Prognosis of Traumatic Brain Injury

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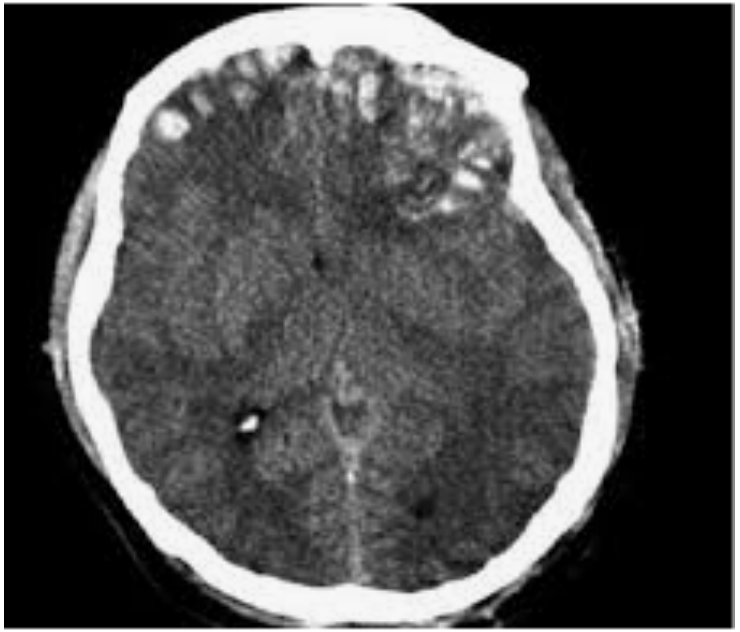
Disclosures: none; no conflicts of interest.

Objectives

- To review the epidemiology, complexity and heterogeneity of TBI
- To develop a prognostic approach that is evidence-based.
- To review clinical predictors and the role of ancillary tests in arriving at a prognosis.

Traumatic Brain Injury (TBI)

- An insult to the brain from the application of an external force.
- In USA 40% of deaths from injury are from TBI = 52,000 deaths/year
- 200,000 hospitalizations/ year



TBI: Facts

- Major global health and economic problem; major cause of disability in young adults; males >> females.
- Incidence of TBI in elderly is increasing.
- TBI is highly heterogenous in mechanisms and pathology, making prognostic studies problematic.
- TBI produces primary and secondary injuries.
- New therapies for preventing secondary injury not found to be generally effective.
- Withdrawal of care in ICU is often premature: an evidence-based approach is needed.

Variability Among Trauma Centres for Mortality after WLST for Severe TBI

- Turgeon et al. CMAJ 2011.

- Mortality varied 10.8%- 44.2% among centres.
- 70% of mortality occurred after WLST.
- Adjusting for risk factors, the institution effect was significant.

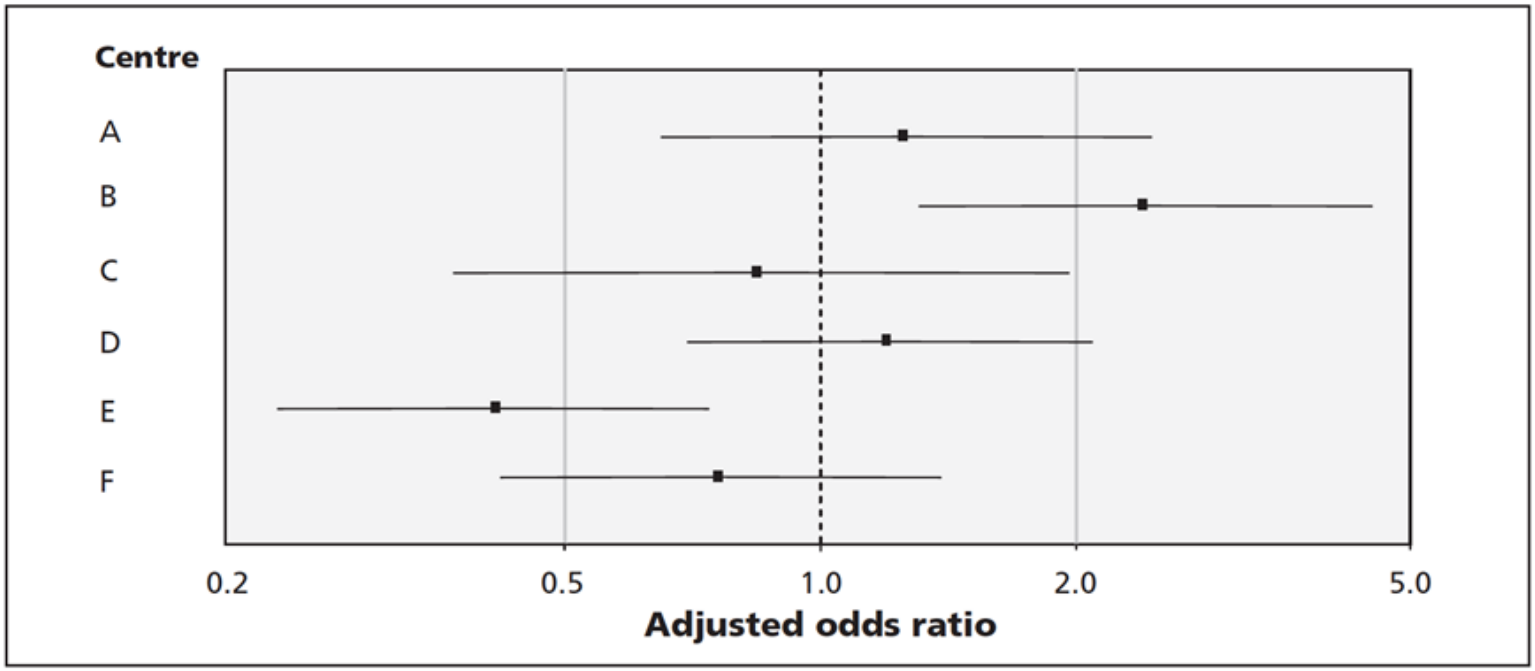
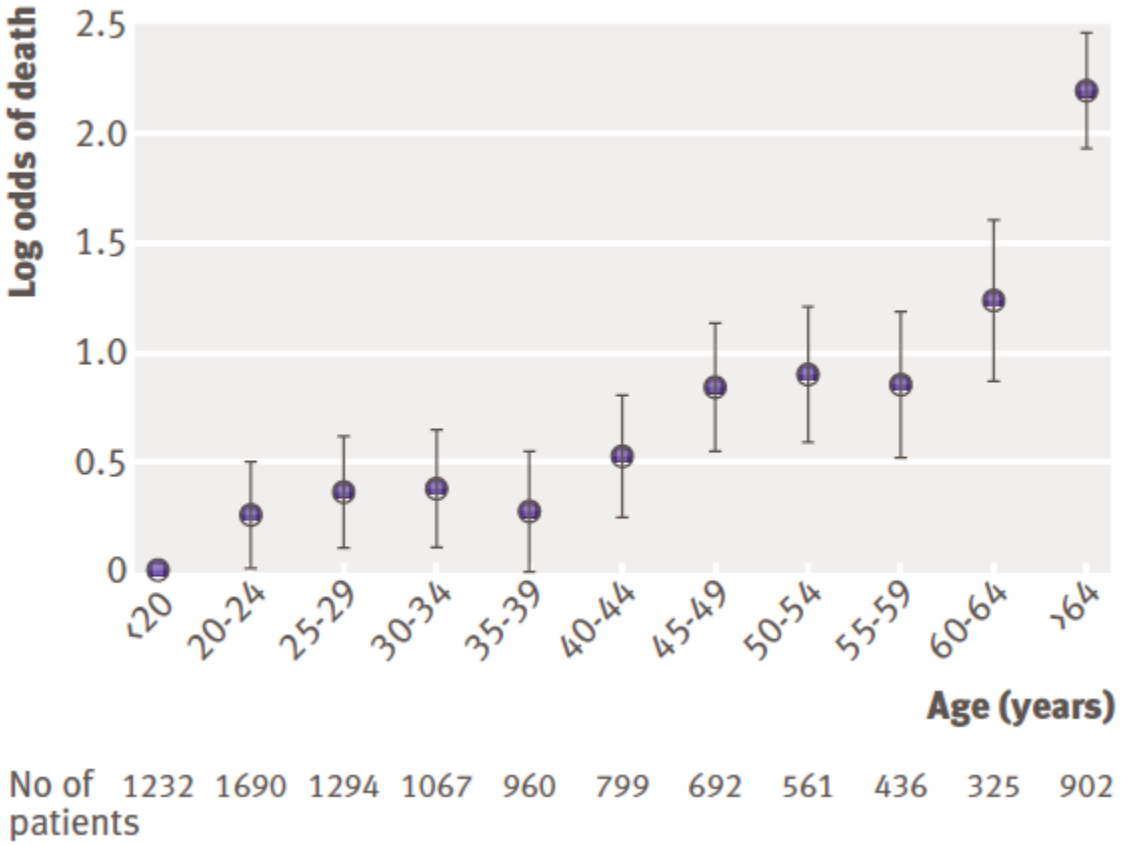


Figure 2: Adjusted odds ratios for hospital mortality following withdrawal of life-sustaining therapy by centre. Odds ratios were adjusted for sex, age, pupillary reactivity and patients' scores on the Glasgow coma scale. An odds ratio greater than 1.00 is associated with greater odds of death; an odds ratio of less than 1.00 is associated with lower odds of death. Error bars indicate 95% confidence intervals.

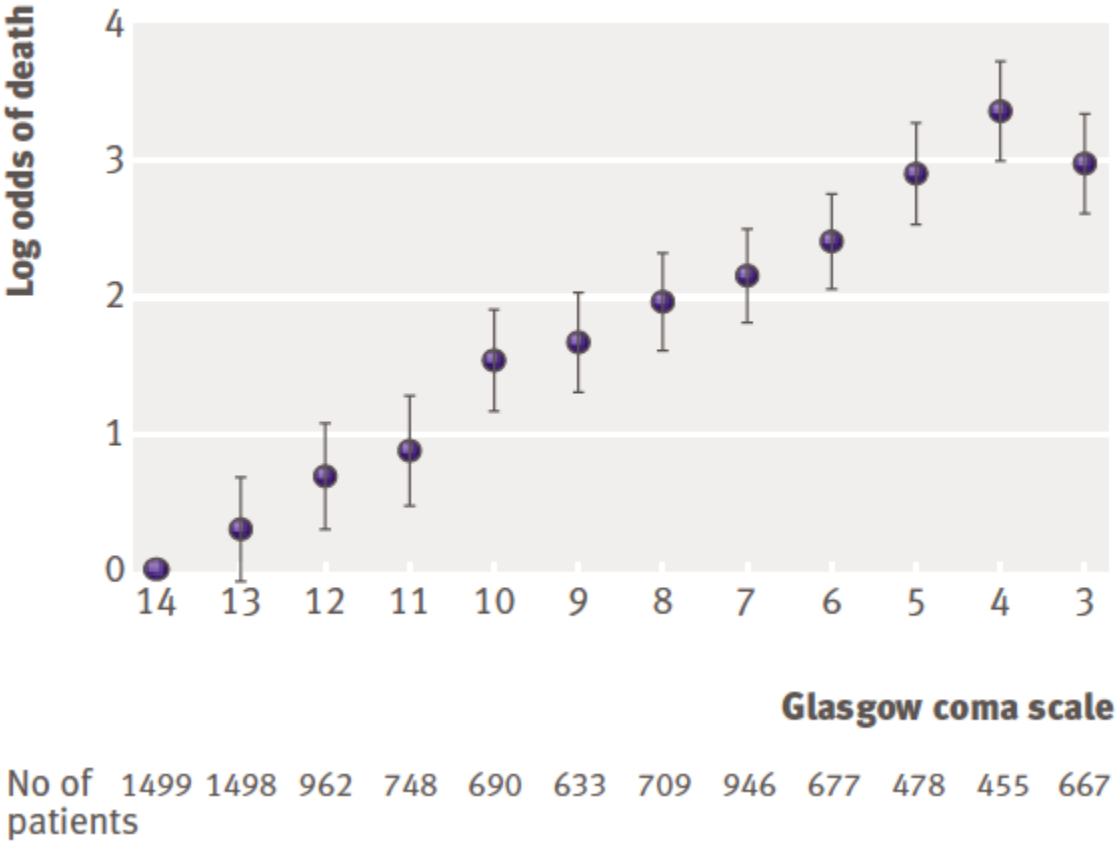
Individual Factors of Prognostic Value

- Age
- Pupillary reactivity
- GCS
- CT

TBI: age and mortality
CRASH Collaborators BMJ



TBI: GCS and Mortality
Crash Collaborators, BMJ



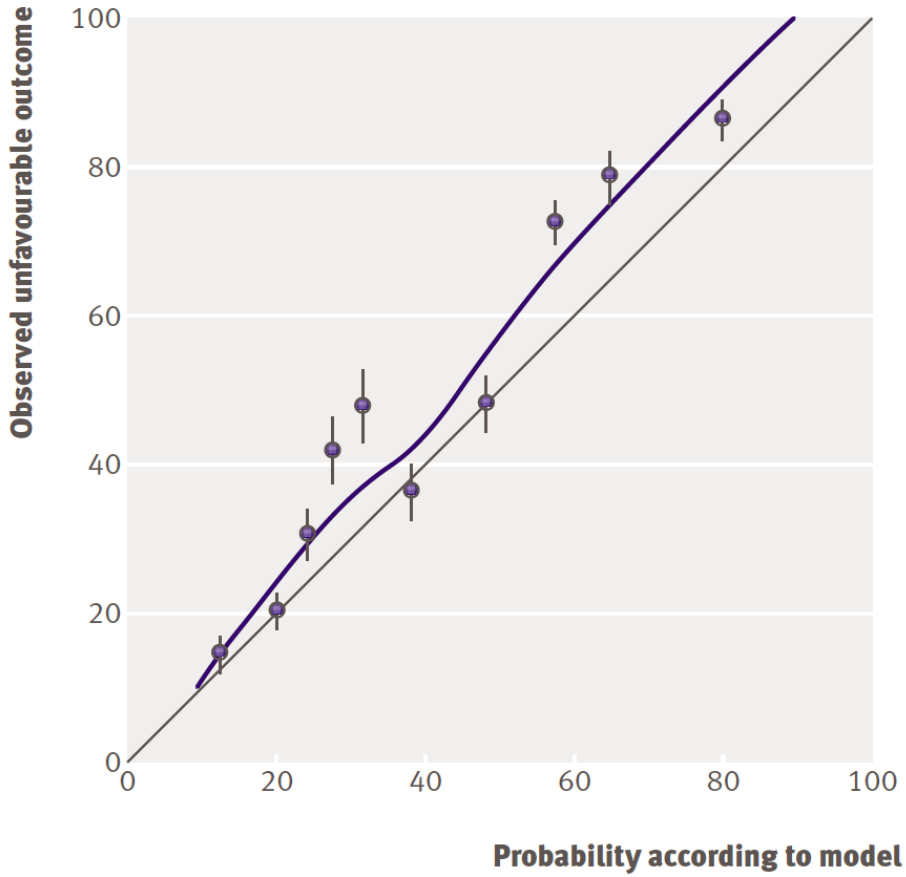
Pupils and Odds of Mortality or Severe Disability at 6 Months (CRASH)

Pupillary Reactivity	High Income Countries	Low Income Countries
Both	1	1
1	2.43	2.01
None	3.28	4.54

CT findings and Odds of Mortality or Severe Disability at 6 months (CRASH)

CT Finding	High Income Countries	Low Income Countries
Petechial hemorrhages	1.21	1.49
Obliteration 3rd ventricle	2.21	1.53
SAH	1.62	1.20
Midline shift	1.93	1.68
Nonevacuated hematoma	1.72	1.68

External Validation of 10 pts (thin line = model; thick line actual)



Illustrative case

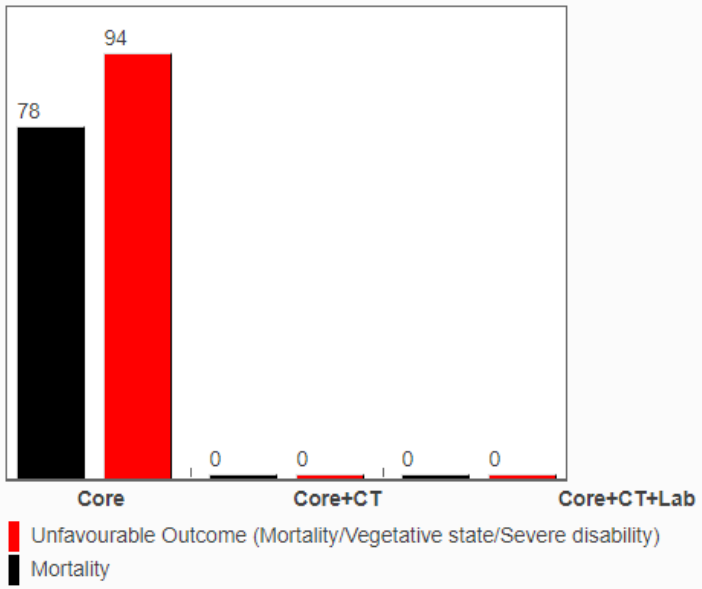
- 72-year-old man fell down a flight of stairs
- Comatose GCS of 4, extensor posturing
- One pupil reacting, other fixed
- No hypoxia,
- Initially hypotensive (BP 80/40)
- Evacuated acute subdural hematoma
- Glucose 20 mmol/L
- Hemoglobin 12 g/L

Case 1 IMPACT score

Prognostic Results:

Predicted probability of 6 month mortality: Core model: 78%

Predicted probability of 6 month unfavourable outcome: Core model: 94%



Illustrative Case 2

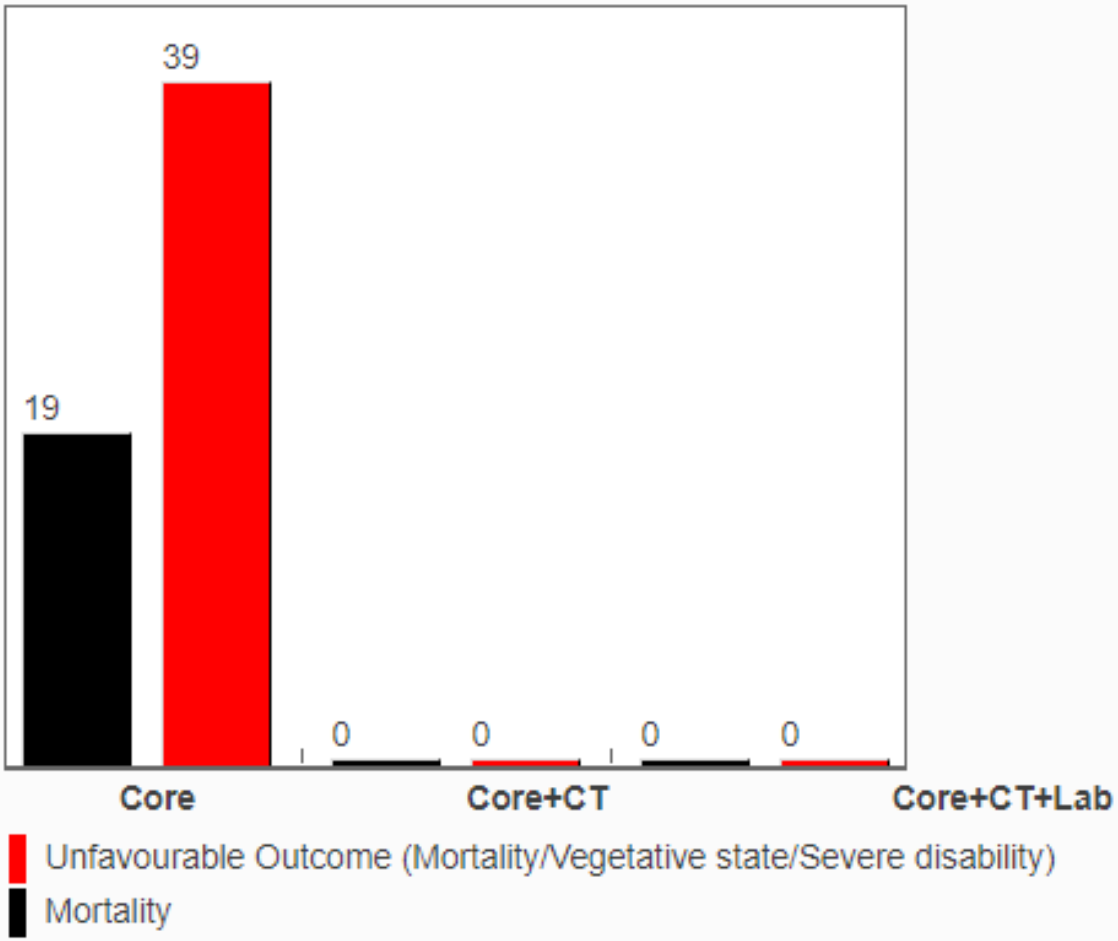
- 25-year-old man comatose after motorcycle accident
- GCS 7
- Abnormal flexion bilaterally
- No hypoxia or hypotension
- Normal glucose and hemoglobin
- Diffuse injury II on CT

Illustrative Case 2 – IMPACT Calculation

Prognostic Results:

Predicted probability of 6 month mortality: Core model: 19%

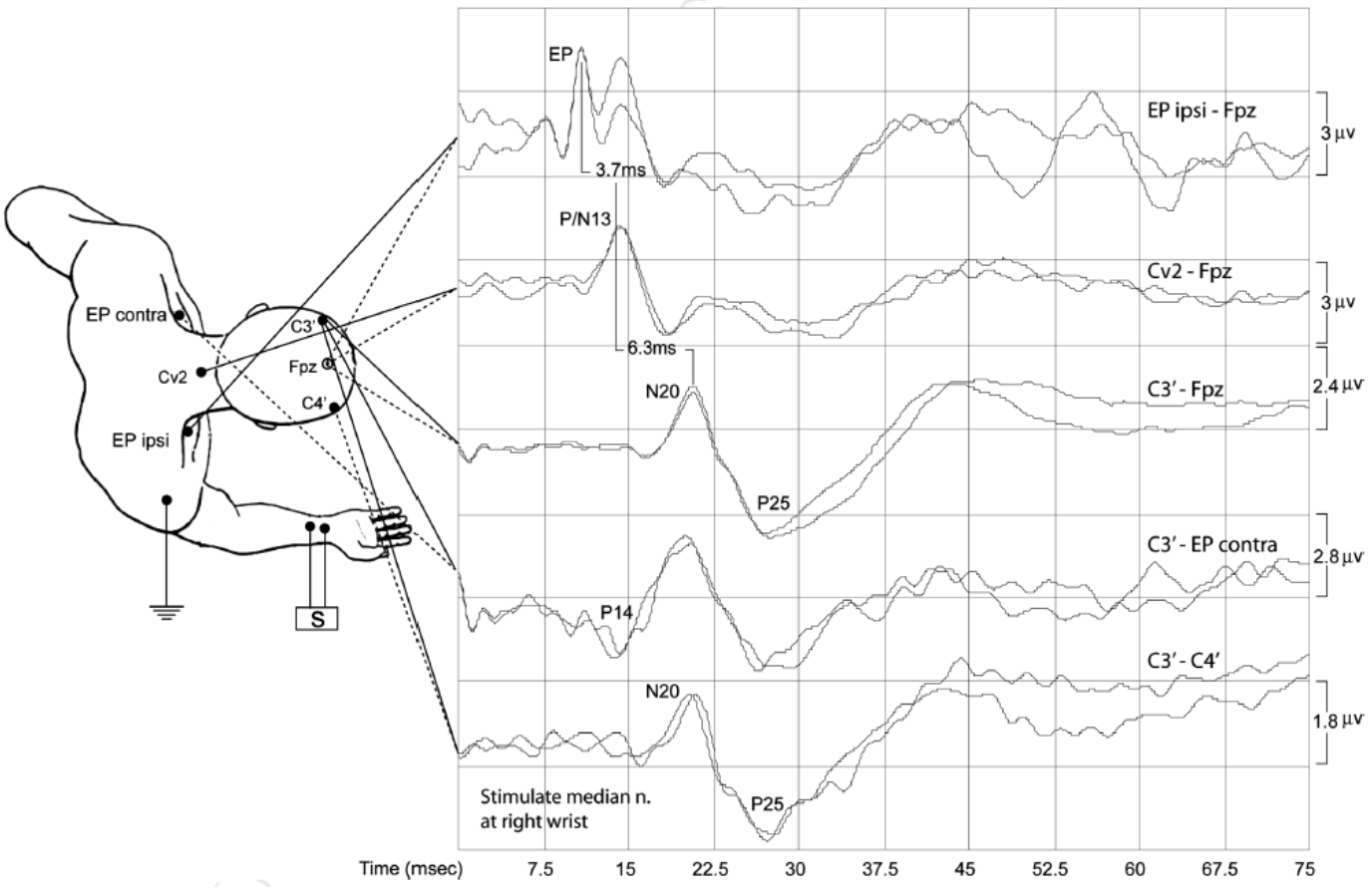
Predicted probability of 6 month unfavourable outcome: Core model: 39%



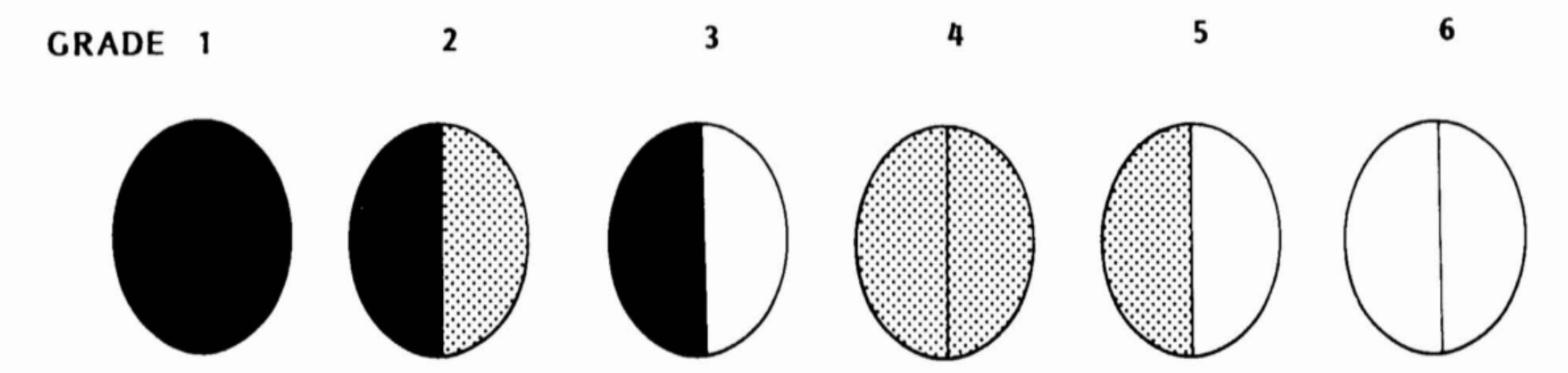
However…

- With ICP targeted therapy, Olivecrona and Koskinen (2012) found outcomes were better than predicted by IMPACT calculator, by 13.6%.
- Should use IMPACT calculator with caution.
- Consider adding other technology.

Somatosensory Evoked Responses

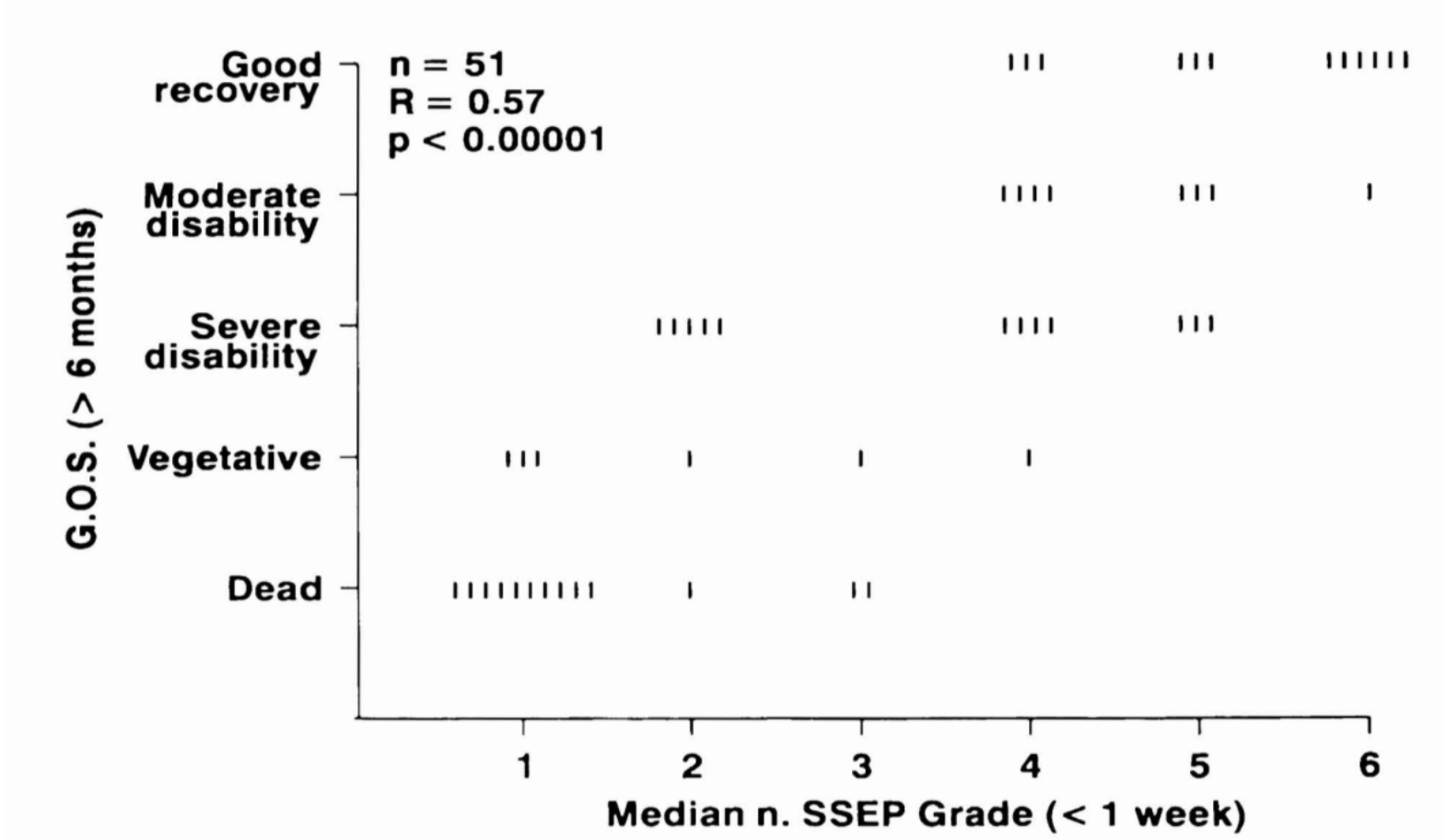


SSEP Grades



Black: absent N20 and P22; dotted: P22 < 0.9 microV or 2.5 x smaller than contralateral side, or P/N13-N20 interpeak latency >7.2 msec; white = P/N13-20 latency normal. Houlden et al., Neurosurgery 1990

SSEP Grades and Outcome
Houlden et al., Neurosurgery 1990



Other Promising Ancillary Tests

- Biomarkers: S-100, NSE, neurofilaments, TNF.
- Diffusion Tensor Imaging with MRI
- Resting State (DFN) MRI
- Transcranial magnetic stimulation.

- Promising, but with small series.
- Need larger validated studies to provide cut off values.
- Limited availability of technology

Conclusions/Key Points

- Use evidence-based criteria in arriving at a prognosis
- In discussion with families give the odds and probabilities: we are never 100% certain, unless brain death is present.
- When prognosis is uncertain consider applying special tests (fMRI, ERPs, EEG) if available and allow more time for re-evaluation.
- Discussion needs input from family re: patient values and directives.
- Stay tuned for promising developments in electrophysiology, tract imaging, fMRI and biomarkers.

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