



# Welkom

## Traumatisch hersenletsel in de acute fase

*Bart Depreitere*



# epidemiologie

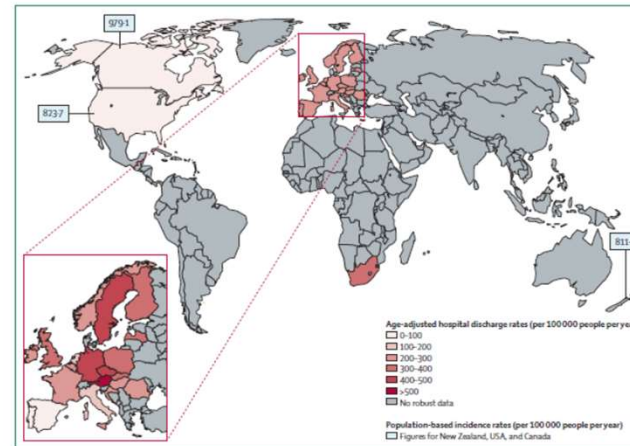
## Algemeen wereldwijd

- Trauma voornaamste doodsoorzaak 15-44j
- Hersentrauma = hoofdoorzaak trauma-gerelateerde mortaliteit en blijvende invaliditeit

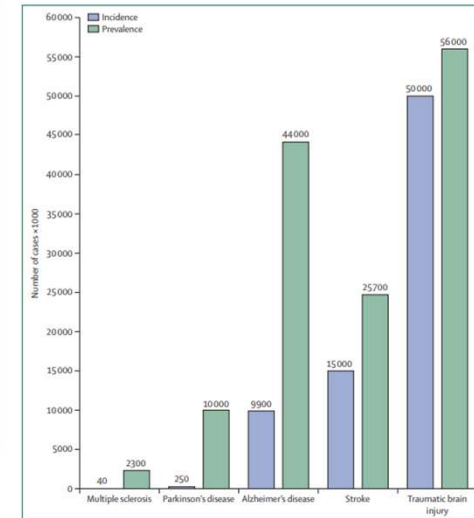
	European Union	USA
Population (millions)	510	321
Total number of new cases annually (indexed per 100 million population)	2 500 000 (490 000)	3 500 000 (1 090 000)
Total number of hospital admissions annually (indexed per 100 million population)	1 446 000 (283 000)	282 000 (88 000)
Total number of deaths from TBI annually (indexed per 100 million population)	57 000 (11 000)	56 000 (17 000)
Percentage of all injury-related mortality caused by or associated with TBI	37%	30-5%

Estimates for the EU are based on four studies.<sup>30, 31, 32, 33</sup> Estimates for the USA are based on five studies.<sup>34, 35, 36, 37, 38</sup> These numbers are an approximation; numbers from original reports have been rounded to the nearest 1000. TBI=traumatic brain injury.

**Table 2: Estimated annual traumatic brain injury volume in the European Union and the USA**



**Figure 3: Worldwide incidence of traumatic brain injury**  
 Age-adjusted hospital discharge rates after traumatic brain injury were available for the USA (823.7 per 100 000 people per year),<sup>39, 40</sup> Canada (47.5-83.1),<sup>41</sup> Europe (282.2),<sup>42</sup> and South Africa (216.4).<sup>43</sup> Population based incidence rates were available for the USA (823.7 per 100 000 per year),<sup>44</sup> Canada (279.1),<sup>45</sup> and New Zealand (811.0).<sup>46</sup> The map highlights the absence of robust data for most regions and the variation in available data between countries. Reported estimates of hospital discharge rates also vary between individual countries, as highlighted for Europe (81.0-643.5 per 100 000 per year, as expanded view).



# epidemiologie

## Leeftijd

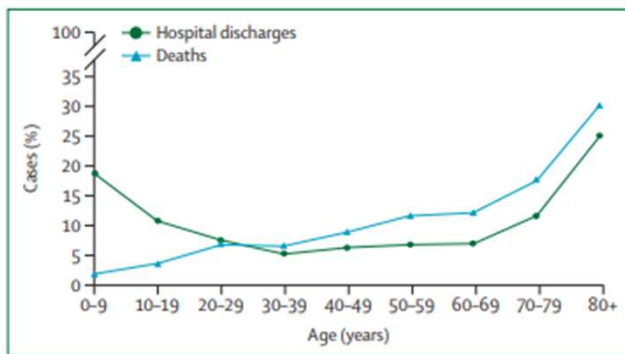
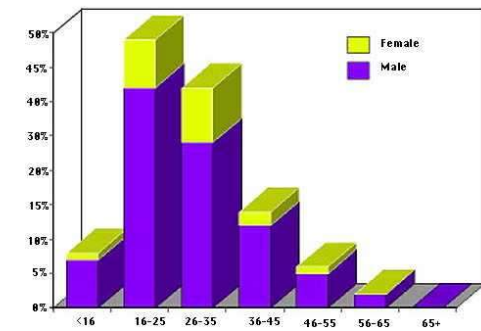
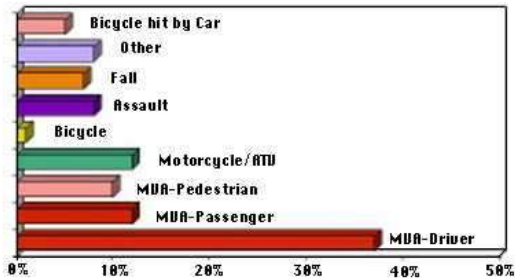


Figure 3: Estimated frequency of hospital discharges and deaths in cases of traumatic brain injury by age group in Europe  
Figure created using data from Majdan et al.<sup>3</sup>

# epidemiologie

## Oorzaken



## Leading Causes Of Traumatic Brain Injury

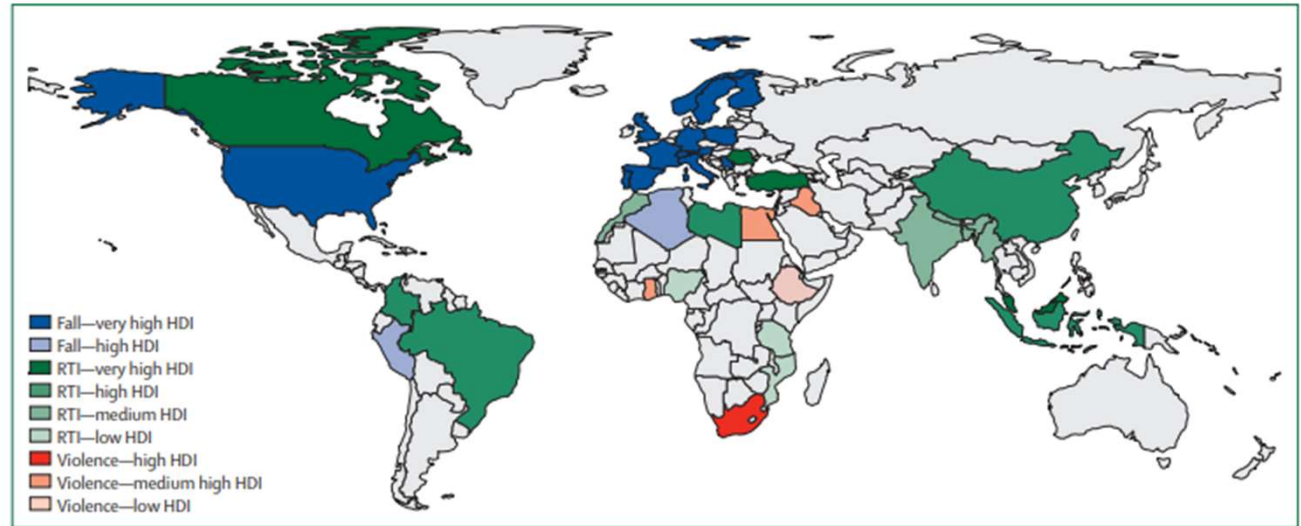
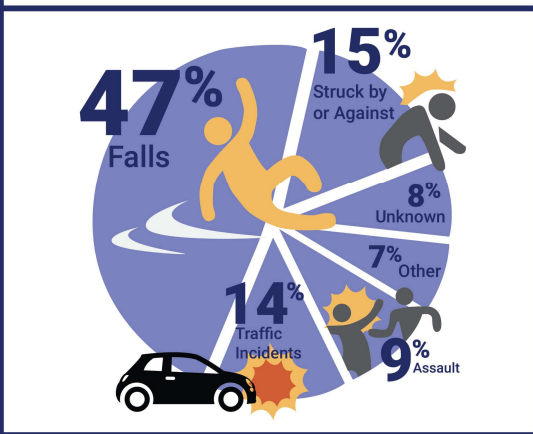
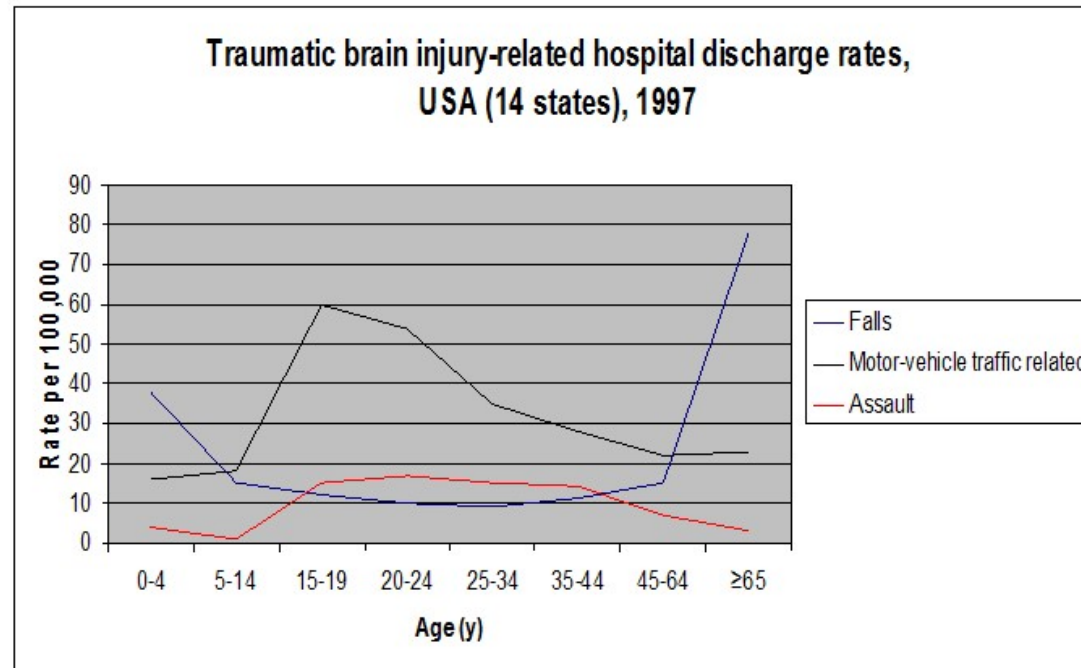


Figure 2: Between-country variations in mechanism of traumatic brain injury according to the Human Development Index  
Figure modified from Clark et al with permission.<sup>18</sup> HDI=Human Development Index. RTI=road traffic incident.

# epidemiologie

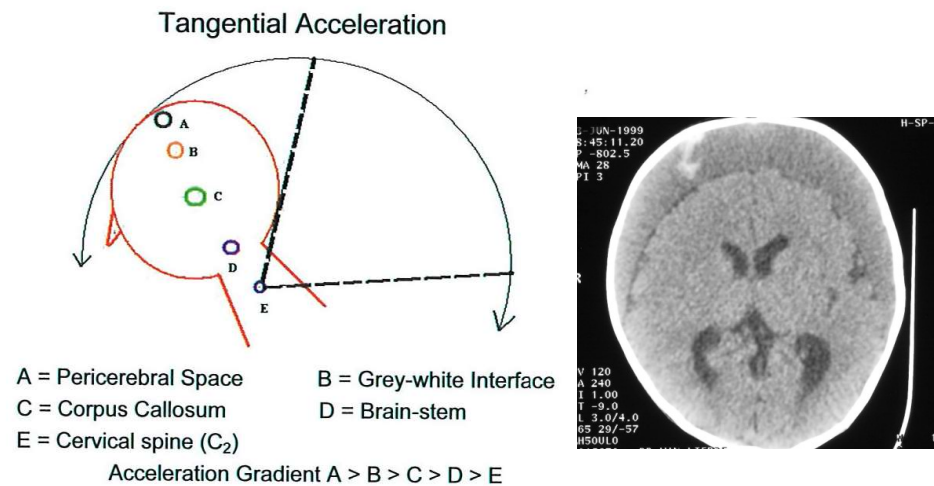
Oorzaak en leeftijd



# epidemiologie

## Oorzaak en leeftijd

- Zuigelingen en niet-accidenteel trauma



### BPSU study of subdural haematoma and effusions (SDH/E) in infancy\*

N = 186

Male 123, female 63

Age: 0-82 weeks (mean 17 weeks, median 13 weeks)

Annual incidence (all aetiologies): 12.7/100,000 under 2 years

24.3/100,000 under 1 year

Incidence of non-accidental SDH/E: 7.28/100,000 under 2 years

14.8/100,000 under 1 year

#### Aetiology:

NAHI	106
Accidental trauma	7
Meningitis	23
Perinatal	26
Other disease	7
Unknown	17

#### Outcome in NAHI group:

Died	18 (17%)
Significant neurodevelopmental problems (evident at 6 months follow-up)	29 (28%)
Normal at 6 months follow-up	46 (43%)
Unknown outcome	13 (12%)

\*Hobbs et al. (2004).

# epidemiologie

- 'Dead at scene': incidentie >40%?
- Belang preventie

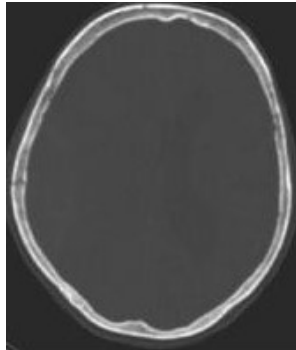


	2019	2020	2021	2022	2022/2019
Personenwagen <sup>[1]</sup>	311	221	215	216	-30,5%
Bestelwagen	17	11	28	27	+58,8%
Vrachtwagen <sup>[2]</sup>	11	17	15	11	0,0%
Motorfiets <sup>[3]</sup>	84	78	62	66	-21,4%
Bromfiets <sup>[4]</sup>	19	13	16	17	-10,5%
Voetganger <sup>[5]</sup>	92	65	75	83	-9,8%
Fiets <sup>[6]</sup>	95	87	87	102	+7,4%
Andere <sup>[7]</sup>	10	6	11	14	+40,0%
Onbekend	5	1	7	4	-20,0%
Totaal	644	499	516	540	-16,1%

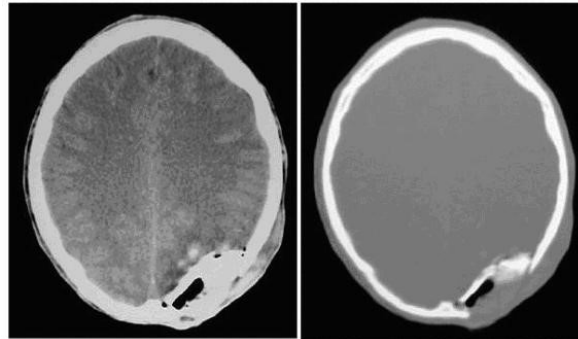
# letseltypes

schedelbreuk

Lineaire schedeldakfractuur



indeukingsfractuur



schedelbasisfractuur



Mogelijk:



Facialisparese  
CSV lekkage  
Intracraniële lucht  
Bloeding a. carotis  
interna



# letseltypes

## Epiduraal hematoom

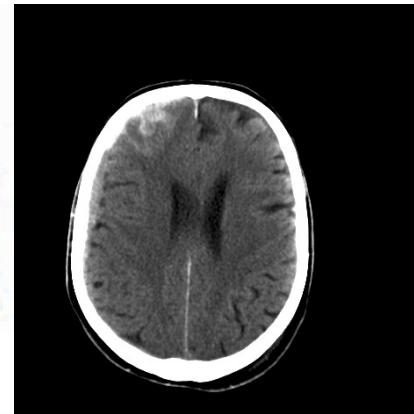
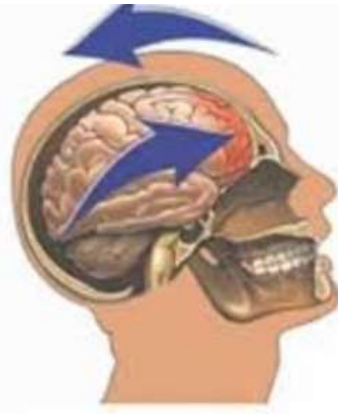
- Arteriële bloeding
- 2/3 geassocieerd met schedeldakfractuur
- Vnl kinderen (>2j) en jongvolwassenen
- Levensbedreigend!!



# letseltypes

## Cerebrale contusie

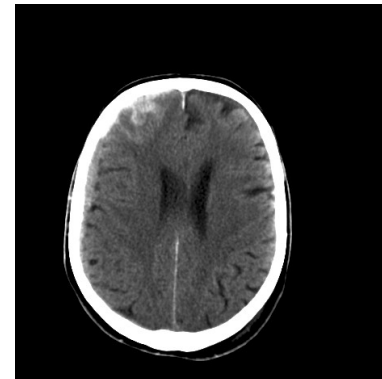
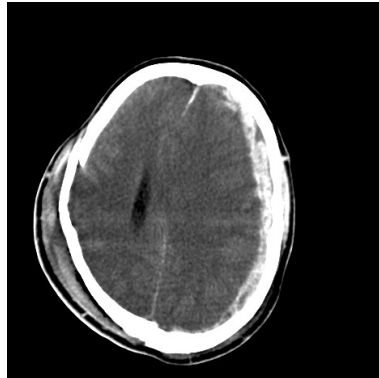
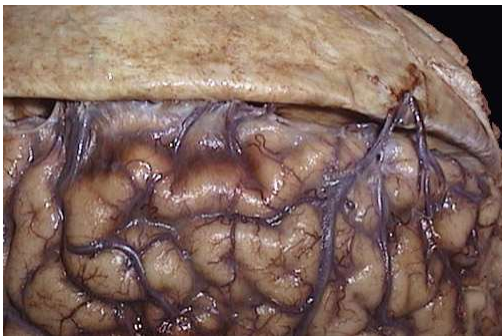
- Kneuzing hersenoppervlak
- Onder impactplaats of op afstand (frontotemporale, contrecoup)
- Kan expanderen
- Aantal/grootte neemt toe met leeftijd

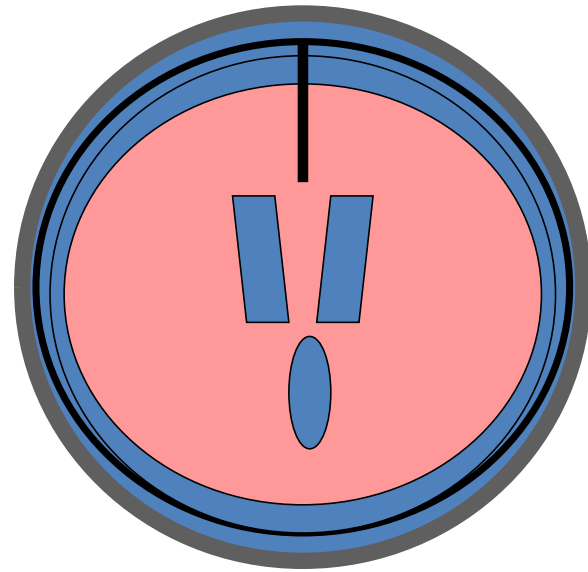


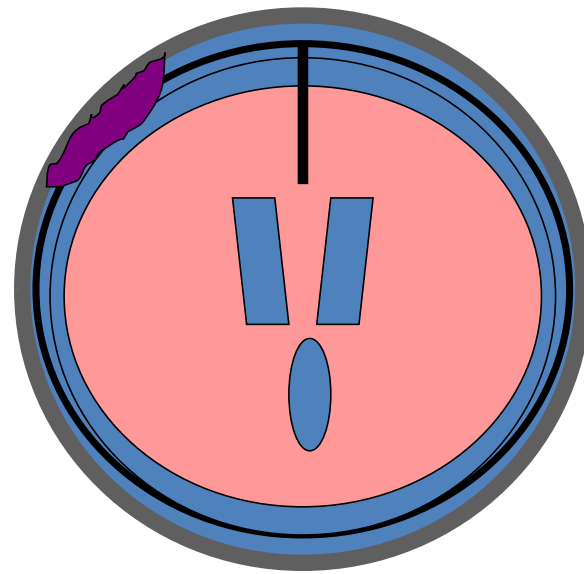
# letseltypes

## Acuut subduraal hematoom

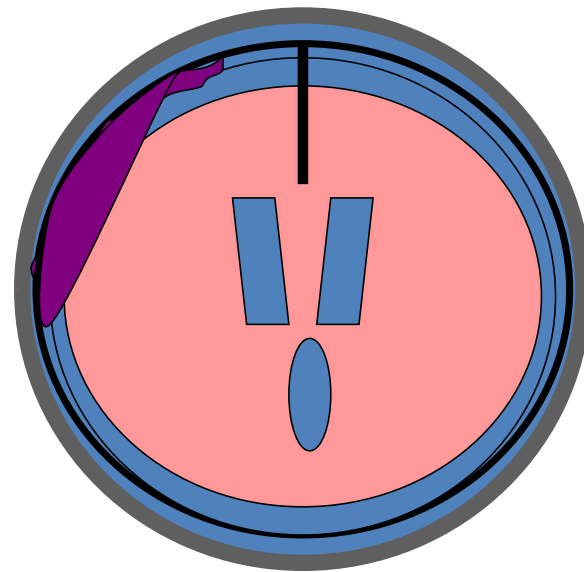
- Door gescheurde brugvene of doorbraak vanuit contusie naar subdurale ruimte
- Hoge mortaliteit
- Zuigelingen / middelbare en oudere leeftijd



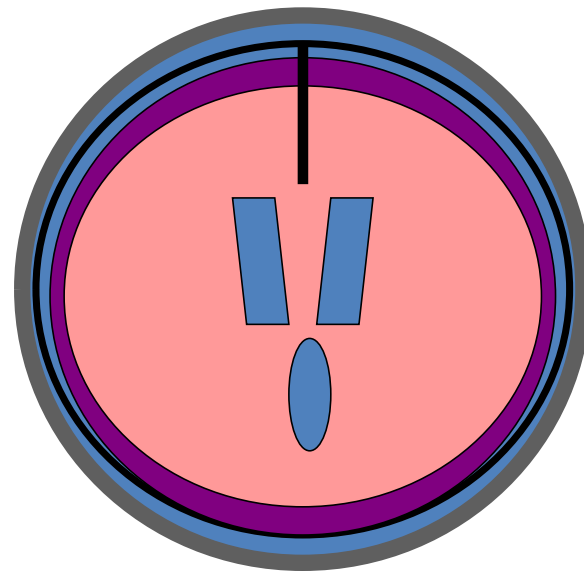




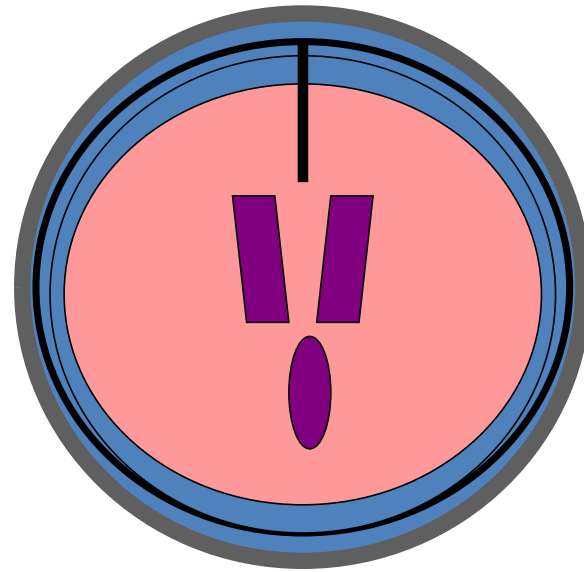
Epiduraal hematoom



Subduraal hematoom

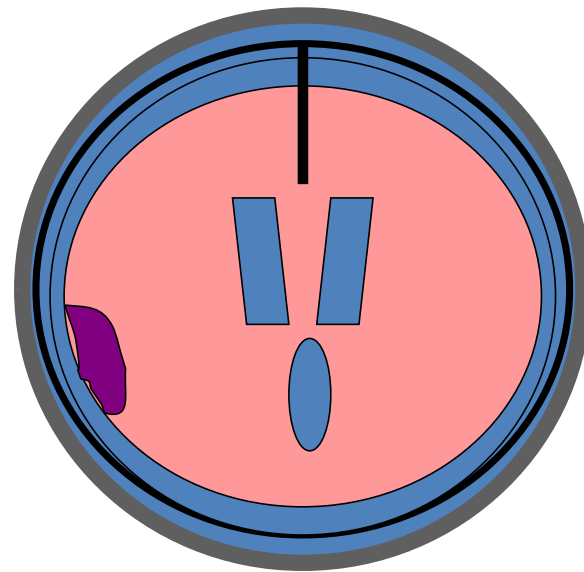


Subarachnoidaal bloed



Intraventriculair bloed



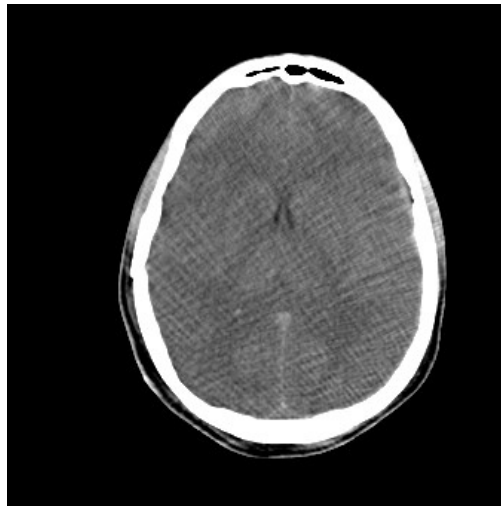


Contusie

# letseltypes

Diffuus hersenoedeem

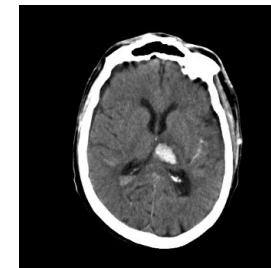
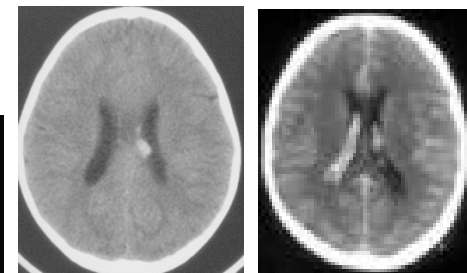
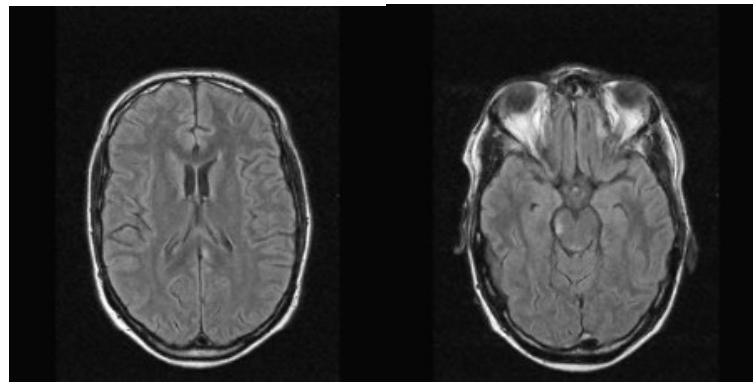
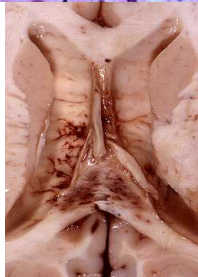
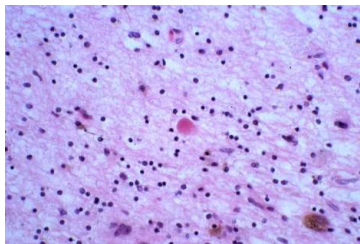
- Cytotoxisch
- Vnl kinderen/jongvolwassenen



# letseltypes

## Diffuse axonal injury

- Shear stress & hoekversnelling
- Zichtbaar op MR, soms geassocieerde bloedingen ook op CT
- Risico op slechte bewustzijnsrecuperatie



# letseltypes

## Hersenschudding (licht hersentrauma)

- Tijdelijke verstoring functie

A concussion is a brain injury associated with rapid brain movement and characteristic clinical symptoms, with no associated objective biomarkers or overt pathologic brain changes, thereby making it difficult to diagnose by neuroimaging or other objective diagnostic tests.

Handb Clin Neurol. 2018;158:51-61.

### What is a concussion?

A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific signs and/or symptoms (some examples listed below) and most often does not involve loss of consciousness. Concussion should be suspected in the presence of **any one or more** of the following:

- Symptoms (e.g., headache), or
- Physical signs (e.g., unsteadiness), or
- Impaired brain function (e.g. confusion) or
- Abnormal behaviour (e.g., change in personality).

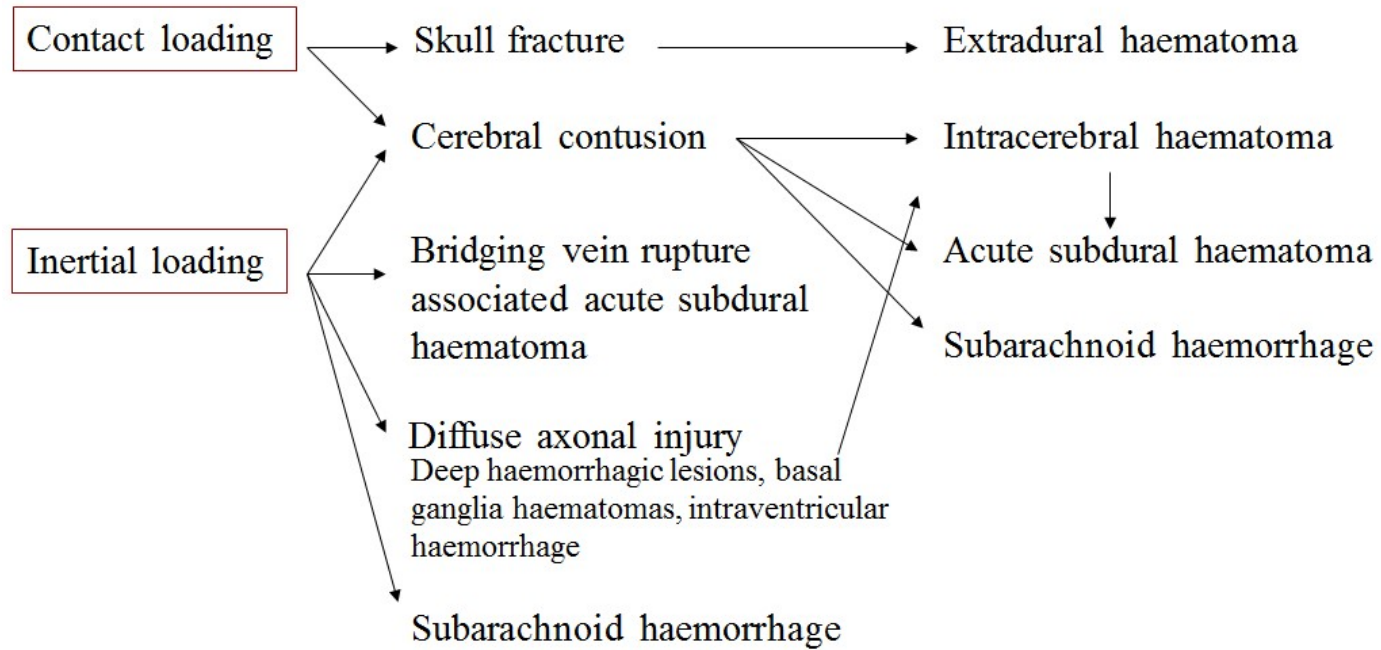
# letseltypes

Hersenschudding (licht hersentrauma)

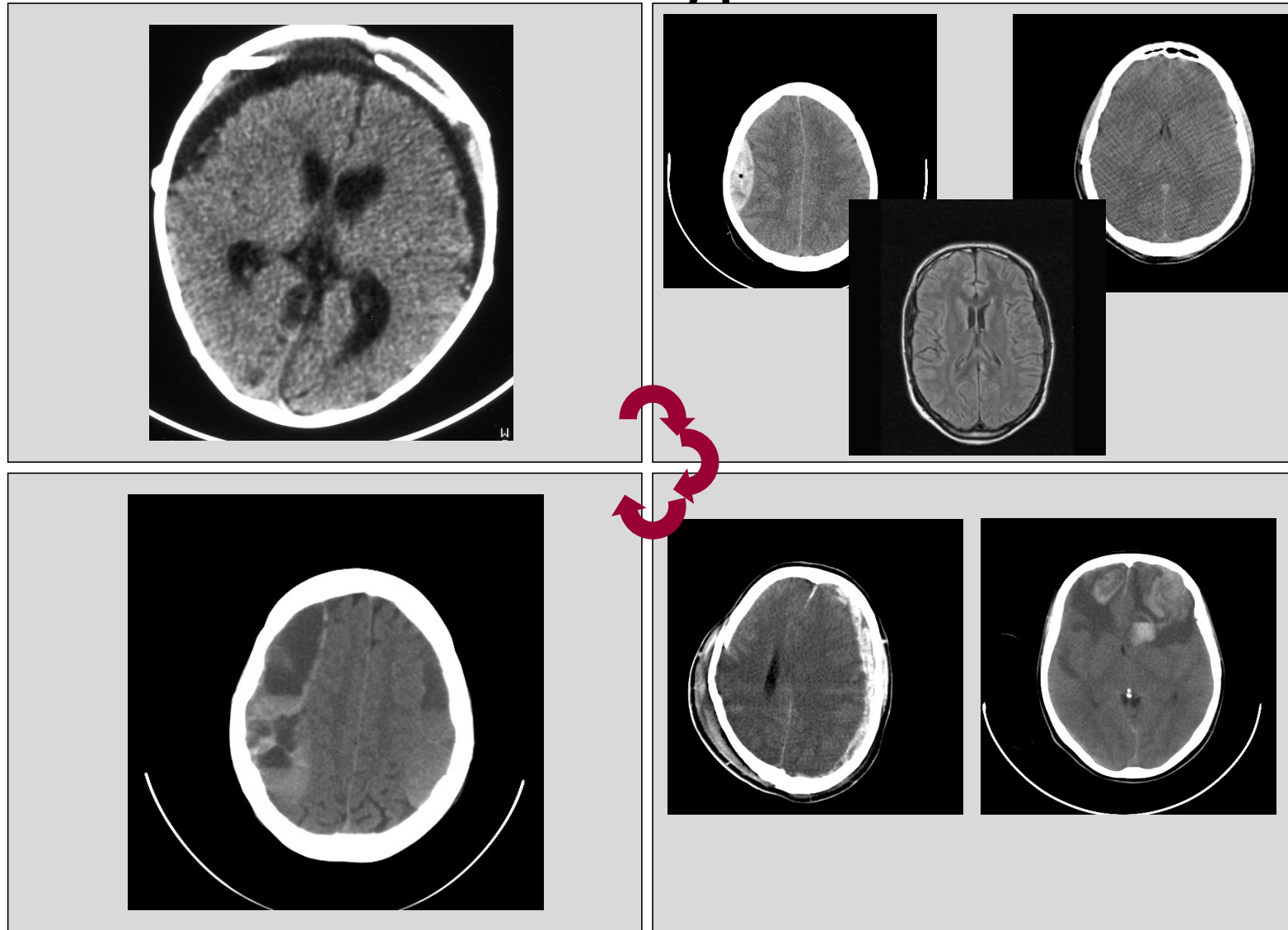
- Tijdelijke verstoring functie
- & hoekversnelling



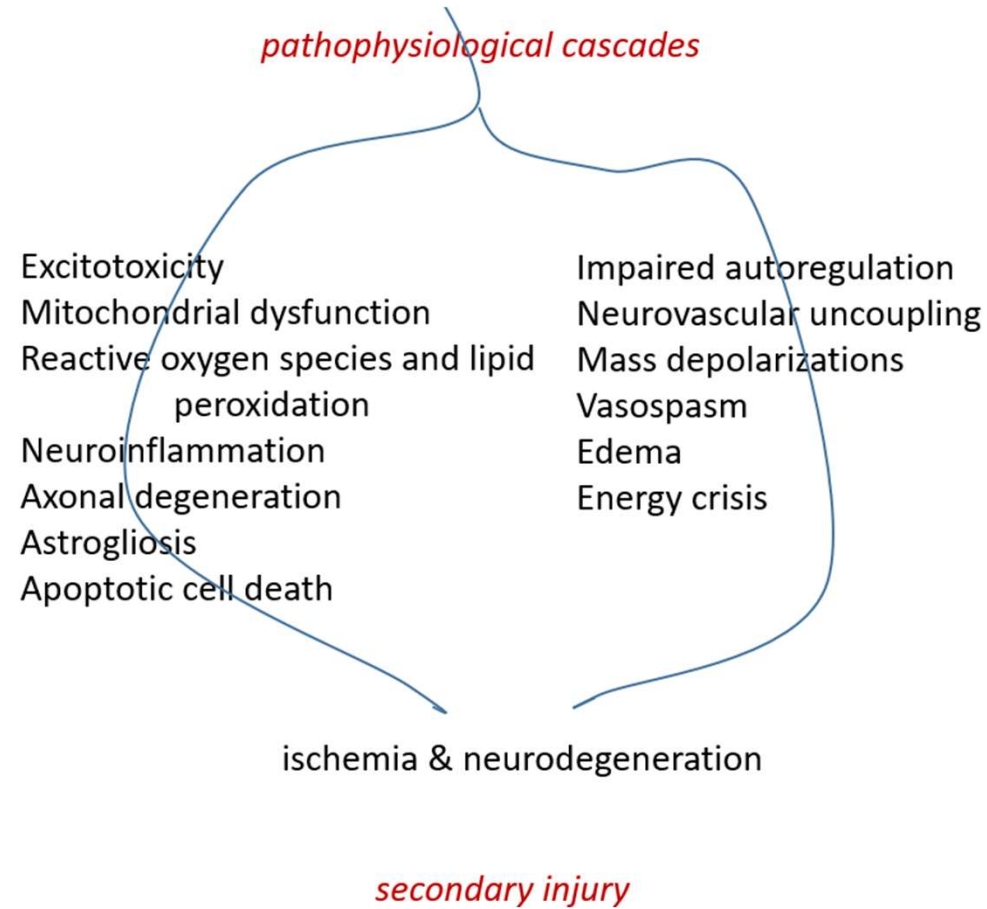
# letseltypes



# letseltypes



# Secundaire schade





# Secundaire schade

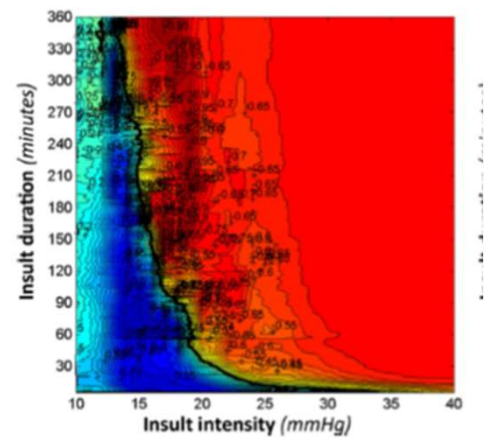
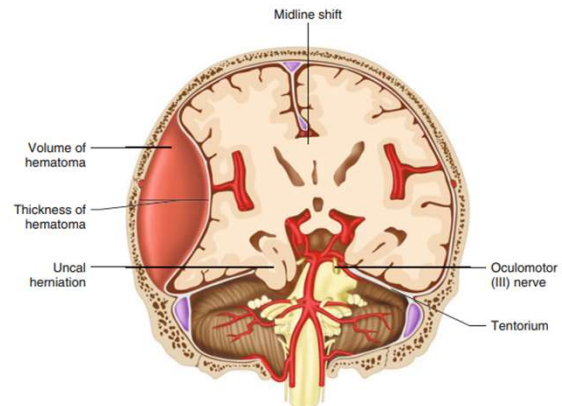
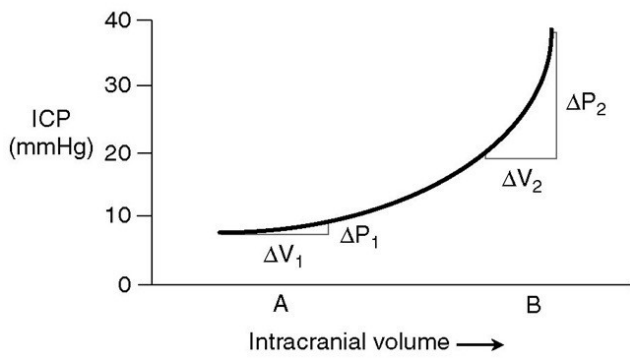
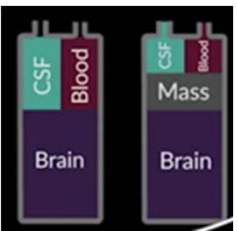
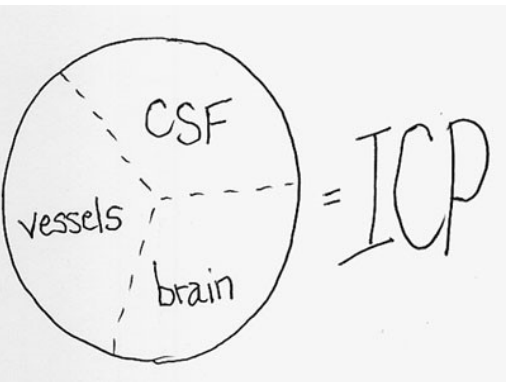
Grotendeels onzichtbaar: hoe gaan we daar mee om?

Vermijden van detecteerbare events = 'secundaire insulten'

- Intracranieële overdruk
- Vasospasmen
- Epilepsie
- Infectie
- Hypoxemie
- Arteriële hypotensie
- Hypercapnie
- Hypocapnie
- Hyperthermie
- Hyperglycemie
- Hypoglycemie
- Hyponatremie

# Secundaire schade

Belangrijke secundair insult = intracranieële overdruk



# Secundaire schade

## **DOEL MEDISCHE BEHANDELING**

**= VERMIJDEN SECUNDAIRE INSULTEN**

**= VERMIJDEN ISCHEMIE EN WEEFSELVERLIES**

# Medische aanpak

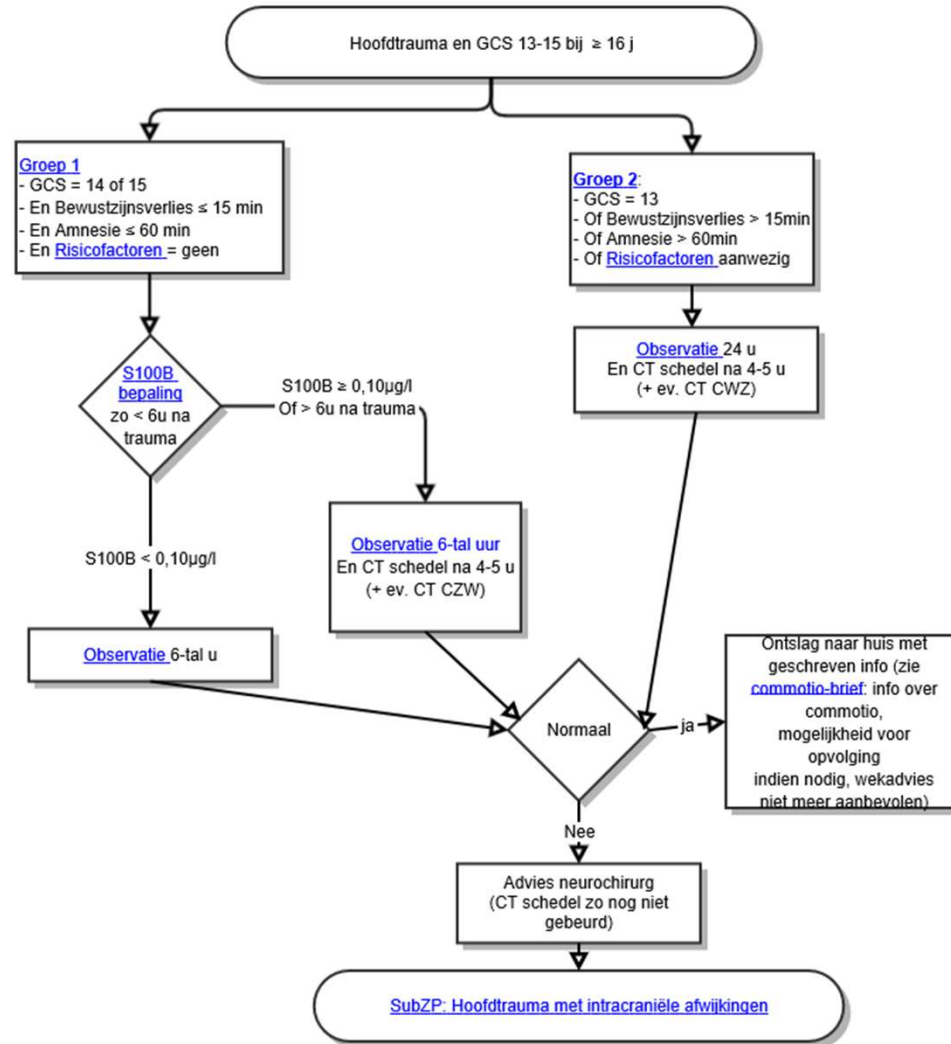
Classificatie ernst traumatisch hersenletsel door Glasgow Coma Schaal

	E: Eye opening	M: motor response	V: verbal response
1	niet	niet	niet
2	op <u>pijn</u> prikkel	extensie op pijn	kreunen
3	op bevel	abnormale flexie	woorden
4	spontaan open	normale flexie	zinnen maar verward
5	-	localiseren	georiënteerd
6	-	bevel uitvoeren	-

- Sum score GCS 13-15: licht
- Sum score GCS 9-12: matig
- Sum score GCS 3-8: ernstig
  - Obstructieve ademhaling → intubatienood

## Acute aanpak licht hersentrauma

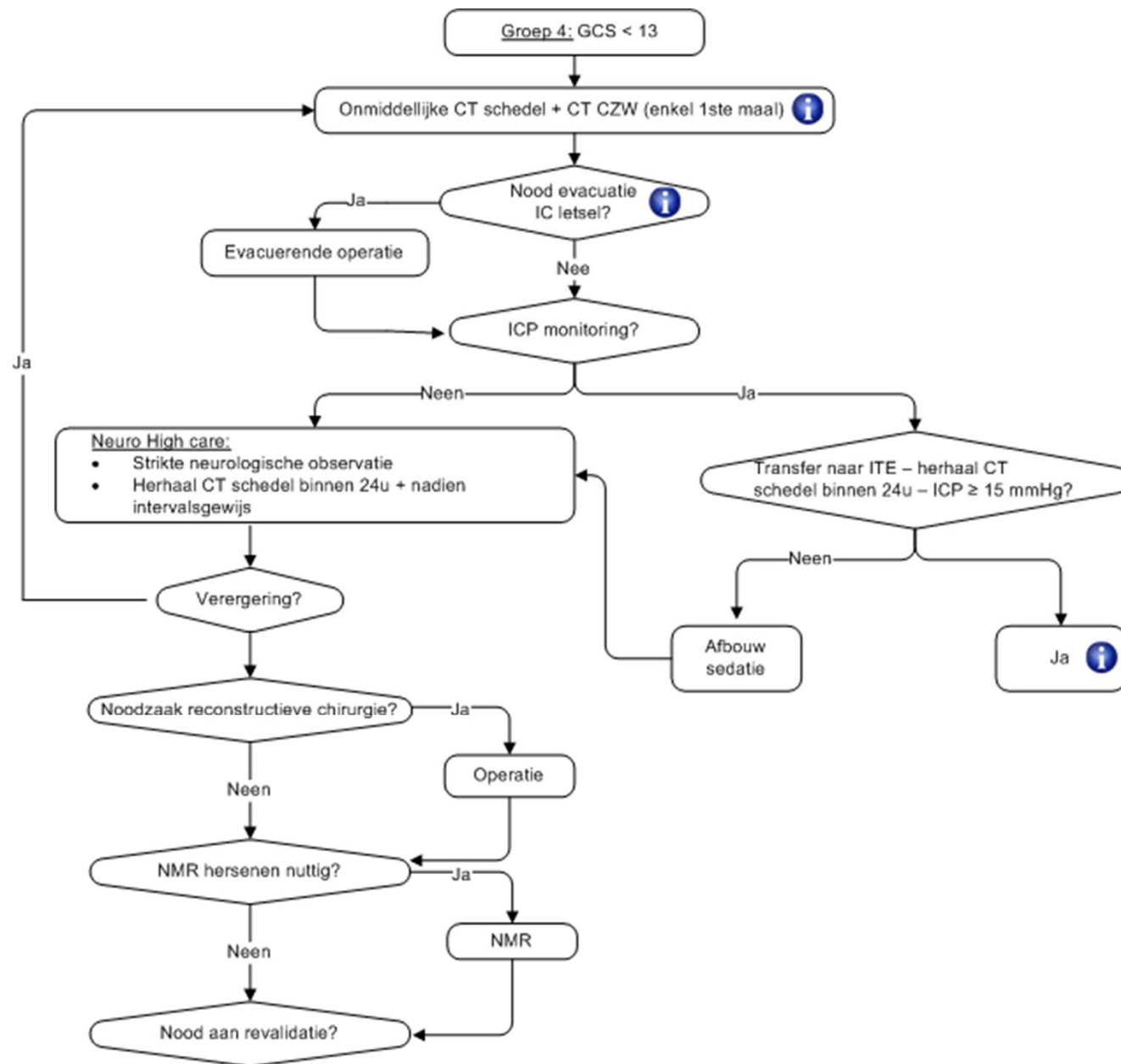
Uitsluiten dat er intracranieële overdruk kan ontstaan



# Acute aanpak matig & ernstig hersentrauma

## Prehospitaal opvang

- Snelheid
- SaO<sub>2</sub> < 90% ongunstig
  - Zuurstof
  - Intuberen
- Systolische BD < 90mmHg ongunstig
  - Veneuze access
  - Toediening vocht (isotone NaCl)



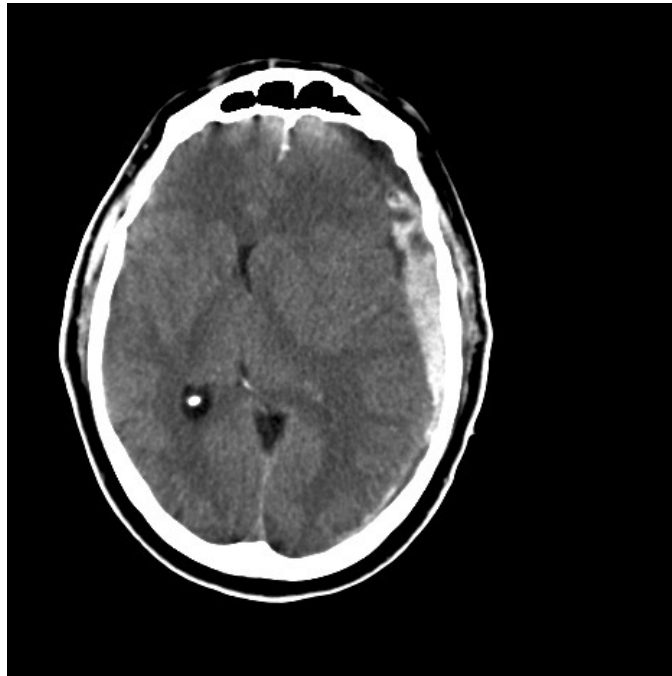
# Acute aanpak matig & ernstig hersentrauma

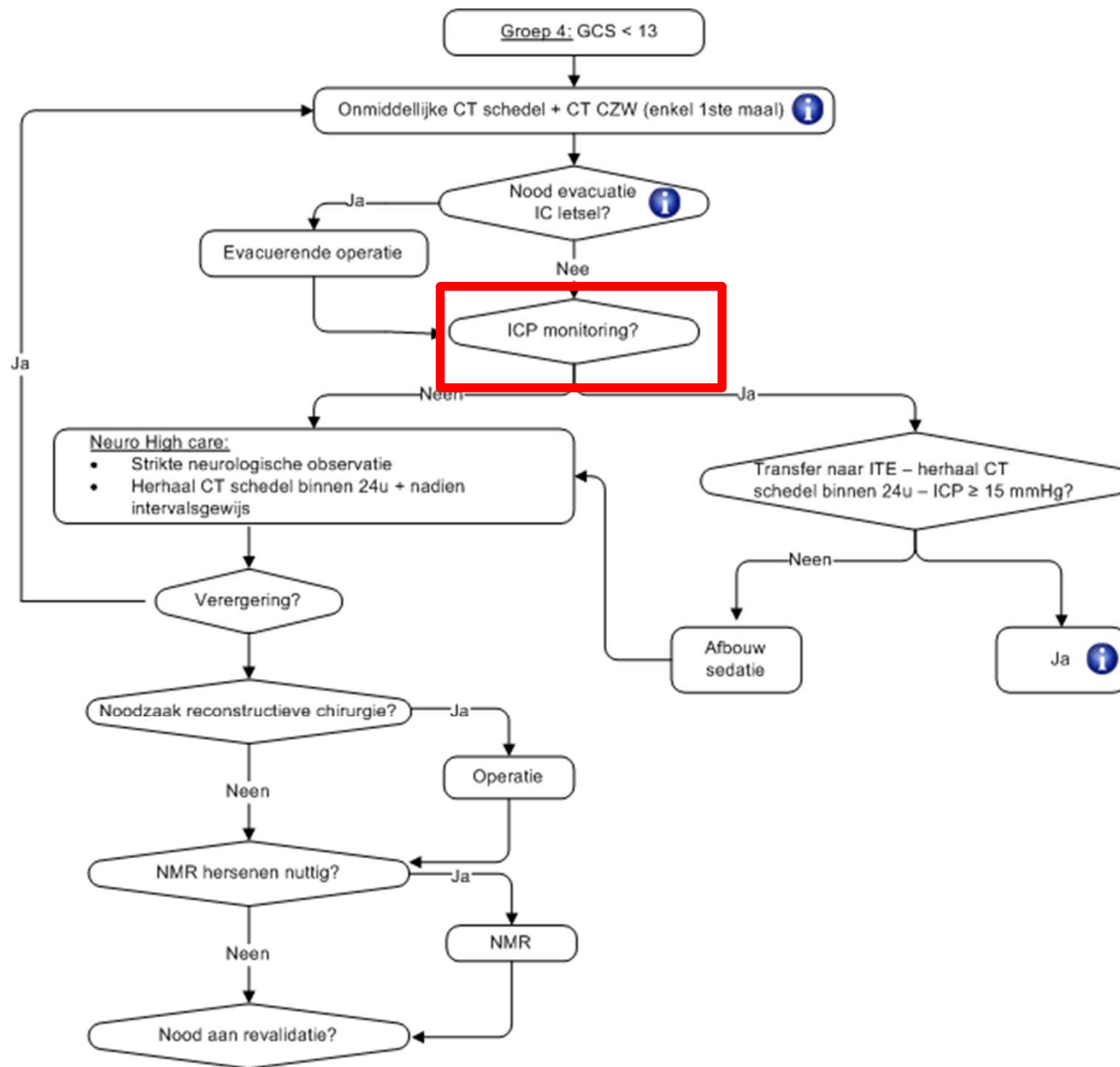
Nood evacuatie hematoom en nood aan ICP meting:

- GCS 9-12:
  - Matige kans op achteruitgang en ongunstige prognose
  - Observatie: nieuwe CT/ingreep bij achteruitgang
  - Bij sedatienood voor andere reden: ingreep/ICP-meting te overwegen
- GCS 3-8:
  - Reële kans op ongunstige prognose
  - Intubatie (obstructief ademen)
  - Evacuerende ingreep zo dit kan
  - ICP meting en monitoring voor secundaire insulten op intensieve afdeling



# Acute aanpak matig & ernstig hersentrauma





# Acute aanpak matig & ernstig hersentrauma

- ICP meting en drainage cerebrospinaal vocht

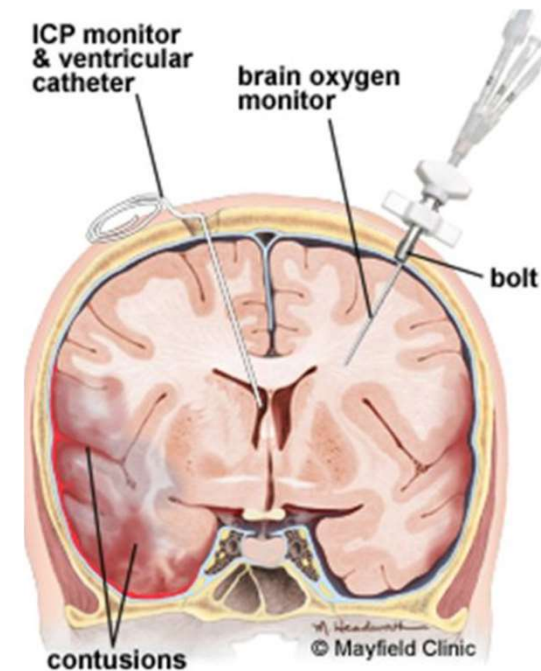
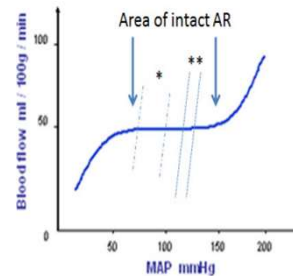
ICP < 20 mmHg

- CPP = MAP – ICP    CBF = CPP/CVR

CPP 60-70 mmHg

- PbO2 meting

PbO2 > 25 mmHg



# Acute aanpak matig & ernstig hersentrauma

## TIER 0 (basismaatregelen)

- Intubatie en mechanische ventilatie.
- Hoofdeinde van het bed op 30-45° (transducers op oorhoogte). Bewaken dat veneuze retour niet gecompromitteerd is (neutrale positie van het hoofd).
- Evaluatie pupillen en neurologische toestand elke 2 uur.
- Sedatie zodat patiënt mechanische beademing/intubatie tolereert \* (niet in functie van ICP/PbO<sub>2</sub>).
- Analgesie:
  - standaard 4dd 1g paracetamol;
  - opiaten (fentanyl of remifentanyl) zodat patiënt mechanische beademing/intubatie tolereert; verder opiaten te titreren in functie van klinische indruk van pijn.
- Streefwaarden
  - Hb > 7 g/dl
  - PaCO<sub>2</sub> 38 – 40 mmHg
  - Centrale temperatuur < 37°C
  - CPP 60 – 70 mmHg
  - SaO<sub>2</sub> > 94%
  - Vermijd hyponatremie
- 2x/week EEG om subklinische epilepsie te detecteren

	ICP<20mmHg	ICP>20mmHg
PbO <sub>2</sub> >20mmHg	<b>Type A</b> Geen nood interventie	<b>Type B</b> Doel: verlaag ICP
PbO <sub>2</sub> <20mmHg	<b>Type C</b> Doel: verhoog PbO <sub>2</sub>	<b>Type D</b> Doel: verlaag ICP + verhoog PbO <sub>2</sub>

# Acute aanpak matig & ernstig hersentrauma

## Type B Doel: verlaag ICP

### TIER 1: optimaliseer

- Verhoog sedatie om ICP te verlagen. \*
- Verhoog analgesie om ICP te verlagen.
- CPP 60-70 mmHg.
- Bolusdrainage via VED.
- PaCO<sub>2</sub> 35-38 mmHg.

### TIER 2: aanvullend

- Bekijk autoregulatie:
  - ICM+:
    - PRx grotendeels groen (actieve CA): verhoog CPP naar 70-80 mmHg.
    - PRx grotendeels rood (deficiënte CA): behoud CPP tussen 60 en 70 mmHg.
    - Vergelijk ook met richtwaarde CPPopt.
  - Indien geen duidelijk advies op basis van PRx: overweeg MAP challenge (door arts met ervaring).
    - Drijf MAP op door vasopressie/inotropie met 10 mmHg gedurende niet meer dan 20 minuten.
    - Monitor ICP/PbO<sub>2</sub>/MAP/ CPP.
    - Beoordeel ICP respons: overweeg opdrijven CPP indien CA intact (ICP gedaald).
- Overweeg trial dosis neuromusculaire blokkade.
- Bolus Mannitol (0,25-1 g/kg) (zolang serum-osmolaliteit < 320 mmol/l). \*
- Lichte hypocapnie (PaCO<sub>2</sub> 32-35 mmHg) mits PbO<sub>2</sub> > 20 mmHg.
- Overweeg (1w) profylactische anti-epileptica; overweeg continue EEG monitoring.

### TIER 3: altijd na overleg ITE-NCH, meestal op supervisie-niveau

- Decompressieve craniëctomie (recente CT schedel). \*
- Barbituratencoma (begin met een bolus Thiopental als trial). \*\*
- Lichte hypothermie (35°C).
- (Diepere hyperventilatie met PaCO<sub>2</sub> 30-32 mmHg mits PbO<sub>2</sub> > 20 mmHg)

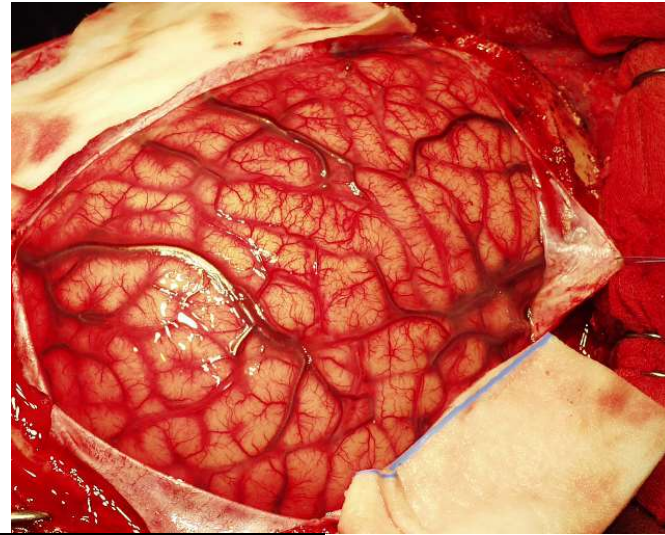
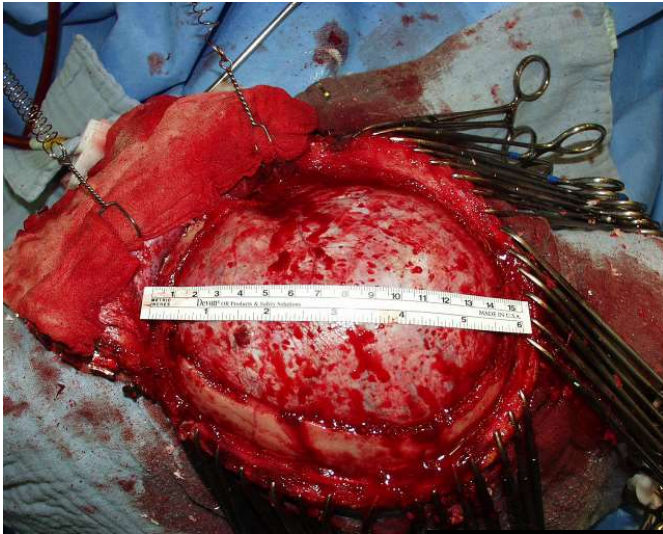
# Acute aanpak matig & ernstig hersentrauma

**Type C**  
Doel: verhoog PbO<sub>2</sub>

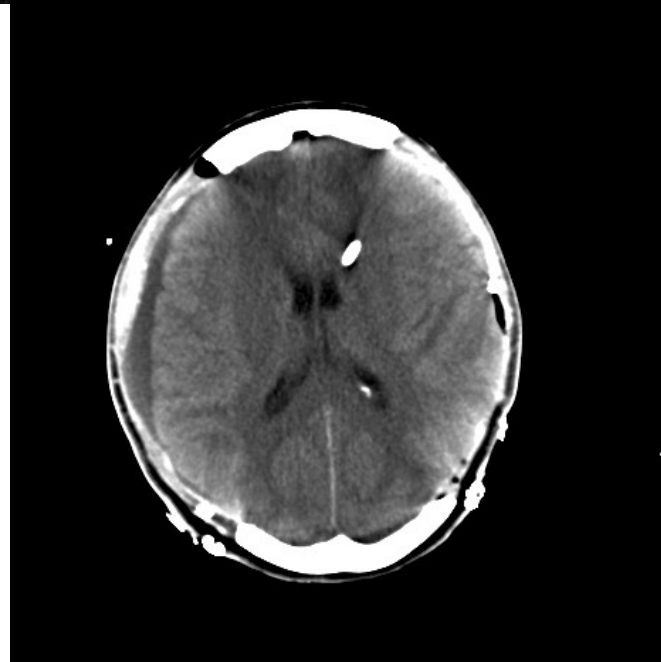
TIER 1: optimaliseer
<ul style="list-style-type: none"><li>- CPP 60-70mmHg. Indien al in die range, verhoog CPP tot max. <u>70 mmHg</u>.</li><li>- PaCO<sub>2</sub> &gt;35mmHg</li><li>- PaO<sub>2</sub>: indien al in gewenste range, verhoog PaO<sub>2</sub> door FiO<sub>2</sub> op te drijven tot 60%</li></ul>

TIER 2: aanvullend
<ul style="list-style-type: none"><li>- Drijf PaO<sub>2</sub> op tot 150mmHg door aanpassen van de ventilator-<u>settings</u></li><li>- Verhoog sedatie om mechanische ventilatie te verbeteren</li><li>- Verlaag ICP nog verder door bolusdrainage</li><li>- Overweeg trial dosis neuromusculaire blokkade</li><li>- Bekijk autoregulatie (CPP is krachtige aandrijver van PbO<sub>2</sub>, maar opdrijven kan ICP doen stijgen als CA deficiënt is)<ul style="list-style-type: none"><li>o ICM+:<ul style="list-style-type: none"><li>▪ <u>PRx</u> grotendeels groen (actieve CA): verhoog CPP naar 70-80mmHg</li><li>▪ <u>PRx</u> grotendeels rood (deficiënte CA): behoud CPP rond 70mmHg</li><li>▪ Vergelijk ook met richtwaarde <u>CPPopt</u></li></ul></li><li>o Indien geen duidelijk advies op basis van <u>PRx</u>: overweeg <u>MAP challenge</u> (door arts met ervaring)<ul style="list-style-type: none"><li>▪ Drijf MAP op door <u>vasopressie/inotropie</u> met 10mmHg gedurende niet meer dan 20 minuten</li><li>▪ Monitor ICP/PbO<sub>2</sub>/MAP/CPP</li><li>▪ Beoordeel ICP en PbO<sub>2</sub> respons: overweeg opdrijven CPP indien CA intact (ICP stijgt niet) en gunstig effect op PbO<sub>2</sub></li></ul></li></ul></li><li>- Overweeg (1w) profylactische anti-epileptica; overweeg <u>ctu EEG monitoring</u></li></ul>

TIER 3: altijd na overleg ITE-NCH, meestal op supervisie-niveau
<ul style="list-style-type: none"><li>- Overweeg transfusie met 1 eenheid PC indien <u>Hb</u> &lt; 9g/dl</li><li>- Overweeg PaCO<sub>2</sub> 45-50mmHg (maar vermijd stijging ICP)</li><li>- Overweeg <u>normobare hyperoxie</u> met PaO<sub>2</sub> &gt; 150mmHg</li></ul>



decompressieve  
craniectomie



# Acute aanpak matig & ernstig hersentrauma

Hersenschade

+ Complicaties

- Algemeen medisch: pneumonie, decubitus, contracturen...
- Craniale zenuwen
  - N. VI door overdruk
  - N. VII door rotsbeenfractuur
  - N. I door traumatische disruptie
- CSV lekkage door schedelbasisfractuur
- Chronisch subduraal hematoom
- Posttraumatische epilepsie
- Hormonenstoornissen (vnl kinderen)
- Posttraumatische ydrocefalie
- Complicaties bij schedelherstel (infectie, epiduraal hematoom, hydrocefalie)
- ...



# Acute aanpak matig & ernstig hersentrauma

Belang van vroege aanvang revalidatie (reeds op intensieve afdeling)



# Outcome matig en ernstig hersentrauma

GOS	GOSE	Interpretation
1 = Dead	1 = Dead	Dead
2 = Vegetative state	2 = Vegetative state	Absence of awareness of self and environment
3 = Severe disability	3 = Lower severe disability	Needs full assistance in ADL
	4 = Upper severe disability	Needs partial assistance in ADL
4 = Moderate disability	5 = Lower moderate disability	Independent, but cannot resume work/school or all previous social activities
	6 = Upper moderate disability	Some disability exists, but can partly resume work or previous activities
5 = Good recovery	7 = Lower good recovery	Minor physical or mental deficits that affects daily life
	8 = Upper good recovery	Full recovery or minor symptoms that do not affect daily life

# Outcome matig en ernstig hersentrauma

**Table 2** Outcomes at 1 and 2 years post injury for matched samples

Variables	Year 1		Year 2		
	MERRC (n=352) n (%)	TBIMS (n=704) n (%)	MERRC (n=352) n (%)	TBIMS (n=704) n (%)	
<b>Employment</b>					
Competitively Employed	129 (38.1)	255 (37.1)	149 (43.8)	258 (36.9)	*
Student	35 (10.3)	47 (6.8)	31 (9.1)	52 (7.4)	*
Unemployed/not in labor force [Missing]	175 (51.6) [13]	485 (56.0) [17]	160 (47.1) [12]	389 (55.7) [5]	*
<b>Living situation</b>					
Independent	144 (41.6)	188 (26.7)	147 (42.0)	214 (30.5)	*
Live with family	198 (57.2)	497 (70.6)	200 (57.1)	472 (67.2)	*
Special Accommodation or other [Missing]	4 (1.2) [6]	19 (2.7) [0]	3 (0.9) [2]	16 (2.3) [2]	
<b>Marital status</b>					
Married	131 (38.8)	181 (25.8)	126 (36.3)	173 (24.7)	*
Single/never married	176 (52.1)	375 (53.5)	188 (54.2)	366 (52.3)	
Divorced	13 (3.8)	91 (13.0)	18 (5.2)	101 (14.4)	*
Separated	13 (3.8)	33 (4.7)	11 (3.2)	38 (5.4)	
Widowed [Missing]	5 (1.5) [14]	21 (3.0) [3]	4 (1.2) [5]	22 (3.1) [4]	*
<b>GOS-E</b>					
Good recovery	113 (33.7)	281 (40.7)	129 (39.7)	308 (44.7)	*
Moderate disability	170 (50.7)	251 (36.4)	158 (48.6)	266 (38.6)	*
Severe disability	42 (12.5)	100 (14.5)	31 (9.5)	75 (10.9)	
VS or lower SD [Missing]	10 (3.0) [17]	58 (8.4) [14]	7 (2.2) [27]	45 (6.6) [15]	*

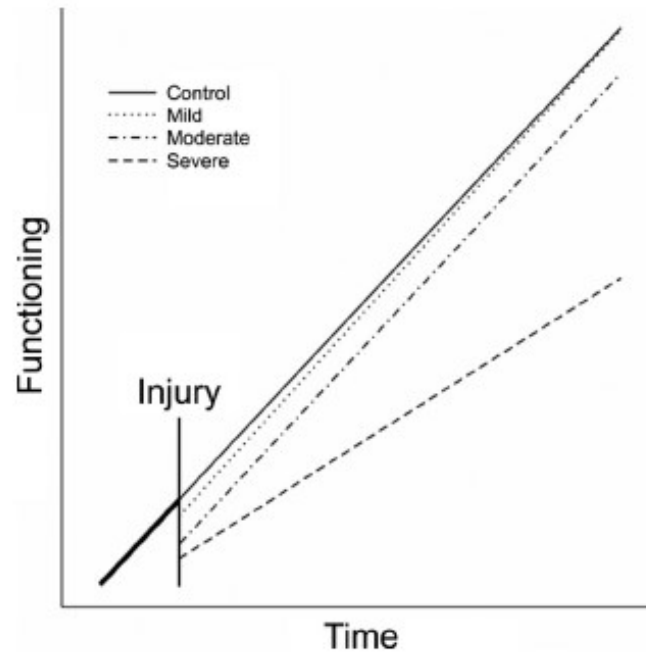
**Outcomes 1 and 2 Years After Moderate to Severe Traumatic Brain Injury: An International Comparative Study**

[Archives of Physical Medicine and Rehabilitation 2021;102:371-7](#)

11.7 – 22.9%  
Unfavorable  
outcome without  
mortality

# Outcome matig en ernstig hersentrauma

Kinderen



Neuropsychology  
2009, Vol. 23, No. 3, 283-296

# Outcome matig en ernstig hersentrauma

Ouderen

Functional outcome, dependency and well-being after traumatic brain injury in the elderly population: A systematic review and meta-analysis

Rebeca Alejandra Gavrila Laic<sup>a,\*</sup>, Liedewij Bogaert<sup>b</sup>, Jos Vander Sloten<sup>a</sup>, Bart Depreitere<sup>c</sup>

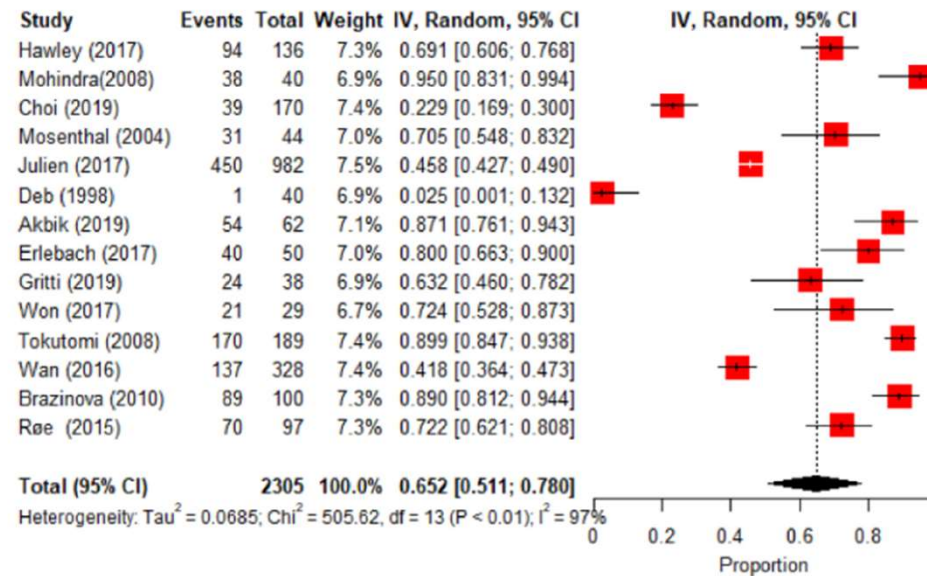


Fig. 2. Meta-analysis results for unfavorable functional outcomes.

# Outcome licht hersentrauma

Theadom et al. Persistent problems 1 year after mild traumatic brain injury: a longitudinal population study in New Zealand. British Journal of General Practice 2016; e16-e23

**Table 2. Proportion of participants experiencing significant impairment over the year after mild TBI**

	Impairment, <i>n</i> participants (%)			
	At baseline	At 1 month	At 6 months	At 12 months
Post-concussion symptoms <sup>a</sup>	107 (70.9)	130 (57.8)	122 (49.8)	139 (47.9)

**Table 4. Percentage of participants reporting a score of  $\geq 2$  on the individual post-concussion symptom items over time**

Symptom	Baseline (%)	1 month (%)	6 months (%)	12 months (%)
Headaches	96 (63.6)	99 (44.0)	88 (35.9)	105 (36.1)
Feelings of dizziness	78 (51.7)	93 (41.3)	76 (31.0)	83 (28.5)
Nausea/vomiting	34 (22.5)	31 (13.8)	35 (14.3)	37 (12.7)
Noise sensitivity	67 (44.4)	71 (31.6)	75 (30.6)	80 (27.5)
Sleep disturbance	65 (43.0)	86 (38.2)	87 (35.5)	93 (32.0)
Fatigue/tiring more easily	97 (64.2)	123 (54.7)	117 (47.8)	118 (40.5)
Being irritable/easily angered	73 (48.3)	82 (36.4)	84 (34.3)	94 (32.3)
Feeling depressed or tearful	46 (30.5)	54 (24.0)	62 (25.3)	70 (24.1)
Feeling frustrated or impatient	77 (51.0)	96 (42.7)	86 (35.1)	98 (33.7)
Forgetfulness/poor memory	85 (56.3)	108 (48.0)	110 (44.9)	119 (40.9)
Poor concentration	78 (51.7)	104 (46.2)	97 (39.6)	99 (34.0)
Taking longer to think	91 (60.3)	123 (54.7)	107 (43.7)	118 (40.5)
Blurred vision	50 (33.1)	60 (26.7)	51 (20.8)	72 (24.7)
Light sensitivity	53 (35.0)	63 (28.0)	62 (25.3)	68 (23.4)
Double vision	16 (10.6)	31 (13.8)	28 (11.4)	34 (11.7)
Restlessness	66 (43.7)	78 (34.7)	75 (30.6)	75 (25.8)

# Outcome licht hersentrauma

Received: 7 October 2022 | Accepted: 7 January 2023

DOI: 10.1111/ene.15713

European Journal  
of Neurology

REVIEW ARTICLE

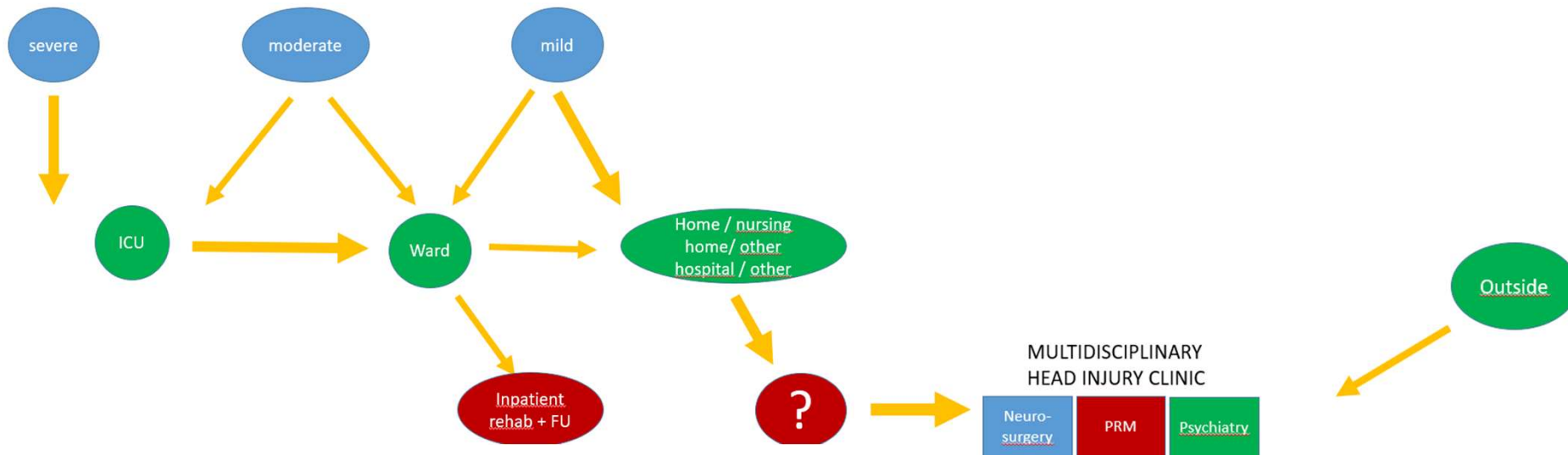
## Relationship between psychosocial and psychiatric risk factors and poor long-term outcome following mild traumatic brain injury: A systematic review

Martijn de Neeling<sup>1</sup> | Dirk Liessens<sup>2</sup> | Bart Depreitere<sup>3</sup> 

Systematic review, M De Neeling, B Depreitere

- Relatief sterke correlatie
  - Angst (vroeg na trauma)
  - Depressie (vroeg na trauma)
  - Premorbide psychiatrische geschiedenis
  - Post-traumatische stress
- Gemengde resultaten
  - Coping
  - Beliefs & attitudes

# Outcome licht hersentrauma



## Hub

Luisteren, geruiststellen

Opvolgen

Coachen, evt inschakeling (neuro)psychologen

Begeleiden verzekeringsdossiers

Symptomatische aanpak (bijv hoofdpijn, nekpijn, WVP, gehoor/evenwichtproblemen, slaapproblemen,...)

## Treatment / Management

Treatment of PCS is individualized to each patient and the patient's particular complaints. Simple reassurance is often the major treatment. It is important to note that most patients will improve within three months. In the absence of specific treatments to be provided for each patient, clinicians can adopt a symptomatic approach.[21]



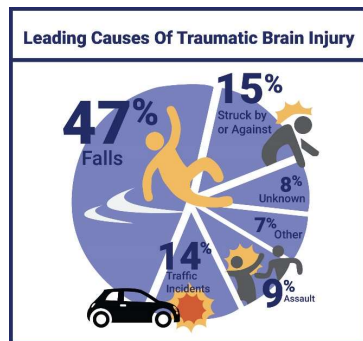
# Uitdagingen

Demografische shift in high income countries: ↑ ouderen

	Overall	ER stratum	Admission stratum	ICU stratum
<b>Demographic characteristics</b>				
Age (years)	50 (30-66)	48 (29-64)	53 (32-69)	49 (29-65)
>65 years	1254/4509 (27.8%)	209/848 (24.6%)	493/1523 (32.4%)	552/2138 (25.8%)

Functional outcome, dependency and well-being after traumatic brain injury in the elderly population: A systematic review and meta-analysis

Rebeca Alejandra Gavrilă<sup>a,\*</sup>, Liedewij Bogaert<sup>b</sup>, Jos Vander Sloten<sup>a</sup>, Bart Depreitere<sup>c</sup>



Ethische dilemma's

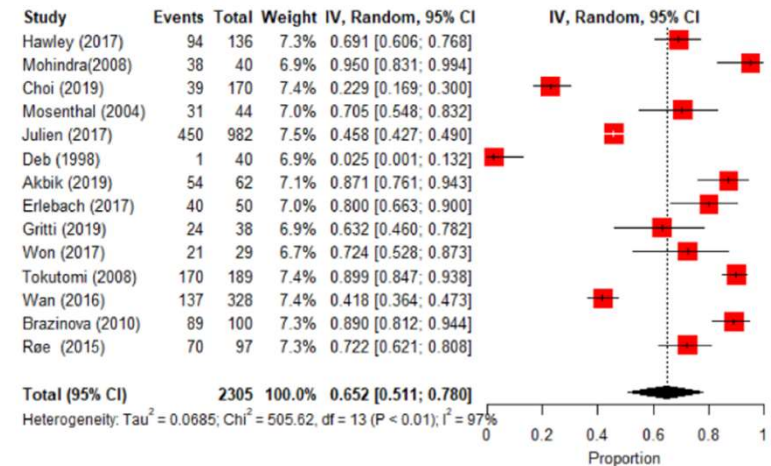


Fig. 2. Meta-analysis results for unfavorable functional outcomes.

# Uitdagingen

## Toegang tot neurotrauma zorg in low/middle income countries

### Casemix, management, and mortality of patients receiving emergency neurosurgery for traumatic brain injury in the Global Neurotrauma Outcomes Study: a prospective observational cohort study

David Clark, Alexis Joannides, Amos Olufemi Adeleye, Abdul Hafid Bajamal, Tom Bashford, Hagos Biluts, Karol Budohoski, Ari Ercole, Rocio Fernández-Méndez, Anthony Figaji, Deepak Kumar Gupta, Roger Härtl, Corrado Iaccarino, Tariq Khan, Tsegazeab Laeke, Andrés Rubiano, Hamisi K Shabani, Kachinga Sichizya, Manoj Tewari, Abenezer Tirsit, Myat Thu, Manjul Tripathi, Rikin Trivedi, Bhagavatula Indira Devi, Franco Servadei, David Menon, Angelos Kollias, Peter Hutchinson, on behalf of the Global Neurotrauma Outcomes Study collaborative\*

	Very high HDI tier (n=78)	High HDI tier (n=33)	Medium HDI tier (n=28)	Low HDI tier (n=14)	Total (n=153)	p value
<b>Availability of resources</b>						
CT availability						0.0005
Always available in base hospital	76 (98%)	26 (79%)	24 (86%)	5 (36%)	131 (86%)	--
Always available in base or nearby hospital	1 (1%)	7 (21%)	4 (14%)	6 (43%)	18 (12%)	--
Not always available	1 (1%)	0 (0%)	0 (0%)	3 (21%)	4 (3%)	--
Intracranial pressure monitoring						0.0005
Yes, always available	68 (87%)	12 (36%)	7 (25%)	0 (0%)	87 (57%)	--
Yes, sometimes available	6 (8%)	8 (24%)	10 (36%)	1 (7%)	25 (16%)	--
No, never or rarely available	4 (5%)	11 (33%)	11 (39%)	13 (93%)	39 (25%)	--
No, not considered clinically useful	0 (0%)	2 (6%)	0 (0%)	0 (0%)	2 (1%)	--
Type of ICU						0.0010
Neurosciences ICU	37 (47%)	6 (18%)	17 (61%)	1 (7%)	61 (40%)	--
Other specialty ICU	14 (18%)	5 (15%)	6 (21%)	4 (29%)	29 (19%)	--
General ICU	27 (35%)	22 (67%)	5 (18%)	9 (64%)	63 (41%)	--
Availability of high-speed drill						0.0005
All cases	72 (92%)	16 (48%)	14 (50%)	2 (14%)	104 (68%)	--
Some or most cases	5 (6%)	16 (48%)	13 (46%)	6 (43%)	40 (26%)	--
Never	1 (1%)	1 (3%)	1 (4%)	6 (43%)	9 (6%)	--
Neurosurgeons per hospital	10 (6-13)	7 (5-14)	5 (2-7)	3 (1-5)	8 (4-12)	<0.0001
Surgeries for TBI per 30-day period	3 (2-5)	9 (4-21)	11 (4-19)	4 (2-17)	4 (2-10)	<0.0001

# Uitdagingen

## Adequate zorgpaden voor licht hersentrauma

Specialist healthcare services for concussion/mild traumatic brain injury in England: a consensus statement using modified Delphi methodology

	Agreement %
<b>1 Care pathway to structured follow-up</b>	
Patients with concussion with persistent symptoms should be able to access specialist clinics.	100
There should be dedicated concussion clinics, or where not possible, clinics with dedicated time for patients with concussion.	100
Specialist head injury clinics should comprise a multidisciplinary team that should include, as a minimum, a clinician, neuropsychologist and vestibular physiotherapist.	100
There should be a direct patient pathway for patients with persistent symptoms to specialist outpatient services from the ED, GP and other sources.	100
<b>2 Prognosis and measures of recovery</b>	
There should be a system for patients to be triaged to a specialist in head injury clinics based on persistent symptoms.	100
There may be a role for digital tools (eg, platforms, apps) to be used for screening for persistent symptoms following concussion.	100
Symptom scales can aid the assessment of symptom burden.	100
Screening for persistent symptoms can be aided by symptom scales.	100

# Uitdagingen

## Classificatie is niet accuraat!

Acta Neurochirurgica (2022) 164:1407–1419  
<https://doi.org/10.1007/s00701-022-05159-0>

ORIGINAL ARTICLE - BRAIN TRAUMA



### Traumatic brain injury in the elderly population: a 20-year experience in a tertiary neurosurgery center in Belgium

Rebeca Alejandra Gavrila Laic<sup>1</sup> · Jos Vander Sloten<sup>1</sup> · Bart Depreitere<sup>2</sup>

	Mild TBI (N=521)
Hospitalization (N (%))*	469 (90.0)
Hospitalization length (days) (median; IQR)*	7;19
Admission ICU (N (%))*	149 (28.6)
Intubation (N (%))*	24 (4.6)
Subdural hematoma evacuation	44 (8.4)
DNR code 1 (N (%))*	2 (4.6)
DNR code 2 (N (%))*	90 (17.2)
DNR code 3 (N (%))*	3 (6.2)
Mortality within 30 days post-TBI (N (%))*	36 (6.9)

# Uitdagingen

(Repetitief) hersentrauma in sport

JAMA Network | **Open**™

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Original Investigation | Neurology

## Contrasting Characteristics and Outcomes of Sports-Related and Non-Sports-Related Traumatic Brain Injury

Michail Ntikas, PhD; William J. Meade, MD; David K. Menon, MD; Linda...

JAMA Network | **Open**™

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Original Investigation | Neurology

## Heading Frequency and Risk of Cognitive Impairment in Retired Male Professional Soccer Players

Shima Espahbodi, PhD; Eef Hogervorst, PhD; Tara-Mei Povall Macnab, BSc; Ahmed Thanoon, MSc; Gwen Sacha Fernandes, PhD; Bonnie Millar, PhD; Ashley Duncan, MSc; ... Tobias Bast, PhD; Michael Doherty, MD; Weiya Zhang, PhD

General Review

---

## Chronic Traumatic Encephalopathy in Soccer Players: Review of 14 Cases

Gerard Hageman, MD, PhD,\* Ivar Hageman, MSc,† and Jik Nihom, MD, PhD\*

434

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promoting excellence in psychology

Journal of Neuropsychology (2022), 16, 434–443  
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www.wileyonlinelibrary.com

Research Article

## Cognitive ability in former professional football (soccer) players is associated with estimated heading frequency

Davide Bruno\*<sup>1</sup>  and Andrew Rutherford<sup>2</sup>

<sup>1</sup>School of Psychology, Liverpool John Moores University, UK  
<sup>2</sup>School of Psychology, Keele University, UK

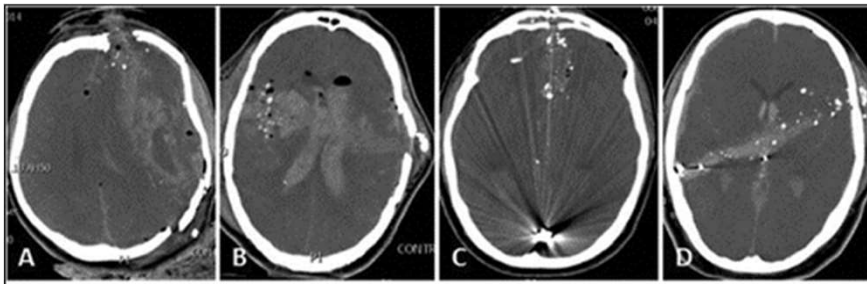
# Uitdagingen

## Toenemende frequentie van schotwonden en militair hersentrauma

Increased Incidence and Mortality of Civilian Penetrating Traumatic Brain Injury in Sweden: A Single-Center Registry-Based Study

Robert D. Lilford<sup>1</sup>, Iftakher Hossain<sup>1-4</sup>, Martin Dahlberg<sup>5</sup>, Carl-Magnus Wahlgren<sup>6,7</sup>, Bo-Michael Bellander<sup>8,9</sup>, Amir Rostami<sup>10,11</sup>, Mattias Günther<sup>1,5</sup>, Jiri Bartek<sup>8,9,12</sup>, Elham Rostami<sup>1,4</sup>

WORLD NEUROSURGERY 182: E493-E505, FEBRUARY 2024



### REVIEW

## Military Traumatic Brain Injury: The History, Impact, and Future

Megan A. Lindberg,<sup>1,2,\*</sup> Elisabeth M. Moy Martin,<sup>1</sup> and Donald W. Marion<sup>1,3</sup>

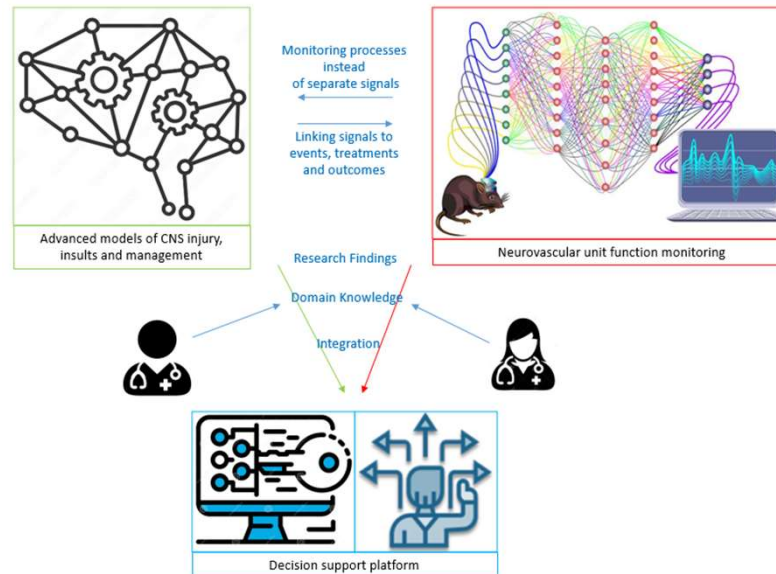
Directive	Title	Specific guidance
DoDI: 6490.11 (2012, 2021)	DoD Policy Guidance for Management of mTBI/Concussion in the Deployed Setting; Reporting guidance, treatment guidance	Events requiring mandatory rest periods and medical evaluations and reporting of exposure of all involved personnel include, but are not limited to: a. involvement in a vehicle blast event, collision, or rollover b. presence within 50 m of a blast (inside or outside) c. a direct blow to the head or witnessed loss of consciousness d. exposure to more than one blast event (SM's commander shall direct a medical evaluation)
DoDI: 6490.13 (2015, 2017)	Comprehensive Policy on TBI-Related Neurocognitive Assessments by the Military Services	Guidance on the use of a computerized neurocognitive assessment tool (ANAM) for the evaluation of SMs with a concussion
Policy Memorandum 19-01 (2019)	Comprehensive Strategy for SOF Warfighter Brain Health	Results from neurocognitive assessment tools, comprehensive histories, and blast exposure monitoring can assist leadership with decision making by providing data for the early detection and treatment of injury. Over the course of an Operator's entire career this policy will surveil exposures, objective cognitive performance, subjective symptoms, and objective data on cumulative blast exposure
DHA-PI: 6490.04 (2021)	Required Clinical Tools and Procedures for the Assessment and Clinical Management of mTBI/Concussion in Non-Deployed Setting	Medical personnel will evaluate individuals as soon as possible following a potentially concussive event. Potentially concussive events may include, but are not limited to: a. involvement in a vehicle blast event, collision, or rollover b. presence within 50 m of a blast (inside or outside) c. a direct blow to the head or witnessed loss of consciousness d. exposure to more than one blast event; falls; or sports-related head impacts Medical personnel will perform the following: a. complete the MACE 2 at initial mTBI/concussion evaluation b. initiate a PRA protocol at follow-up and continue to c. monitor/assess the patient regularly until an exertional test is successfully completed and the patient is cleared for return to full duty or normal activity, as applicable. d. track and document required mTBI/concussion patient reported outcome measures using NSI, and other recommended tools as outlined by the TAC to ensure patient outcomes are improving with treatment

# Uitdagingen

## Acute pathofysiologie: hoe openen we de black box?

*European Training Network for developing Smart neuroMonitoring to support Precision medicine in Acute central Nervous Injury*

KU Leuven  
LUMC Leiden  
UMCU Utrecht  
Univ of Cambridge  
St George Univ London  
Charité Berlin  
Johan Kepler Linz  
+ Moberg Analytics  
+ Imec



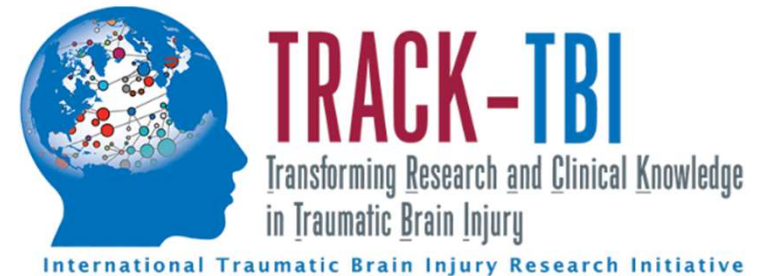
MARIE SKŁODOWSKA-CURIE ACTIONS

**Doctoral Networks (DN)**  
**Call: HORIZON-MSCA-2022-DN-01-01**

10 PhD projects  
2.7 million Euro  
Dec 2023 - 2027

# Uitdagingen & opportuniteiten

## Internationale netwerken



Global Epidemiology and Outcomes of Traumatic Brain Injury (GEO-TBI) Registry





# Dank u

## L'NRG

Geert Meyfroidt  
Fabian Güiza  
Stéphanie De Vleeschauwer  
Tom Theys

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Jan Ivens  
Ignaas Verpoest

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Grace Musigazi  
Zhao Ying Cui  
Markos Kapeliotis  
Andrea Menichetti  
Michel Woering  
Rebecca Gavrila Laic  
Paulien Vandemaele

## SOPRANI team

## Multidisciplinaire hersentrauma raadpleging team

Dirk Liessens  
Dominike Bruyninckx  
Hilde Beyens  
Wouter Lambrechts

**KU LEUVEN**

LEUVENS UNIVERSITEITSFONDS



**Een hersentrauma  
verandert je leven**

Help de impact verminderen

Eager Brains Fonds steunt onderzoek  
naar betere behandelmethoden  
bij een ernstig hersentrauma.

- Meer informatie over het Eager Brains Fonds en het hersentrauma-onderzoek  
Prof. dr. Bart Depreitere  
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