Chest Injuries Associated with Head Injury

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ABSTRACT

Background: Although there have been significant advances in the management of traumatic brain injury (TBI), associated severe injuries, in particular chest injuries, remain a major challenge. This paper analyses the contribution of chest injuries to the outcome of head injuries in the University of Nigeria Teaching Hospital (UNTH) and the Memfys Hospital for Neurosurgery (MHN) in Enugu, Nigeria. **Materials and Methods:** This is a retrospective review of the medical records, operative notes, and radiological findings of all patients admitted for head injury who had associated significant chest injuries in the MHN from 2002 to 2009 and the UNTH between 2007 and 2010. Patients with only head injury and other extracranial injury not affecting the chest were excluded. Patients who were inadequately investigated were also excluded. **Results:** Nineteen patients from the MHN and 11 patients from the UNTH were analyzed. Ages ranged from 9 to 65 years and the male:female ratio was 3:1. Injuries were most common between 30 and 50 years and road traffic accident accounted for 60%. Barotrauma from ventilation was documented in 2 patients. The commonest types of intrathoracic injuries are pneumothorax and hemothorax. Chest wall injuries are more common but carry less morbidity and mortality. Only 20% of patients presented within 48 hours of injury. Management of the associated chest trauma commenced in the referring hospitals only in 26.4% of the patients. All patients with hemo-pneumothorax had tube thoracostomy as did 96% of patients with pneumothorax. 10% of patients with haemothorax needed thoracotomy. Mortality is 43%, which is higher than for patients with only TBI with comparable Glasgow coma scale. Outcome is influenced by the time to admission and the GCS on admission. **Conclusion:** Associated chest injuries result in higher mortality from head injuries. This association is more likely in the young and more productive. All patients presenting with head and spinal cord injury should be specifically and carefully evaluated for associated chest injuries. Computerized tomographic has not replaced the need for good quality chest radiograph in the emergency management of Head Injury associated chest trauma.

KEYWORDS: Chest injuries, head injuries, outcome

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INTRODUCTION

Traumatic brain injury (TBI) is a common cause of mortality and severe morbidity. Although there have been significant advances in management, associated severe injuries, in particular chest injuries, remain a major challenge. Extracranial injuries, especially chest injuries increase mortality in patients with TBI in both short and long term after 6 months although the mechanisms remain unresolved.[1,2] Attempts have been made to predict outcome for TBI using various models.[1] In these models, extracranial injury is regarded as significant if it requires hospital admission in its own right.[3]

It is well established that cerebral hypoxia worsens outcome following severe TBI.[4,5] The presence of injuries that contribute to early secondary brain injury by the presence of hypoxemia (<60 mmHg or 8 kPa) or hypotension (systolic blood pressure <90 mmHg) on admission has been used to predict 6-month mortality and unfavorable neurologic outcomes.[6] Associated chest trauma may produce hypoxia by a number of mechanisms that constitute secondary insult to the brain.[7-9]

It has been estimated that up to 30% of patients with TBI have concomitant chest injuries.[10] Leone *et al.* found that pulmonary contusion occurred with an overall frequency rate of 29% in head trauma patients.[11] With this association, mortality may be as high as 80%.[10] Early and prompt management of associated injuries improve survival in severe head injury.[12] Unfortunately, evaluation for these associated injuries is often overshadowed by emphasis on head injury.

In Nigeria, trauma remains the major cause of mortality in the younger population. This is mostly due to road traffic accidents and falls from heights and these cases are sometimes associated with other significant injuries. There has been many reports on both chest and head trauma in Nigeria and Africa[13-21] but no studies, to our knowledge, have addressed the association of head

and chest injuries directly in Nigeria. We analyse the contribution of associated chest injuries to the outcome of head injuries in the University of Nigeria Teaching Hospital (UNTH) and the Memfys Hospital for Neurosurgery (MHN) in Enugu, Nigeria.

Materials and Methods

The study involves a retrospective review of the medical records, operative notes and radiological findings of all patients admitted for head injury who had associated significant chest wall and intrathoracic injuries in the MHN from 2002 to 2009 and the UNTH between 2009 and 2010. Chest wall injuries are regarded as significant if they require suturing or involve fracture of one or more ribs. Patients with only head injury and other extracranial injury not affecting the chest were excluded. Patients who were inadequately investigated were also excluded.

Results

There were 19 patients from the MHN and 11 from the UNTH. The ages ranged from 9 to 75 years and the male:female ratio was 3:1. These injuries were most common between 30 and 50 years [Table 1]. The commonest cause was road traffic accident. Barotrauma from ventilation was documented in two patients (one a 9-year-old boy) [Table 2]. Table 3 shows the types of head injuries identified on computed tomography and the concomitant intrathoracic injuries. Although all patients had computerized tomographic (CT) scan of their head as part of their diagnostic work-up, only 10% had CT chest. About 46.7% of patients had more than one type of chest or intracranial injury and/or in more than one location. The commonest type of intrathoracic injury in this series is pneumothorax either in isolation or in combination with haemothorax. Brain contusions were the commonest intracranial lesions found. Chest wall injuries are shown in Table 4. Time to presentation varied in the two units with patients presenting earlier in the UNTH. Table 5 shows treatment outcome. Twenty patients had neurosurgical procedure, 17 of these in association with thoracostomy drainage. Mortality is similar in all the treatment groups except in two patients who had thoracotomy. Tables 6 and 7 show the outcome at discharge as measured using the Glasgow outcome score (GOS). The more the delay before arrival at definitive care centers the poorer the outcome [Table 6]. The Glasgow coma scale (GCS) on admission also affected the outcome Table 7. Management of the associated chest trauma commenced in the referring hospitals only in 26.4% of the patients. All patients with hemo-pneumothorax had tube thoracostomy as did 96% of patients with pneumothorax. Two patients with hemothorax needed thoracotomy and both died.

Table 1: Age and sex distribution of patients with chest injuries

Age range	*n* (%)	Male (%)	Female (%)
<10	1 (3.3)	0	1
10–20	1 (3.3)	1	0
20–30	4 (13.3)	3	1
30–40	9 (30.0)	6	3
40–50	8 (26.7)	7	1
50–60	5 (16.8)	3	2
60–70	1 (3.3)	1	0
>70	1 (3.3)	1	0
Total	30	22 (73.3)	8 (26.7)

Table 2: Causes of chest/head injury

Cause	Number	Percentage
Road traffic accident	18	60.0
Gunshot injury	3	10.0
Assault	4	13.3
Iatrogenic	2	6.7
Falls	3	10.0
Total	30	100.0

Discussion

The association of chest and head injury is not uncommon[11] and results in higher mortality and morbidity than either injury alone. Although head injury may be more apparent initially, chest injuries should be considered early in all cases of head or spinal injuries. Careful clinical evaluation and resuscitation following the advanced trauma life support (ATLS) protocol is necessary and plain chest radiographs are essential part of the initial workup of the patient with head injuries.[12]

Associated chest wall injuries carry less mortality and morbidity than intra-thoracic injuries. Rib fractures were identified in 53.9% of patients in our series. Simple and isolated rib fractures are easily managed with analgesics as they are usually splinted by the rib cage. Multiple fractures may become more troublesome especially if more than one segment of a single rib is fractured. Patients with four or more fractured ribs after blunt trauma should be admitted for observation to monitor for progressive hypoxemia or respiratory failure. Thoracic spinal fractures occurred in four of our patients and were associated with other chest wall injury in one patient.

Flail chest occurs when multiple rib fractures result in an unsupported segment. This leads to paradoxical movement and may affect gas exchange. Early diagnosis and treatment can reduce mortality and chronic disability. Four of our patients had a flail chest and 50% of these had underlying pulmonary contusion. Flail injuries are often associated with underlying lung parenchymal injuries and treatment should anticipate acute respiratory failure and must be directed toward the underlying pulmonary contusion and chest wall pain.[12] Effective analgesia helps prevent respiratory decompensation due to atelectasis and retained secretions. In patients with head injury and a flail chest segment, chest X-ray alone is not reliable as predictor of respiratory decompensation. Although the presence of a flail segment on chest X-ray is not an indication for mechanical ventilation,[12] its association with TBI increases the patient's risk of respiratory failure and it has been suggested that such patients should be ventilated.[22] Patients with severe TBI are generally routinely intubated.

Table 3: Patient-specific injury types identified in the 30 patients

Head injury type	Intrathoracic chest injuries						
	Lung contusion	Haemo-thorax	Peumo-thorax	Haemo/ pneumo-thorax	Major vessel	Total	Mortality
Extradural hematoma	1	–	1	–	–	2	–
Subdural hematoma	1	1	3	1	–	6	3
Intracerebral hematoma	–	3	2	1	2	8	2
Contusion/diffuse axonal injury	3	5	4	2	–	14	8
Total	5	9	10	4	2	30	–
Mortality	3	4	2	2	2	–	13

Table 4: Types of associated chest wall injuries in the 30 patients (*n*=43)

Injuries	Number	Percentages
Chest wall		
Lacerations	11	28.2
Penetrating	3	7.6
Rib fractures	21	53.9
Flail chest	4	10.3
Thoracic spine	4	10.3

Associated intra thoracic injuries are less common than chest wall injuries but results in more morbidity and mortality. Once diagnosed, aggressive treatment following resuscitation takes priority over the head injury.[12] Patients managed conservatively in this series are more prone to die than those managed surgically. This was more likely to occur in patients presenting late. Many studies from Nigeria and Africa indicate late presentation as a problem affecting management[13,16,19] and this was also our experience, with poor outcome in over 66.7% of patients presenting after one week.

Socioeconomic and geographic factors affect the prevalence of trauma in different centers worldwide. In Nigeria and some other developing countries this is compounded by literacy, political and religious practices. These contribute to late presentation and may result in inadequate assessment and management of trauma patients. Only 10% of the patients in this series had a chest computed tomography (CT) scan. This proportion is low compared to practice in more developed countries but is similar to other studies from developing countries.[23] This is due primarily to economic pressures. When possible, CT chest should be done in all patients in coma as part of the initial radiological assessment. This allows for early diagnosis of chest injuries. Using this protocol it was shown that up to 40% of trauma patients have pulmonary contusions.[24] In our series with proportionately few CT chest scans, only 18.9% had pulmonary contusions. This message needs to be emphasized and uptake of CT for chest traumas should be increased to a level comparable with that for brain scans.

In many cases however, diagnosis of intrathoracic injury can easily and safely be based on clinical examination supported by simple easily available chest radiograph and so poor availability of CT facility should not be an obstacle to good patient management. Tension pneumothorax for instance is a clinical diagnosis and intervention in such patients should not be delayed for radiology.[12] Pneumothorax and hemothorax are the most common intrathoracic injuries in our series. They have been reported to occur in over 50% of patients with chest trauma.[10] Thoracostomy tube drainage is an effective initial management. The insertion of a thoracostomy tube should be within the competence of any properly trained Medical personnel running a private hospital. Even where this is not possible, life threatening tension pneumothorax can emergently be treated with needle thoracostomy.[12] In 26.4% of the patients, treatment was already commenced in the referral hospital although majority of these were tertiary hospitals that lacked neurosurgical support. There were no cases of myocardial injuries in our series possibly because such cases did not reach hospital. There were two cases of great vessel injury and both did not survive.

Presence of life-threatening injuries such as acute lung injury, great vessel injury, and myocardial contusion are mechanisms associated with high morbidity and mortality in TBI. Both patients with great vessel injury died, one before any intervention was possible and one after thoracotomy. Mortality in our series is 43.3%. This is higher than mortality generally reported in patients with comparable coma score who had only TBI[3,10] or in patients with chest trauma.[15-18] Morbidity and mortality are affected by the admission GCS. The adverse effect of low admission GCS on the GOS is well established in patients with head injury. In patients with associated chest injuries the admission GCS is a reflection of the severity of the original head and chest injury, and especially where patient present late as in our series, it may also reflect the cumulative secondary injury to the brain and the adequacy of earlier management. It is impossible to determine the contribution of each of these factors to the outcome from the design of this study and more studies are required to evaluate the importance of these factors. The influence of delay in management on morbidity and mortality however suggests that secondary brain insult from the associated chest injury may play a significant role. Outcome was good (GOS IV and V) in over 50% of patients who presented earlier than one week. In patients presenting after one week, the GOS was poor (III-I) in 66.7%. Severe concomitant chest injuries can have direct and indirect effects on mortality.

Table 5: Mortality outcome related to treatment

Treatment modality		Number	Survived	Died
Chest injury	Head injury			
Thoracostomy drainage (23)	Craniotomy/burr hole	17	11	6
	Conservative	6	4	2
Thoracotomy (2)	Craniotomy/burr hole	0	0	0
	Conservative	2	–	2
Conservative (5)	Craniotomy/burr hole	3	2	1
	Conservative	2	–	2
Total		30	17	13

Table 6: Outcome at discharge (Glasgow outcome scale) in relation to time to arrival to Hospital

Time to arrival	Total (%)	Glasgow outcome scale				
		Good outcome	Moderate disability	Severe disability	Persistent vegetative	Death
<48 hours	6 (20.0)	3	1	–	–	2
2–7 days	12 (40.0)	7	2	–	–	3
8–14 days	9 (30.0)	1	1	1	–	6
>14 days	3 (10)	–	–	1	–	2
Total	30	11	4	2	–	13

Table 7: Outcome at discharge (Glasgow outcome score) in relation to Glasgow coma score on admission

Glasgow outcome scale	Glasgow coma score on admission		Total
	Mild/moderate 9–15	Severe 3–8	
Good (V)	11	1	12
Moderate disability (IV)	3	–	3
Severe disability (III)	1	1	2
Persistent vegetative (II)	–	–	–
Death (I)	8	5	13
Total	23	7	30

Mortality is affected directly through great vessel injury, massive blood loss, and fat embolism. This is true even when chest trauma occurs in isolation. When associated with head injuries, chest trauma frequently also result in indirect mortality. Indirect mortality occurs through sustained secondary brain injuries,[10] increased risk of allogeneic blood transfusion,[25] acute lung injury[26] infection, venous thromboembolism, and difficulties in rehabilitation in patients with concomitant spinal and pelvic injuries.[27] These are modifiable by aggressive early diagnosis and treatment of concomitant chest injuries as well as sustained vigilance for subsequent deterioration.

The proportion of patient presenting with concomitant chest injuries to the UNTH is high considering the short duration of data collection. This is because UNTH is a major trauma referral center while the MHN is a specialized neurosurgery center. This study is limited by the small number of patients. The mortality analysis could have been affected by selection bias, since not all crash victims who died immediately, such as motorcyclists, may have been brought to hospital. Moreover, some injured patients may have been treated at other small hospitals. Another limitation was that the data did not include information about use of safety devices.

Conclusion

Associated chest injuries result in higher mortality from head injuries. This association is more likely in the young and more productive. All patients presenting with head injury and spinal cord injury (SCI) should be specifically and carefully evaluated for associated chest injuries. Diagnosis is readily achieved by careful clinical assessment and simple good quality chest radiograph. CT has not replaced the need for good quality chest radiograph in the emergency management of head injury associated chest trauma. Where it is readily available and time permits, however, CT chest is increasingly being utilized for all cases.

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