The Value of Scheduled Repeat Cranial Computed Tomography After Mild Head Injury: Single-Center Series and Meta-analysis

**BACKGROUND:** After an initial computed tomography (CT) scan revealing intracranial hemorrhage resulting from traumatic brain injury, a standard of care in many trauma centers is to schedule a repeat CT scan to rule out possible progression of bleed.

**OBJECTIVE:** To evaluate the utility of routine follow-up CT in changing the management of mild head injury patients despite clinical stability, although repeat imaging is indicated to assess a deteriorating patient.

**METHODS:** The trauma database at our institution was retrospectively reviewed and the literature was searched to identify patients after mild head injury with positive initial CT finding and scheduled repeat scan. Patients were divided into 2 groups for comparison. Group A included patients who had intervention based on neurological examination changes. Group B comprised patients requiring a change in management according to CT results exclusively. The meta-analysis of the present cohort and included articles was performed with a random-effects model.

**RESULTS:** Overall, 15 studies and 445 patients met our eligibility criteria, totaling 2693 patients. Intervention rates of groups A and B were 2.7% (95% confidence interval, 1.7-3.9; \( P = .003 \)) and 0.6% (95% confidence interval, 0.3-1; \( P = .21 \)), respectively. The statistical difference between both intervention rates was clinically significant with \( P < .001 \).

**CONCLUSION:** The available evidence indicates that it is unnecessary to schedule a repeat CT scan after mild head injury when patients are unchanged or improving neurologically. In the absence of supporting data, we question the value of routine follow-up imaging given the associated accumulative increase in cost and risks.

**KEY WORDS:** Follow-up CT, Intracranial hemorrhage, Meta-analysis, Mild head injury, Repeat computed tomography

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Head injury is a major public health problem and a common admission to neurosurgical wards at most trauma centers. After a patient with an intracranial hemorrhage (ICH) detected on computed tomography (CT) is admitted, the standard of care in many institutions is to obtain a second CT scan within 24 hours as a scheduled routine follow-up to assess the need for intervention, regardless of patient’s neurological stability. This practice has been adopted to rule out the progression of the intracranial bleed and to evaluate any secondary changes that might occur after the first image is obtained.\(^1\)\(^-\)\(^3\)

Additional benefits may involve acquiring radiological evidence that may help in planning patient transfer or discharge. One factor that has led to the increased use of imaging is the availability of CT scanner machines in most institutions. However, radiation exposure from obtaining a CT scan is inevitable. Various reports have shown an increased risk of cancer from the cumulative effect of radiation.\(^4\)\(^,\)\(^5\) Although CT scanners are very useful tools, in an era of diminishing resources and a need to justify medical costs, this practice needs to be evaluated. Evidence needs to be provided for increased image use without compromising the quality of patient care. Finally, ordering the scan is an easy task; however, the involvement of multiple personnel, including the nursing staff, transportation team, and employees.
of the radiological departments, adds to the cost and interferes with the workflow efficiency.\(^6\)

The goal of this study is to evaluate the need for repeat CT scans as routine follow-up for patients with mild head injuries in the context of a stable neurological status to determine whether this practice influences the management. We conducted a meta-analysis in addition to our institution case series to examine whether the second CT should be guided by neurological changes or if it should be a scheduled routine practice within 24 hours regardless of the patient’s clinical stability.

**PATIENTS AND METHODS**

**Present Series**

All patients with blunt traumatic mild head injuries admitted to our trauma center between April 2006 and March 2011 were reviewed. Only adult patients (> 17 years old) with mild head injury, as defined by having a Glasgow Coma Score of 13, 14, or 15,\(^7\) were included. A positive initial CT scan finding of ICH, including contusions, subdural hematomas, epidural hematomas, and subarachnoid hemorrhage, was required for selection. Every enrolled patient had a repeat CT, either as scheduled routine within 24 hours or after neurological deterioration. Patients who did not have a follow-up CT were excluded from the study. Any patients with a history of prior craniotomy, cranial pathology, or underlying coagulopathy were also excluded. Furthermore, patients who underwent a neurosurgical intervention based on the first CT and initial assessment were excluded. The main outcome measure was the requirement for intervention. We divided eligible patients into 2 groups for comparison. The first group included patients requiring interventions based on neurological changes regardless of subsequent CT results; the main predictor of intervention was the neurological examination. Meanwhile, in the second group, the decision to intervene was made according to CT scan findings despite stable clinical status. Our definition of intervention was any change in management, including medical treatment, eg, the use of mannitol or hypertonic saline, or any surgical intervention, which included intracranial pressure monitor insertion or the need for a craniotomy. Neurological changes were defined as any decrease in the level of consciousness, motor or sensory deficits, new cranial nerve palsy, or symptoms suggestive of high intracranial pressure such as persistent severe headaches or frequent vomiting. We recorded patient demographics, initial neurological assessment, Glasgow Coma Score, Injury Severity Score, initial CT findings, follow-up image results, and the need for intervention, surgical or medical, based on neurological changes or CT findings. For the present center series retrospective chart review, descriptive analyses were performed. Categorical variables were reported as proportions and 95% confidence intervals (CIs) when appropriate. Continuous variables were reported as mean with standard deviation.

**Literature Search**

Two reviewers (S.A. and I.B.) performed an independent detailed electronic search of MEDLINE (January 1966-February 2012) and EMBASE (January 1980-February 2012) for studies written in English. The following key words were used in relevant combinations: “routine,” “repeat,” “follow-up,” “scheduled,” “serial,” “minimal,” “minor,” “mild,” “head,” “brain,” “intracranial,” “injury,” “trauma,” “bleed,” “hemorrhage,” “hematoma,” “CT,” and “computed tomography.” The full-text versions of all studies considered relevant were obtained. References of all studies with potential relevance were screened manually to identify any applicable studies that were not previously identified. No related trials or reviews were found in a search of the Cochrane Central Register of Controlled Trials or the Cochrane database of systematic reviews. Any disagreement between the 2 reviewers concerning the decision to include or exclude a study was solved by consensus with a third reviewer (B.Y.). Interrater reliability was calculated from raw agreement and the \(k\). The level of agreement between the 2 reviewers was reported. We included studies that examined patients with mild head injury only and those that included all classes of head trauma (mild, moderate and severe) but conducted a separate analysis of the mild type. We excluded small studies (< 30 patients). Only studies that differentiated between the 2 groups of patients requiring intervention, if any, after a repeat scan were included (ie, the patients who had a change in management based on neurological deterioration and the individuals whose treatment was influenced exclusively by CT results). We abstracted the data from eligible studies to include the following: the total number of mild head injury patients with positive initial CT findings undergoing subsequent neurological examination and a repeat CT, the percentage of worsened follow-up imaging, the type of intervention, the CT findings resulting in change in management and the patients requiring intervention after the repeat CT, and whether, on the basis of neurological deterioration or scheduled imaging, the methodology quality assessment of included studies was evaluated with the Newcastle-Ottawa Scale.

**Statistical Analysis**

To evaluate the utility of a scheduled routine CT scan, we abstracted the data from the present series and the eligible studies and calculated the weighted proportions to form 2 groups of patients. Group A included patients who required intervention based on neurological examination changes, regardless of the results of repeat CT and whether the CT was scheduled within 24 hours or obtained earlier on an urgent basis secondary to neurological deterioration. The main factor driving the change in management in this group was the neurological examination. In group B, the decision to intervene with the patients’ treatment, despite the lack of neurological changes, was based exclusively on the repeat scheduled image findings. The purpose of dividing the group of patients requiring intervention into 2 subgroups was to evaluate the value and usefulness of both diagnostic tools (ie, the neurological examination and the repeat CT) in changing the management by comparing a debatable method (ie, scheduled follow-up CT) with the neurological examination, a practice with a known reported significance. Heterogeneity among studies was tested with the Q test. The \(I^2\) statistic was reported, representing the percentage of total variation across studies, with a predefined \(I^2 > 50\) as the statistical heterogeneity. We used a random-effects model (DerSimonian-Laird) because of the inherent heterogeneity of case series to calculate the pooled weighted proportion. Pooled estimates of weighted proportions with 95% CIs for single group studies were calculated. The proportions of intervention rates for neurological examination and repeat CT were compared by the use of normal approximation with the binomial distribution method. A value of \(P < .05\) was considered a criterion for statistical significance. StatsDirect 2.7 (StatsDirect Ltd, Cheshire, United Kingdom) was used for data analysis.

**RESULTS**

**Present Series**

During the 5-year study period, 1121 trauma patients were admitted to our center with mild head injury and ICH detected on
We excluded 676 patients who failed to meet the previously described eligibility criteria. The remaining 445 patients made up the population of our present series, with a mean age of 45 ± 22 years. These patients underwent close neurological evaluation with a repeat CT scan within 24 hours unless neurological deterioration was noted, in which case the scan was obtained more urgently. Of these, 320 (72%) were male. Initial Glasgow Coma Score was 15 in 274 patients (61.6%), 14 in 131 patients (29.4%), and 13 in 40 patients (9%). The mean Injury Severity Score was 20 ± 9.7. After the CT scan was repeated, 91 images (20.4%) showed an increase in ICH, and 354 scans (79.6%) remained unchanged or improved after the initial CT. Overall, 25 patients from our center (5.6%) required a change in their management after the second CT was obtained. Twenty candidates (4.5%) had surgical intervention, 4 required the administration of mannitol, and 1 had both medical and surgical treatment. Of the 20 patients who had a surgical procedure, 14 (70%) underwent a decompressive craniectomy, 4 (20%) had an external ventricular drain inserted, and 2 (10%) had both. The predictive factor for changing the management was the neurological deterioration preceding the second scan in 23 patients (5.2%; 95% CI, 3.5-7.6). The repeat CT results alone influenced the treatment for 2 patients (0.45%; 95% CI, 0.1-1.6). Further investigation revealed that the managing physician decided to treat the latter group of patients with 1 dose of mannitol each after obtaining image results that showed an increasing edema surrounding the contusions despite a stable neurological status.

Search Results

Our initial electronic database search yielded 974 studies (Figure 1). By screening the titles, abstracts, or both of the articles and removing the duplicates, we excluded 929 studies. After reviewing the full text of the remaining publications, we excluded 30 articles. The most common reason for exclusion was the failure to identify the 2 groups of patients, if any, who required intervention after a repeat scan was obtained and the main factor that led to intervention (ie, neurological changes or CT results alone). Other reasons for exclusion included non-English studies, small studies (< 30 patients), or the failure to specify the outcome of mild head injury patients separately. Fifteen studies8-22 met the previously discussed eligibility criteria. Agreement over the included articles between the 2 reviewers was high, and calculated κ = 1. Six articles were designed prospectively and 9 were retrospective. With the use of the Newcastle-Ottawa Scale, the overall score of included papers was moderate to high in methodological quality assessment. The number of patients from the included studies totaled 2248, excluding the 445 patients from the present series. Six articles evaluated mild head injury patients; the rest studied head injury in general with all classes of traumatic brain injury (mild, moderate, and severe); however, in a separate specified subgroup analysis of the mild type, we abstracted only the data specific to the mild head injury patients. All included studies indicated the number of patients who required an intervention, if any, after a repeat scan and specified the main reason for the change in management (ie, CT findings exclusively or neurological changes). The percentages of worsened repeat CT scans were variable depending on the criteria in each article for considering an increase in ICH. Twelve of the eligible studies specified the number of patients with hemorrhage progression. Overall, 22.4% of these images were considered worse and clearly were not always a factor leading to the alteration of management. The most common specified follow-up CT scan finding leading to intervention in the included studies was the presence of subdural hematoma. The Table summarizes the results of the studies included in the meta-analysis.

Analysis of the Clinical Significance of Routine Repeat CT Scan for Intervention

Overall, 2693 patients were evaluated (445 patients from the present series and 2248 from the 15 eligible studies). The results of the random-effects meta-analysis were as follows: For Group A, the calculated Q test was 41.2 and I² = 63.6%. The weighted proportion of a change in management based on the neurological examination was 2.7% (95% CI, 1.7-3.9) with P = .003 (Figure 2). In group B, the Q was 19 and I² = 21.2%. The weighted proportion of intervention based on CT results, despite neurological stability, was 0.6% (95% CI, 0.3-1) with P = .21 (Figure 3).

Although the heterogeneity in group A was attributed mainly to acceptable variable thresholds to intervene among different
centers, the variability in group B was lower because most studies had no patients requiring intervention based on CT results alone. Thirteen of 17 patients (76.5%) making up group B were abstracted from only 2 involved studies. In addition to the fact that the number of patients requiring intervention based on follow-up imaging exclusively was not as significant as the number of individuals who had a change in management after neurological examination changes, we performed a comparative analysis. We compared the intervention rate based on routine repeat CT (questionably needed) with the intervention rate based on neurological examination changes (gold standard), and the difference between the intervention rates was statistically significant ($P < .001$).

### DISCUSSION

Since the introduction of the CT scanner machine into clinical practice by Hounsfield and Cormack in 1972, its use has increased dramatically in many countries. The benefits of head CT in evaluating patients with cranial pathology and its role in examining the type and magnitude of ICH are well known. However, using this helpful device is not risk free. The medical side effects from the accumulative factor of ionizing radiation have been reported. They include nonnegligible risks such as increased probability of lifetime cancer from multiple imaging, especially in children, induced cataracts caused by irradiation to the lens, effects on cognitive functions when exposed during...
infancy, and the potential risk of causing harm to a critically ill patient during the transfer process if portable scanners are not used. In an era of continually increasing health costs, it is a responsibility to minimize expenses as much as possible without compromising patient quality of care. Thus, the liberal use of CT scans should be justified. Moreover, the involvement of multiple health personnel in transporting a patient to the scanner machine not only adds to the cost but also interferes with workflow efficiency and contributes to the time waiting for an image. The increase in utility of imaging, in addition to the lack of supporting data, calls for evidence-based practice rules to be implemented.

The standard of care in many trauma centers after admittance of a patient with mild head injury with a positive initial CT is to obtain a scheduled repeat scan within 24 hours despite neurological stability to rule out secondary changes that would require possible intervention. However, a common observation among the authors of the present study is that this practice does not yield a change in the management except when neurological examination changes have occurred, warranting a more urgent CT that accordingly would help with the management. The rules for obtaining an initial CT for patients with mild head injury are well defined, although the same cannot be said for routine follow-up imaging. Wang and colleagues conducted a comprehensive systematic review that was published in 2006 suggesting that the indications for repeat head CT after traumatic brain injury are unclear. Although their study includes all classes of head injury, they did not statistically analyze the data to determine the reasons behind the change in management, neurological changes, or the scheduled repeat imaging

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<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Total Patients No.</th>
<th>Total No. of Interventions</th>
<th>Interventions Neurologically Based</th>
<th>Point of Estimate and (95% CI)</th>
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<tr>
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<td>5</td>
<td>5</td>
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<td>0.0000 (0.000, 0.060)</td>
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<tr>
<td>Chiaregato 2005</td>
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<td>0</td>
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<tr>
<td>Velmahos 2006</td>
<td>179</td>
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<tr>
<td>Brown 2007</td>
<td>72</td>
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<td>5</td>
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<tr>
<td>Smith 2007</td>
<td>43</td>
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<td>2</td>
<td>0.0470 (0.006, 0.150)</td>
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<tr>
<td>Hollingsworth 2007</td>
<td>257</td>
<td>3</td>
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<td>Tureti 2008</td>
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<tr>
<td>Roka 2008</td>
<td>32</td>
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<td>2</td>
<td>0.0630 (0.008, 0.208)</td>
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<tr>
<td>Bee 2009</td>
<td>207</td>
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<tr>
<td>Thomas 2010</td>
<td>457</td>
<td>17</td>
<td>9</td>
<td>0.0290 (0.009, 0.037)</td>
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<tr>
<td>Sifri 2011</td>
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<td>6</td>
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<td>Washington 2012</td>
<td>321</td>
<td>4</td>
<td>3</td>
<td>0.0090 (0.002, 0.027)</td>
</tr>
<tr>
<td>Current series</td>
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<td>23</td>
<td>0.0520 (0.033, 0.077)</td>
</tr>
<tr>
<td>Total</td>
<td>2693</td>
<td>95</td>
<td>78</td>
<td>0.0270 (0.017, 0.039)</td>
</tr>
</tbody>
</table>

FIGURE 2. Forrest plot presents the intervention rates based mainly on neurological examination changes (group A) of all studies. CI, confidence interval.

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<table>
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<tr>
<th>Study or Subgroup</th>
<th>Total Patients No.</th>
<th>Total No. of Interventions</th>
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FIGURE 3. Forrest plot presents the intervention rates based on repeat computed tomography results exclusively (group B) of all studies. CI, confidence interval.
and accordingly failed to define the role of the follow-up CT. A second systematic review was conducted, published online ahead of print at the time of writing this paper, to evaluate the utility of repeat CT after mild head injury. The review was well presented; however, a few studies within their eligibility criteria were missed, and the data in their review were pooled without calculation of the random effects of the involved articles, which is of value given the inherent heterogeneity of the variable studies. Moreover, their definition of intervention was limited only to patients undergoing craniotomy without involving other examples associated with the management changes, which ultimately affects the evaluation of the role of repeat CT. Considering our hypothesis that the neurological examination is a better and risk-free indicator of intervention, we excluded the population of patients with moderate and severe head injuries because monitoring these groups is more difficult and less sensitive. However, it has been reported that for unchanged or improving neurologic examination in children sustaining moderate or severe traumatic brain injury who are appropriately monitored, it may be adequate to exclude the possibility of neurosurgical intervention and hence repeat head CT scans.

When we examined the present series data, 25 of 445 patients (5.6%) were found to require intervention, either surgical or medical. Neurological deterioration and subsequent CT scan results led to the change in management in all except 2 patients (0.45%). After reviewing the charts of the 2 patients, we found that despite a stable neurological status, the managing physician had the impression of an increased amount of edema surrounding the contusions shown by the scheduled repeated CT scans; accordingly, a dose of mannitol was ordered for each. Other physicians in the same institution might have managed these patients conservatively, which reflects acceptable variable thresholds for management. We conducted a comprehensive review of the literature and found that several authors such as Brown et al, Dharap et al, Kaups et al, Roka et al, Schuster and Waxman, Sifri et al, Smith et al, Velmahos et al reported that a routine repeat CT scan is unnecessary for patients who are stable or improving neurologically and that the clinical indicator should guide the need for follow-up imaging. Considering the pediatric population, Hollingworth et al evaluated 257 patients with mild head injuries and initial CT findings as a subgroup analysis. After the repeat scan, only 3 required craniotomies, and neurological deterioration was the indicator to intervene. On the other hand, Bee et al discussed the need for routine repeat scanning for mild head injury patients and intensive care monitoring. They retrospectively examined 207 patients with mild head injury; only 16 of them required intervention. Five of them remained asymptomatic. The follow-up CT results were predictive of intervention. However, Washington and Grubb argued against the need for repeat imaging and intensive care admission for all mild head injury patients because such a management plan increases the burden on the healthcare system and creates substantial difficulty in appropriately allocating beds and imaging resources. Another study that reported the value of scheduled repeat scanning was a retrospective subgroup analysis by Thomas et al. They found that 17 of their 457 patients required a change in management. Eight of them remained neurologically the same. For patients presenting with Glasgow Coma Score < 12 or an initial scan finding of epidural hematoma or multiple lesions, Park et al suggested the usefulness of repeat imaging.

To determine the clinical significance of routine repeat imaging after mild head injury, we categorized the patients (from our present series and the literature) who required a change in management into 2 groups for comparison. The first group included patients who underwent intervention based on neurological examination and for whom CT was subsequently obtained. The second group included patients who had a change in management as a result of the scheduled CT findings despite a stable or unchanged clinical status. The main reason for dividing patients who required intervention into 2 groups was to compare a questionably needed tool (ie, routine repeat CT) with the neurological examination, a risk- and cost-free predictive factor for intervention that all previous reports have recommended. The weighted rates of intervention were 2.7% and 0.6%, respectively. A comparative analysis of both groups resulted in a statistically significant difference. Through this meta-analysis, we found that the predictive factor for intervention is the neurological examination and that the clinical status is the guide for the need to repeat imaging, which is consistent with the findings from most studies evaluating the role of routine repeat imaging after head injury. Although the radiological evidence in addition to clinical stability obtained from repeat imaging that rules out possible secondary changes is an assuring factor for the managing physician and the patient, a common clinical practice cannot be based on this reassurance alone. A follow-up CT may be obtained by some physicians for medicolegal purposes to cover the possibility of worsened imaging despite neurological stability. In addition, it may be argued that there are potential benefits from obtaining a routine head CT to facilitate patient transfer and perhaps to help with an earlier discharge plan; however, routine follow-up scans with the associated radiation exposure and the potential raise in medical costs cannot be recommended on the basis of such a subjective argument alone. The available data show no added clinical significance when the repeat CT is obtained routinely. Strong evidence supporting the benefit should be provided before rules are implemented, especially when considering the associated risks and the accumulative increase in costs.

There are certain strengths and limitations of the present center case series and the meta-analysis. This single-center experience is one of the largest series in the literature, but it is a retrospective chart review. Retrospective designs are prone to data inaccuracy and to missing information. The meta-analysis part of the study is a review of the best available evidence in the literature, a mixture of prospective and retrospective cohort studies; the lack of randomized trials is one of the limitations. However, we have applied rigorous methodology to search the literature and to assess the quality of the involved studies to ensure that we have included all of the eligible articles and excluded the small series (< 30 patients).
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to reduce the variation. Our data extraction was also performed by 2 independent individuals to ensure that the correct information was extracted from the included studies.

CONCLUSION

Although the standard of care in many trauma centers is to schedule a repeat CT within 24 hours for patients with mild head injury and initial scan findings, regardless of the neurological status to rule out secondary changes, our data suggest that this is unnecessary. The meta-analysis did not show statistical evidence supporting the utility of routine follow-up imaging for unchanged or improving patients after mild traumatic brain injury. Considering that this practice is neither risk nor cost free, evidence-based rules should be implemented. Furthermore, we found that the simple yet important neurological examination is the predictive factor of changing the management and guiding the need for repeat imaging after mild head injury.

Disclosure

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this article.

REFERENCES

COMMENTs

The topic the author addressed with this article, though not novel, is an important one. Many authors before them reported their experience on the value of routine repeat head CT in complicated mild TBI in the form of retrospective and systematic reviews. Most recently a prospective study was published on this topic. The authors report their experience with repeat head CT in complicated mild TBI based on a retrospective review of 445 patients, a meta-analysis of the existing literature. They divided their patient population into 2 groups: In group A, the intervention was based on neurological change. In group B, it was based solely on follow-up head CT findings. They found it statistically significant that more interventions were based on neurological deterioration than on head CT changes alone without clinical changes.

The authors concluded there is little value in the practice of routine follow-up head CTs in complicated mild TBI patients and recommend base neurosurgical intervention for neurological deterioration only. However, the authors did not address how many patients who underwent neurosurgical intervention had a worsening head CT as a major omission. This is relevant because not all patients who have neurological decline will show progression on head CT.

Interestingly, the authors report a very high intervention rate in their complicated mild TBI population. Literature reports an intervention rate of less than 1% based on the first head CT. Here the authors have a surgical intervention rate of 4.5% after the first head CT was deemed non-operative; 70% of their patients who underwent surgery secondary to neurological decline had a decompensating craniectomy and this in patients with a mild TBI and a non-operative first CT scan. This is difficult to explain from a neurophysiological standpoint. I wonder if this result is due to a data collection error secondary to the retrospective nature of this paper.

The authors achieved the same results as we did with our study published in February 2012. However, in our study, we omitted Smith et al. and Thomas et al., whereas they omitted Alahmadi et al., which demonstrates how unreliable the process of reviewing data can be, even when the most stringent rules and criteria are applied. However, this does not deduct from the importance of the findings, which support abandoning the practice of routine follow-up head CT in complicated mild TBI patients.

I warn against generalizing this class III data too wildly. Most recently a prospective study was published also questioning the practice of routine repeat cranial imaging. In addition, the present study does not address whether the findings on repeat imaging had any impact on follow-up management after discharge from the hospital.

Although the vast majority of scheduled repeat cranial CT studies obtained in the authors’ series, as well as in the reviewed literature, did not result in a direct intervention, there were a limited number of exceptions. It is important to remember the potential for these exceptions and the potentially catastrophic outcome that can (albeit rarely) occur. The present study is valuable in that it demonstrates that the yield of routine repeat cranial imaging places a heightened importance on vigilant assessment for changes in examination and perhaps warrants a somewhat lower threshold for obtaining repeat imaging in the setting of questionable or subtle clinical changes.

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The authors should be congratulated for providing an outstanding assessment of a controversial issue in the management of head injury. They not only provide a systematic review of the literature, but also contribute a substantial series from their own institution. This study further reinforces the conclusions from previous reports, that the practice of routinely obtaining a scheduled repeat cranial CT in the setting of mild head injury, without change in neurological status, may not be necessary.

Length of intensive care unit and overall hospital stay were not addressed in the present study. Routinely obtaining a repeat cranial CT can help to provide physicians with the reassurance that they may need for earlier transfer of patients from higher acuity care (eg, intensive care unit) to the regular ward and also the reassurance needed to facilitate earlier hospital discharge. These benefits may help offset costs of routinely obtaining repeat cranial CT imaging. In addition, the present study does not address whether the findings on repeat imaging had any impact on follow-up management after discharge from the hospital.

Although the vast majority of scheduled repeat cranial CT studies obtained in the authors’ series, as well as in the reviewed literature, did not result in a direct intervention, there were a limited number of exceptions. It is important to remember the potential for these exceptions and the potentially catastrophic outcome that can (albeit rarely) occur. The present study is valuable in that it demonstrates that the yield of routine repeat imaging for these patients is very low. However, moving away from the practice of routine repeat cranial imaging places a heightened importance on vigilant assessment for changes in examination and perhaps warrants a somewhat lower threshold for obtaining repeat imaging in the setting of questionable or subtle clinical changes.

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Given our current healthcare environment and with the coming of the Affordable Care Act in 2014, this is a timely and important study. There are always inherent difficulties in designing and conducting such a study, and a meta-analysis is usually fraught with inconsistencies in care management, transfer process, and surgical intervention. Despite this heterogeneity, this research adds to our body of knowledge regarding better economical utilization of radiological resources and avoiding unnecessary radiation.

Over a 5-year period, 455 patients with mild TBI met their inclusion criteria, and were considered in 2 groups: those who had a change in their
neurological examination, and those who had neurosurgical procedures based upon abnormalities seen on CT. In their series, 25 (5.6%) required medical or surgical therapy, while the intervention rates for those patients who had neurological deterioration vs those with exclusively CT scan changes, were 2.7% and 0.6%, respectively, which were statistically significant differences. Only 2 patients, who required medical intervention, had changes which were not predicted by neurological deterioration and subsequent CT scanning. Their conclusion that routine CT gives no added clinical benefit in patients who are stable and unchanged neurologically seems sound, is corroborated by other published studies, and I believe is a contribution to our literature. Thus, the days of obtaining a repeat CT scan in this patient population on a routine basis may be coming to an end. Furthermore, since it appears to me unlikely that meaningful medicolegal reform will be a part of the coming changes in healthcare, studies such as this are going to be important to reinforce best practices for patient management.

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