Abusive head trauma (AHT) is a well-established cause of devastating neurological injuries in children that may result in costly, long-term neurologic sequelae. We sought to characterize the burden of AHT on the patient and hospital systems within the first year of injury. Using a recently developed AHT injury severity grading scale, we hypothesized that initial injury severity correlated with costs of initial admissions and returns to the hospital within the first year of injury.

Methods

We retrospectively compiled a database of AHT cases that presented to Le Bonheur Children’s Hospital in Memphis, Tennessee from January 2009 and August 2016.

For initial admission costs, we included costs associated with both initial and return hospital visits within one year of injury as measured from the electronic medical record. AHT injury severity was graded using the pattern of brain/skull injury, need for surgical intervention, presence or absence of stroke, and mortality (Table 1).

Table 1. Modified Grading System for AHT

<table>
<thead>
<tr>
<th>Grade</th>
<th>Skull fracture alone with or without associated cranial soft tissue injury</th>
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</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>Intracranial hematoma or contusion without surgical intervention</td>
</tr>
<tr>
<td>Grade II</td>
<td>Intracranial hematoma or contusion with surgical intervention</td>
</tr>
<tr>
<td>Grade III</td>
<td>Intracranial hematoma or contusion with surgical intervention or evacuation of intracranial hematoma or contusion</td>
</tr>
<tr>
<td>Grade IV</td>
<td>Intracranial hematoma or contusion with surgical intervention or evacuation of intracranial hematoma or contusion and death</td>
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</table>

Inpatient charges accounted for the vast majority of return-to-hospital charges (65.7%) and overall charges (84%). The total calculated cost to care for 278 patients for 1 year was $25,043,774.60.

Of the 278 patients studied, 162 (59.6%) returned to the hospital at some point within the first 365 days after initial non-accidental trauma (NAT) admission, resulting in a total of 326 return visits from a total of 146 patients who returned within 1 year of their initial-injury. Of these, 109 (86.5%) were neurosurgical procedures with the most common procedure being percutaneous transfontanelle subdural tap (21.4%).

Results

Between January 2009 and August 2016, a total of 278 cases of AHT were identified. The largest proportion of patients were classified as Grade II injuries (43.8%) followed by Grade I (25.2%) and Grade III (26.2%). Between January 2009 and August 2016, a total of 674 return visits were documented. The largest proportion of patients were classified as Grade IIa injuries (36.7%), followed by Grade I (25.2%). Patients with Grade I injuries had the shortest median length of stay with 2 days (range, 1–6 days), while those with Grade II injuries had a median length of stay of 12 days (range, 1–71 days). Of the 278 patients studied, 162 (59.6%) returned to the hospital within the first year of injury sustained Grade IIa injuries (38.9%), which is almost identical to the proportion of Grade IIa injuries on original presentation (38.7%).

Discussion

Neurosurgical procedures were the leading surgical procedures performed on both admission and within the first year of AHT. The neurosurgical procedures included initial evacuation of intracranial hematomas that either recurred or were initially managed expectantly, treatment of delayed hydrocephalus, and management of post-surgical complications.

Almost 60% of our patients required additional hospital multi-specialty services within the first year after injury. Outpatient services accounted for approximately two-thirds of return visits, and a third of all services utilized were outpatient clinic visits. All neurosurgical and some ophthalmologic and orthopedic outpatient visits could not be counted because they were conducted at private clinics not affiliated with LeBonheur.

Emergency room visits and inpatient readmissions accounted for approximately 10% and 30%, respectively. For the first year of AHT, these visits were 10% more common in patients requiring return to inpatient hospitalization within the first year, respectively. The three-quarters of the inpatient readmissions were due to the NAC and 57% of these were due to neurosurgical problems.

Neurosurgey was the most common service involved in readmissions, followed by internal medicine.

Despite the breadth of services involved in caring for victims of AHT, medical costs are leading contributors to lifetime costs. Peterson et al has estimated the average cost of US healthcare for ED and inpatient visits in children due to AHT as $2,581 (95% CI: $1,988–$3,174) per victim. As a result of diagnostic tests and hospital stays, it is estimated that the total medical costs per victim of AHT was $2,600 million for the first year of injury and $11 million for 1st year follow-up. For fiscal year 2010, Medicare costs were the third most common contributor to Figure 2. Box-and-whisker plot comparison of total cost of initial admission across injury grades.

Figure 3. Box-and-whisker plot comparison of total cost of readmission across injury grades.

Figure 4. Bar graph illustrating grand totals of cost by injury grade, initial, and return; ED visits are included in outpatient return costs (points in USD).

Figure 5. Pie chart illustrating total costs of care, delineated by initial admission, inpatient readmission, and return; ED visits are included in outpatient return costs (points in USD).

Figure 6. Line chart showing return-to-hospital course within the first year of sustaining AHT.

Figure 7. Line chart showing return-to-hospital course within the first year of sustaining AHT.

Figure 8. Line chart showing return-to-hospital course within the first year of sustaining AHT.

Figure 9. Line chart showing return-to-hospital course within the first year of sustaining AHT.