Case report

Traumatic subdural haematoma: integrating case-based clinical judgement with guidelines

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SUMMARY

Traumatic brain injury (TBI) is one of the leading causes of mortality and morbidity with a significant loss of functional capacity and a huge socioeconomic burden. Road traffic accidents are the most common (60%) cause followed by falls and violence in India and worldwide. This case discusses the story of a 23-year-old man with severe TBI–subdural haematoma, who presented in a comatose state. The patient was a purported candidate for emergency decompressive surgery as per Brain Trauma Foundation (BTF) guidelines but was managed conservatively. This case questions the plausibility of the BTF guidelines for severe TBI, particularly in rural hospitals in India and how such cases are often managed with clinical judgement based on the review of literature. The patient recovered well with a perfect 8/8 on Glasgow Outcome Scale Extended Score.

BACKGROUND

Traumatic brain injury (TBI) is one of the leading causes of mortality and morbidity with physical and mental disability and a huge socioeconomic burden in India and around the world. Road traffic accidents are categorically the most common and important cause of TBI, which contribute to about 60% cases. Falls and violence are the other two major causes of TBI.1,2 Although national data is scant, one epidemiological study done in Bengaluru, a metropolitan city in the south Indian state of Karnataka, with a population of more than 8 million reported that the incidence, mortality and case fatality rates were 150/100 000, 20/100 000% and 10%, respectively.3

The purpose of this article is to highlight how in global practice any guideline needs to be tailored to local context and also hint at the large variability of outcomes that are often hidden from available evidence resources that go into guidelines as a result of which they continue to evolve.4 This paper will also briefly highlight the acute and chronic neuropsychiatric and cognitive dysfunctions in patients with TBI.5

Brain Trauma Foundation (BTF) guidelines4 advocate for surgical evacuation of a subdural haematoma (SDH) when the following criteria are met:

Any SDH with a thickness greater than 10 mm and with a midline shift of greater than 5 mm, irrespective of the Glasgow Coma Scale (GCS).

Smaller SDHs with a GCS less than 9 and along with one of the following criteria:
- Serial assessment revealing a two-point decrease in GCS.
- An intracranial pressure (ICP) higher than 20 mm Hg.
- Evident signs of herniation (pupillary asymmetry).

The guidelines also recommend the use of phenytoin for the first 1 week after primary insult to prevent post-traumatic seizures (PTSs) in the early phase (day 0–7) (Class IIA recommendation). Many severe cases happen in remote roadsides that are proximal only to rural tertiary care.

Figure 1 CT images at presentation—plain axial CT of the brain showing subdural haematoma (SDH) measuring 10 mm in thickness in right frontal convexity with mass effect in the form of midline shift of 6.3 mm and cerebral oedema predominantly in frontal region.

Figure 2 MRI taken on day 2. Left: coronal section showing a right frontotemporal subdural haematoma of 10 mm in thickness and a midline shift of 6.3 mm. Right: axial section showing decreased effacement of the anterior horn of the right lateral ventricle. There is also right anterior-temporal haemorrhage with surrounding oedema.
Global health

institutes such as ours and our experiences with the patient we report here makes us question the plausibility of the guidelines mandated by BTF, where expensive invasive ICP monitors and the requirement of level 1 neurosurgical care for all severe TBI cases is not possible. This also highlights the need for training general surgery residents in basic neurosurgical care until such facilities become available.6

CASE PRESENTATION

A 23-year-old, right-handed man without any previous history of neurological or psychiatric symptoms presented to the emergency room (ER) in a comatose state. He was the pillion rider on a speeding motorcycle when his vehicle suddenly collided head on with another motorcycle when the driver applied brakes suddenly while taking a sharp left turn, which lifted our patient off his vehicle and land with high impact on the right side of his head and shoulder on the road, causing multiple soft tissue injuries and multifocal skin abrasions without any ENT (ear, nose & throat) bleed, apparent fractures or convulsive seizures. He presented to us within 20 min of the event.

Initial evaluation revealed a clear airway with no adventitious sounds and a spontaneous and normal breathing pattern with adequate chest rise and an oxygen saturation of 94% on room air. Parameters of circulation were taken; his pulse rate was 80 beats/ min and blood pressure in both arms in supine position was 170/100 mm Hg. ECG showed normal sinus rhythm with 1:1 atrioventricular (AV) conduction. His GCS was E1 V1 M1. Pupils were equal in size, round, 10 mm and dilated, not reacting to light. Glucometer-based blood sugar was 204 mg/dL and his body temperature was 100°F. Cardiovascular and respiratory systems’ examination was normal. No papilloedema was seen on fundoscopy.

The patient was immediately put on invasive mechanical ventilation as he was at risk of not protecting his airway due to poor GCS. Initial CT brain images are shown in figure 1 (images with maximum SDH thickness and midline shift are depicted). The patient had indications for emergency decompressive surgery. Neurosurgery was not available at our hospital and the patient was immediately referred to a level 1 trauma centre as the BTF guidelines advocate for immediate surgical evacuation of an SDH with a thickness greater than 10 mm and with a midline shift of greater than 5 mm.

However, in the interim time before referral, infection prophylaxis with intravenous ceftriaxone and metronidazole was given, osmotic therapy (to relieve cerebral oedema) with loading dose of mannitol was given, loading dose of phenytoin for seizure prophylaxis, pantoprazole for ulcer prophylaxis and diclofenac and a tetanus toxoid shot was also given.

Although we referred our patient to a level 1 neurosurgical centre, in a nation where the out-of-pocket expenditure for healthcare is very high (64.5% of total health expenditure in 2016) particularly for the low income segment, the patient’s relatives took him to a nursing home with possibly just a single neurosurgery consultant and unlikely level 1 facilities (such as invasive ICP monitoring), fearing prohibitive costs. Telecommunication for informational continuity was not possible after referral, but after discharge from the other centre, the patient’s relative came back to our hospital stating that they were unable to bear the financial burden imposed on them by the nursing home and hence wanted any further management required for the patient at our centre.

When we received the patient back from the other centre, his GCS was 15/15 and we learnt from the nursing home notes that the neurosurgeon there assessed the case and based on his clinical judgement decided that craniotomy would not be required and the patient be continued on conservative management. ICP was shown to have decreased. The patient was discharged on day 5 of admission with GCS 15/15 and, with his relatives’ consent, we performed a post discharge structured interview of the patient to assess functional capacity using Glasgow Outcome Scale Extended Score.

Figure 3 Second CT Brain taken on day 3 of admission shows resolving subdural haematoma and oedema with midline shift.

Figure 4 Background record is showing predominantly beta wave (>13 Hz) rhythm with right frontoparietal theta–beta pattern suggestive of hypoxic–ischaemic encephalopathy. No paroxysmal ictogenic activity is otherwise seen in entire tracing.

Figure 5 Post discharge structured interview of the patient to assess functional capacity using Glasgow Outcome Scale Extended Score.
monitoring was not possible as the necessary equipment was not available there.

As per their notes, conservative management included mannitol (osmotic therapy for 5 days), antibiotics and ulcer prophylaxis. No further doses of phenytoin were given.

The sequence of events that occurred at the referral centre is briefly documented below.

On day 2 of his admission, he underwent MRI of the brain (to rule out posterior fossa lesions or additional sources of haemorrhage such as intracerebral haemorrhage (ICH)) (figure 2). The patient also underwent second non-contrast CT (NCCT) of the brain on day 3 (figure 3).

On day 3, his GCS improved (from E1 V1 M4 at admission to E2 V1 M4) and he was extubated successfully on day 4 with a GCS of 9 (E2 V3 M4). On day 7, with a GCS of 13 (E4 V3 M6), the patient was discharged from the referral centre with a Glasgow Outcome Scale Extended (GOS-E) Score—4/8—needing partial assistance with daily living activities.

The patient was readmitted at our hospital for continuation of supportive care and further neuropsychiatric evaluation. An electroencephalography was done as shown in figure 4. Structured interview 8 of the patient to assess the functional capacity on GOS-E, done on the day of readmission, is shown in figure 5.

Over the course of the next 1 week, we found the patient to be conscious, awake and mobilising well but extremely irritable, emotionally labile, with rapid ruminating speech, uneven impairment of cognitive functions, marked memory deficits, difficulties in concentrating and performing mental tasks, sleep difficulties, dizziness and headache. He was impulsively reacting to questions and had reduced tolerance to stressors unlike his previous self. He was tentatively diagnosed with vascular dementia of acute onset with postconcussional syndrome.

Figure 6 depicts the summary of sequence of events since primary insult.

**OUTCOME AND FOLLOW-UP**

Two weeks after primary insult, the patient was able to carry out daily functional activities by himself, which led to an improvement on the GOS-E Score to 7/8.

His lobar neurological examination (table 1) and mental status examination finding pattern over the following 6 months is depicted in table 2. The patient was started on memantine 10 mg3 with quetiapine 50 mg, both once daily along with cognitive remediation therapy and neuropsychiatric rehabilitation.

**GLOBAL HEALTH PROBLEM LIST**

1. Severe TBI almost always requires level 1 neurosurgical expertise for best outcomes. Most hospitals in India are not level 1 trauma centres and are insufficiently equipped to handle these cases.

2. Level 1 trauma centres are few and far between in India and case-related decisions are largely taken on clinical judgement, where it becomes extremely difficult to follow these stringent BTF guidelines.

3. Lack of strong evidence and robust data for prophylactic anticonvulsant therapy and clarity on when to consider decompressive surgery or continue conservative management are concerning.

4. After reviewing the literature, the outcomes with applying these two interventions are not superior to placebo. This also warrants for large and well-designed randomised controlled trials (RCTs).

5. There is also a dearth in published data on TBI—incidence, morbidity and mortality, neuropsychiatric sequelae and management of TBI in India.

**GLOBAL HEALTH PROBLEM ANALYSIS**

TBI as a global health problem—perspectives of a South Indian rural tertiary hospital

There is currently no official data on the total number of level 1 trauma centres in India. However, these centres are few and far between. Many centres only have a visiting neurosurgeon and are often poorly equipped to manage severe TBI cases according to the BTF guidelines.

With 330 approved medical colleges, only 59 are equipped with neurosurgical departments with a MCh (Master of Chirurgiae) training programme.10 Apart from these, there are some state-of-the-art private hospitals which, however, bring cost affordability issues. With an acute shortage of neurosurgeons in the country, a dearth in neurosurgical centres is expected. With severe TBI being a very prevalent problem,6 advanced neurosurgical care remains out of reach for most patients. This is further compounded by the BTF guidelines requiring advanced neurosurgical care for severe TBI, including equipment for invasive ICP monitoring, which is rarely available. Most of the consensus in treatment of TBI is based on level IIB or III recommendations.

Our institute in Narketpally, Nalgonda, Telangana, is the only accessible tertiary care centre for three districts and several villages. Although we do not have official data, our hospital...
receives several cases of severe TBI per week, which are referred to a level 1 trauma centre due to lack of appropriate equipment in our centre. This case, however, gives us hope that cases of severe TBI can be managed without the need for level 1 trauma care.

Further analyses of other global health problems below show that strict adherence to BTF guidelines is not followed even in level 1 trauma centres which are adequately equipped with what is required. Even in hospitals where ICP monitoring is available, lack of clarity on what to consider as failure of conservative management and when to intervene surgically is concerning and that often leaves clinical decision-making to clinical judgement alone.

At first look, our patient had clear indications for decompressive surgery. However, this was deferred. Although the referral hospital continued conservative management with hyperosmolar therapy (mannitol), BTF states:

Although hyperosmolar therapy may lower intracranial pressure, there was insufficient evidence about effects on clinical outcomes to support a specific recommendation, or to support use of any specific hyperosmolar agent, for patients with severe traumatic brain injury.

BTF, in their fourth edition, has opted not to carry forward their recommendation from the third edition in view of lack of evidence meeting their current standards set for this recommendation.

On invasive ICP monitoring, BTF states:

There was high-quality evidence from a multi-centre, Class 1 RCT (N=324) that outcomes for patients managed with information from clinical assessment do not differ from those for patients managed with information from the ICP monitor. As such, the findings do not constitute the basis for a recommendation to use either method preferentially.

Therefore, with thorough appraisal of the literature for these recommendations, it can be gathered that there is a lack of superiority in outcomes with decompressive surgery over conservative management, there is a lack of any clinical benefit of hyperosmolar therapy and there is no difference in outcomes for patients managed with clinical assessment alone over invasive ICP monitoring.

All in all, we strongly believe that clinical judgement stands paramount and that patients can be managed conservatively even at centres not equipped with level 1 trauma facilities.

Global health analysis of decompressive surgery and seizure prophylaxis

Although not set in stone and never meant to be followed dogmatically, guidelines are generally developed to maintain uniformity in care and treatment. However, most clinicians, as early as from their residency training years, misconstrue guidelines as hard and fast ‘rules’, which they hope and believe bring the best outcomes with little confusion on the plan of management.

Created in 1986, BTF developed guidelines based on contemporary clinical research in the hope of bringing the best possible patient outcomes. Over the next 30 years, with the emergence of new clinical data, these guidelines were revised thoroughly and received universal acclaim because of their strict adherence to ‘evidence-based guidelines’. The current version is the fourth edition, released as recently as September 2016.

Ours being a rural medical college without a neurosurgeon, once the CT of the brain at presentation revealed a SDH with 10 mm thickness and midline shift with >5 mm, the patient was referred to a level 1 trauma centre, which was about 2 hours away from our hospital for decompressive craniectomy (DC) but it turned out that the patient got himself admitted in a nursing home with an on-call neurosurgeon and in spite of not receiving any decompressive surgery, he recovered his consciousness after 3 days, which made us review the evidence beyond what was mentioned in the guidelines and we found an RCT that was unable to establish efficacy of decompressive surgery over conservative management.

There is only one well done RCT comparing the outcomes between DC versus conservative medical management published in 2011. The trial reported an insignificant difference in the mortality or other complications between both groups with a higher incidence of vegetative state and severe disability in the DC group. Notably, the conservative care group had a good recovery and higher incidence of moderate disability.

### Table 1 Prominent findings on lobar function tests

<table>
<thead>
<tr>
<th>Lobe</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Frontal lobe</td>
<td>Impaired executive functioning, problem solving, abstract thinking, personality, language, reasoning and confabulations</td>
</tr>
<tr>
<td>Parietal lobe</td>
<td>Acalculia, finger anomia, spatial disorientation and constructional apraxia</td>
</tr>
<tr>
<td>Temporal lobe</td>
<td>Impaired memory—immediate (with/without cues) and recent, and post-traumatic amnesia</td>
</tr>
<tr>
<td>Occipital lobe</td>
<td>No impairment</td>
</tr>
</tbody>
</table>

### Table 2 Prominent findings on serial MSE(s)

<table>
<thead>
<tr>
<th>S. no.</th>
<th>Day</th>
<th>MSE findings</th>
<th>Symptoms</th>
<th>GOS-E Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Day 7</td>
<td>La belle indifference +2; acalculia; constructional apraxia and visuospatial deficits; impaired abstract thinking, executive functioning and problem solving; impaired immediate memory and recent memory; post-traumatic amnesia; insight 2/6</td>
<td>Labile affect; irritability, palpitations, dry mouth, subjective tension and worry, and poor frustration tolerance</td>
<td>7/8</td>
</tr>
<tr>
<td>2</td>
<td>Day 28</td>
<td>Acalculia; impaired executive functioning; impaired immediate memory; post-traumatic amnesia; insight 3/6</td>
<td>Irritability; subjective tension and worry</td>
<td>7/8</td>
</tr>
<tr>
<td>3</td>
<td>Day 60</td>
<td>Impaired executive functioning; impaired immediate memory; insight 4/6</td>
<td>Irritability</td>
<td>7/8</td>
</tr>
<tr>
<td>4</td>
<td>Day 90</td>
<td>Impaired executive functioning; impaired immediate memory; insight 4/6</td>
<td>None</td>
<td>7/8</td>
</tr>
<tr>
<td>5</td>
<td>Day 120</td>
<td>Almost normal</td>
<td>None</td>
<td>8/8</td>
</tr>
<tr>
<td>6</td>
<td>Day 180</td>
<td>Normal</td>
<td>None</td>
<td>8/8</td>
</tr>
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</table>

GOS-E, Glasgow Outcome Scale Extended; MSE, Mental Status Examination.
In another study looking at small DC group versus large DC group (level 2—small, single centre RCT—N=74 with 37 patients among both groups), significant differences in mortality and functional capacity were noted among both groups (mortality at 1 month: 27% in large DC group and 57% in small DC group). Nearly the same incidence was seen in terms of GOS-E Score of 4–5 among both groups.12

This discussion on the need for DC clearly shows us that the outcomes with standard care are not inferior and functional capacity at the end of 6 months was superior in the standard care group.

In 2019, Fatima et al,13 have published a systematic review and meta-analysis with the objective to evaluate the efficacy of early DC versus standard medical management in improving clinical outcome in severe TBI and included 45 studies. Their analysis revealed that patients who had early DC had no statistically significant likelihood of having a favourable outcome at 6 months compared with those who had standard medical care alone or with late DC (OR=1.00; CI: 0.75 to 1.34; p=0.99).

Thus, in our case, with more than 48 hours of coma with right-sided diffuse cerebral swelling and midline shift of 6.3 mm on NCCT of the brain, it could have been a thin boundary for choosing to continue medical management and deferring or delaying DC. It is compounded perhaps by the insufficient quality of evidence in the BTF guidelines with reference to timing of DC as they considered only two observational studies. There is also no certainty on how long medical management can be tried before surgical intervention is considered.

The patient did not have any improvement in GCS with medical management for the first 3 days. However, he showed good improvement over the next 2 days and was discharged after 1 week. While there was a clear indication for decompressive surgery in the first 3 days, BTF also advocates for osmotic therapy when the ICP is more than 22 mm Hg. However, there is no clear consensus on how long osmotic therapy can be tried before surgical intervention is warranted.

A retrospective study done at a level 1 trauma centre in New Delhi14 reported the functional outcomes of patients with severe TBI (126 of 791). Only 11% (13) of the patients required surgical management and the rest (113) were managed conservatively. At the end of 6 months, 80% (100) of the patients had a GOS-E Score of 5 or more. The other 20% (26) expired, with 7 deaths from the surgery group and 19 deaths in the conservatively managed group. The authors report ‘abnormality not sizeable enough’ and the absence of compound fractures as the main reasons for not operating in spite of positive CT findings.

Post Graduate Institute of Medical Education and Research and Dr. Ram Manohar Lohia Hospital, New Delhi, India, is an eminent level 1 trauma centre which conducted this study. It is unclear whether the authors monitored the ICP for every severe TBI patient as the data on invasive ICP monitoring was not presented in the paper. We assume that clinical decisions were taken based on the neurosurgeon’s clinical judgement and ICP monitoring was not required for every patient with severe TBI. The reasons for not using invasive ICP monitoring could have been the past clinical experiences and prohibitive cost. In any case, good clinical outcomes have been shown even with conservative management in patients with TBI.

Much akin to the recommendations for DC, there are no Class 1 recommendations for the use of phenytoin for early post traumatic seizures (PTS) prophylaxis (up to day 7). None of the studies from Classes 1, 2 or 3 presented in the BTF guidelines establish benefit of phenytoin over placebo. Although one study by Temkin et al15 showed that phenytoin did significantly reduce the incidence of early PTS, there was no significant difference in the functional capacity of the patients at the end of 6 months.

Deasrh in published data and neuropsychiatric sequelae of TBI

TBI is one of the most common causes of acute and chronic morbidity and mortality in India and around the world. Although national data is scant, one epidemiological study done in Bengaluru, a metropolitan city in the south Indian state of Karnataka, with a population of more than 8 million reported that the incidence, mortality and case fatality rates were 150/100 000, 20/100 000% and 10%, respectively.16

Another important purpose of this article is to highlight the importance of data collection and publication and a steadily increasing trend in the number of articles and publications made on TBI in India in this decade compared with previous decades is shown in figure 7.

Just like this paper, 28.8% (180) publications from the bar chart above were case reports. Most publications were made by departments of neurosurgery, forensic medicine and neurology. This also goes to show that the chronic sequelae of TBI, one of the most common neuropsychiatric manifestations, are often left unreported. The importance of these neuropsychiatric sequelae is clearly seen in this case—where it took 6 months for the patient to be fully normal and carry out daily activities unassisted, indicating the long term effects of severe TBI on the patient’s functional status.16 17

An observational study done in Rome, Italy, noted that psychiatric symptoms found in 120 persons with severe TBI included apathy (42%), irritability (37%), dysphoria/depressed mood (29%), disinhibition (28%), eating disturbances (27%) and agitation (24%).18

In another epidemiological study done in Seattle, USA, in 939 TBI patients, the prevalence of any psychiatric illness in the first year was 49% following moderate-to-severe TBI and 34% following mild TBI. Mild TBI is associated with persistent psychiatric illness, whereas moderate-to-severe TBI is associated with a higher initial risk.19

Hence, the case presented here is an example of individualisation of patient management as the patient neither received early or late PTS prophylaxis (although he was given a single loading dose of phenytoin before his referral), nor was he considered for decompressive surgery. However, the patient had not only recovered from subdural haematoma and vascular dementia.
but also has been integrated back to his life with full functional capacities.

Thus, with this paper, we aim to present two pressing issues—first, strict adherence to guidelines may not always bring the best outcomes and that clinical judgement and critical appraisal of literature is required to improve patient-related outcomes. Second, in a country where nearly two-third of the total annual health expenditure comes from out of pocket, expensive equipment like invasive ICP monitors and advanced neurosurgical equipment may not be readily available and hence it becomes imperative that general surgery residents, particularly in rural tertiary hospitals, are adequately trained in basic neurosurgical care before an appropriate referral is made.

## Patient’s perspective

I remember me and my brother working as motorbike mechanics in Narketpally before we met with the accident. I do not have any memory of the event and I vaguely remember being seen by doctors at your institute. I also do not remember when I left that place and started working here in West Bengal again. I was told that I would require surgery and I am quite sure my brother could not have afforded it. I am thankful that such a situation did not arise. Financially, it would have set us back by several years!

In the aftermath, I am now able to carry out my daily activities independently; I still have occasional lapses in memory. Sometimes, it affects my sleep too, like the other day when I switched on the motor for water to get filled in the tank and I also switched it off once the tank got filled. However, after a while, I forgot that I had already finished this task but because I could not remember any of this happening. I had to wake up from my sleep and check the tank again. This does not happen daily, only occasionally. All in all, I am thankful that I have come out of that event relatively unscathed.

## Learning points

- Treating the traumatic brain injury patient is always challenging and this difficulty is compounded by insufficient and controversial clinical evidence published as recommendations in Brain Trauma Foundation guidelines.
- Although most guidelines are supported by evidence, a thorough study into the grade and class of evidence may give us a true understanding of how well certain therapies are supported. It becomes pertinent for a clinician to individualise the data to his/her patient appropriately and integrate case specific clinical judgement with these guidelines.
- Clinical judgement is paramount, and residents must be trained in bettering their clinical judgement rather than a dogmatic reliance on sketchy guidelines.
- Promoting a high resource monitoring system along with a siloed workflow where only very few experts can handle life-saving procedures is akin to negating availability of care in low resource settings, where both equipment and experts are in short supply. General surgery residents should be adequately trained in providing basic neurosurgical care, including learning the critical skill of burr hole surgery.