Wie ist das Langzeitoutcome nach Schädel-Hirn-Trauma?

Christian Senft

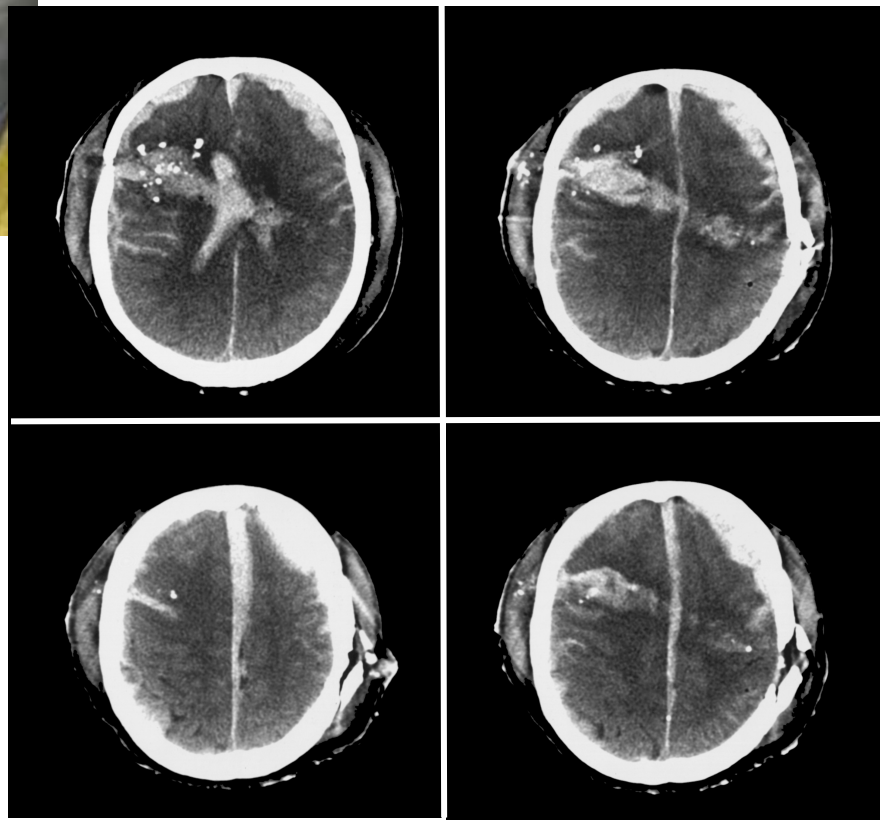
Stellv. Klinikdirektor

Klinik und Poliklinik für Neurochirurgie
Universitätsklinikum Frankfurt

Gliederung

- Allgemeines zum SHT
- Outcome-Assessment
- Darstellung aktueller Studienergebnisse
- Prognose-Abschätzung

Quelle: B.Z. Online, 14.6.2017



Primäre Hirnschädigung

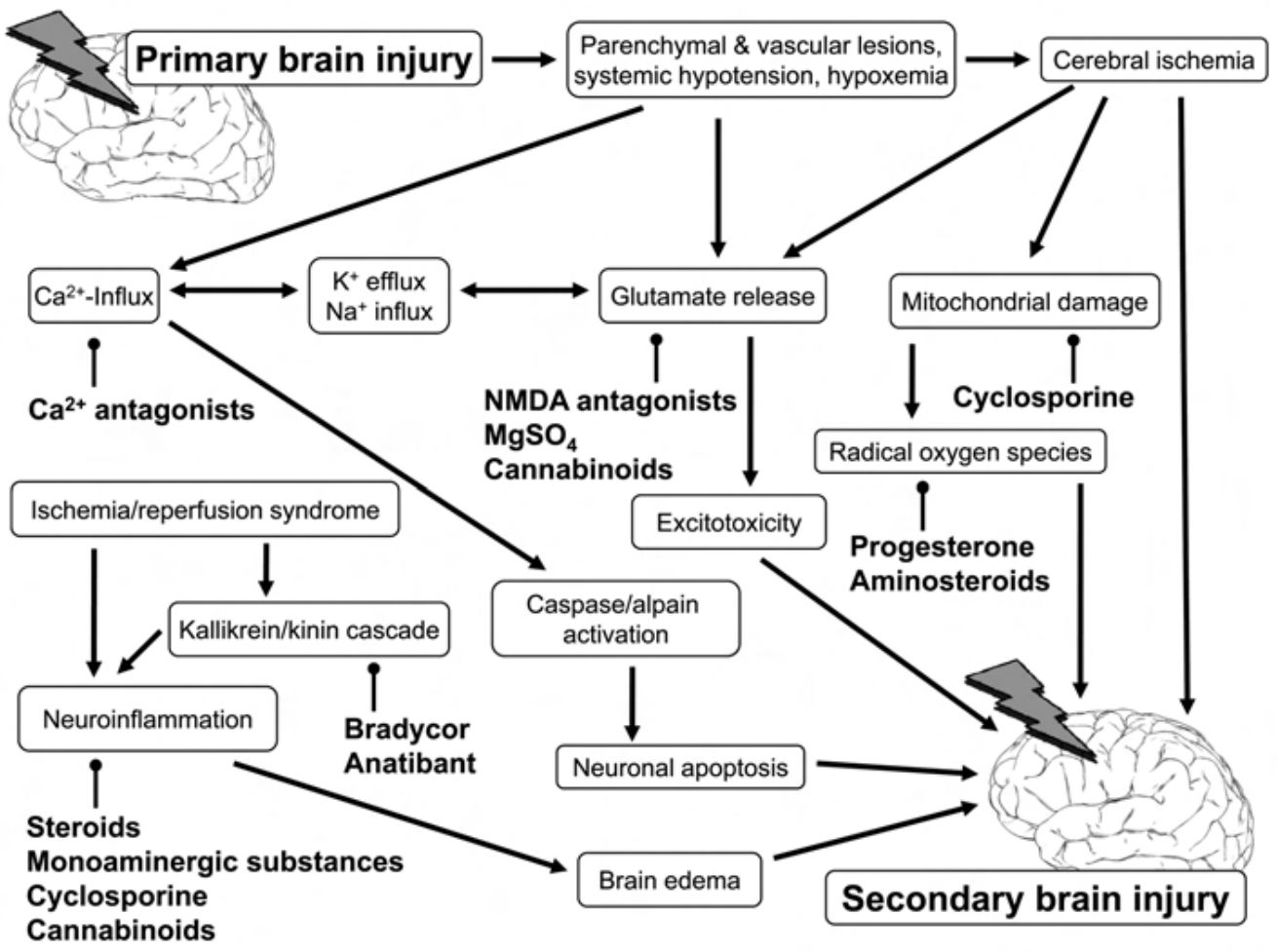
- Direkte Schädigung des Hirns durch Gewalteinwirkung
- sofortiges Auftreten
- beeinflussbar nur durch (Unfall-)Vermeidung oder Rehabilitation

Sekundäre Hirnschädigung

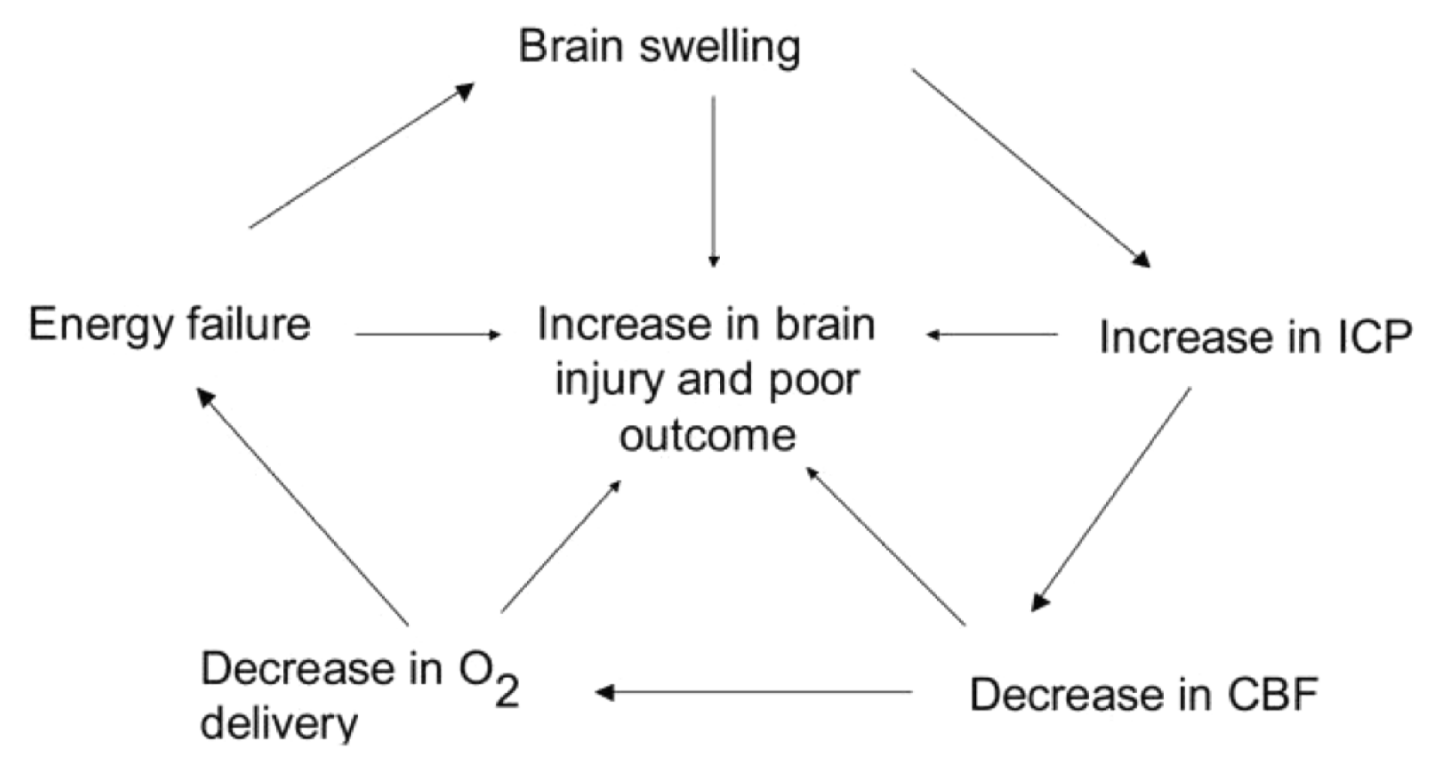
- Verzögertes Auftreten
  (Minuten – Stunden – Tage – Wochen)
  - Epi-/subdurales Hämatom
  - Kontusionsblutung
  - Perifokale Ödeme/Ischämien

- Hirndruckanstieg
- Lokale Hypoxie/Hypoperfusion

- (Langzeit-)Komplikationen
  - Hydrocephalus
  - Hormonstörungen, u.a.



Beauchamp/Mutlak et al. , Mol Med 14: 731-740, 2008



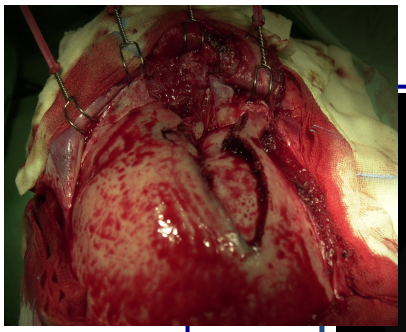
Hutchinson, Kirkpatrick *Curr Opin Crit Care* 2004

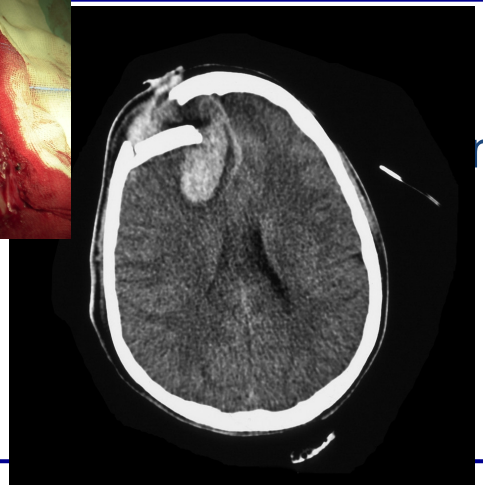
Einteilung des Schädel-Hirn-Traumas

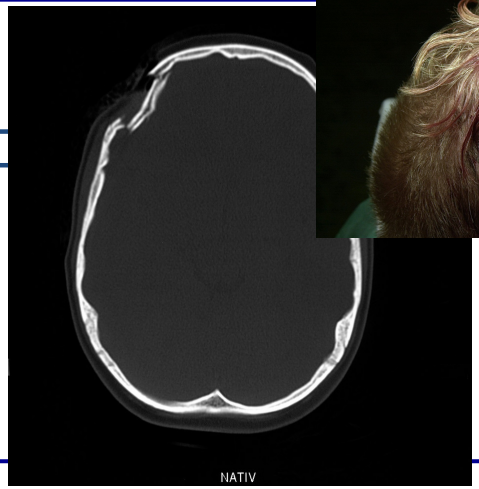
- Leicht (GCS 13-15)
- Mittel (GCS 9-12)
- Schwer (GCS ≤8)

offen – geschlossen

(Integrität der Dura mater)







Die Prognose von Patienten mit schwerem Schädel-Hirn-Trauma hat sich in den letzten 20 Jahren erheblich verbessert. ... Dies wird auf die zunehmende **Qualität der Versorgung** direkt nach dem Unfall zurückgeführt sowie auf Fortschritte der bildgebenden Verfahren wie CT und MRT, des **Neuromonitorings** und der **Intensivmedizin**.

...

Eine frühzeitige und **intensive Rehabilitation** verbessert die Chancen auf eine weitgehende Wiederherstellung der geistigen und körperlichen Fähigkeiten. Patienten und Angehörigen müssen jedoch sehr viel Zeit und Geduld mitbringen, da die Rehabilitation **oft Monate oder Jahre dauern** kann.

Auch wenn nicht wenige Schädel-Hirn-Verletzte nach einer umfassenden Therapie und entsprechenden Reha-Maßnahmen wieder am Berufsleben teilnehmen können, bleiben doch für die Mehrzahl der Hirngeschädigten **lebenslange körperliche oder geistige Behinderungen** zu bewältigen. Bei schweren Hirnverletzungen sind **bleibende Schäden sehr wahrscheinlich**. Diese können von leichten Störungen der Persönlichkeit und Merkfähigkeit bis zu schweren Ausfällen wie einem Wachkoma (Apallisches Syndrom) reichen.

ICU

- **N**ormoxie
  - Sicherung der Atemwege
  - Intubation bei GCS≤8,
- **N**ormoventilation ($paCO_2$<44)
- **N**ormotonie
  - Syst. >100, MAP >80
- **N**ormothermie
- **N**ormoglykämie
  - keine Glucocorticoide!

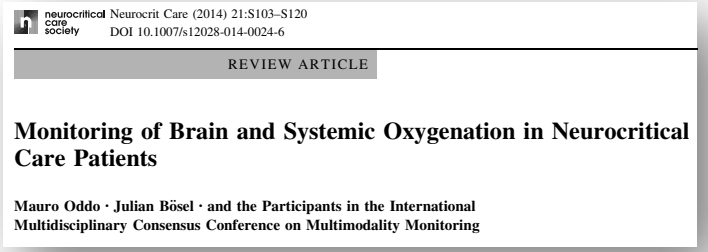
Initial treatment measures
- Head elevation
- Ventilation
- Sedation
- Analgesia
- Paralysis (optional)

Monitoring
- Central venous pressure
- Arterial blood pressure
- Intracranial pressure

Optional treatments that can be added
- Ventriculostomy
- Inotropes
- Mannitol
- Hypertonic saline

Neuromonitoring

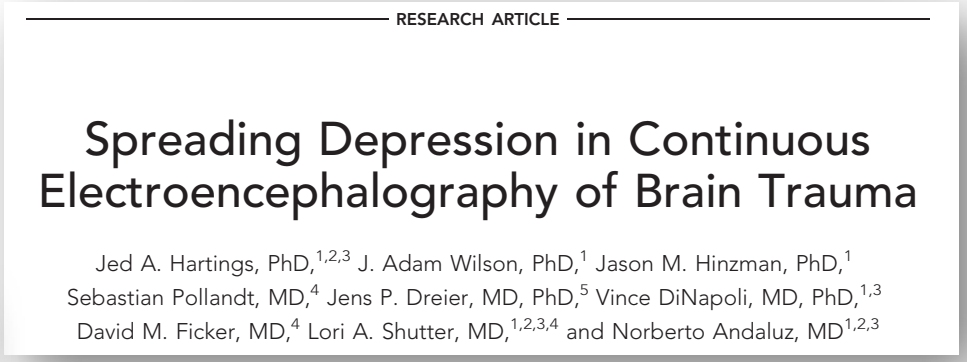
- ICP-Messung
- ptO_2-Messung
- Neurophysiologie
- Mikrodialyse/Biomarker


neurocritical care society Neurocrit Care (2014) 21:S103–S120
DOI 10.1007/s12028-014-0024-6

REVIEW ARTICLE

Monitoring of Brain and Systemic Oxygenation in Neurocritical Care Patients

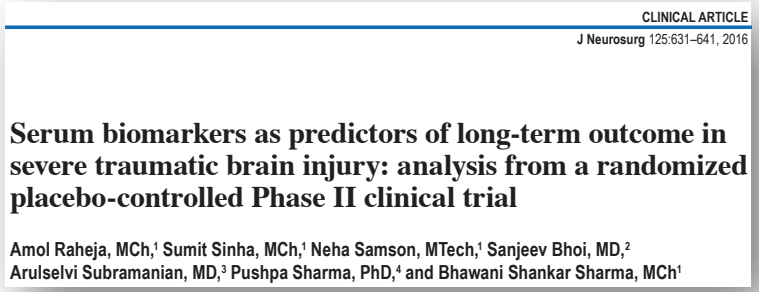
Mauro Oddo · Julian Bösel · and the Participants in the International Multidisciplinary Consensus Conference on Multimodality Monitoring



RESEARCH ARTICLE

Spreading Depression in Continuous Electroencephalography of Brain Trauma

Jed A. Hartings, PhD,[1,2,3] J. Adam Wilson, PhD,[1] Jason M. Hinzman, PhD,[1] Sebastian Pollandt, MD,[4] Jens P. Dreier, MD, PhD,[5] Vince DiNapoli, MD, PhD,[1,3] David M. Ficker, MD,[4] Lori A. Shutter, MD,[1,2,3,4] and Norberto Andaluz, MD[1,2,3]

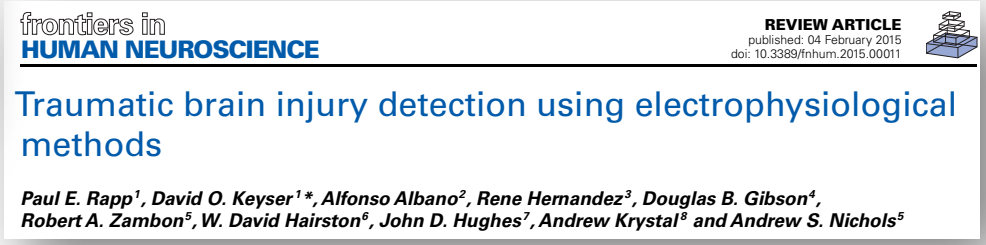


CLINICAL ARTICLE

J Neurosurg 125:631–641, 2016

Serum biomarkers as predictors of long-term outcome in severe traumatic brain injury: analysis from a randomized placebo-controlled Phase II clinical trial

Amol Raheja, MCh,[1] Sumit Sinha, MCh,[1] Neha Samson, MTech,[1] Sanjeev Bhoi, MD,[2] Arulselvi Subramanian, MD,[3] Pushpa Sharma, PhD,[4] and Bhawani Shankar Sharma, MCh[1]



frontiers in HUMAN NEUROSCIENCE

REVIEW ARTICLE
published: 04 February 2015
doi: 10.3389/fnhum.2015.00011

Traumatic brain injury detection using electrophysiological methods

Paul E. Rapp[1], David O. Keyser[1], Alfonso Albano[2], Rene Hernandez[3], Douglas B. Gibson[4], Robert A. Zambon[5], W. David Hairston[6], John D. Hughes[7], Andrew Krystal[8] and Andrew S. Nichols[5]*

Bratton et al., J Neurotrauma 24(1 Suppl): S37-44, 2007

Indications for intracranial pressure monitoring

Empfehlungen zum ICP-Monitoring

level I
Mangelnde Datenlage, um einen Standard zu empfehlen.

level II
Schweres SHT (GCS 3-8) und auffälliges CT (ICB, Kontusion, Schwellung, Herniation, basale Zisternen).

level III
Schweres SHT und unauffälliges CT, wenn 2 oder mehr Kriterien zutreffen:
Alter: > 40 Jahre
uni- oder bilaterales Beugen/Strecken
Hypotension (syst. < 90 mmHg)

- Wer ist gefährdet?
- Sind ICP-Werte hilfreich?
- Verbessert die ICP-Messung das Outcome?

ICP-Messung

The NEW ENGLAND JOURNAL of MEDICINE

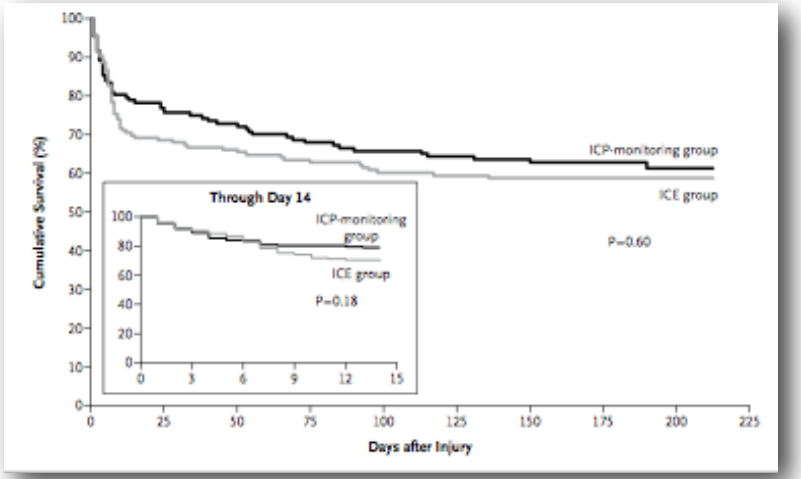
ESTABLISHED IN 1812 DECEMBER 27, 2012 VOL. 367 NO. 26

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*

Table 2. Clinical Outcomes.*

Variable	Pressure-Monitoring Group (N=157)	Imaging–Clinical Examination Group (N=167)	P Value	Proportional Odds Ratio (95% CI)†
Patients assessed at 6 mo — no. (%)	144 (92)	153 (92)		
Primary outcome‡			0.49§	1.09 (0.74–1.58)
Median	56	53		
Interquartile range	22–77	21–76		
Cumulative mortality at 6 mo — %	39	41	0.60¶	1.10 (0.77–1.57)
GOS-E scale at 6 mo — no. (%)‖				
Death	56 (39)	67 (44)**	0.40§	1.23 (0.77–1.96)
Unfavorable outcome	24 (17)	26 (17)		
Favorable outcome	63 (44)	60 (39)		



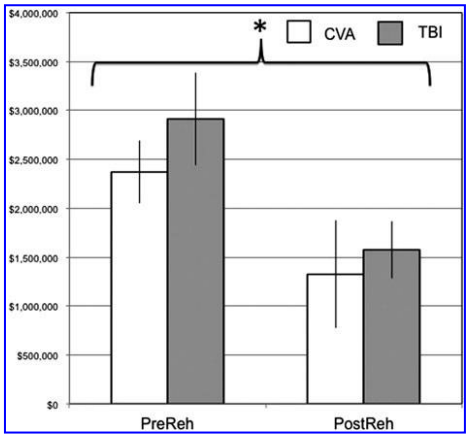
Rehabilitation

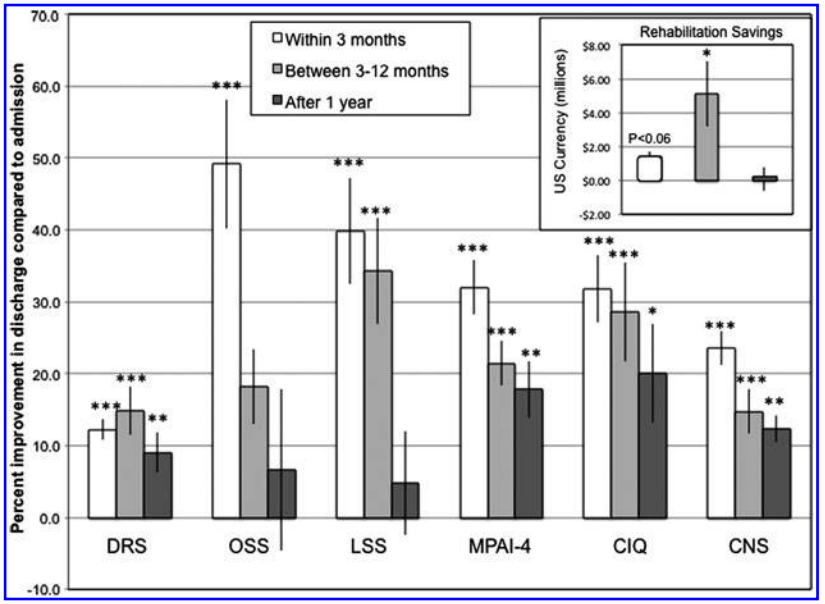
JOURNAL OF NEUROTRAUMA 32:704–711 (May 15, 2015)

DOI: 10.1089/neu.2014.3754

Post-Acute Traumatic Brain Injury Rehabilitation: Effects on Outcome Measures and Life Care Costs

Grace S. Griesbach,[1,2] Lisa A. Kreber,[1] David Harrington,[1] and Mark J. Ashley[1]





Outcome Assessment nach SHT

Glasgow Outcome Scale and its extended version

	GOS		GOSE
1	*Death* Mortality from any cause	1	*Death*
2	*Vegetative state* Unable to interact with environment, unresponsive	2	*Vegetative state*
3	*Severe disability* Conscious but dependent	3	*Lower:* dependent on others for activities of daily living *Upper:* dependent on others for some activities
		4	
4	*Moderate disability* Independent but disabled	5	*Lower:* unable to return to work or participate in social activities
		6	*Upper:* return to work at reduced capacity, reduced participation in social activities
5	*Good recovery* Return to normal occupation and social activities, may have minor residual deficits	7	*Lower:* minor social or mental deficits which do not impair normal functioning
		8	*Upper:* full recovery, no residual complaints or deficits

GOS: Glasgow Outcome Scale; GOSE: Glasgow Outcome Scale - Extended.

Mögliche Folgen eines SHTs

- posttraumatische Belastungsstörung
- Veränderungen von
  - Kognition
  - Stimmung
  - Verhalten
- posttraumatischer Kopfschmerz
- u.v.m.

Return to work (GOS-E ≥ 6)

Return to work following traumatic brain injury: Trends and challenges

JEFFREY SHAMES[1], IULY TREGER[2], HAIM RING[2] & SALVATORE GIAQUINTO[3]

[1]*Day Rehabilitation Center, Maccabi Health Services, Rishon LeZion,* [2]*Department of Neurological Rehabilitation, Loewenstein Rehabilitation Center, Ra'anana, and Sackler Faculty of Medicine, Tel Aviv University, Israel, and* [3]*Department of Neurological Rehabilitation, IRCCS San Raffaele Pisana, Roma, Italy*

Disability and Rehabilitation, September 2007; 29(17): 1387–1395

Handbook of Clinical Neurology, Vol. 131 (3rd series)
Occupational Neurology
M. Lotti and M.L. Bleecker, Editors

Chapter 26

Considerations for return to work following traumatic brain injury

DEBORAH M. LITTLE[1,2,*], ANDREW J. COOK[2,3], SANDRA B. MORISSETTE[2,3], AND JOHN W. KLOCEK[4]
[1]*Baylor Scott and White Healthcare, Temple, TX, USA*
[2]*Neuroscience Institute, Texas A&M Health Science Center College of Medicine, Temple, TX, USA*
[3]*Central Texas Veterans Healthcare System, Temple, TX, USA*
[4]*Department of Psychology and Neuroscience, Baylor University, Waco, TX, USA*

Table I. Studies of return to work rates.

Study	Population	Results	Comments
McMordie et al. [7] (USA)	Mixed severity TBI	45% RTW, 19% competitive, average 6 years post injury	Included some stroke patients
Ruffolo et al. [8] (Canada)	Mild TBI following motor vehicle accident	12% full RTW, 30% modified in 6–9 months	All patients working pre-morbidly
Roa et al. [9] (USA)	Mixed-severity TBI	66% at average of 16 months post injury	Work or school
Possl et al. [11] (Germany)	Severe TBI + CVA	37% stable premorbid RTW, 28% retired in 7 years	Included vocational re-entry program
Ruff et al. [39] (USA)	Severe TBI	18% RTW at 6 months, 31% at 12 months, 66% return to school	
Dombovy and Olek [66] (USA)	Mild-moderate TBI	39.5% employed 6 months post-discharge	
Matsushima et al. [67] (Japan)	moderate to severe TBI	No RTW	Follow-up period variable
Kraft et al. [68] (USA)	Veterans w/ penetrating injuries, mixed severity	56% gainfully employed	15 year follow-up period
Haboubi et al. [69] (UK)	Mild TBI	87.5% RTW at 6 weeks	
Chua and Kong [70] (Singapore)	Mixed severity (few mild) TBI	25% RTW 1 year post-injury	All initially inpatients 77% employed prior to injury

TBI, Traumatic brain injury; CVA, Cerebrovascular accident; RTW, Return to work.

Most common behavioral diagnoses following traumatic brain injury

Diagnosis	Frequency
Apathy	60%[1]
Depression	10–50%[2]
Agitation	25%[3]
Posttraumatic stress disorder	11–18%[4]
Psychosis	7–10%[5]

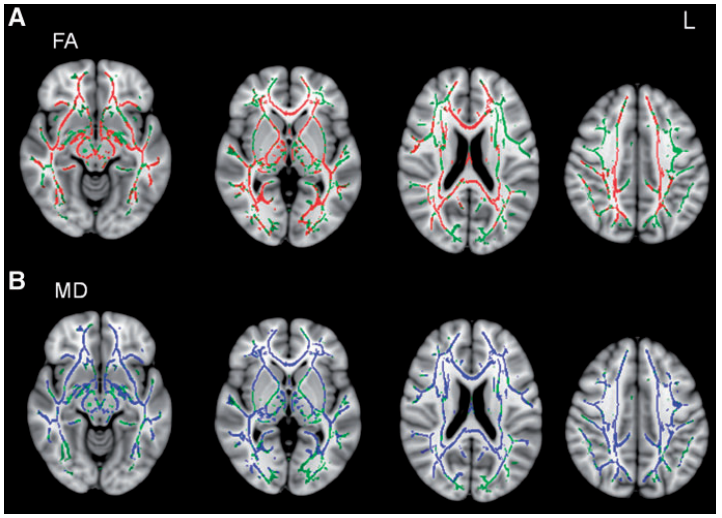
MRT-Korrelate der Funktion

doi:10.1093/brain/awq347 Brain 2011: 134; 449–463 | 449

BRAIN
A JOURNAL OF NEUROLOGY

White matter damage and cognitive impairment after traumatic brain injury

Kirsi Maria Kinnunen,[1] Richard Greenwood,[2] Jane Hilary Powell,[1] Robert Leech,[3] Peter Charlie Hawkins,[1] Valerie Bonnelle,[3,4] Maneesh Chandrakant Patel,[5] Serena Jane Counsell[6] and David James Sharp[3]



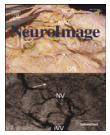
Region Name
cuneus wm right
sagittal stratum left
lingual wm right
sagittal stratum right
posterior thalamic radiation right
fusiform wm left
cingulum (hippocampus) left
inferior occipital wm left
superior longitudinal fasciculus right
posterior thalamic radiation left
cingulum (hippocampus) right
inferior occipital wm right
superior parietal wm left
anterior corona radiata left
middle occipital wm right
lateral fronto-orbital wm right
cingulum wm left
inferior frontal wm left
splenium of corpus callosum right
lingual wm left
inferior frontal wm right
middle fronto-orbital wm right
external capsule left
superior occipital wm right
lateral fronto-orbital wm left

NeuroImage 58 (2011) 109–121

Contents lists available at ScienceDirect

NeuroImage

journal homepage: www.elsevier.com/locate/ynimg



The generation and validation of white matter connectivity importance maps

Amy Kuceyeski [a,*], Jun Maruta [b], Sumit N. Niogi [c], Jamshid Ghajar [b,d], Ashish Raj [a]

[a] Imaging Data Evaluation and Analytics Laboratory (IDEAL), Dept. of Radiology, Weill Cornell Medical College, 515 E. 71st St., New York, NY 10065, USA
[b] Brain Trauma Foundation, 7 World Trade Center, 34th Floor, 250 Greenwich St, New York, NY 10007, USA
[c] Department of Radiology, Weill Cornell Medical College, 1300 York Ave., New York, NY 10065, USA
[d] Department of Neurological Surgery, Weill Cornell Medical College, 1300 York Ave., New York, NY 10065, USA

Lokalisation der Schädigung wichtiger als Ausmaß!

Outcome in großen Studien

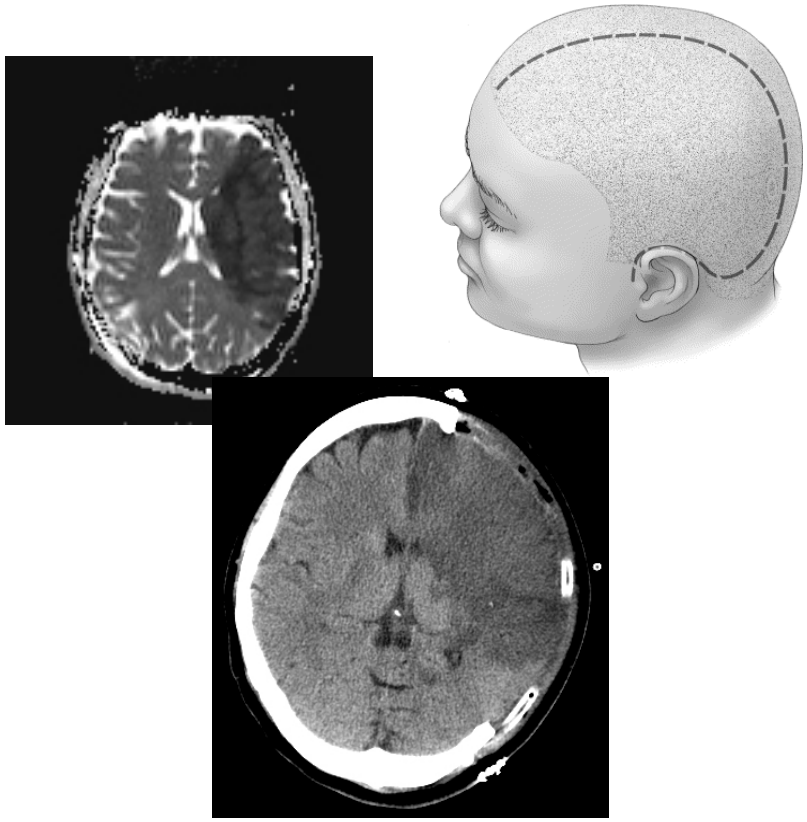
DECRA

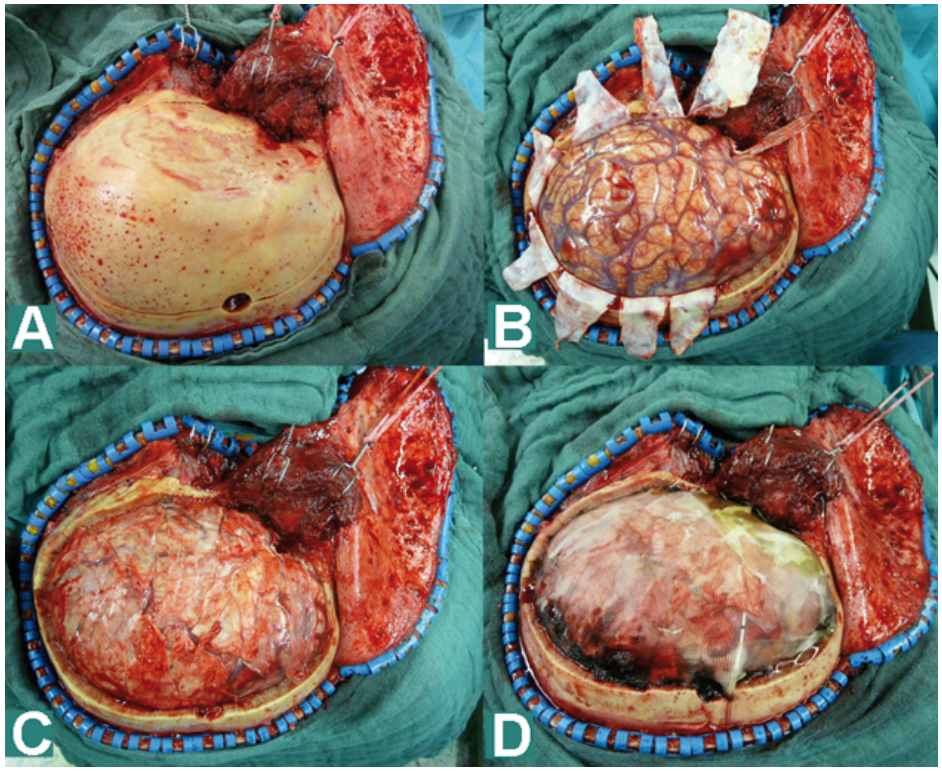
RESCUE-ICP

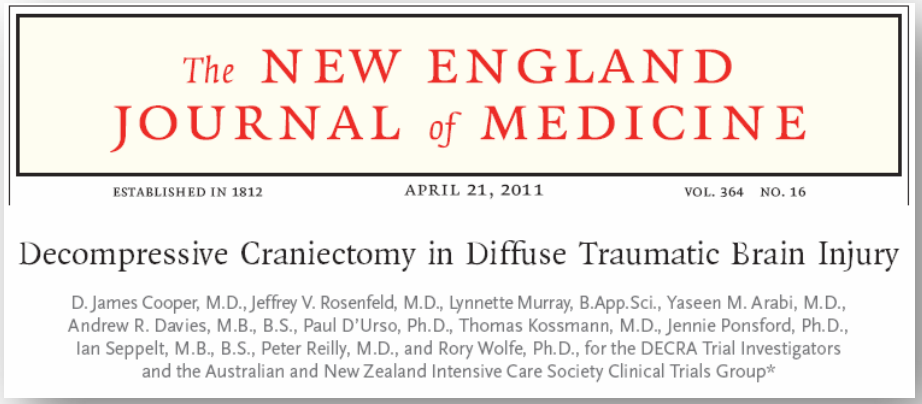
Hemicraniektomie

Early decompressive surgery in malignant infarction of the middle cerebral artery: a pooled analysis of three randomised controlled trials

Katayoun Vahedi, Jeannette Hofmeijer, Eric Juettler, Eric Vicaut, Bernard George, Ale Algra, G Johan Amelink, Peter Schmiedeck, Stefan Schwab, Peter M Rothwell, Marie-Germaine Bousser, H Bart van der Worp, Werner Hacke, for the DECIMAL, DESTINY, and HAMLET investigators







The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 APRIL 21, 2011 VOL. 364 NO. 16

Decompressive Craniectomy in Diffuse Traumatic Brain Injury

D. James Cooper, M.D., Jeffrey V. Rosenfeld, M.D., Lynnette Murray, B.App.Sci., Yaseen M. Arabi, M.D., Andrew R. Davies, M.B., B.S., Paul D'Urso, Ph.D., Thomas Kossmann, M.D., Jennie Ponsford, Ph.D., Ian Seppelt, M.B., B.S., Peter Reilly, M.D., and Rory Wolfe, Ph.D., for the DECRA Trial Investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group*

Zielsetzung: Evaluierung des Effekts einer frühen (< 72 h) Entlastungskraniotomie (bilaterale frontotemporale Kraniektomie) versus Standard-Intensivtherapie

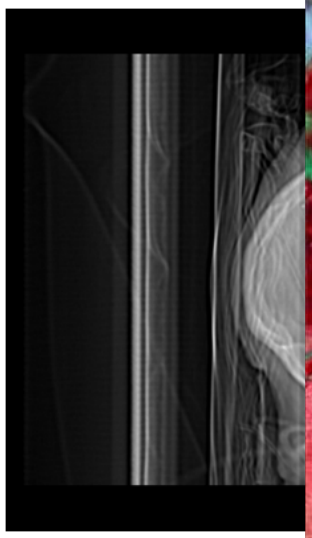
Studientyp: prospektiver RCT

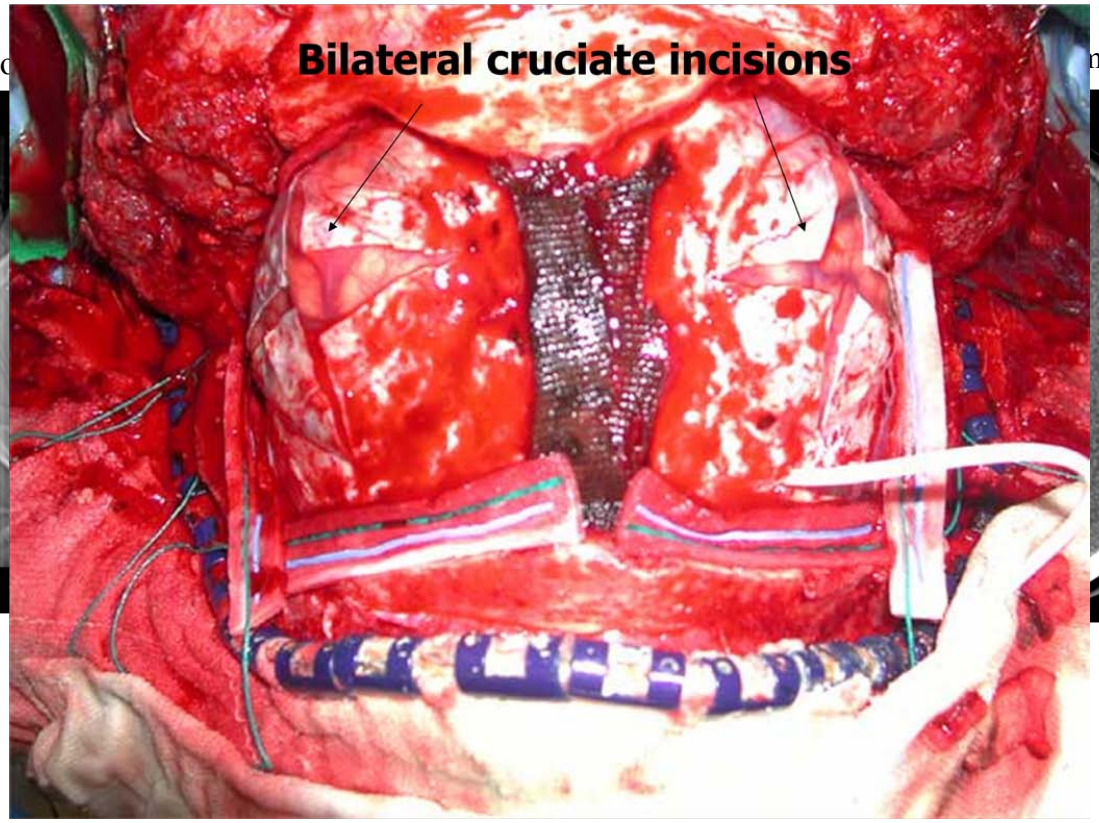
Patientenanzahl: 155 (aus einer Population von 3478 SHT Patienten)
Kraniektomie n=73, Standard Intensivtherapie n= 82

Inklusionskriterien: 15 bis 58 jährig. Pat. nach schwerem, diffusen SHT
refraktäre ICP-Werte (> 20mmHg > 15 min) innerhalb der ersten 72 h

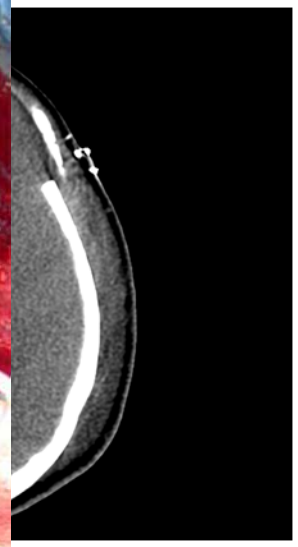
OP-Technik

Panel A. Post-craniecto





mporo-parietal craniectomy



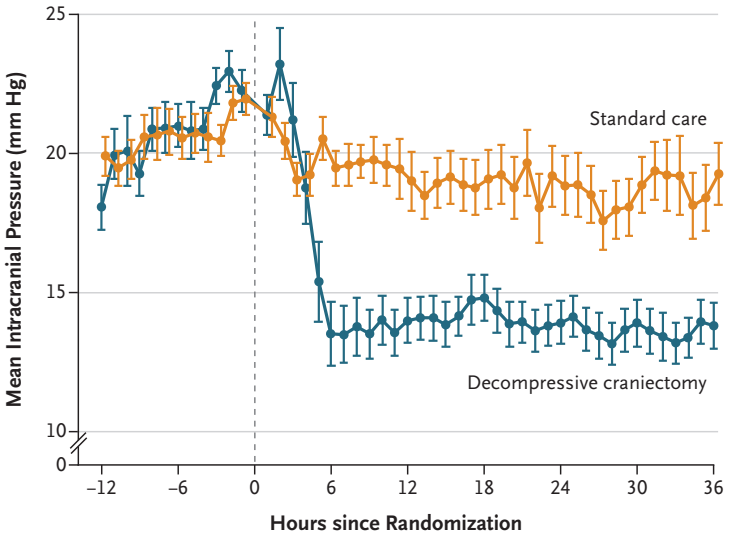
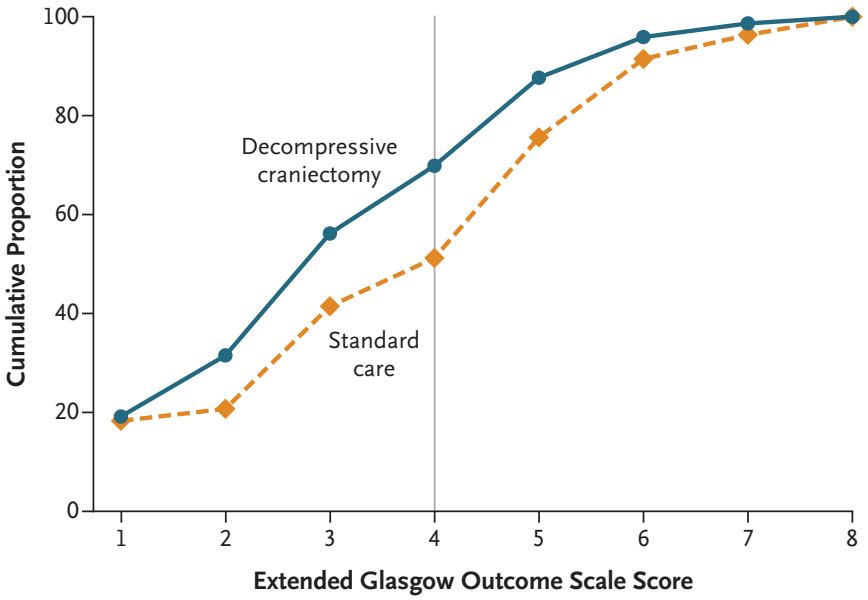


Figure 1. Intracranial Pressure before and after Randomization.
Shown are the mean measurements of intracranial pressure in the two study groups during the 12 hours before and the 36 hours after randomization. The I bars indicate standard errors.

Entlastungskraniotomie-Gruppe:

- signifikante Reduktion ICP
- Veringerung Liegedauer auf ICU

Outcome DECRA



Schlechtes Outcome
(Tod, Status vegetativus, schwere Behinderung)
nach 6 Monaten:

70 % Craniektomie

51 % kons. Gruppe

p= 0.02

Studienkritik

Table 1. Baseline Characteristics of the Patients.*

Characteristic	Decompressive Craniectomy (N=73)	Standard Care (N=82)	P Value†
Age — yr			0.89
Median	23.7	24.6	
Interquartile range	19.4–29.6	18.5–34.9	
Male sex — no. (%)	59 (81)	61 (74)	0.44
Systolic blood pressure — mm Hg	135.4±32.0	135.7±27.6	0.95
Glasgow Coma Scale			
Overall score‡			0.31
Median	5	6	
Interquartile range	3–7	4–7	
Motor score§			0.49
Median	3	3	
Interquartile range	1–4	1–5	
Maximum score for head injury on Abbreviated Injury Scale — no. (%)¶			0.52
3 or 4	35 (48)	44 (54)	
5	38 (52)	38 (46)	
Injury Severity Score‖			0.88
Median	33	32	
Interquartile range	25–38	24–41	
Trauma Score–Injury Severity Score **			0.46
Median	0.74	0.72	
Interquartile range	0.42–0.88	0.51–0.90	
Reactivity of pupils — no./total no. (%)			0.04
Neither pupil	19/71 (27)	10/80 (12)	
One or both pupils	52/71 (73)	70/80 (88)	
Hypotension — no. (%)	24 (33)	25 (30)	0.93
Hypoxemia — no. (%)	18 (25)	24 (29)	0.55
Traumatic subarachnoid hemorrhage — no. (%)	42 (58)	48 (59)	0.90
Cause of injury — no./total no. (%)			0.72
Motor-vehicle or motorcycle accident	45/70 (64)	55/81 (68)	
Bicycle accident	4/70 (6)	2/81 (2)	
Pedestrian accident	5/70 (7)	4/81 (5)	
Other	16/70 (23)	20/81 (25)	

- Sehr frühes Einschlußkriterium (ICP>20 für 15min)
- Cross-over: 15 Pat. (18%) der konservativen Gruppe erhielten Craniektomie
- Bifrontale Craniektomie?
- Randomisierungs-Bias?

What Can Be Learned from the DECRA Study

Stephen Honeybul[1], Kwok M. Ho[2], Christopher R. P. Lind[1,3]

neurocritical care society Neurocrit Care (2016) 25:10–19
DOI 10.1007/s12028-015-0232-8

CrossMark

ORIGINAL ARTICLE

Decompressive Craniectomy in Patients with Traumatic Brain Injury: Are the Usual Indications Congruent with Those Evaluated in Clinical Trials?

Andreas H. Kramer[1,2,3] · Nathan Deis[1,2] · Stacy Ruddell[1] · Philippe Couillard[1,2,3] · David A. Zygun[4] · Christopher J. Doig[1,5] · Clare Gallagher[1,2,3]

REVIEW

Decompressive craniectomy in traumatic brain injury after the DECRA trial. Where do we stand?

Juan Sahuquillo, Francisco Martínez-Ricarte, and Maria-Antonia Poca

Commentary on:
What Can Be Learned from the DECRA Study
by Honeybul et al. pp. 159-161e.

Surgical Neurology International

Editorial

DECRA...Where do we go from here?

Roland Torres

Department of Neurosurgery, Stanford Univ. Medical School, Stanford, USA

E-mail: *Roland Torres - ratorres@stanford.edu
*Corresponding author

Received: 23 March 12 Accepted: 27 March 12 Published: 14 May 12

This article may be cited as:
Torres R. DECRA...Where do we go from here?. Surg Neurol Int 2012;3:54.
Available FREE in open access from: http://www.surgicalneurologyint.com/text.asp?2012/3/1/54/96150

PERSPECTIVES

Commentary on:
What Can Be Learned from the DECRA Study
by Honeybul et al. pp. 159-161.

J. Marc Simard, M.D., Ph.D.
Professor, Department of Neurosurgery
University of Maryland

The DECRA Trial and Decompressive Craniectomy in Diffuse Traumatic Brain Injury: Is Decompression Really Ineffective?

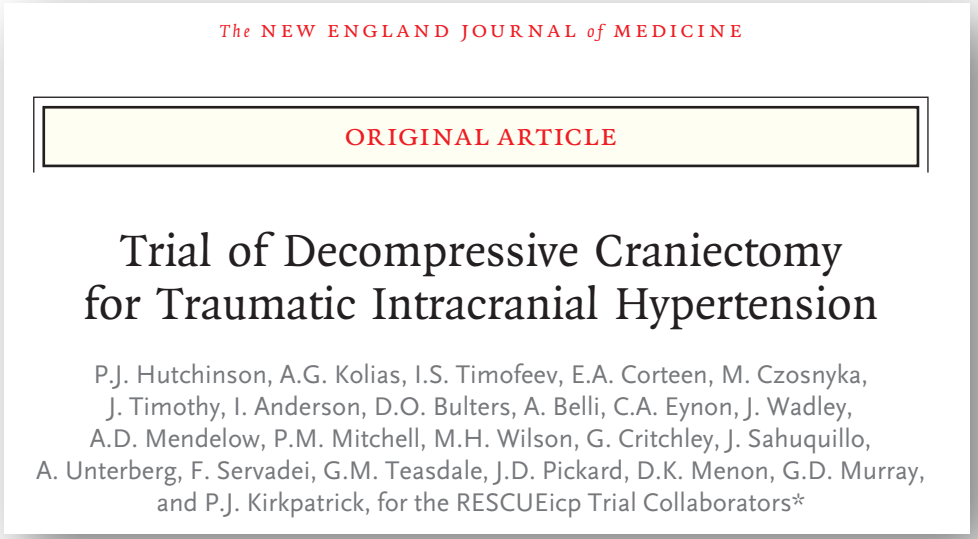
Brian P. Walcott, Kristopher T. Kahle, J. Marc Simard

PERSPECTIVES

Franco Servadei, M.D.
Director and Chairman
Neurosurgery-Neurotraumatology Unit and Department of Emergency Medicine
University Hospital of Parma

Decompressive Craniectomies: Time to Discuss Not the DECRA Study but the Comments to the DECRA Study

Corrado Iaccarino, Paolo Schiavi, Franco Servadei



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Trial of Decompressive Craniectomy for Traumatic Intracranial Hypertension

P.J. Hutchinson, A.G. Kolias, I.S. Timofeev, E.A. Corteen, M. Czosnyka, J. Timothy, I. Anderson, D.O. Bulters, A. Belli, C.A. Eynon, J. Wadley, A.D. Mendelow, P.M. Mitchell, M.H. Wilson, G. Critchley, J. Sahuquillo, A. Unterberg, F. Servadei, G.M. Teasdale, J.D. Pickard, D.K. Menon, G.D. Murray, and P.J. Kirkpatrick, for the RESCUEicp Trial Collaborators*

N Engl J Med 2016;375:1119-30

Zielsetzung: Evaluierung des Effekts einer späten Entlastungskraniotomie versus Standard-Intensivtherapie

Studientyp: prospektiver RCT

Patientenanzahl: >400 aus 52 Zentren in 20 Ländern
Kraniektomie n=202, Standard Intensivtherapie n= 196
Januar 2004 bis März 2014

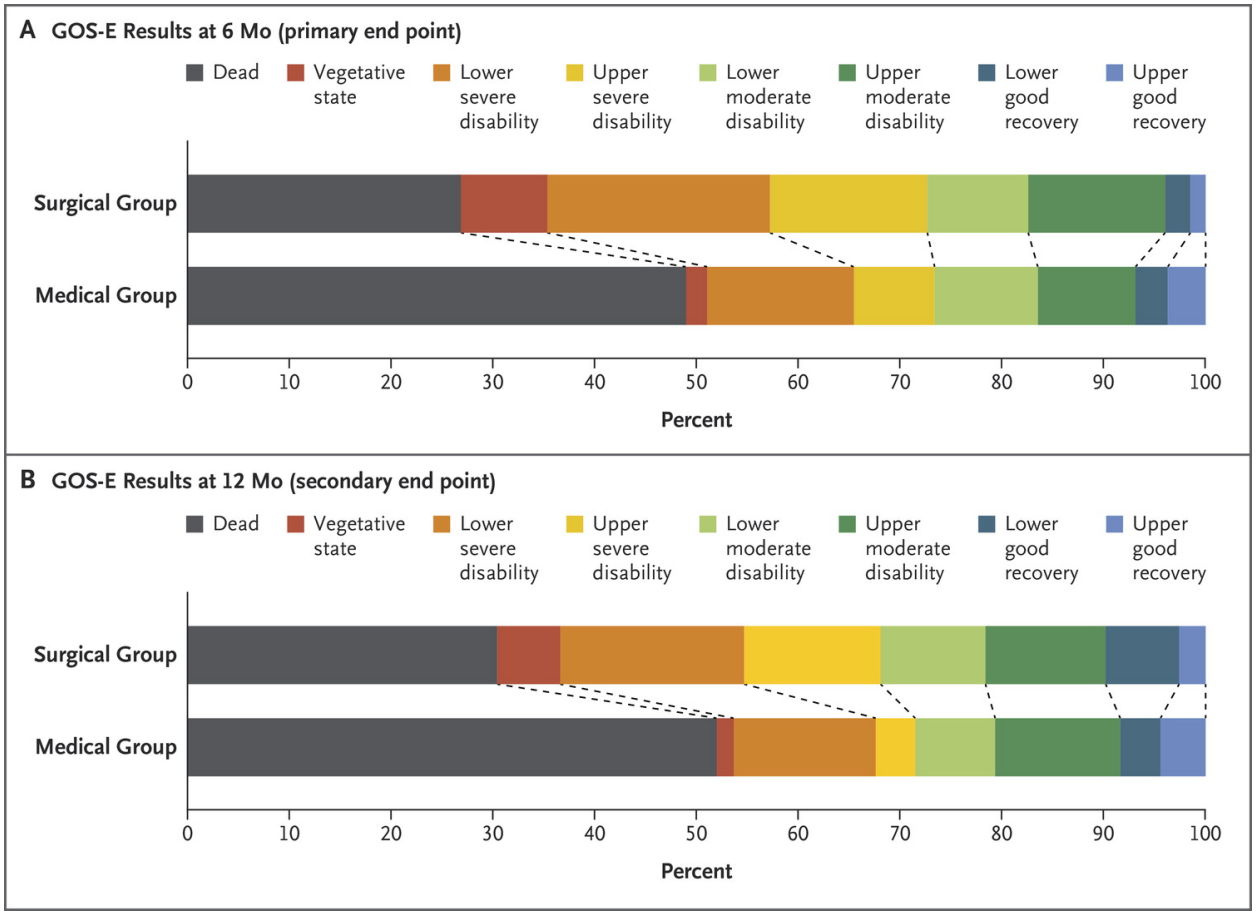
Table 1. Characteristics of the Patients at Baseline.*

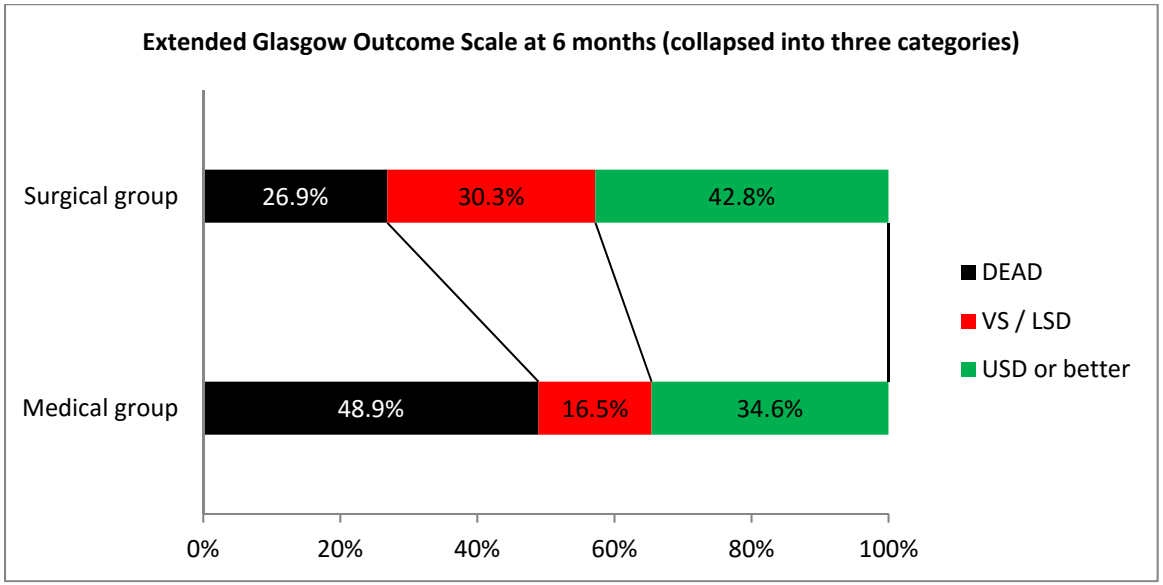
Characteristic	Surgical Group (N = 202)	Medical Group (N = 196)
Age — yr	32.3±13.2	34.8±13.7
Male sex — no./total no. (%)	165/202 (81.7)	156/195 (80.0)
GCS motor score at first hospital — no./total no. (%)†		
1 or 2	96/181 (53.0)	85/170 (50.0)
3–6	85/181 (47.0)	85/170 (50.0)
Pupillary abnormality — no. (%)‡	59 (29.2)	57 (29.1)
Hypotension — no. (%)§	40 (19.8)	42 (21.4)
Hypoxemia — no. (%)¶	49 (24.3)	52 (26.5)
History of drug or alcohol abuse — no. (%)	50 (24.8)	69 (35.2)
Extracranial injury — no. (%)	75 (37.1)	83 (42.3)
Injury classification on basis of CT imaging — no./total no. (%)‖		
Diffuse injury	161/198 (81.3)	141/186 (75.8)
Mass lesion	37/198 (18.7)	45/186 (24.2)

Table 2. Treatments and Interventions.*

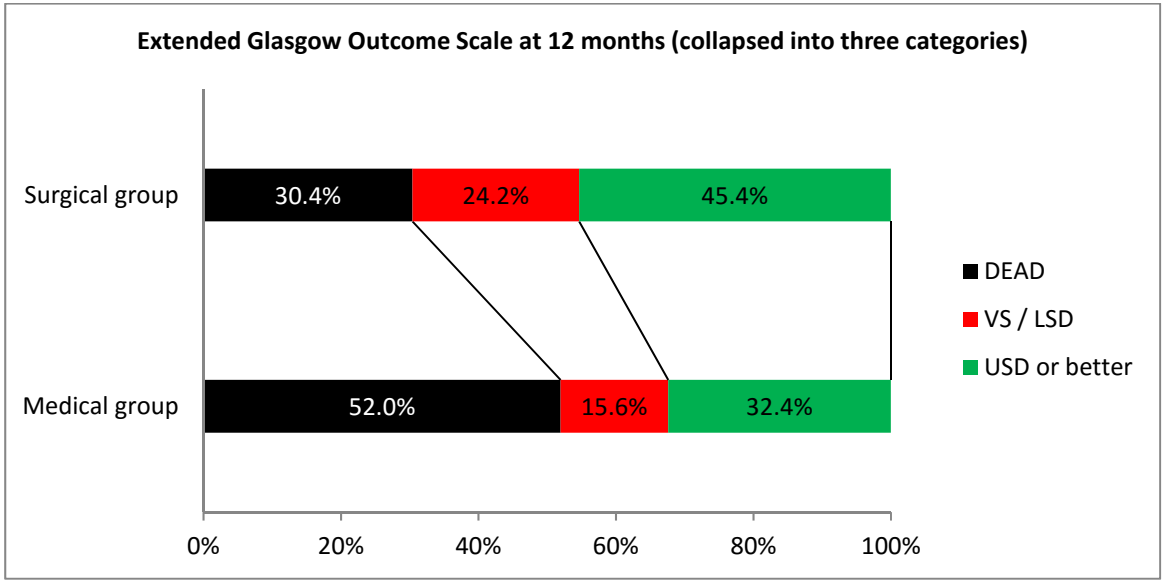
Treatment or Intervention	Surgical Group (N = 202)	Medical Group (N = 196)
Craniotomy for evacuation of hematoma — no. (%)	26 (12.9)	30 (15.3)
Ventriculostomy — no. (%)	34 (16.8)	43 (21.9)
Neuromuscular paralysis — no. (%)	101 (50.0)	103 (52.6)
Pharmacologic blood-pressure augmentation — no. (%)	112 (55.4)	116 (59.2)
Osmotherapy — no. (%)	146 (72.3)	144 (73.5)
Therapeutic hypothermia — no. (%)	47 (23.3)	53 (27.0)
Decompressive craniectomy — no. (%)†	187 (92.6)	73 (37.2)
Bifrontal — no./total no. (%)	109/173 (63.0)	NA
Unilateral — no./total no. (%)	64/173 (37.0)	NA
Barbiturates — no. (%)‡	19 (9.4)	171 (87.2)

Outcome RESCUE-ICP




Extended Glasgow Outcome Scale at 6 months (collapsed into three categories)
Surgical group
Medical group
26.9%
30.3%
42.8%
48.9%
16.5%
34.6%
DEAD
VS / LSD
USD or better
0%
20%
40%
60%
80%
100%

P < 0.001


Extended Glasgow Outcome Scale at 12 months (collapsed into three categories)
Surgical group
Medical group
30.4%
24.2%
45.4%
52.0%
15.6%
32.4%
DEAD
VS / LSD
USD or better
0%
20%
40%
60%
80%
100%

P = 0.002

Anmerkungen zu RESCUE-ICP

- Bifrontale oder unilaterale Craniektomie?
- Subgruppen?

Table S14 – Patients aged ≤40 years

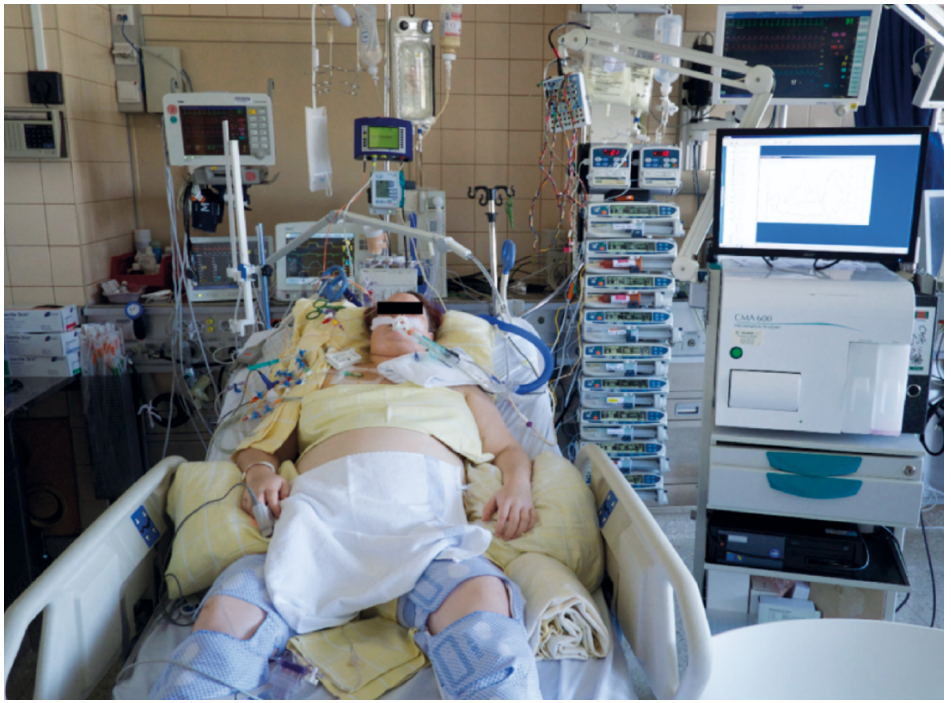
	Surgical Group	Medical Group	Absolute Difference (95% CI)
Unfavourable outcome	69 (48.6%)	81 (63.8%)	
Favourable outcome	73 (51.4%)	46 (36.2%)	15.2% (3.5% to 26.9%)

Table S15 – Patients aged >40 years

	Surgical Group	Medical Group	Absolute Difference (95% CI)
Unfavourable outcome	46 (78.0%)	42 (68.9%)	
Favourable outcome	13 (22.0%)	19 (31.1%)	-9.1% (-24.8% to 6.6%)

Fazit Outcome schweres SHT

- hohe Letalität
- hohe Morbidität



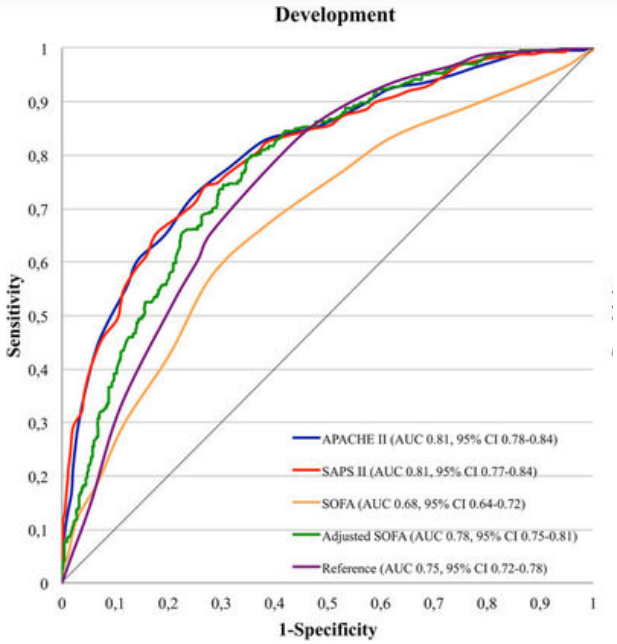
Scores zur Prognoseabschätzung?

Raj *et al. Critical Care* 2014, **18**:R60
http://ccforum.com/content/18/2/R60

CRITICAL CARE

RESEARCH Open Access

Predicting six-month mortality of patients with traumatic brain injury: usefulness of common intensive care severity scores



Performance variable	Discrimination		Calibration		Precision
	AUC	95% CI	H-L *P*-value	GiViTI *P*-value‡	Brier score
Development cohort					
APACHE II	0.81	0.78, 0.84	0.153	NA	0.160
SAPS II	0.81	0.77, 0.84	0.343	NA	0.160
SOFA	0.68	0.64, 0.72	0.282	NA	0.201
Adjusted SOFA*	0.78	0.75, 0.81	0.444	NA	0.175
Reference†	0.75	0.72, 0.78	0.144	NA	0.185
Validation cohort					
APACHE II	0.79	0.75, 0.82	0.062	0.653	0.167
SAPS II	0.80	0.77, 0.83	0.775	0.782	0.166
SOFA	0.68	0.64, 0.72	0.691	0.710	0.201
Adjusted SOFA*	0.79	0.76, 0.82	0.177	0.574	0.174
Reference†	0.77	0.74, 0.80	0.086	0.072	0.181

CRASH Studie

Effect of intravenous corticosteroids on death within 14 days in 10 008 adults with clinically significant head injury (MRC CRASH trial): randomised placebo-controlled trial

*CRASH trial collaborators**

Lancet 2004; 364: 1321–28

See Comment page 1291

*Listed at end of report

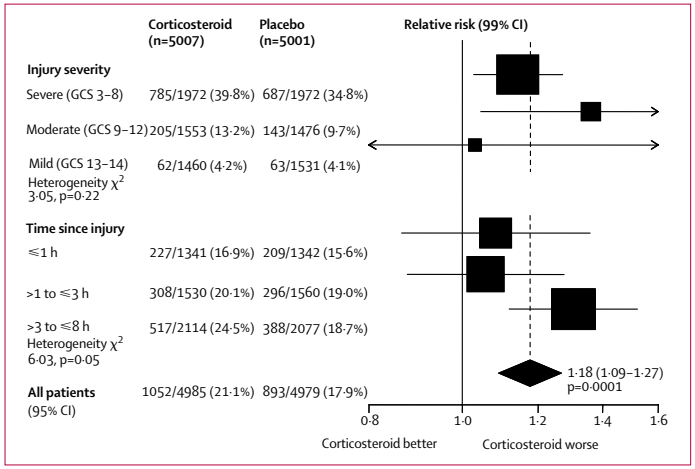
Correspondence to: CRASH Trials Coordinating Centre, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK
crash@lshtm.ac.uk

Summary

Background Corticosteroids have been used to treat head injuries for more than 30 years. In 1997, findings of a systematic review suggested that these drugs reduce risk of death by 1–2%. The CRASH trial—a multicentre international collaboration—aimed to confirm or refute such an effect by recruiting 20 000 patients. In May, 2004, the data monitoring committee disclosed the unmasked results to the steering committee, which stopped recruitment.

Methods 10 008 adults with head injury and a Glasgow coma score (GCS) of 14 or less within 8 h of injury were randomly allocated 48 h infusion of corticosteroids (methylprednisolone) or placebo. Primary outcomes were death within 2 weeks of injury and death or disability at 6 months. Prespecified subgroup analyses were based on injury severity (GCS) at randomisation and on time from injury to randomisation. Analysis was by intention to treat. Effects on outcomes within 2 weeks of randomisation are presented in this report. This study is registered as an International Standard Randomised Controlled Trial, number ISRCTN74459797.

Findings Compared with placebo, the risk of death from all causes within 2 weeks was higher in the group allocated corticosteroids (1052 [21·1%] *vs* 893 [17·9%] deaths; relative risk 1·18 [95% CI 1·09–1·27]; p=0·0001). The relative increase in deaths due to corticosteroids did not differ by injury severity (p=0·22) or time since injury (p=0·05).



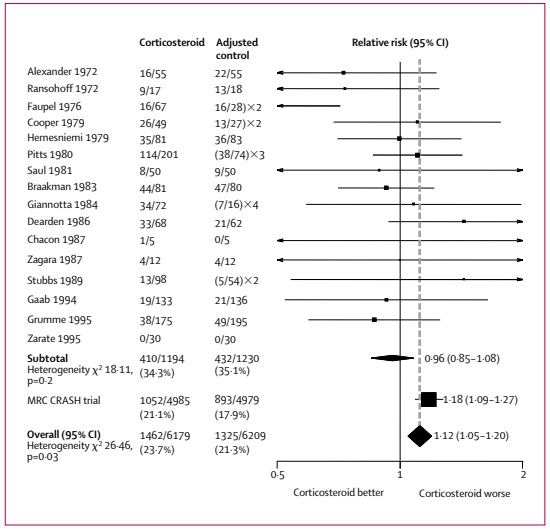


Figure 5: Updated meta-analysis of effect of corticosteroids on death after head injury

IMPACT Studien

JOURNAL OF NEUROTRAUMA
Volume 24, Number 2, 2007
© Mary Ann Liebert, Inc.
Pp. 232–238
DOI: 10.1089/neu.2006.0024

Prognosis and Clinical Trial Design in Traumatic Brain Injury: The IMPACT Study

ANDREW I.R. MAAS,[1] ANTHONY MARMAROU,[3] GORDON D. MURRAY,[4] SIR GRAHAM M. TEASDALE,[5] and EWOUT W. STEYERBERG[2]

JOURNAL OF NEUROTRAUMA
Volume 24, Number 2, 2007
© Mary Ann Liebert, Inc.
Pp. 287–293
DOI: 10.1089/neu.2006.0031

Prognostic Value of Secondary Insults in Traumatic Brain Injury: Results from the IMPACT Study

GILLIAN S. McHUGH,[1] DOORTJE C. ENGEL,[2] ISABELLA BUTCHER,[1] EWOUT W. STEYERBERG,[3] JUAN LU,[4] NINO MUSHKUDIANI,[3] ADRIÁN V. HERNÁNDEZ,[3] ANTHONY MARMAROU,[4] ANDREW I.R. MAAS,[2] and GORDON D. MURRAY[1]

JOURNAL OF NEUROTRAUMA
Volume 24, Number 2, 2007
© Mary Ann Liebert, Inc.
Pp. 270–280
DOI: 10.1089/neu.2006.0029

Prognostic Value of the Glasgow Coma Scale and Pupil Reactivity in Traumatic Brain Injury Assessed Pre-Hospital and on Enrollment: An IMPACT Analysis

ANTHONY MARMAROU,[1] JUAN LU,[1] ISABELLA BUTCHER,[2] GILLIAN S. McHUGH,[2] GORDON D. MURRAY,[2] EWOUT W. STEYERBERG,[3] NINO A. MUSHKUDIANI,[3] SUNG CHOI,[1] and ANDREW I.R. MAAS[4]

Prognostische Scores

Comparison of CRASH and IMPACT prediction models

	Predicted outcome	Core model	CT model	Laboratory model
IMPACT	Mortality or unfavorable outcome at 6 months	Age, motor score, pupil reactivity	Core model plus: hypoxia, hypotension, CT classification, traumatic subarachnoid hemorrhage on CT, epidural mass on CT	Core model plus: glucose and hemoglobin concentrations
CRASH	Mortality at 14 days or unfavorable outcome at 6 months	Age, GCS score, pupil reactivity, major extracranial injury	Core model plus: petechial hemorrhages, obliteration of the third ventricle or basal cisterns, subarachnoid bleeding, midline shift, nonevacuated hematoma	

CRASH, Corticosteroid Randomisation After Significant Head Injury; GCS, Glasgow Coma Scale; IMPACT, International Mission for Prognosis and Clinical Trial design in TBI; TBI, traumatic brain injury. (Data from MRC CRASH Trial Collaborators, 2008, and Steyerberg et al., 2008.)

Validierung von CRASH und IMPACT

JOURNAL OF NEUROTRAUMA 31:1146–1152 (July 1, 2014)

DOI: 10.1089/neu.2013.3003

External Validation of the CRASH and IMPACT Prognostic Models in Severe Traumatic Brain Injury

Julian Han,[1] Nicolas K.K. King,[1] Sam J. Neilson,[2] Mihir P. Gandhi,[3,4] and Ivan Ng[1]

300 Pat.

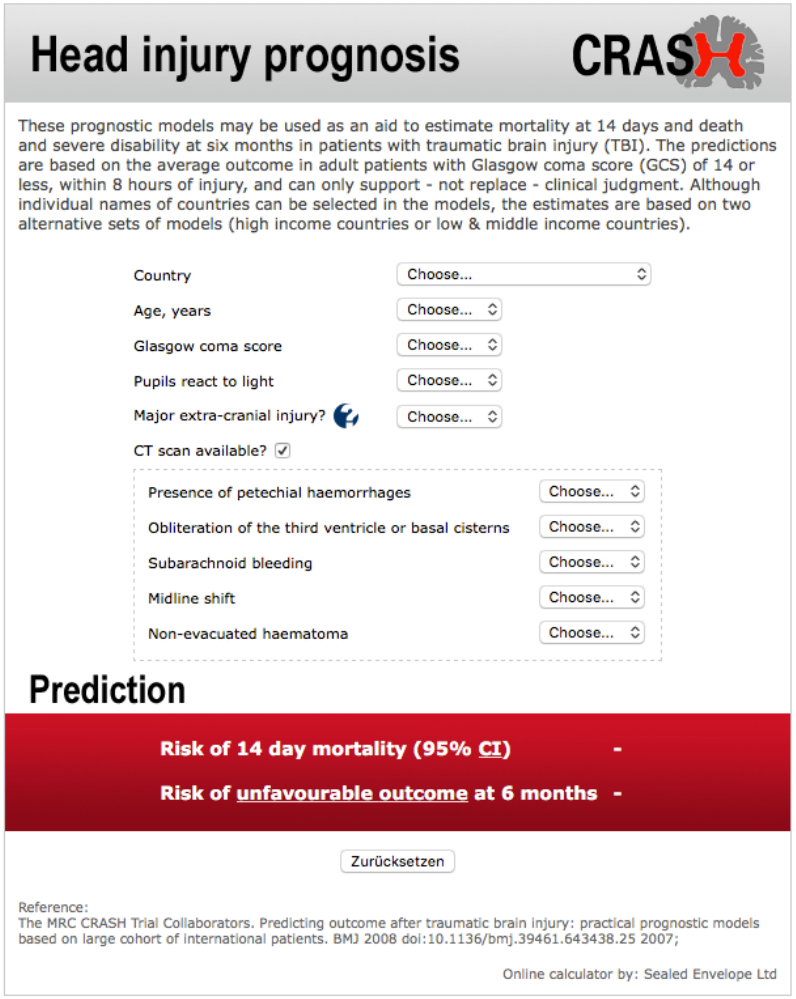
14d-Sterblichkeit: 47,7%

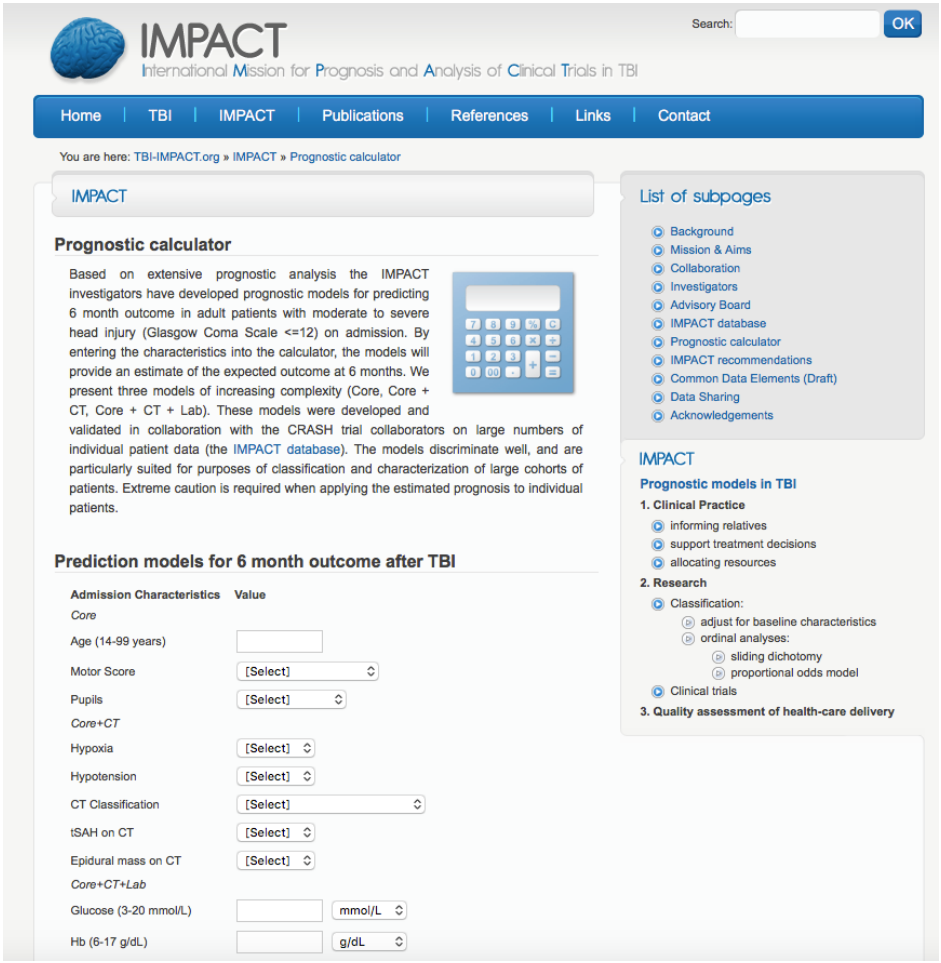
6Mo. schlechtes Outcome: 71,0%

Table 2. Application of CRASH and IMPACT Models in NNI Data for Mortality and Outcome

Models	*Predicted mortality*	*AUC (95% CI)*	*Cox slope (95% CI)*	*Cox intercept (95% CI)*	*Predicted 6 month unfavorable outcome*	*AUC (95% CI)*	*Cox slope (95% CI)*	*Cox intercept (95% CI)*
CRASH base model	38.1% (14 days)	0.80 (0.75–0.85)	0.95 (0.71–1.18)	0.51 (0.20–0.82)	67.6%	0.86 (0.81–0.90)	1.34 (1.01–1.67)	2.39 (1.84–2.95)
CRASH CT model	46.6% (14 days)	0.83 (0.78–0.87)	0.85 (0.64–1.05)	0.03 (−0.24–0.31)	74.8%	0.89 (0.84–0.93)	1.12 (0.85–1.39)	1.78 (1.33–2.22)
IMPACT core model	40.5% (6 months)	0.80 (0.75–0.85)	1.14 (0.85–1.43)	0.81 (0.48–1.13)	54.4%	0.84 (0.80–0.89)	1.37 (1.02–1.71)	1.07 (0.74–1.39)
IMPACT extended model	44.2% (6 months)	0.81 (0.76–0.86)	1.15 (0.86–1.43)	0.59 (0.29–0.89)	57.8%	0.88 (0.83–0.92)	1.58 (1.20–1.97)	0.88 (0.55–1.21)
IMPACT lab model	40.8% (6 months)	0.80 (0.75–0.86)	1.17 (0.86–1.49)	0.81 (0.48–1.15)	57.4%	0.87 (0.82–0.92)	1.46 (1.09–1.83)	0.94 (0.59–1.30)

CRASH, Corticosteroid Randomization After Significant Head injury; IMPACT, International Mission for Prognosis and Analysis of Clinical Trials in Traumatic Brain Injury; NNI, National Neuroscience Institute; AUC, area under the receiving operating characteristic curve.





http://www.trialscoordinatingcentre.lshtm.ac.uk/Risk%20calculator/index.html

http://www.tbi-impact.org/?p=impact/calc

Predicted Unfavorable Neurologic Outcome Is Overestimated by the Marshall Computed Tomography Score, Corticosteroid Randomization After Significant Head Injury (CRASH), and International Mission for Prognosis and Analysis of Clinical Trials in Traumatic Brain Injury (IMPACT) Models in Patients with Severe Traumatic Brain Injury Managed with Early Decompressive Craniectomy

Jose D. Charry[1,2], Jorman H. Tejada[3], Miguel A. Pinzon[3], Wilson A. Tejada[4], Juan D. Ochoa[4], Manuel Falla[4], Jesus H. Tovar[3], Ana M. Cuellar-Bahamón[4], Juan P. Solano[5]

World Neurosurg. (2017) 101:554-558.

Table 2. Correlation Between Mortality and Predictive Models

Model	Six-Month Predicted Mortality	Six-Month Mortality	Spearman rho	*P* Value
Marshall	52.80%	29.13%	0.145	0.105
Impact	71.00%		0.392	<0.001
Crash	59.90%		0.314	<0.001

Model	Six-Month Predicted Unfavorable Outcome	Six-Month Unfavorable Outcome	Spearman rho	*P* Value
Impact	77.00%	37.00%	0.284	0.001
Crash	80.50%		0.176	0.048

Cave: mildes SHT

JOURNAL OF NEUROTRAUMA 32:83–94 (January 15, 2015)

DOI: 10.1089/neu.2014.3384

Outcome Prediction after Mild and Complicated Mild Traumatic Brain Injury: External Validation of Existing Models and Identification of New Predictors Using the TRACK-TBI Pilot Study

Hester F. Lingsma,[1] John K. Yue,[2,3] Andrew I.R. Maas,[4] Ewout W. Steyerberg,[1] Geoffrey T. Manley,[2,3] and the TRACK-TBI Investigators including: Shelly R. Cooper,[2,3,5] Kristen Dams-O'Connor,[6] Wayne A. Gordon,[6] David K. Menon,[8] Pratik Mukherjee,[2,5] David O. Okonkwo,[7] Ava M. Puccio,[7] David M. Schnyer,[9] Alex B. Valadka,[10] Mary J. Vassar,[2,3] and Esther L. Yuh[2,5]

AUC

CRASH-Model: 0.50

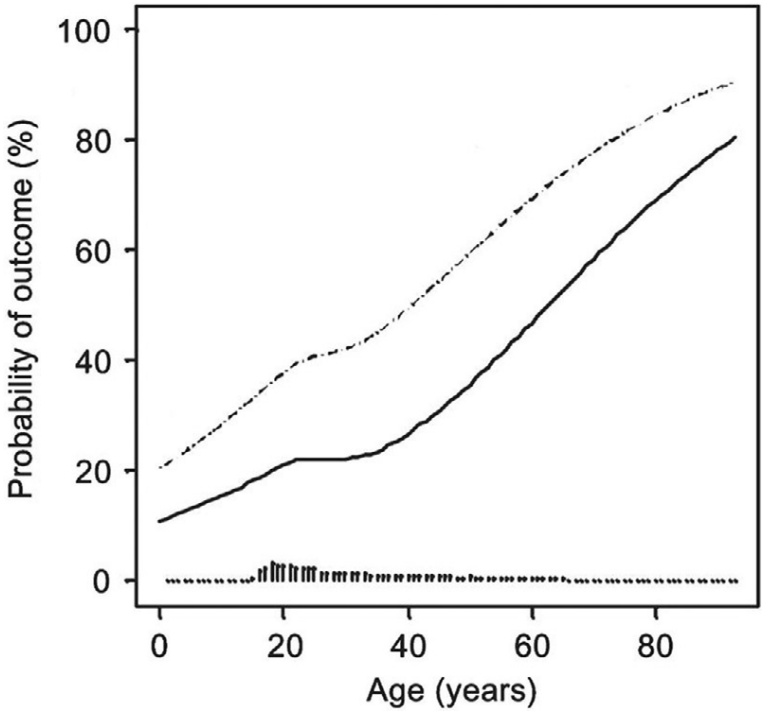
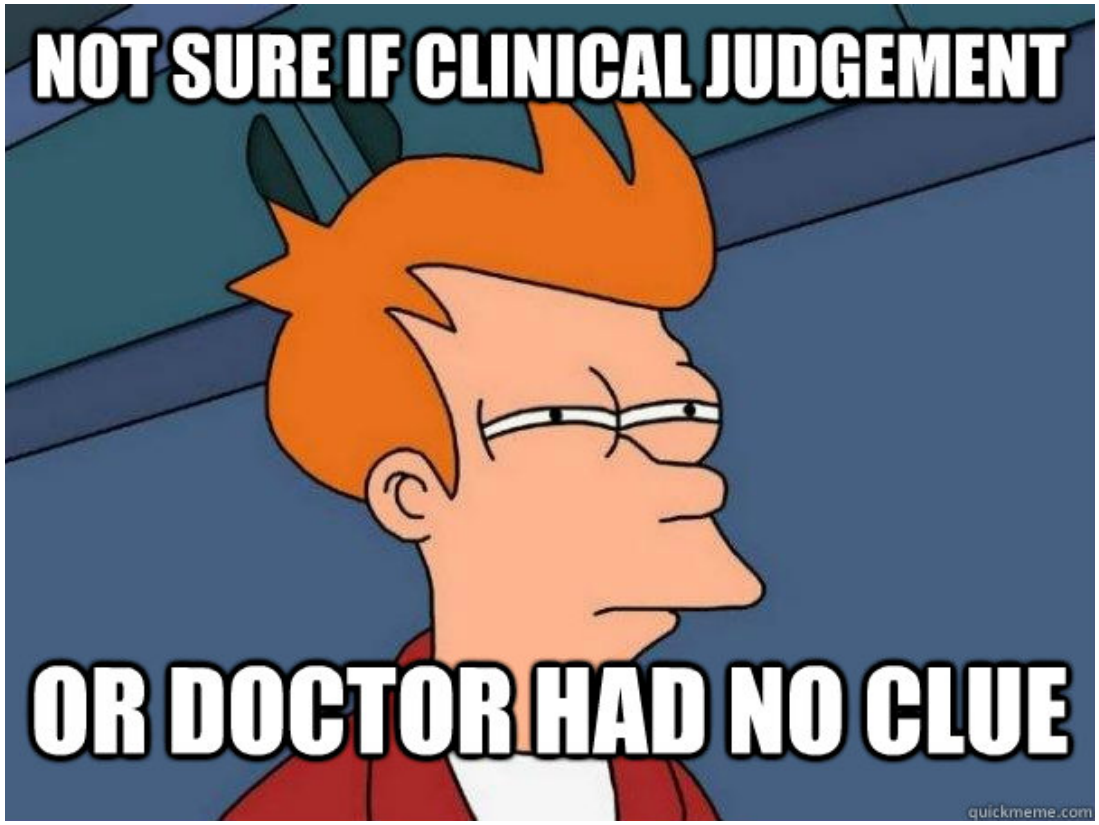


Fig. 29.2. Continuous association between age and outcome as demonstrated in the IMPACT studies. The upper line denotes the probability of unfavorable outcome. The lower line denotes the probability of mortality. (Reproduced from Mushkudiani et al., 2007.)

Fazit Prognostische Scores



Zusammenfassung

- SHT ist volkswirtschaftlich extrem bedeutsam
  - Letalität schweres SHT: 25-70%
  - hohe Rate an Pflegebedürftigkeit
  - Return-to-work Quote niedrig
- Scores bilden Schädigungsvielfalt nicht adäquat ab
- Prognoseabschätzung ist schwierig (ALTER!)
- Multidisziplinäre Herausforderung

c.senft@med.uni-frankfurt.de

Danke für Ihre Aufmerksamkeit