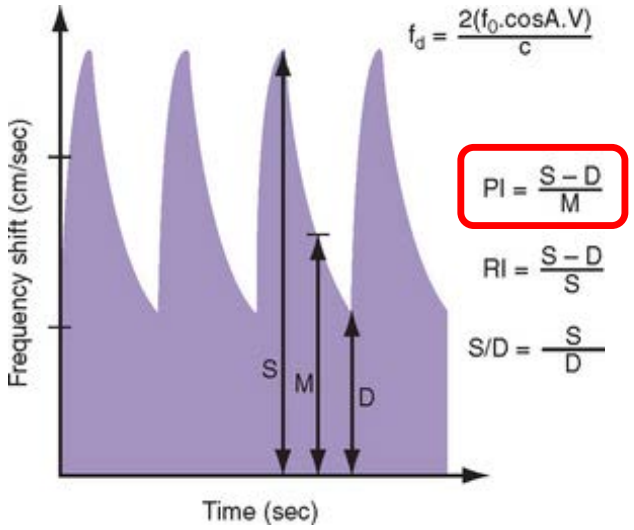


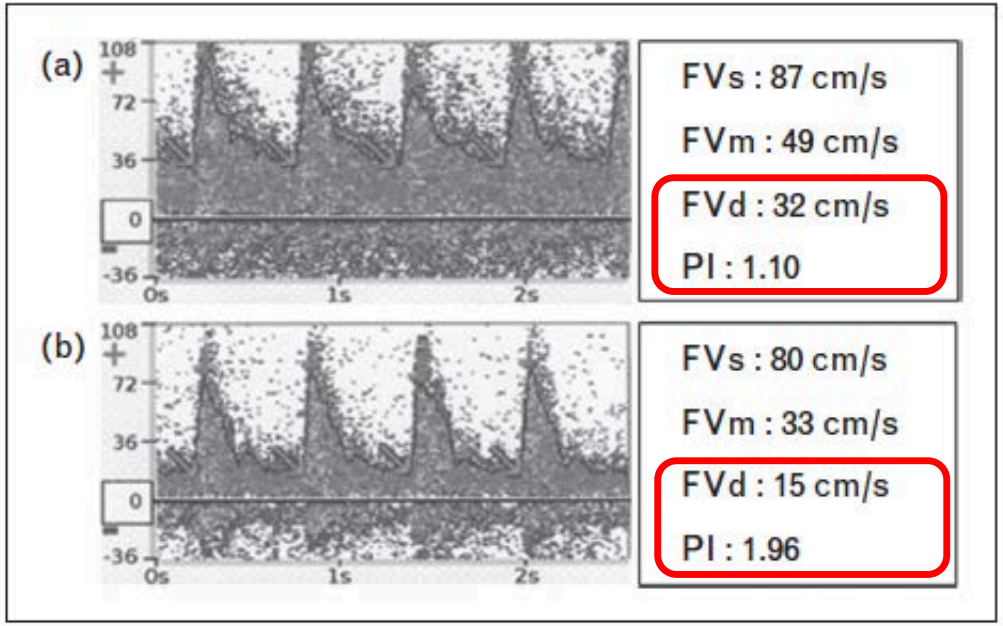
EARLY TRIAGE

- ✓ Reduced **FVd** (<20 cm/sec) and Increased **PI** (>1.2) predict secondary neuro-worsening and the need for subsequent therapies to reduce elevated ICP
- ✓ Estimation of **non-invasive ICP** (high NPV)

Bouzat, Neurosurgery 2011 *Ract, ICM 2007* *Rasulo, Crit Care 2022*

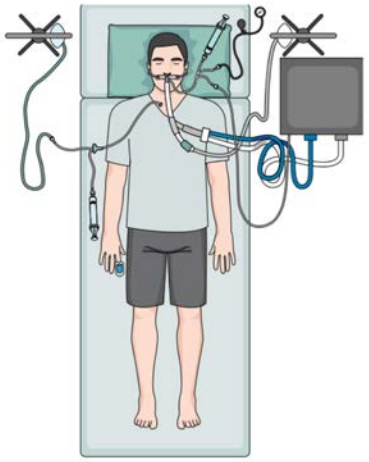


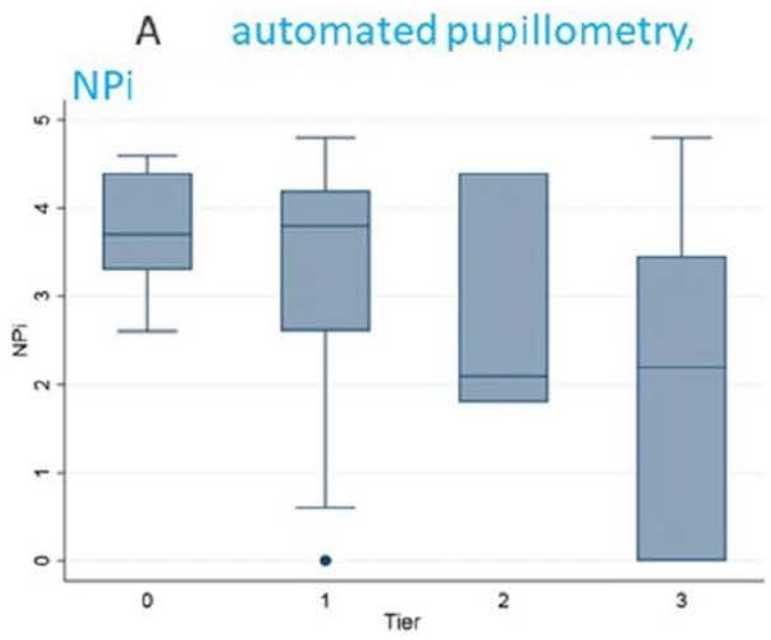


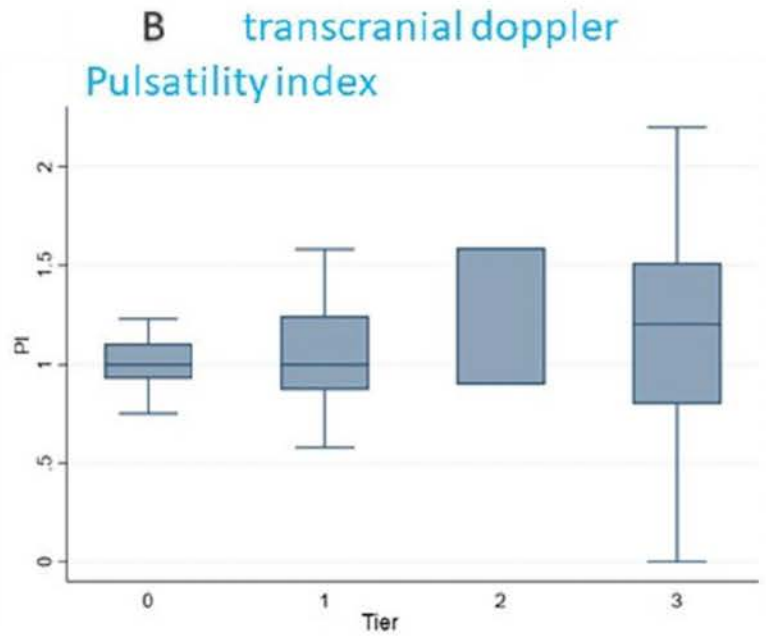


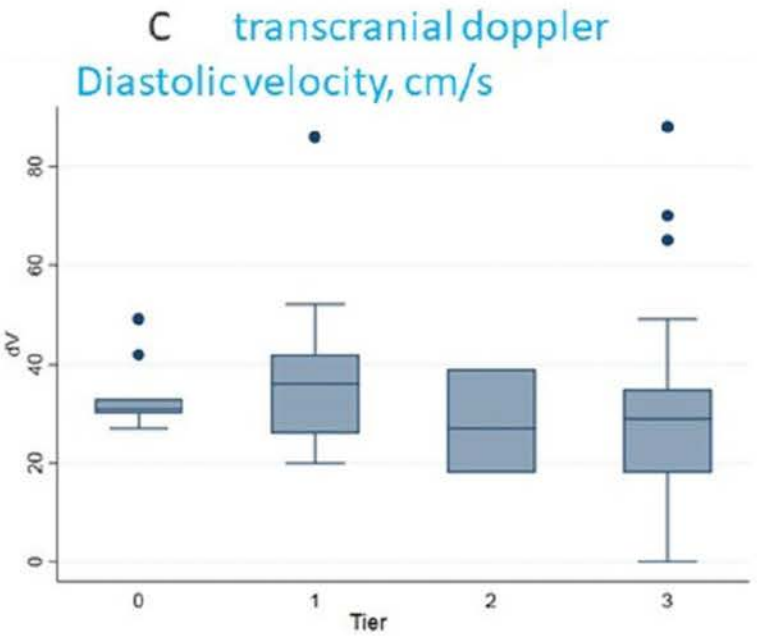
Prediction of neurocritical care intensity through automated infrared pupillometry and transcranial doppler in blunt traumatic brain injury: the NOPE study

Pierluigi Banco[1] · Fabio Silvio Taccone[2] · Dimitri Sourd[3] · Claudio Privitera[4] · Jean-Luc Bosson[3] · Thomas Luz Teixeira[2] · Anais Adolle[1] · Jean-François Payen[1] · Pierre Bouzat[1] · Tobias Gauss[1]





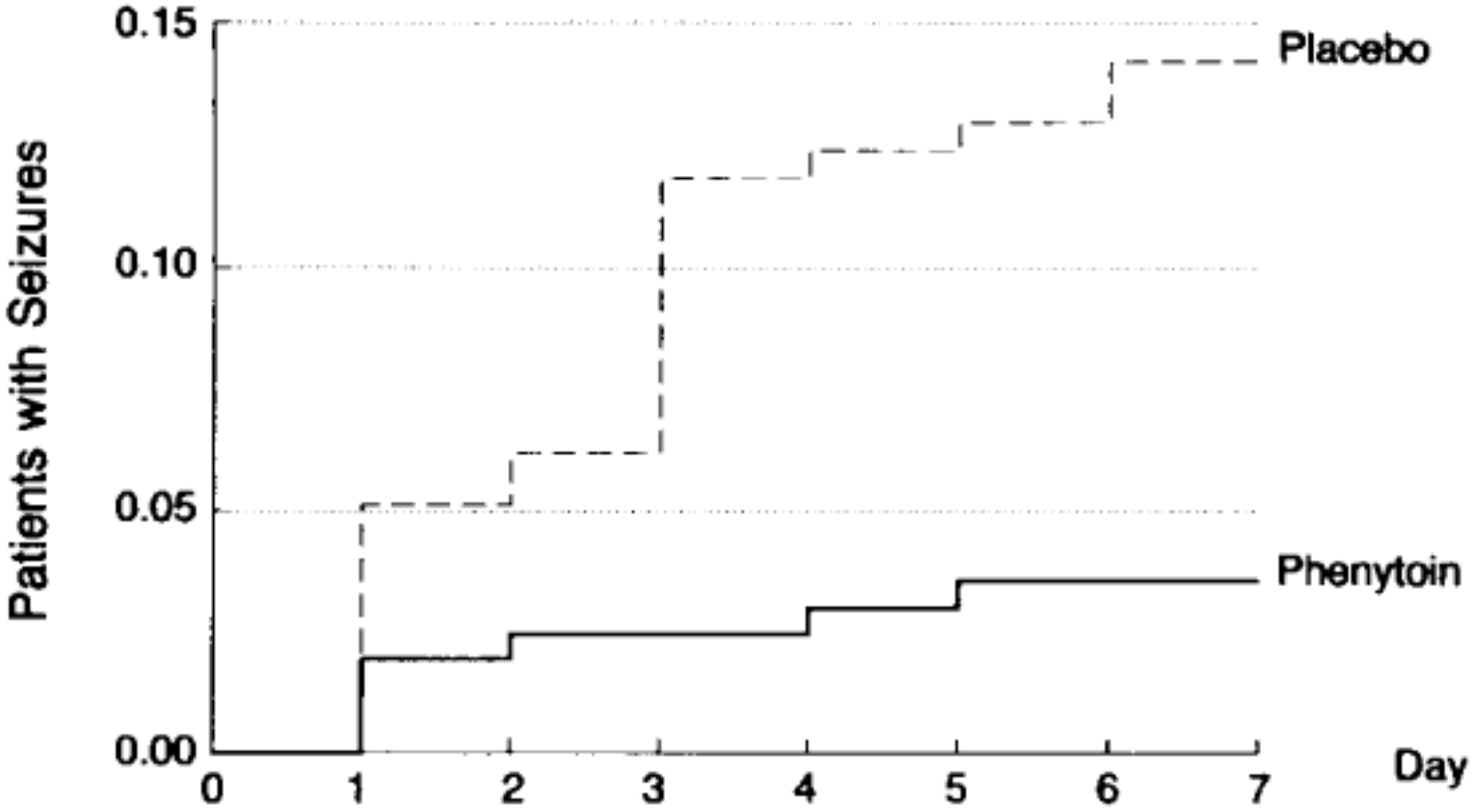




4 EARLY NEUROPROTECTION

A RANDOMIZED, DOUBLE-BLIND STUDY OF PHENYTOIN FOR THE PREVENTION OF POST-TRAUMATIC SEIZURES

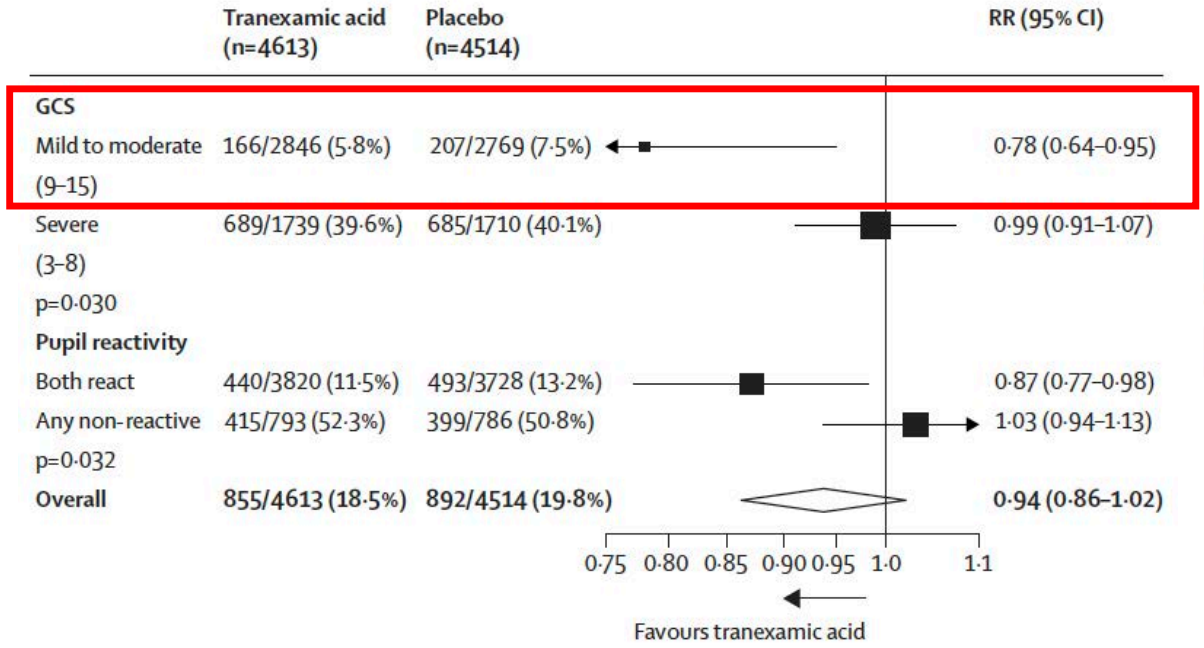
NANCY R. TEMKIN, PH.D., SUREYYA S. DIKMEN, PH.D., ALAN J. WILENSKY, M.D., PH.D., JANE KEIHM, R.N., M.S., SHARON CHABAL, R.N., M.S., AND H. RICHARD WINN, M.D.

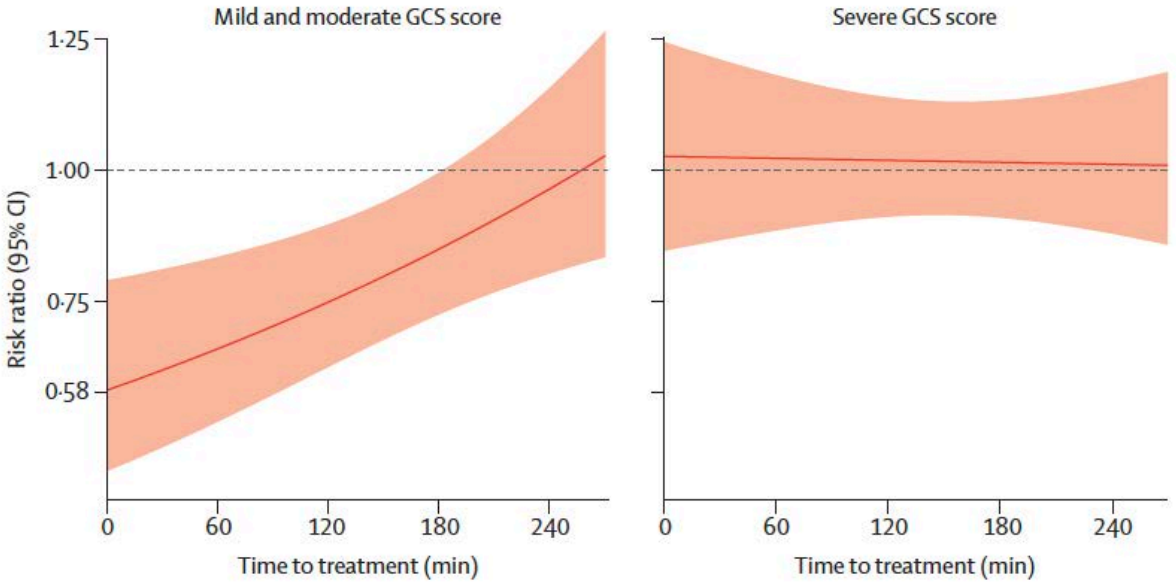


Cortical Contusion
Hemorrhagic Lesion
Depressed Skull Fracture
Penetrating Wound
Seizure <24 hrs
Adm GCS ≤10

Effects of tranexamic acid on death, disability, vascular occlusive events and other morbidities in patients with acute traumatic brain injury (CRASH-3): a randomised, placebo-controlled trial

*The CRASH-3 trial collaborators**

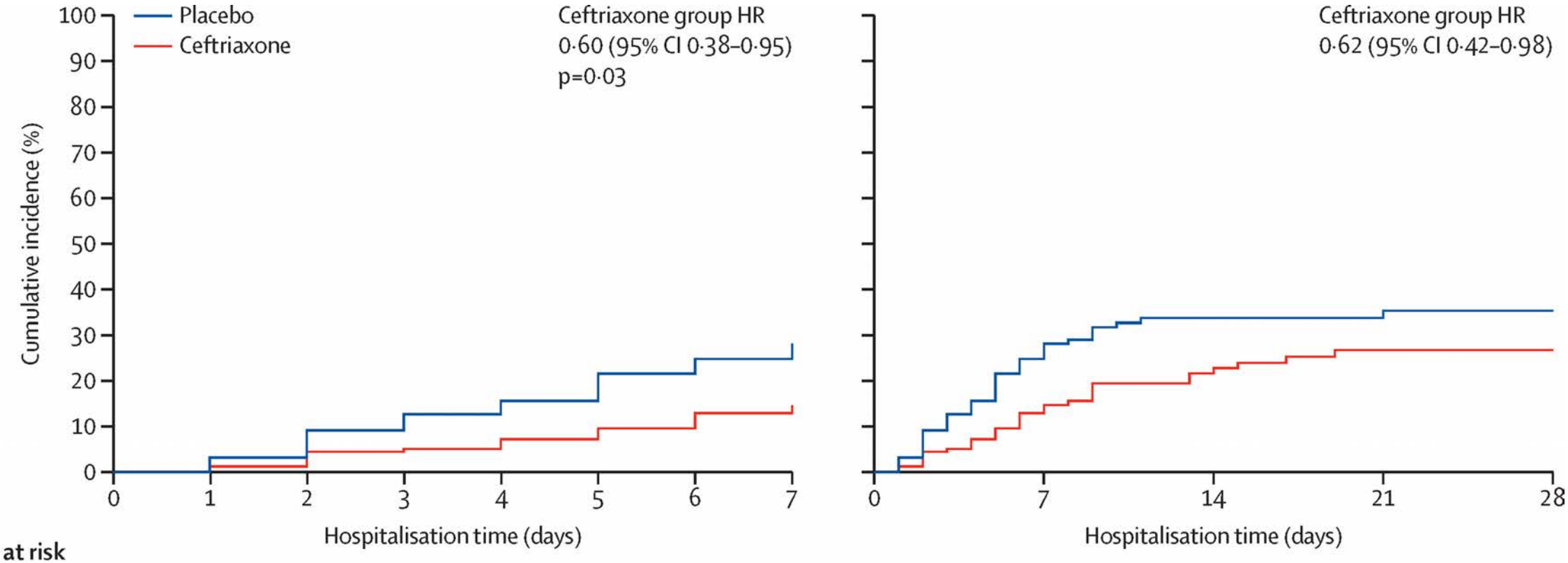




No improvement in Neurological Outcome
No differences in complications

Ceftriaxone to prevent early ventilator-associated pneumonia in patients with acute brain injury: a multicentre, randomised, double-blind, placebo-controlled, assessor-masked superiority trial

*Claire Dahyot-Fizelier, Sigismond Lasocki, Thomas Kerforne, Pierre-Francois Perrigault, Thomas Geeraerts, Karim Asehnoune, Raphaël Cinotti, Yoann Launey, Vincent Cottenceau, Marc Laffon, Thomas Gaillard, Matthieu Boisson, Camille Aleyrat, Denis Frasca, Olivier Mimoz, on behalf of the PROPHY-VAP Study Group and the ATLANREA Study Group**



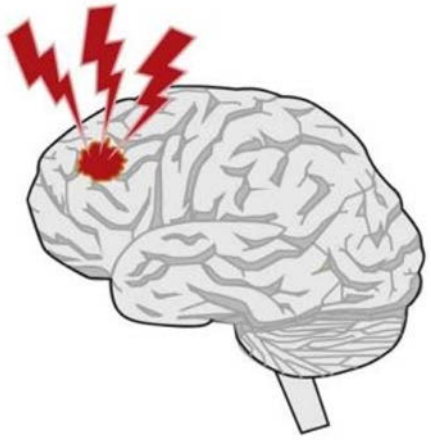
Number at risk

Ceftriaxone	162	160	149	134	125	119	107	100	162	100	65	46	20
Placebo	157	154	140	121	109	98	93	86	157	86	58	37	27

5 WHAT TO DO ???

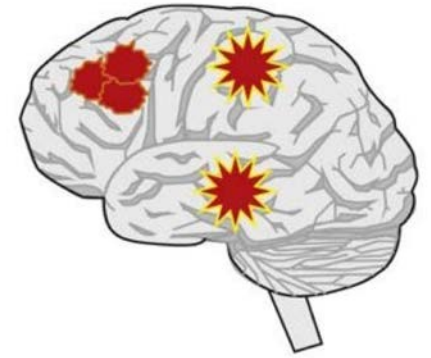
MONITORING

THERAPY



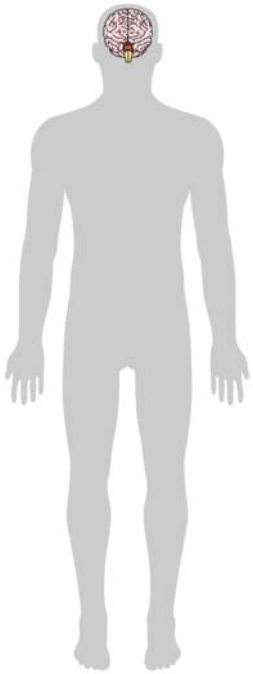
Primary injury

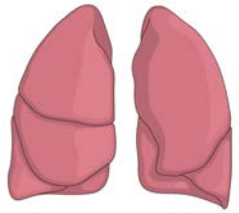
CLINICAL CONSEQUENCES



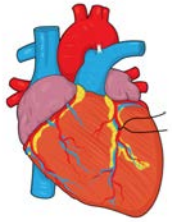
Secondary injury

METABOLIC DISTURBANCES





RESPIRATORY SYSTEM

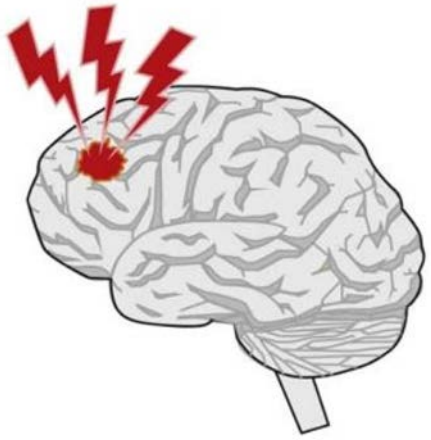


CARDIOVASCULAR SYSTEM

TEMPERATURE DISCONFORT

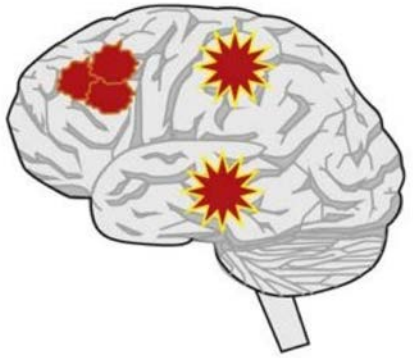
Glucose
Haemoglobin
Oxygen
Sodium
Temperature
Comfort
Arterial Pressure
$PaCO_2$

Taccone, Crit Care 2020



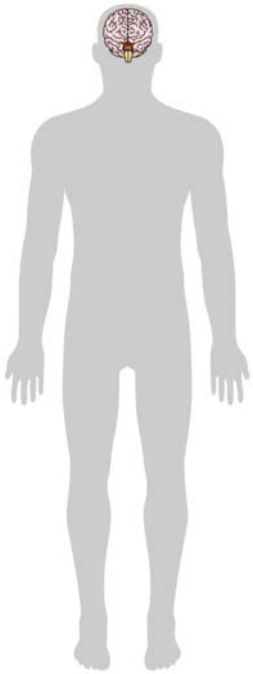
Primary injury

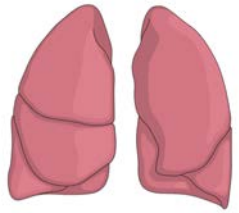
CLINICAL CONSEQUENCES



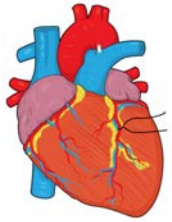
Secondary injury

METABOLIC DISTURBANCES





RESPIRATORY SYSTEM



CARDIOVASCULAR SYSTEM

TEMPERATURE DISCONFORT

Glucose	**80-150 mg/dL**
Hemoglobin	**> 9 g/dL**
PaO_2	**80-120 mmHg**
Sodium	**135-145 mmol/L**
Temperature	**<37.5°C**
Comfortable	
MAP	**> 70 mmHg**
$PaCO_2$	**35-45 mmHg**

Effects of balanced solution on short-term outcomes in traumatic brain injury patients: a secondary analysis of the BaSICS randomized trial

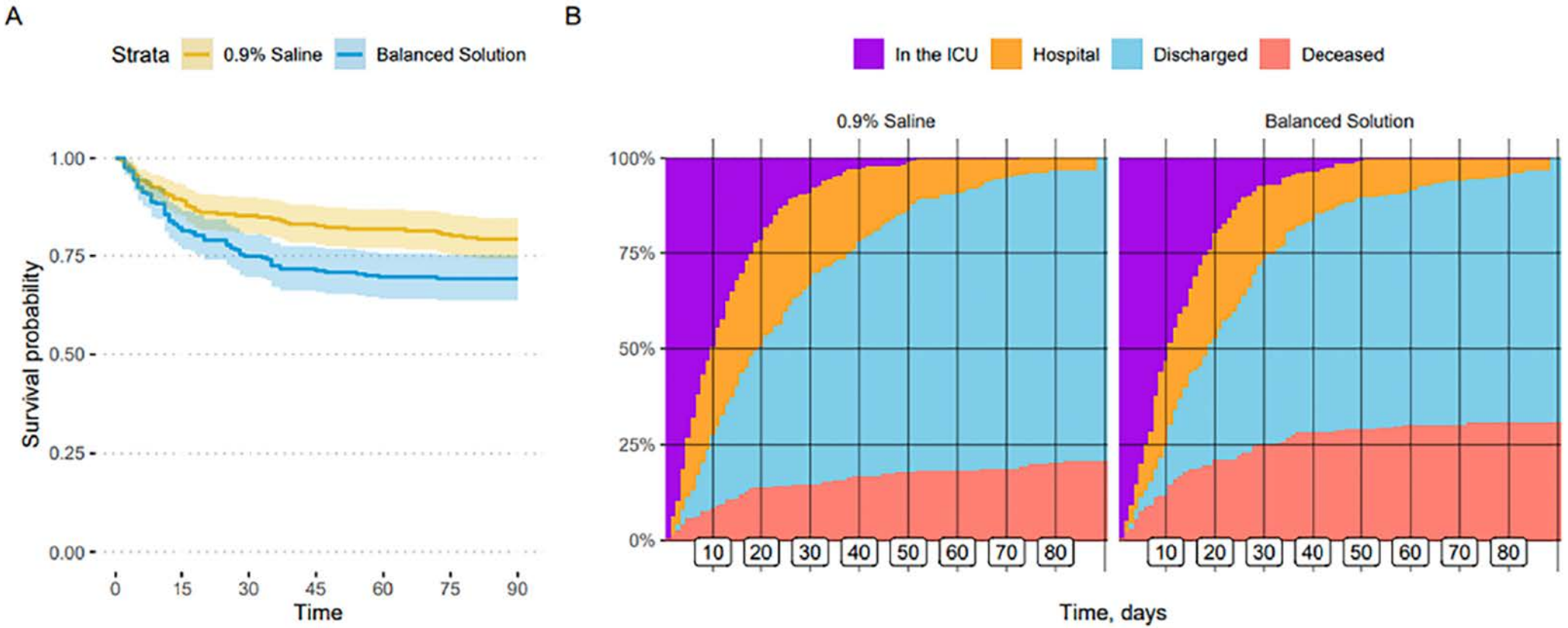


Figure 2 - (A) Survival curves for included patients, stratified according to intervention arm. (B) Patient status over time up to 90 days (only the first intensive care unit admission is considered); each vertical line represents 10-day intervals.

ICU - intensive care unit.

JAMA | Original Investigation

Effect of Continuous Infusion of Hypertonic Saline vs Standard Care on 6-Month Neurological Outcomes in Patients With Traumatic Brain Injury

The COBI Randomized Clinical Trial

B Kaplan-Meier estimates of the unadjusted probability of death at 6 mo (secondary end point)

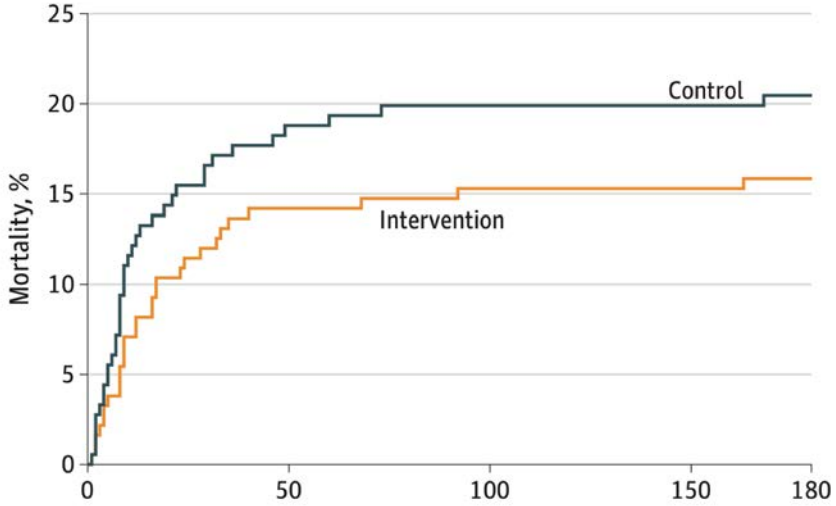


Figure 3. Outcomes at 6 Months

A GOS-E score at 6 mo (primary end point)

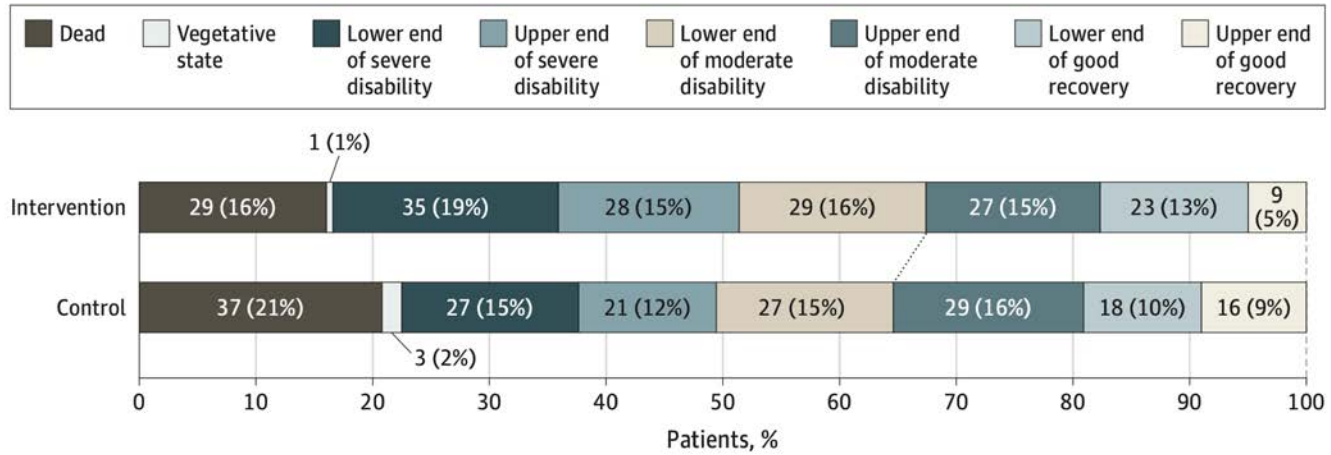


Table 2. Secondary Outcomes

Outcomes	Intervention (n = 185)	Control (n = 185)	Absolute difference (95% CI)[a]	Odds ratio (95% CI)
Good neurological outcomes, No./total (%)[b]				
At 3 mo	62/175 (35.4)	53/176 (30.1)	5.31 (−4.49 to 15.12)	1.27 (0.79-2.06)
At 6 mo	59/181 (32.6)	63/178 (35.4)	−2.80 (−12.59 to 7.00)	0.85 (0.53-1.36)

Saline or Albumin for Fluid Resuscitation in Patients with Traumatic Brain Injury

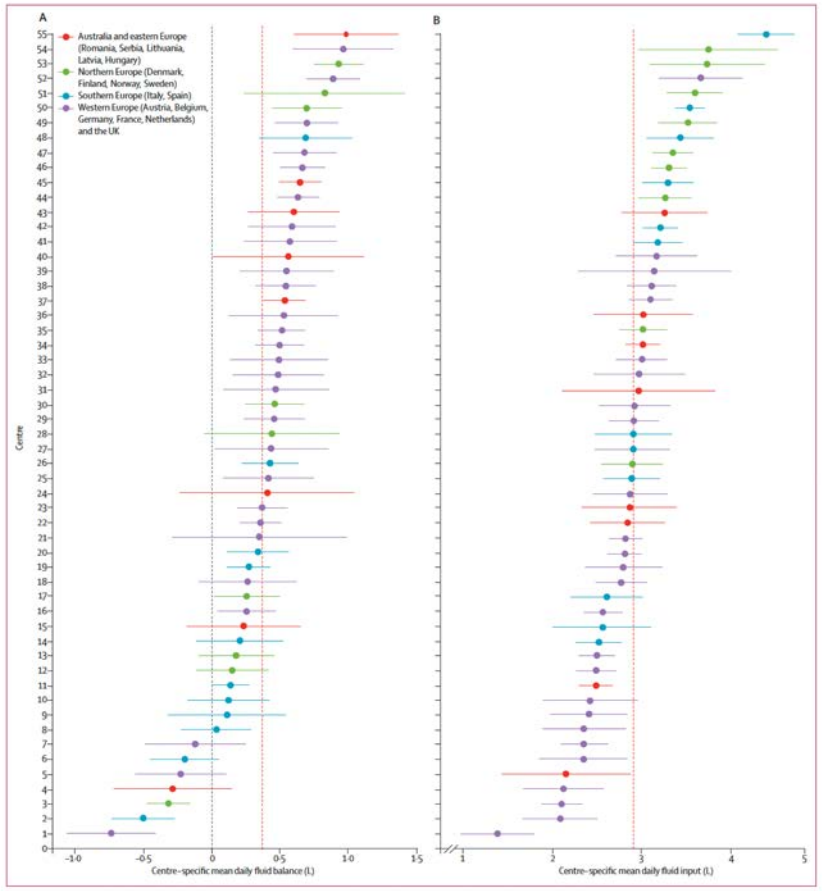
The SAFE Study Investigators*

Outcome	Albumin Group	Saline Group	Relative Risk (95% CI)	P Value
All patients				
Deaths — no./total no. (%)				
Within 28 days	61/231 (26.4)	36/229 (15.7)	1.68 (1.16–2.43)	0.005
Within 6 mo	68/221 (30.8)	40/217 (18.4)	1.67 (1.18–2.35)	0.003
Within 12 mo	69/220 (31.4)	40/216 (18.5)	1.69 (1.20–2.38)	0.002
Within 24 mo	71/214 (33.2)	42/206 (20.4)	1.63 (1.17–2.26)	0.003
Favorable score on the GOSe at 24 mo	96/203 (47.3)	120/198 (60.6)	0.78 (0.65–0.94)	0.007
Survivors at 24 mo	96/132 (72.7)	120/156 (76.9)	0.95 (0.83–1.08)	0.41
Patients with a GCS score of 3–8				
Deaths — no./total no. (%)				
Within 28 days	55/160 (34.4)	30/158 (18.9)	1.83 (1.23–2.71)	0.002
Within 6 mo	60/154 (38.9)	32/149 (21.5)	1.81 (1.26–2.61)	0.001
Within 12 mo	61/153 (39.9)	32/149 (21.5)	1.86 (1.29–2.67)	0.001
Within 24 mo	61/146 (41.8)	32/144 (22.2)	1.88 (1.31–2.70)	<0.001

Fluid balance and outcome in critically ill patients with traumatic brain injury (CENTER-TBI and OzENTER-TBI): a prospective, multicentre, comparative effectiveness study

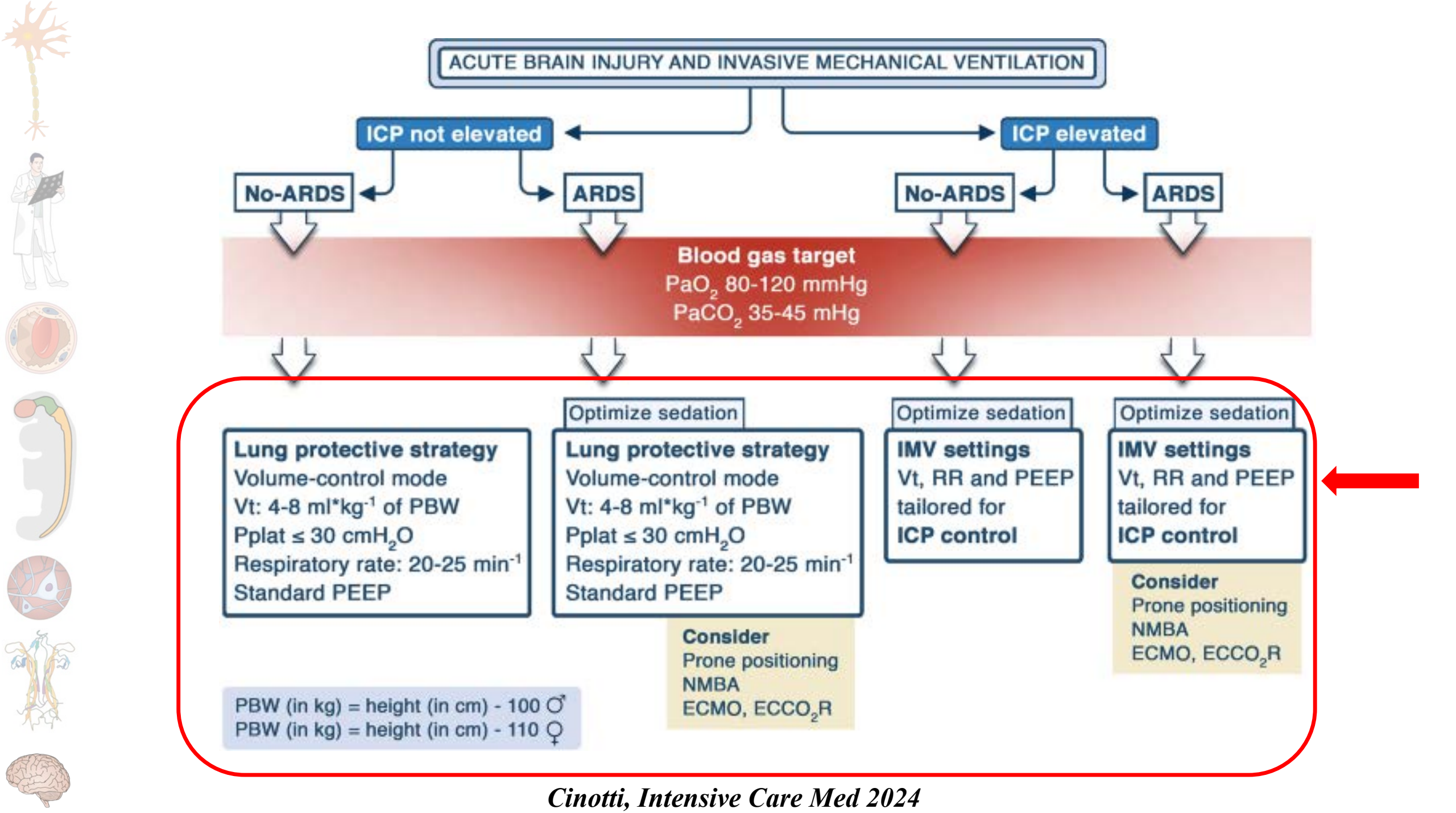
*Eveline Janine Anna Wiegers, Hester Floor Lingsma, Jilske Antonia Huijben, David James Cooper, Giuseppe Citerio, Shirin Frisvold, Raimund Helbok, Andrew Ian Ramsay Maas, David Krishna Menon, Elizabeth Madeleine Moore, Nino Stocchetti, Diederik Willem Dippel, Ewout Willem Steyerberg, Mathieu van der Jagt, on behalf of the CENTER-TBI and OzENTER-TBI Collaboration Groups**

N=2125

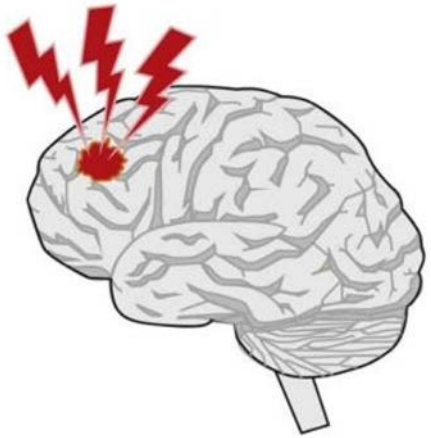


	ICU mortality: worse short-term outcome		Ordinal GOSE score: worse outcome at 6 months	
	Odds ratio (95% CI)	p value	Odds ratio (95% CI)	p value
Unadjusted, per 0·1 L increase				
Mean daily positive fluid balance	1·10 (1·08–1·12)	<0·0001	1·06 (1·04–1·07)	<0·0001
Mean daily negative fluid balance	0·98 (0·94–1·02)	0·32	1·00 (0·98–1·03)	0·71
Mean daily fluid input	1·05 (1·04–1·06)	<0·0001	1·05 (1·04–1·05)	<0·0001
Adjusted,* per 0·1 L increase				
Mean daily positive fluid balance	1·10 (1·07–1·12)	<0·00001	1·04 (1·02–1·05)	<0·0001
Mean negative fluid balance	0·96 (0·90–1·01)	0·11	0·99 (0·97–1·02)	0·68
Mean daily fluid input	1·05 (1·03–1·06)	<0·00001	1·04 (1·03–1·04)	<0·0001

ICU=intensive care unit. GOSE=Glasgow Outcome Scale Extended. *Adjusted for age, Glasgow Coma Scale (GCS) motor score at baseline, pupillary reactivity, hypoxia, hypotension, Marshall CT classification, epidural haematoma, traumatic subarachnoid haemorrhage, first haemoglobin, first glucose, any major extracranial injury (Abbreviated Injury Scale ≥3), and a random intercept for centre.

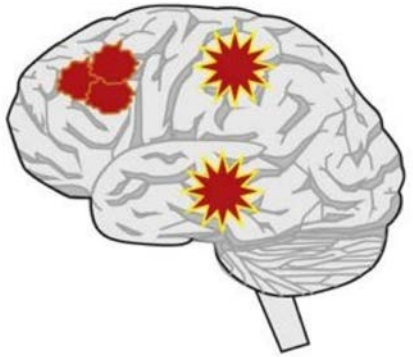


Cinotti, Intensive Care Med 2024

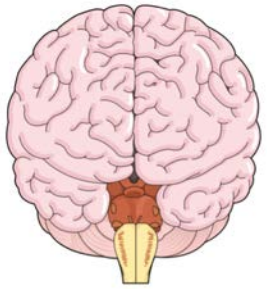


Primary injury

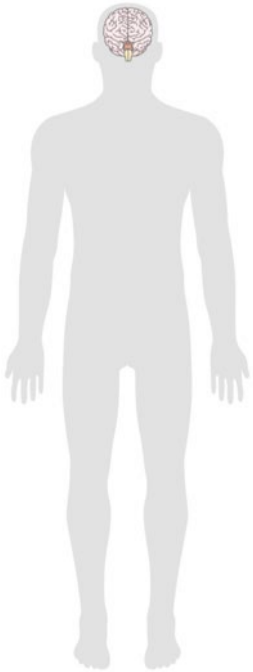
CLINICAL CONSEQUENCES

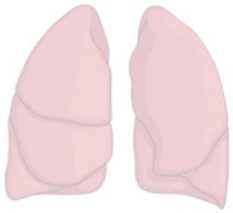


Secondary injury

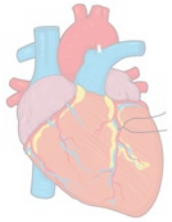


METABOLIC DISTURBANCES

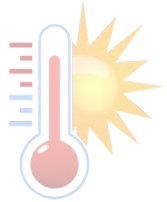




RESPIRATORY SYSTEM

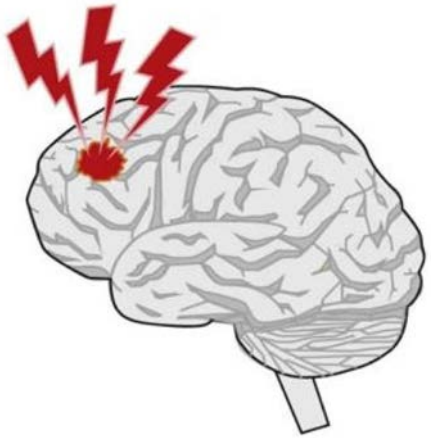


CARDIOVASCULAR SYSTEM



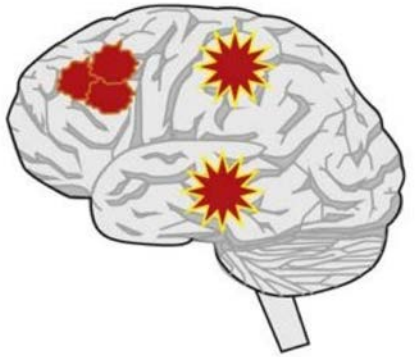
TEMPERATURE DISCONFORT

Loss of Compliance
Tissue Hypoxia
Seizure
Metabolic Disturbances
Neuro-inflammation

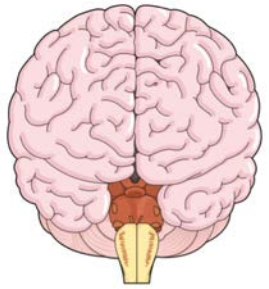


Primary injury

CLINICAL CONSEQUENCES



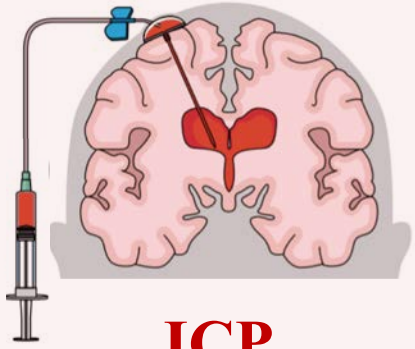
Secondary injury



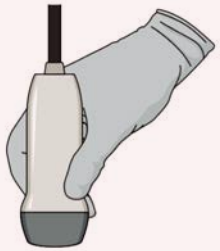
Anemia	Vasodilation	↖ CBF	↖ ICP
Hypoxemia	Vasodilation	↖ CBF	↖ ICP
Hyponatremia	Water Shift	↖ IC Vol	↖ ICP
Fever	Metabolism	↖ CBF	↖ ICP
Agitation/Pain	Metabolism	↖ CBF	↖ ICP
Hypotension	Vasodilation	↖ CBF	↖ ICP
Hypertension	Vasoconstriction	↘ CBF	↘ ICP
Hypercapnia	Vasodilation	↖ CBF	↖ ICP
Hypocapnia	Vasoconstriction	↘ CBF	↘ ICP

Loss of Compliance
Tissue Hypoxia
Seizure
Metabolic Disturbances
Neuro-inflammation

PERFUSION

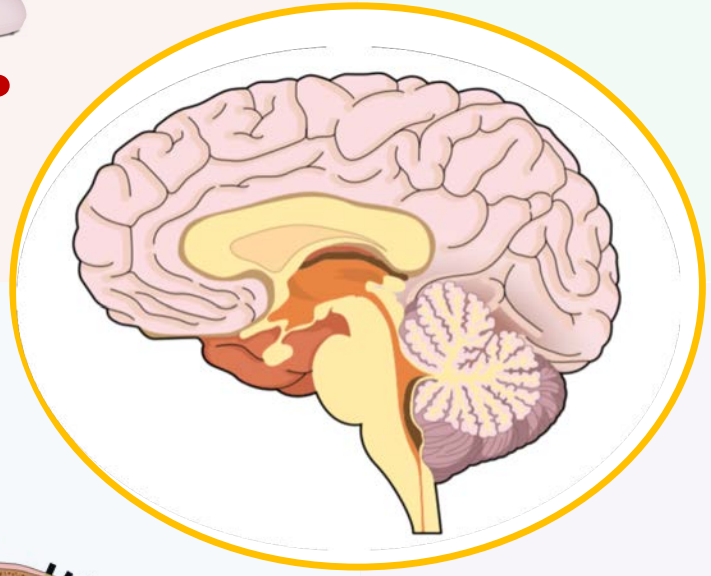


ICP

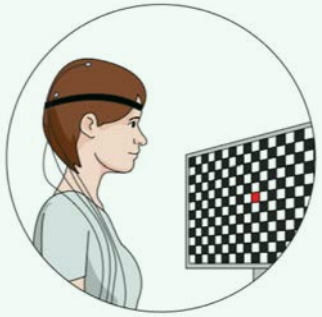


US

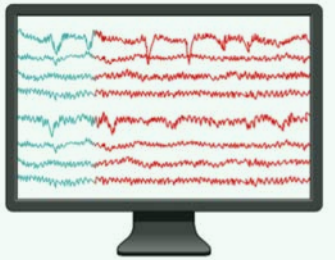
AP



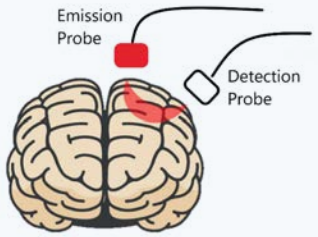
FUNCTION



EP

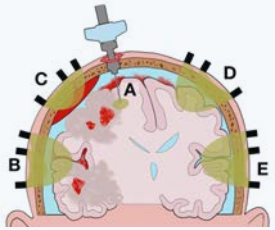


EEG



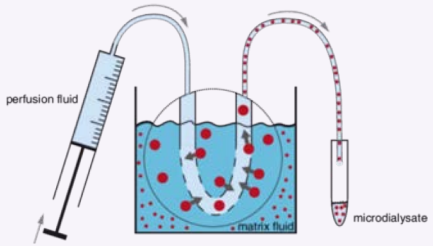
NIRS

$SvjO_2$



$PbtO_2$

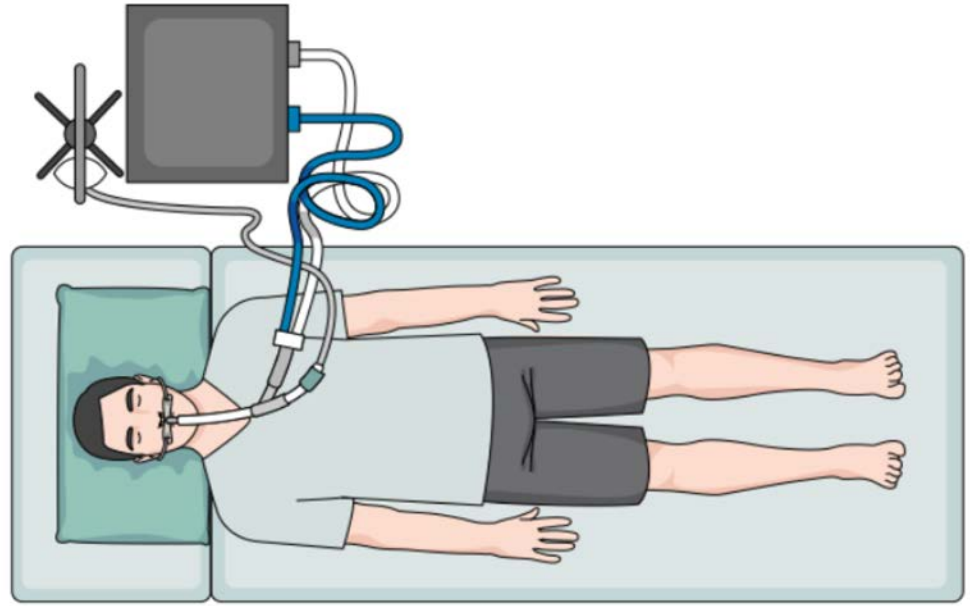
OXYGENATION



CMD

METABOLISM

GCS 15 14 13 12 11 10 9 8 7 6 5 3-4



CLINICAL EXAMINATION (PUPI) - SYSTEMIC VARIABLES

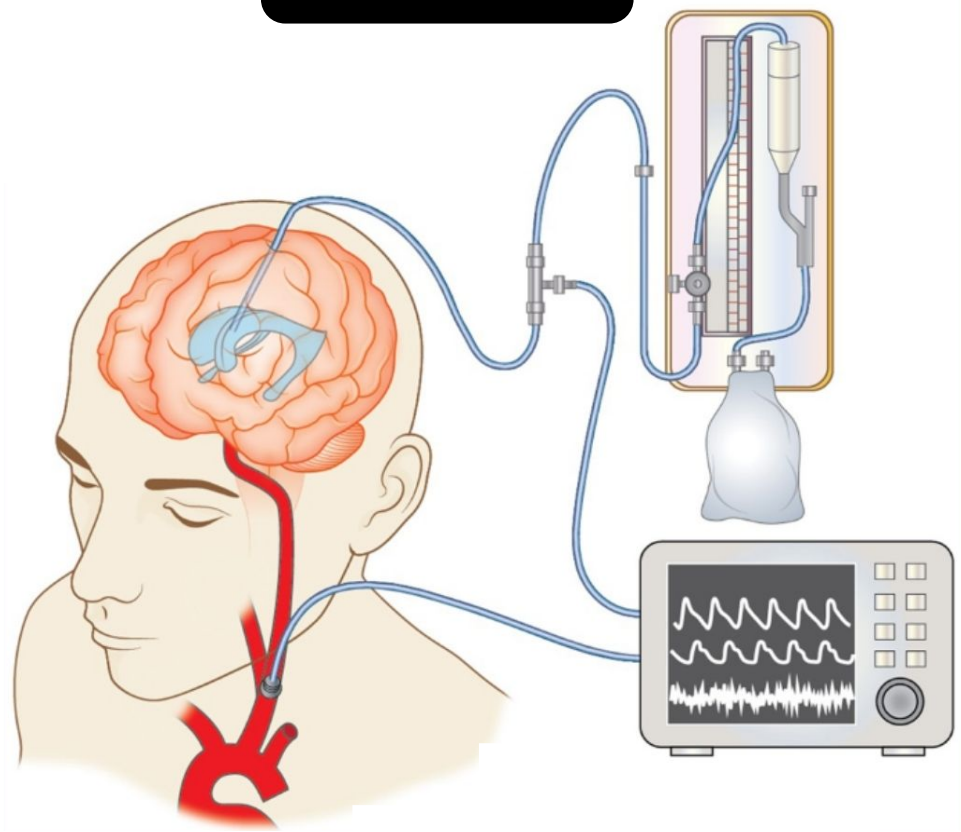
CEREBRAL ULTRASOUND

EEG

INVASIVE MMM

6 ICP MONITORING ?

GCS < 9



Indications for ICP monitoring in severe TBI (GCS ≤ 8)

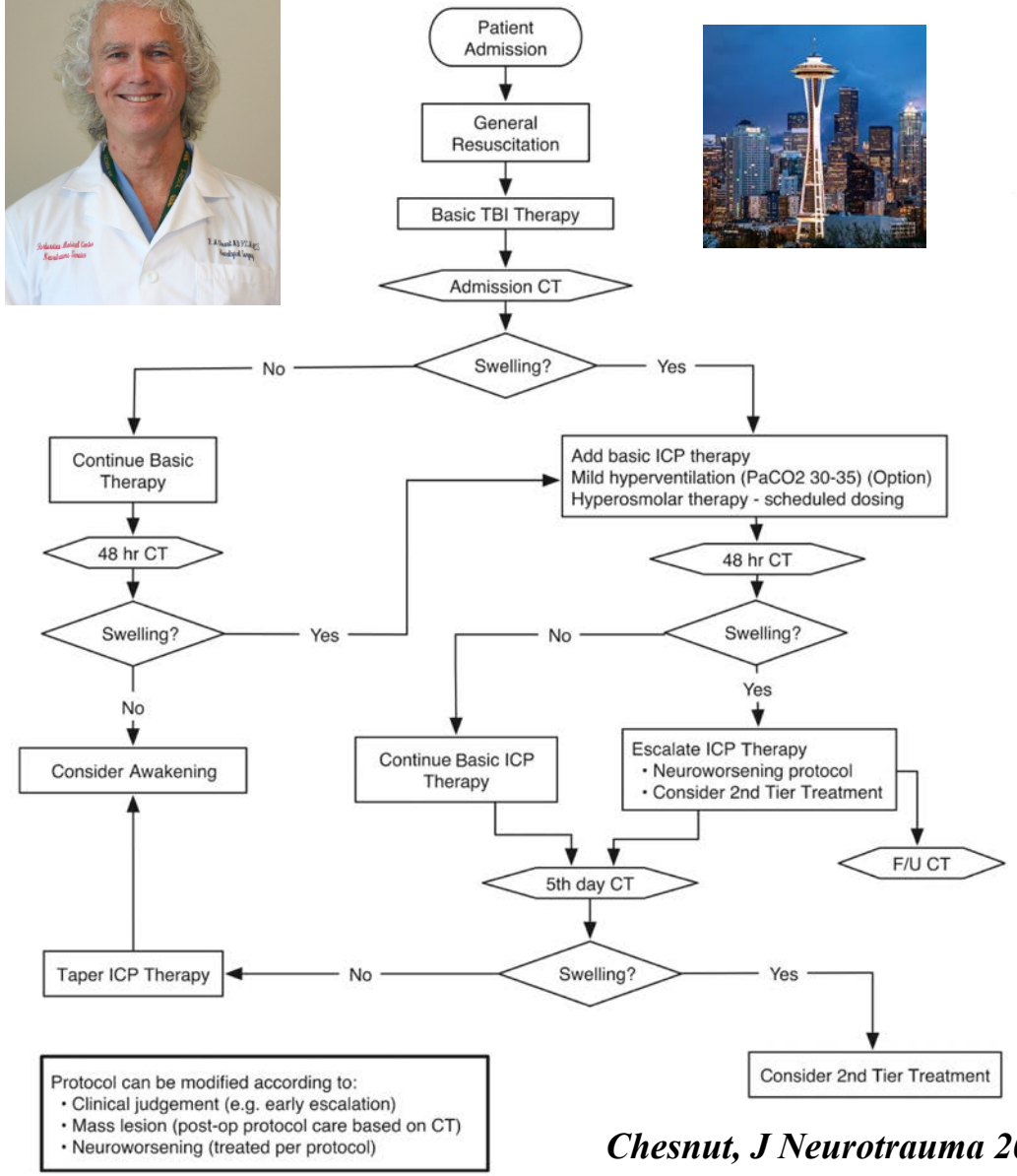
*Patient with normal head CT scan and two or more of the following:

- Motor posturing
- Age >40 years
- Arterial hypotension (systolic <90)

*Patient with abnormal head CT scan:

- Edema/swelling
- Hematoma or contusion
- Compression of basal cisterns

ICP MONITORING ?

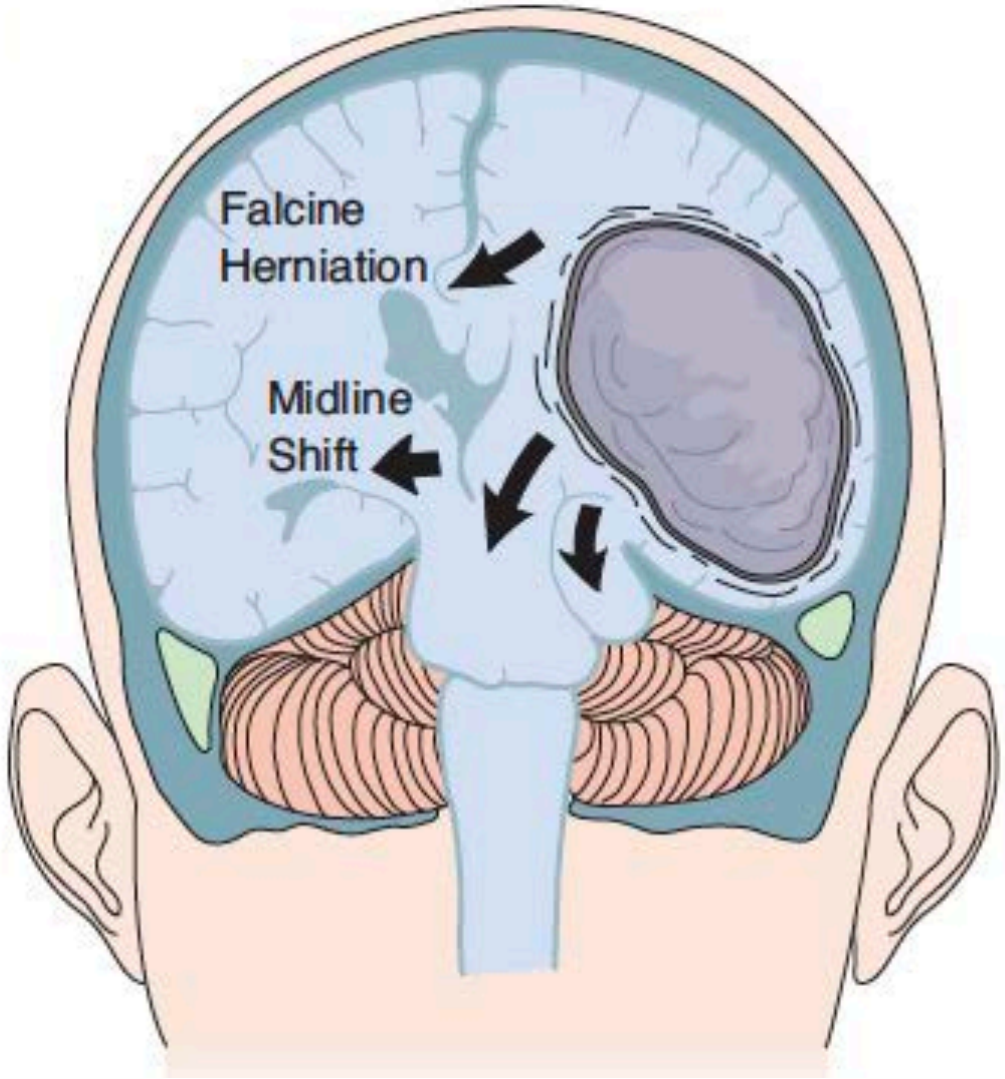


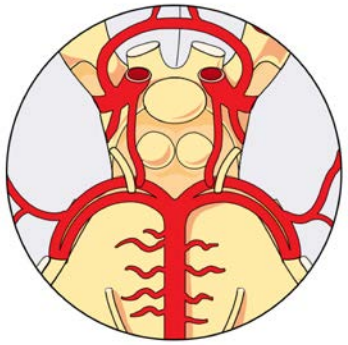
Chesnut, J Neurotrauma 2018

A Trial of Intracranial-Pressure Monitoring in Traumatic Brain Injury

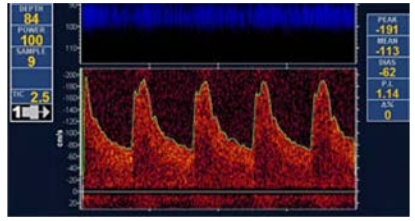
Randall M. Chesnut, M.D., Nancy Temkin, Ph.D., Nancy Carney, Ph.D., Sureyya Dikmen, Ph.D., Carlos Rondina, M.D., Walter Videtta, M.D., Gustavo Petroni, M.D., Silvia Lujan, M.D., Jim Pridgeon, M.H.A., Jason Barber, M.S., Joan Machamer, M.A., Kelley Chaddock, B.A., Juanita M. Celix, M.D., Marianna Cherner,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

HOW TO SELECT CANDIDATES FOR ICP ?

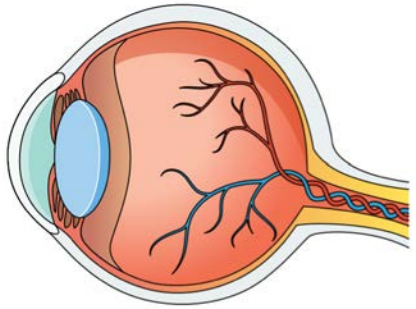




CBF velocities



Vd < 20 cm/sec
PI > 1.2
eICP > 20 mmHg



Pupil / ONSD

ONSD > 6 mm
NPI < 3

HOW TO SELECT CANDIDATES FOR ICP ?

CONFERENCE REPORTS AND EXPERT PANEL

The Brussels consensus for non-invasive ICP monitoring when invasive systems are not available in the care of TBI patients (the B-ICONIC consensus, recommendations, and management algorithm)

Pupil / ONSD

ONSD > 6 mm
NPI < 3

HOW TO USE ICP ?

Topic	Recommendations
Blood pressure thresholds	Level III
	• **Maintaining SBP at ≥100 mm Hg for patients 50 to 69 years old or at ≥110 mm Hg or above for patients 15 to 49 or >70 years old may be considered to decrease mortality and improve outcomes.**
Intracranial pressure thresholds	Level IIB
	• **Treating ICP >22 mm Hg is recommended because values above this level are associated with increased mortality.**
	Level III
	• A combination of ICP values and clinical and brain CT findings may be used to make management decisions.
	*The committee is aware that the results of the RESCUEicp trial[2] were released after the completion of these Guidelines. The results of this trial may affect these recommendations and may need to be considered by treating physicians and other users of these Guidelines. We intend to update these recommendations if needed. Updates will be available at https://braintrauma.org/coma/guidelines.
Cerebral perfusion pressure thresholds	Level IIB
	• **The recommended target CPP value for survival and favorable outcomes is between 60 and 70 mm Hg. Whether 60 or 70 mm Hg is the minimum optimal CPP threshold is unclear and may depend upon the autoregulatory status of the patient.**
	Level III
	• Avoiding aggressive attempts to maintain CPP >70 mm Hg with fluids and pressors may be considered because of the risk of adult respiratory failure.
Advanced cerebral monitoring thresholds	Level III
	• Jugular venous saturation of <50% may be a threshold to avoid in order to reduce mortality and improve outcomes.

Neurosurgery 0:1–10, 2016

Tier 1

- Maintain CPP 60–70 mmHg
- Increase analgesia to lower ICP
- Increase sedation to lower ICP
- Maintain P_aCO_2 at low end of normal (35–38 mmHg/4.7–5.1 kPa)
- Mannitol by intermittent bolus *(0.25–1.0 g/kg)*
- Hypertonic saline by intermittent bolus*
- CSF drainage if EVD *in situ*
- Consider placement of EVD to drain CSF if parenchymal probe used initially
- Consider anti-seizure prophylaxis for 1 week only (unless indication to continue)
- Consider EEG monitoring

Principles for Using Tiers:

- When possible, use lowest tier treatment
- There is no rank order within a tier
- It is not necessary to use all modalities in a lower tier before moving to the next tier
- If considered advantageous, tier can be skipped when advancing treatment

Tier 2

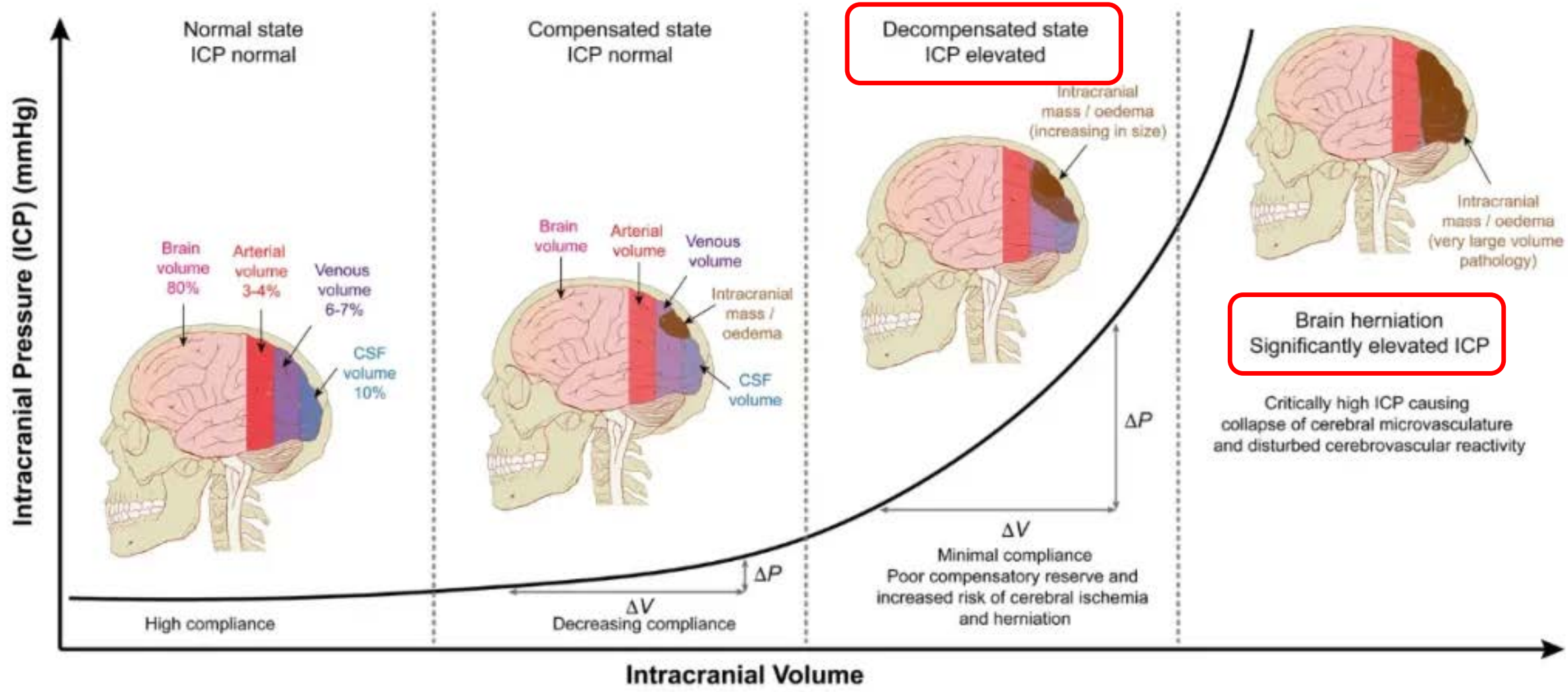
- Mild hypocapnia range 32–35 mmHg/4.3–4.6 kPa)
- Neuromuscular paralysis in adequately sedated patients if efficacious**
- **Perform MAP Challenge to assess cerebral autoregulation and guide MAP and CPP goals in individual patients†**
  - *Should be performed under direct supervision of a physician who can assess response and ensure safety*
  - *No other therapeutic adjustments (ie. sedation) should be performed during the MAP Challenge*
  - *Initiate or titrate a vasopressor or inotrope to increase MAP by 10 mmHg for not more than 20 minutes*
  - *Monitor and record key parameters (MAP, CPP, ICP and $P_{bt}O_2$) before during and after the challenge*
  - *Adjust vasopressor/inotrope dose based on study findings*
- Raise CPP with fluid boluses, vasopressors and/or inotropes to lower ICP when autoregulation is intact

- Re-examine the patient and consider repeat CT to re-evaluate intracranial pathology
- Reconsider surgical options for potentially surgical lesions
- Consider extracranial causes of ICP elevation
- Review that basic physiologic parameters are in desired range (e.g. CPP, blood gas values)
- Consider consultation with higher level of care if applicable for your health care system

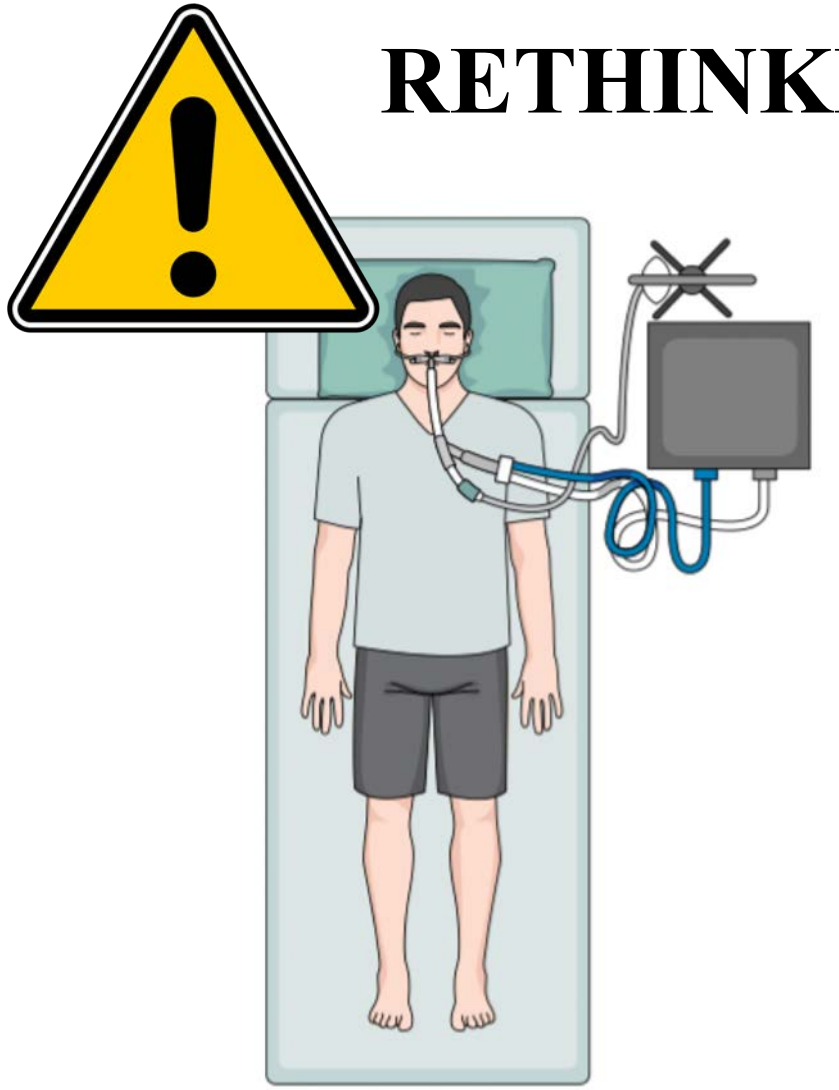
Tier 3

- Pentobarbital or Thiopentone coma titrated to ICP control if efficacious‡
- Secondary decompressive craniectomy
- Mild hypothermia (35–36°C) using active cooling measures

HOW TO USE ICP ?

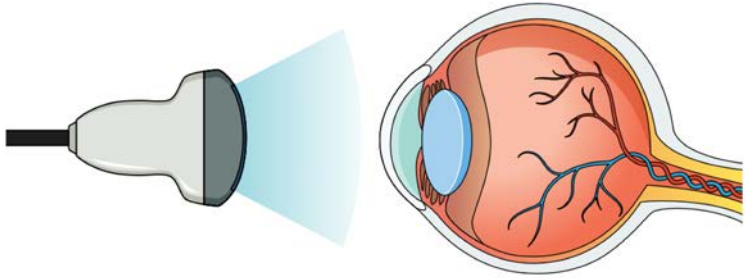


RETHINKING BRAIN COMPLIANCE

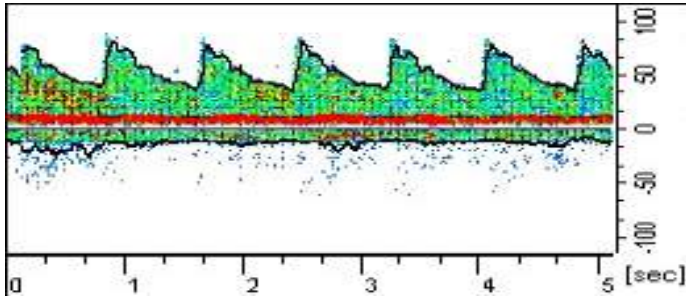


UNCONSCIOUS

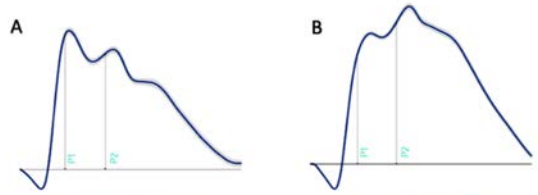
NPI < 3



ONSD > 5.5-6.0 mm

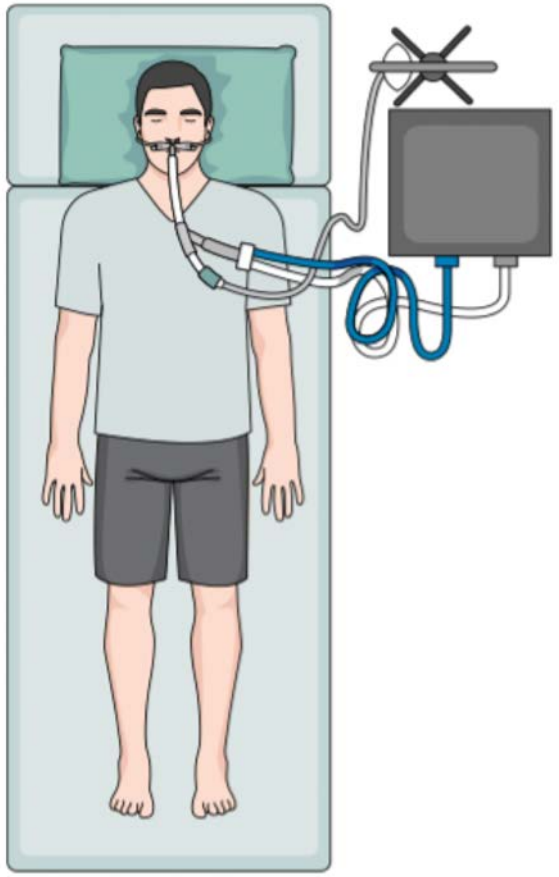


Vd < 20 cm/sec or PI > 1.2(1.4)

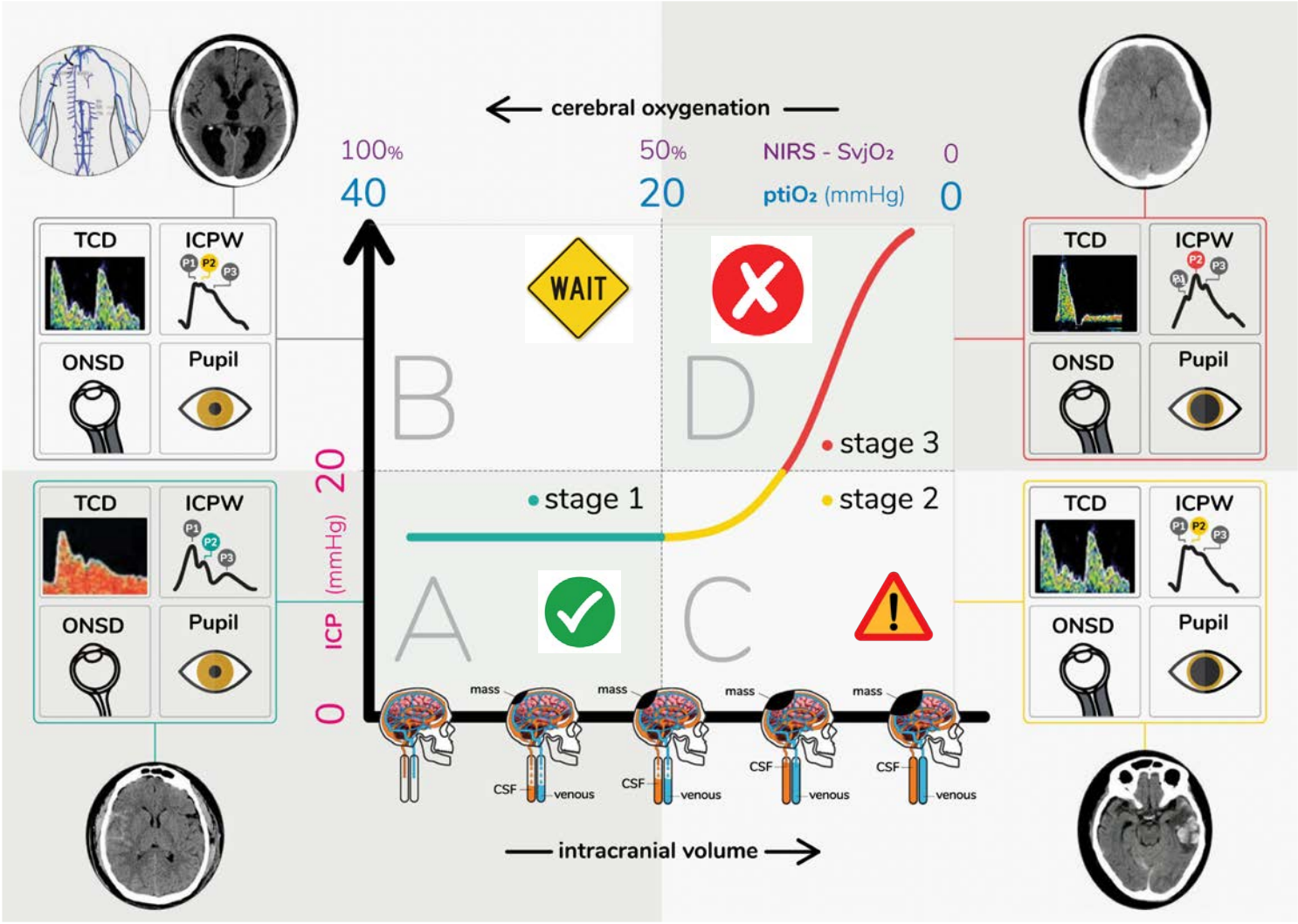


P2/P1 > 1.2

INTRACEREBRAL COMPARTMENT SYNDROME



UNCONSCIOUS



HOW TO USE CPP ?

Differences In Management Approaches to the Head-injured Patient

	Approaches to the Critical Care Management of Traumatic Brain Injury			
	Traditional	**CPP management [2]**	**Lund therapy [4,15]**	**Individualized therapy [6]**
General Management:				
Head position	15-30° elevation	Flat	Flat	whatever position gives best CPP and ICP
Sedation	morphine + lorazepam	No	low dose thiopental	morphine + lorazepam
Treatment of systemic hypertension	Treat SBP > 160 mmHg, using labetalol	No	metoprolol + clonidine	Ischemia/hypoperfusion pattern, do not treat Adequate perfusion, may treat with labetalol
Nutritional support	Yes, avoid hyperglycemia	No	Yes, avoid hyperglycemia	yes, avoid hyperglycemia
Treatment of Intracranial Hypertension				
Neuromuscular blockade	Yes	Yes	No	yes
Hyperventilation	Yes	No	No	Ischemia/hypoperfusion pattern, don't use Adequate perfusion, may use
CSF drainage	Yes	Yes	No	Yes
Osmotherapy	Yes	Yes	No	Hypoperfusion/edema pattern, yes Hyperemia/vascular engorgement pattern, no
Barbiturate coma	Yes	No	No	Hypoperfusion/edema pattern, no Hyperemia/vascular engorgement pattern, yes
Management of Cerebral Perfusion Pressure				
Goal for CPP	Not considered, keep ICP < 20 mmHg and normal BP	>70-80 mmHg (above lower limit of autoregulation)	>50-60 mmHg (whatever provides adequate perfusion)	Hypoperfusion/ischemia pattern-increase CPP to improve CBF, especially if autoregulation is impaired Adequate perfusion, maintain normal CPP

Targeting Autoregulation-Guided Cerebral Perfusion Pressure after Traumatic Brain Injury (COGiTATE): A Feasibility Randomized Controlled Clinical Trial

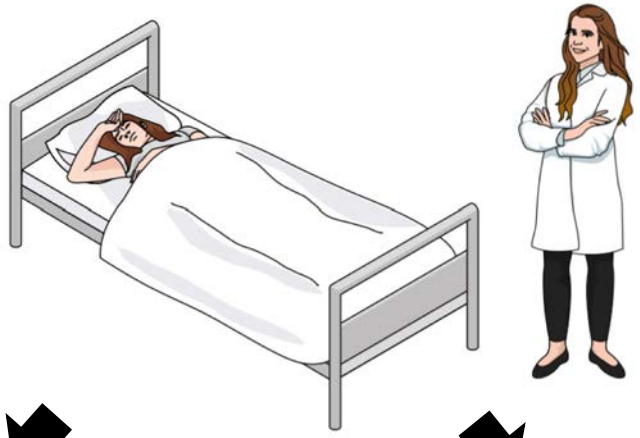
Jeanette Tas,[1,2,*] Erta Beqiri,[3] Ruud C. van Kaam,[4] Marek Czosnyka,[3,5] Joseph Donnelly,[3] Roel H. Haeren,[2,6] Iwan C.C. van der Horst,[1,7] Peter J. Hutchinson,[8] Sander M.J. van Kuijk,[9] Analisa L. Liberti,[1,10] David K. Menon,[11] Cornelia W.E. Hoedemaekers,[4] Bart Depreitere,[12,**] Peter Smielewski,[3,**] Geert Meyfroidt,[13,**] Ari Ercole,[11,**] and Marcel J.H. Aries[1,2,**]

Intracranial pressure monitoring with and without brain tissue oxygen pressure monitoring for severe traumatic brain injury in France (OXY-TC): an open-label, randomised controlled superiority trial

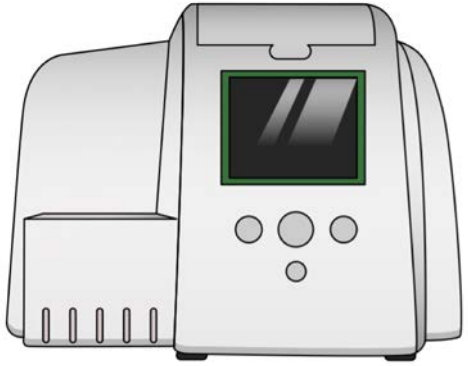
*Jean-François Payen, Yoann Launey, Russell Chabanne, Samuel Gay, Gilles Francony, Laurent Gergele, Emmanuel Vega, Ambroise Montcriol, David Couret, Vincent Cottenceau, Sebastien Pili-Floury, Clement Gakuba, Emmanuelle Hammad, Gerard Audibert, Julien Pottecher, Claire Dahyot-Fizelier, Lamine Abdennour, Tobias Gauss, Marion Richard, Antoine Vilotitch, Jean-Luc Bosson, Pierre Bouzat for the OXY-TC trial collaborators**

TRAUMATIC BRAIN INJURY

CLINICAL EXAMINATION

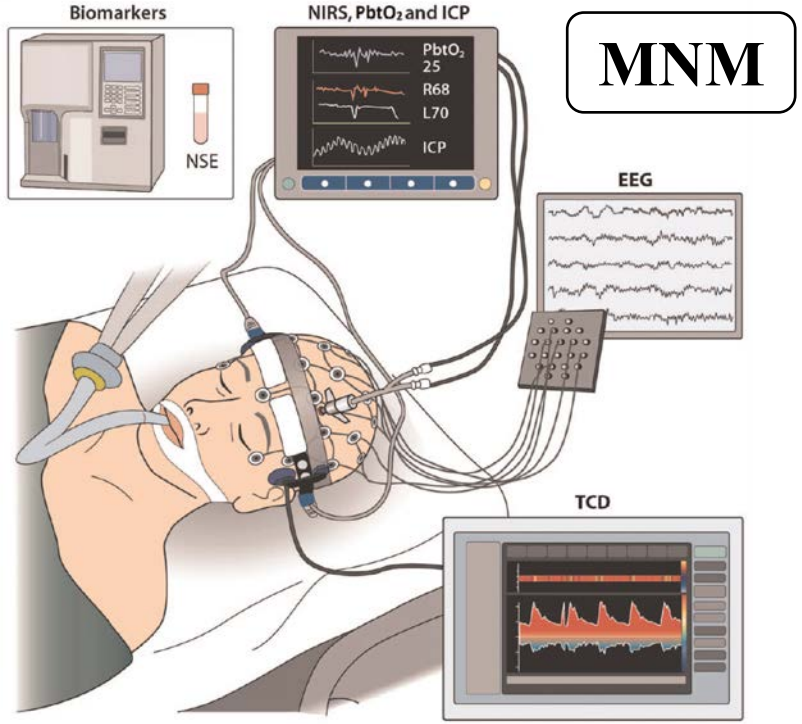


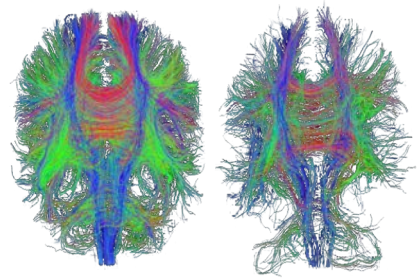
MONITOR



BLOOD GASES ANALYZER

MNM





Thanks

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