

<b>Article details: 2018-0188</b>	
Title	The clinical significance of post-traumatic intracranial hemorrhage in clinically mild brain injury: a retrospective cohort study of radiographic imaging and surgical management
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<b>Reviewer 1</b>	Nishant Mishra
Institution	Neurology, Icahn School of Medicine at Mount Sinai, New York, NY
General comments (author response in bold)	<p>This is a well written manuscript looking at the need for repeat CT Heads amongst a carefully selected patient population as listed in the study's exclusion criteria with mild TBI, GCS 13-15, and least likelihood of clinical deterioration. It is an analysis of retrospective data held within Ontario repository, and is based on a small sample size of about 600 patients. 60% had GCS of 15. 5 patients, less than 1 percent of their population, needed neurosurgical intervention. They report these patient characteristics in the manuscript. The analyses shows that the risk is low and the policy of frequent CT head in this population should be revisited. The weakness is that the sample size is small, &lt;1% patients had clinical worsening, and we cannot undertake additional prediction modeling to determine who will deteriorate.</p> <p><b>Thank you Dr. Mishra for your insightful comments. We agree that with only a small subset of patients who clinically deteriorated, requiring neurosurgical intervention, it was difficult to perform any predictive modelling to determine which patients with mild TBI are at higher risk of deterioration. To answer this question, ideally a larger single centre or multicentre prospective study should be undertaken or a subsequent meta-analysis of available trials on mild TBI may help provide some answers.</b></p>
<b>Reviewer 2</b>	Mona Hicks PhD
Institution	One Mind, Rutherford, Calif.
General comments (author response in bold)	<p>This is a timely manuscript with important implications for clinical management. It is well-written and the tables provide additional information in a clear and efficient way. I have only a few minor questions and comments.</p> <p><b>Dear Dr. Hicks, thank you for the kind comments, please see our responses to your insightful questions below, answered to the best of our ability.</b></p> <p>1. The Ontario Trauma Registry is closed for reasons of privacy. How did you get access?  <b>The Ontario Trauma Registry is closed to the public but researchers can request specific data from this database by way of application through a Data Inquiry Form.</b></p> <p>2. If I understand correctly, you restricted your analysis to data in the Ontario Trauma Registry that came from your institution (Sunnybrook Health Sciences Center). Why not search the entire database and after completing your primary analysis, conduct a secondary analysis to evaluate center differences? Was it a question of manpower, data quality concerns, limited access or ???  <b>Although certainly it would have been valuable to examine the data from multiple different trauma centres in order to increase the power of our analyses, and to make comparisons between centres, the Ontario Trauma Registry limits access to data to the centre of the requesting corresponding author only. The OTR was used to screen for eligible participants and extract</b></p>

certain data, demographics, neurological status, system-based injury characteristics; however the database does not contain granular radiographic information or operative details. This information was extracted through retrospective chart review. Owing to privacy constraints we only had access to this information at our own institution, thereby limiting the patient population.

3. Were other tests besides the GCS used to evaluate neurological deterioration or is this unknown? Given its importance to this study, it would be helpful to know if the GCS alone is sufficient to identify neurological deterioration or if other tests are also recommended.

**The GCS was used as the primary tool to evaluate neurological deterioration as it has been found to be reliable, easily reproducible, well known, efficient, and more objective than most other measures of level of consciousness with a sensitivity of 92% and a specificity of 85%. Neurological deterioration was defined as a drop in the GCS of 1 or more points. Other signs of neurologic deterioration were investigated at the discretion of the physician looking after the patient but were not consistently reported.**

4. In the future, it might be interesting and feasible to see if your findings are externally validated in the TRACK-TBI study, which has a large, multicenter cohort of CT positive patients with mild TBI. They also have quite a few patients > 70 years, so this would present the opportunity to explore an older age group, too. Similarly, if data is available on patients < 16 years old, it would be helpful to know if the findings are similar for younger ages.

**We are familiar with the TRACK-TBI study and agree that external validation of these results by comparison with results of their mild TBI cohort would be of great interest. Since the majority of centres involved in TRACK-TBI are from the United States, it would also provide some insight into practices differences between the US and Canada.**

**Similarly, we agree that it would be interesting to assess differences in the management and outcome of mild TBI in a young and elderly population. We know that mild TBI in the elderly, particularly with radiographic findings of hemorrhage, is a prevalent issue and can occur often in the context of a low mechanism injury, and their management is complicated by their medical comorbidities and increasing use of anticoagulation. In young patients however, most of the research on mild TBI has focussed on concussions. However, a study by Greenberg et al. in 2014, published in the Journal of Trauma and Acute Care Surgery looked at patients  $\leq 18$  years of age with mild TBI and traumatic ICH admitted to a single institution and concluded that only a small subset (6.8%) had clinically important neurological decline, with 5.1% requiring neurosurgical intervention. The relatively higher rate of intervention in this cohort may be due to lower anatomical reserve in younger patients with minimal brain atrophy and decreased ability to accommodate mass effect intracranially.**

5. Head CT scans done in emergency care centers in the U.S. appear to cost quite a bit more than in Canada, so the potential impact on costs is probably much greater in North America overall. Repeat CTs also add to the burden of care in EDs.

	<b>We agree with this that repeat CT scans also represent a significant use of resources in the ED, and if these scans are not necessarily required and is not likely to change management, may unnecessarily prolong a patient's stay in the ED.</b>
<b>Reviewer 3</b>	Yves Starreveld
Institution	University of Calgary, Department of Clinical Neurosciences, Calgary, Alta.
General comments (author response in bold)	<p>I find this a timely study that just happens to reflect my pattern of practice. I think a significant additional impact could be had if some financial modelling were done to address which of these patients, having been scanned at a home institution, were never transferred to a neurosurgical hospital in the first place. If parameters similar to the CT scanning rules could be determined that show a risk of "needing intervention" to be zero, much greater impact of this study would follow.</p> <p><b>Thank you for your insightful comments Dr. Starreveld. A more detailed economic analysis and financial modelling are beyond the scope of this article but certainly would be warranted in light of our findings. Stein et al. in 2008 in the Journal of Trauma published their study on routine serial CT scans in mild TBI and actually found that routine scans are more cost effective than waiting for clinical deterioration before scanning. However, they found that the benefits of routine scanning were greater in younger patients and diminished with patient age. However, their analysis was done independent of important patient risk factors for delayed deterioration including anticoagulation use, coagulopathy etc. It also was based on the comparatively higher costs of CT scans and interventions in the US compared to Canada. A comprehensive cost effectiveness study on repeat CT scans in the context of mild TBI in Canada would be informative and a possible next step.</b></p>