Why 6-month Outcome of Recent Cohort of Mass Evacuation in Severely Brain Injuries Comparing Two Decades Was Not Improved as other Severe TBI Treatments? A Single Center Series of 1082 Patients With IMPACT Prognostic Benchmark

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Introduction
In 2012 we explored reduction of mortality in severe brain injuries (SHI, GCS<9) by 3-types of care: evacuated mass (EM), other neurosurgical operation and no surgery (only ICP placements). There was no improvement in 6-month mortality in patients with evacuated mass over those years. The simple to apply prognostic IMPACT score as benchmark was added to the previous cohort until 2018. This methods flattened the variability and any subgroup big enough that shows significant better outcome might need further exploration. The use of “active registry” may hint to areas where further intervention might help.
Methods

Active concurrent neurotrauma registry was used to generate outcome in specific treatment groups. Since the creation of individual core+CT-IMPACT score we add it and compared the pooled group proportion of 6-month dying to the actual and assess differences that reached significance. In 2012 publication we had 613 EM between two periods of 1999-2009 that had no improved survival compared with other 2 types of neurosurgical treatment. We add for 2010-2018 additional 471 patients and verified specific process parameters.
The 2 periods had 31.5% 6-month mortality significantly better than pooled IMPACT of 37.9% (p=0.002). Mode of treatment was also significantly changed: one-half had decompressive craniectomy (DC) recently versus one-fifth in the older cohort. Better than predicted outcome was found in:

1. EM with no DC versus DC in both periods (44.2% vs 24.6%, p<0.0001)

2. Both cohorts of secondary DC had better than predicted outcome (p=0.04)

3. The overall secondary DC predicted mortality was significantly lower than primary DC but the actual was even better (22.9%, p=0.01)
The benefit of the IMPACT prognostic score over univariate analysis was proved. The subgroups with clinical significant change in pooled IMPACT but with no such difference in the specific risk factors:

1. Age is a critical factor in prognosis. In most subgroups it was not changed yet the IMPACT and actual outcome was different.
2. GCS, ISS and rate of hypotesion were similar.
3. IMPACT detects significant outcome difference between those who needed primary DC (51.2%), EM with (37%) or without presence of shift (32%).
Results- 3

There was higher proportion of death with IMPACT score above 50 in the primary DC, than EM without DC (43.6% vs 15.7%, $P < 0.0001$).

Time to neurotrauma was 108 minutes for DC versus 140 minutes for other EM.

There was higher proportion of survivors among those who reached mass evacuation within 4 hours of injury-36.6% of primary DC survivors vs 52.7% of EM without DC ($P < 0.0001$).
Summary points
Advanced care increases survivability especially for comatose patients who needed urgent mass evacuation. Doing more DC did not translate to improved 6-month outcome and advantage over IMPACT prediction was only in plain EM without shift.

Only minor trend for improvement was noted when timing to evacuation was achieved under 4 hours from injury. Most of the improvement was noted in patients that had no need for mass evacuation.
### 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.

### Prediction models for 6 month outcome after TBI

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<thead>
<tr>
<th>Admission Characteristics</th>
<th>Value</th>
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<tr>
<td>Age (14-89 years)</td>
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