



Traumatic chest injury in children: A single thoracic surgeon's experience in two Nigerian tertiary hospitals

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ABSTRACT

Background: This study was to determine the extent and outcome of childhood chest injury in Nigeria, and to compare results with that of other literatures. **Patients and Methods:** A Prospective study of all children under 18 years of age with chest trauma in two tertiary hospitals in Southern Nigeria from January 2012 to December 2014 was reviewed. The aetiology, type, associated injury, mechanism, treatment and outcome were evaluated. The patients were followed up in the clinic. The data were analysed using SPSS version 20.0 with a significant $P < 0.05$. **Results:** Thirty-one patients (12.1%) under 18 years of age of 256 chest trauma patients were managed in the thoracic units. The mean age was 9.78 ± 6.77 years and 27 (87.1%) were male. The aetiology in 13 was from falls, 10 from automobile crashes, 3 from gunshots, 4 from stabbing and 1 from abuse. The highest peak of chest injury was on Saturday of the week and April of the year. The pleural collections are as follows: 15 (71.4%) was haemothorax, 4 (19.1%) pneumothorax, 2 (9.5%) haemopneumothorax and 18 patients had lung contusion in combination or alone with the pleural collections. Seven patients who presented >12-h versus 2 who presented <12-h and 6 of children between 0 and 9 years versus 3 at 10-18 years of age had empyema thoracis (P value not significant). One death was recorded. **Conclusion:** Chest trauma in children is still not common, and blunt chest injury from falls and automobile accidents are more common than penetrating chest injury. Treatment with tube thoracostomy is the major management modality with empyema thoracis as the most common complication.

Key words: Thoracic trauma, chest injury, children, thoracic surgeon, Nigeria

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INTRODUCTION

The occurrence of chest trauma in children is not as common as that seen in adults. Furthermore, the aetiology of chest injuries in children is different from that of adults; it is commonly caused by non-penetrating injuries such as automobile crashes and falls.^[1-4]

Children have reduced functional residual capacity with higher oxygen consumption per unit body mass^[5] thus the major complications of chest trauma in the early period is hypoxia.^[4] Early diagnosis and treatment are imperative to prevent the death, which may result from chest injuries in children.^[2]

Falls from heights and while playing seems to contribute significantly to the high rate of paediatric chest trauma in Nigeria and in the late presentation, empyema thoracis may be a common complication. However, there are no data from published literatures in the country to support these hypotheses.

This study was undertaken to determine the extent and outcome of paediatric chest injury in Nigeria, and to compare results with that of other literatures.

PATIENTS AND METHODS

Prospectively collected data from a standard proforma of children under 18 years of age who had chest trauma

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in University of Port-Harcourt Teaching Hospital, Port-Harcourt and Federal Medical Centre, Owerri both in the Southern part of Nigeria from January 2012 to December 2014 were retrospectively reviewed.

The study evaluated the aetiology, type of chest trauma, the mechanism/pattern of chest trauma, associated injuries, the number of days on admission, the treatments, the complications and the outcome. The diagnoses of chest injuries were made mainly by clinical evaluation and plain chest roentgenograms.

The management of chest injury in our centre is dependent on the time of presentation with respect to early (<12 h) or late presentation (>12 h). In the patients presenting early, we evaluated the patients by adopting the Advanced Trauma Life Support protocol; ensuring that the airway was patent and patient was ventilating well, the circulation was assessed by feeling for the pulsation and measuring the blood pressure and the mental state was assessed by using the paediatric Glasgow coma scale. The intravenous line is secured, and sample taken for measuring of the haemogram, electrolytes, urea, creatinine and the hepatitis virus and retroviral screenings. Then, full monitoring (including pulse, temperature, blood pressure and respiratory rate) was performed. Pulse oximetry and chest computed tomography were only used in a few selected cases. Treatment was by the use of analgesics, antibiotics, chest physiotherapy and closed tube thoracostomy instituted for those who had significant pleural fluid collection and pneumothorax. For late presentation, adequate clinical evaluation was done, and an appropriate investigation started with chest roentgenogram. Following discharge, the patient was seen in one week, then 2 week and 3 monthly at surgical out patient. However, there was a great deal of default at follow-up.

The data were analysed using SPSS version 20.0 windows (SPSS Inc., Chicago, II, USA statistical package) with a significant $P < 0.05$.

RESULTS

A total of 31 patients (12.1%) under 18 years of age were recorded of 256 chest trauma patients managed in the thoracic units. The mean age was 9.78 ± 6.77 years, 27 (87.1%) were male with a male to female ratio of 5.2:1. The aetiology of the chest trauma in 13 were from falls (trees and domestic accidents), 10 were from automobile crashes (4 pedestrian accidents in the neighbourhood while crossing the road and 6 passenger road traffic

crash, one of the patient, was an 18-month-old baby girl who sustained a blunt chest injury, which was deployed by the mother),^[6] 3 were from gunshot injuries, 4 were from stab injuries with jack knife and 1 patient sustained chest trauma from abuse by his guardian [Tables 1 and 2]. Depending on the type of chest injuries; 24 (77.4%) were blunt chest injuries while 7 (22.6%) were penetrating chest injuries. Considering the month of year; 4 patients had their injuries in January, 2 in February, 5 in March, 8 in April (4 in this month was due to fall from economical trees), 4 in May, 3 in June, 2 in August, 1 in September and 1 in November [Figure 1]. Considering the quarter of the year; 12 had their chest injuries in the first quarter of the year, 15 had in the second quarter, 3 in the third quarter while 1 was in the fourth quarter. While considering day of the week; 1 had it on Monday, 4 had on Tuesday, 6 on Wednesday (all due to domestic accident and stabbing injuries from assault), 1 on Thursday, 6 on Friday (all due to falls), 9 on Saturday (falls and gunshots) and 4 on Sunday (all

Table 1: The aetiology of chest injury

Aetiology	Number of cases	Percentage
Fall	13	41.9
RTC	10	32.2
Stab injuries	4	12.9
Gunshot injuries	3	9.7
Child abuse	1	3.2

RTC: Road traffic collision

Table 2: The aetiology with respect 0-9 versus 10-18 years

Aetiology	Age (0-9)	Age (10-18)	Age (0-18)
Fall at home	8	—	8
Fall from tree	—	5	5
Passenger RTC	4	—	4
Pedestrian RTC	3	3	6
Stab injury	1	3	4
Gunshot injury	—	3	3
Abuse	—	1	1
Total	16	15	31

RTC: Road traffic collision

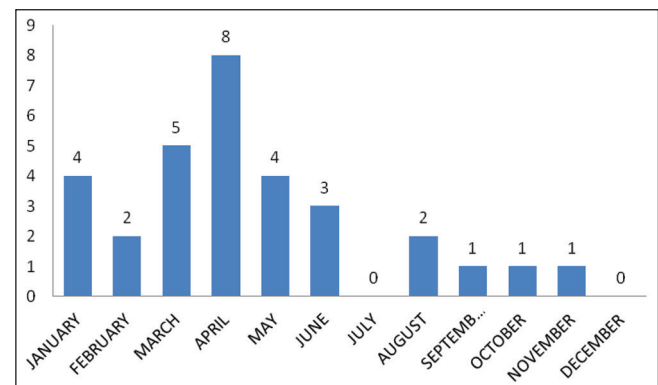


Figure 1: The number of thoracic injuries per month

as a result of road traffic crash) [Figure 2]. There were 5 (16.1%) patients who had rib fractures (4 the patients were aged 12, 17, 17, 18 had 2 rib fractures each while 1 patient aged 10 years had 4 ribs fracture all from blunt chest injury). Four (12, 17, 17 and 18) fall from trees. Twenty-one patients had pleural collection as follows; in 15 (71.4%) patients it was haemothorax, 4 (19.1%) pneumothorax, 2 (9.5%) haemo-pneumothorax and 18 patients had lung contusion in isolation or combination with pleural collection [Table 3]. Two patients had subcutaneous emphysema from blunt chest injury, seven patients had tension pleural collection; 2 (6.3%) patients had tension pneumothorax, which required the preliminary insertion of wide bore canular on the 2nd intercostal space midclavicular line (1.2 years and 2 years) and 5 (15.3%) had massive pleural fluid collection (1.1, 2, 3, 5 and 12 years). The extrathoracic fractures are fracture head of scapular and dislocation of left sternoclavicular joint and the associated injuries included: One patient with severe head injury (acute cerebral haemorrhage), 2 patients with spinal cord injuries and paraplegias, 2 patients had acute abdomen with haemoperitoneum (one from splenic injury and the other secondary penetrating abdominal injury) and 1 diaphragmatic rupture. The time between injury and presentation range from 1 h to 504 h; mean timing of presentation 105.83 ± 174.83 h breakdown showed: 7 (22.6%) presented in <12 h while 24 (77.4%) was >12 h with various reasons adduced such as presentation in another health centre, lack of funds and not thinking

the injury was severe enough. Seven patients presenting >12 h to the hospital against 2 presenting <12 h had empyema thoracis as complication (*P* value is not significant) [Table 4]; 6 patients of children under 9 years against 3 children <10 years had empyema thoracis (*P* value not significant) [Table 5]. There was one mortality (3.1%) from the 17-year-old patient who had a fall from a tree and sustained blunt chest injury, acute abdomen and spinal injury T8 paraplegia. The treatment for all those who had significant pleural collections (haemothorax; pneumothorax; pneumohaemothorax and empyema) was the passage of appropriate size chest tube for the age while laparotomies were done for those who had penetrating abdominal injury, splenic injury and thoracotomy for diaphragmatic rupture while the 2 who had spinal cord injury with paraplegia were discharged to the neurosurgical unit after drainage of the pleural collection and treatment from the thoracic unit. The days on admission ranged from 2 to 22 days; mean days on admission 10.79 ± 7.6 days.

DISCUSSION

To the best of our knowledge, this is the first account of chest injuries in the paediatric age group in Nigeria. The male to female ratio was 5.2:1. This is not unexpectedly as boys are generally noted to have increased risk for all causes of injury.^[7] They are the ones who are more likely to engage in activities that will cause chest injuries such as climbing trees and playing in this region.

In our present study, blunt chest injuries occurred in about 24 of 31 cases (77.4%) thereby putting penetrating chest injuries at the lower end of the ladder. Similarly, other previous reports from other parts of the world robustly noted that blunt chest injuries were high and ranged between 89.8% and 97.1% of all paediatric chest injuries.^[1,2,4,7,8] However, a study done over 3 decades ago in the United States of American showed increased cases of penetrating injuries than blunt chest injuries.^[9] This in actual fact is a deviation from the general findings.

The experience from developing country, especially in civil setting, is that of blunt chest injuries than

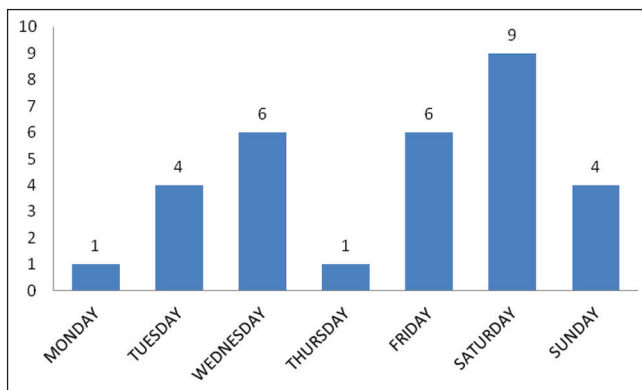


Figure 2: The number of thoracic injuries per day

Table 3: The type of chest injury and associated injuries

Trauma type	Associated injury	Pneumothorax	Haemothorax	Pneumo-haemothorax	Pulmonary contusion	Rib fracture
Fall	3		7	1	9	3
RTC	2	2	3		8	2
Stab injury		1	1			
Gunshot	1	1	3	1	1	
Abuse			1			
Total	6	4	15	2	18	5

RTC: Road traffic collision

Table 4: The age of patients and complication

Age range	Complications		Total	P
	Empyema	Pneumothorax		
0-9 versus 10-18	6	1	7	0.576
	3	1	4	
Total	9	2	11	

Table 5: The timing of presentation and complication

Time (h)	Complications		Total	P
	Empyema	Pneumothorax		
<12	2	1	3	0.425
≥12	7	1	8	
Total	9	2	11	

penetrating chest injuries. This like of equality in the type of chest injury observed in our environment is probably due to increased cases of blunt chest injuries resulting from falls and automobile crashes in the paediatric age group.

Falls occurred in about 40.6% of the patients reviewed, which was the most common aetiology of chest injuries seen in children in our country. The children were falling from mainly economical trees such as fruit and palm trees and at homes when they trip off while playing in constraint spaces in their home. The reason given by the patients for climbing the trees is for plucking of fruits or tapping of palm wine,^[10] in other to provide financial support for their families, and the reasons given for playing at home is because of the absence of recreational facilities or, that playing outside the homes was not safe enough for them. This is a result of the spate of rapid urbanisation in the cities that is taking up each and every small piece of land for the building of houses and business centres and the security challenges, the country is currently facing that makes safety an issue in allowing children play outside their homes. A similar account of paediatric chest injuries resulting from playing at inappropriate place was reported by Meller *et al.*, in which they noted an increased incidence of blunt trauma in children related to the frequent use of city streets as playgrounds.^[9]

It is instructive, that we call the attention of urban/city/town planners to incorporate recreational facilities with security around the residential areas and the need for stronger legislative actions against allowing children take up the role of breadwinners in the family.

The aetiologies of chest injury whether blunt or penetrating is occasioned by what is readily available as a wounding object in any country.^[9] For instance, in the USA, gunshot injuries was observed as a significant

cause of thoracic injuries among American children because these younger group were more likely to sustain injury by unintentional crossfire (35.3% vs. 14.7%) than intentional assault (0% vs. 47.2%).^[11] Similarly, another study in the USA, in which 68 paediatric chest injuries were reviewed, showed that 40 (59%) sustained penetrating injuries caused by gunshots more frequently than stabbings by a ratio of 1.5:1.^[9] In Saudi Arabia, a review of children up to 12 years of age who sustained blunt chest trauma, 82 children sustained motor vehicle crashes.^[1] In India, blunt impact trauma was the major cause in 58.3%, resulting from bullock-cart accidents; bull-horn and buffalo-hoof injuries.^[12] A review of blunt trauma in 137 children in Turkey showed a significant cause of chest trauma from falls in about 46.7% of cases.^[3] In other studies, falls as causes of childhood injuries were about 20%.^[13,14] In China, traffic crashes were the predominant cause of children's chest trauma resulting to 56.6% of cases.^[4] One can, therefore, state that the aetiology of paediatric chest injuries could result from by what is commonly present as the wounding object in a particular country. In our own case, the availability and accesses to trees and lack of space for recreational activities led to increased blunt chest injuries from falls. From this research, the main aetiology of falls differed from what was reported in other countries.

Automobile accident is another significant cause of paediatric chest trauma. It is pertinent to note that 31.3% of chest injury from our study occurred from automobiles accident. The factors contributing to these are poor driving culture, children crossing the road unaided by experienced adults, over speeding, drivers not observing some road signs like zebra crossing, lack of provision of restrained seat and seat belt for children and poor passenger culture like a mother caring a baby in the front of cars. Child abuse by guardians as a cause of chest injury also featured with other causes such as gunshot and stab injuries.

In considering the periods, 26 (83.9%) patients had the chest injuries during the first half of the year; 15 (48.4%) had it during the second quarters of the year; 8 (25.8%) had it in April; these are the periods that fruits could be plucked by these children such as mangoes and oranges, occur in preponderance. Over half of the injuries 19 (61.3%) occurred during the weekend when the children are at home and the highest day of the week chest injuries occurred in 9 (29.0%) of children was on Saturday for the same aforementioned reason. A previous study from the same region over a decade ago had associated months and days with the occurrence of stab injuries.^[15]

The percentage of rib fracture from this review is 16.1% when compared with a study from Turkey of which the incidence of rib fracture was about 9.1%,^[3] it is deemed high. Rib fractures are uncommon in younger children, although they may occur more frequently in adolescents^[5] as the calcification of bone increases. This may explain the findings from our study as rib fractures occurred more in children who were 10 years and above. These fractures were confirmed by simple chest roentgenograms and the lack of callus on subsequent chest roentgenogram^[4,16] also further confirmed the absence of rib fracture after 2-3 weeks in the patients who did not have it.

It is worthy of note that none of the children had flail chest, and ventilator support was not required in any of them. Flail chest was reported as being extremely uncommon occurrence in children^[9] and Nakayama *et al.*, noted flail chest as an important prognostic determinant of patients with a chest injury with respect to the ventilatory support.^[7]

Pleural collections such as haemothorax, pneumothorax and pneumo-haemothorax occurred in 21 patients while 18 patients had lung contusion with or without pleural collections. These conditions were detected by mainly chest roentgenograms. Though the use of chest computerised tomography scan was stated as being important in diagnoses, especially in lung contusion,^[4,17] this did not translate to any therapeutic advantages from this study and thus was not readily employed.

The mediastinum in a child is pliable and is subjected to a great deal of translocation to contralateral side when there is a considerable pleural fluid collection and this may lead to haemodynamic instability^[4] from the tension created by excessive pleural fluid. From this research, we had 7 (22.6%) of 31 patients with tension pneumothorax and tension pleural collections that necessitated expedite treatment in others to avoid cardiac arrest.

The most common late complication that could occur in a paediatric patient with chest trauma was empyema thoracis. Though not statistically significant, 7 of nine patients with empyema thoracic presented more than 12 h while 2 with empyema presented less than 12 h and 6 patients within 0-9 years and three patients in children aged 10-18 developed empyema thoracis, the import of this finding is that irrespective of the timing of presentation or the age with respect to young or older children, whenever there is significant accumulation of blood in the pleural space, it may form a nidus for

subsequent colonisation by bacteria, infection and resultant empyema thoracis.

This morbidity can be prevented by ensuring early evaluation of paediatric chest trauma with roentgenogram and significant haemothorax drained by the insertion of a chest tube and administration of prophylactic antibiotics, especially for penetrating chest injuries.

The most common associated injury was neuro-trauma, which occurred in three patients. Earlier report in the country for adult patients showed that the most common associated injury in chest injuries was neuro-trauma.^[18] This was similar to our finding as about 3 of the six patients with extrathoracic injuries were with the nervous system — severe head injury and traumatic spinal cord injuries.

It was in only one patient that thoracotomy was done for diaphragmatic rupture and the other two had laparotomies for associated acute abdomen from blunt and penetrating abdominal injuries otherwise most of these children were treated by chest intubation to drain pleural fluid collections.

RECOMMENDATIONS

1. Patient with significant haemothorax should have it drained and commenced on intravenous antibiotics because of increased likelihood of developing empyema thoracis.
2. The younger children should be helped to cross the road while going to school by an adult.
3. Serious penalties for guardians/persons who use offensive weapons on children.
4. Educate children about the dangers of climbing trees.
5. Discourage the use of children for labour.
6. Provisions of proper recreational facilities for children at home to avoid them playing in a confined area, which will result in injuries.

CONCLUSION

Chest trauma in children is still not common in our environment. However, blunt chest injury from mainly domestic/industrial accidents from falls and automobile accidents are still common than penetrating chest injury. Treatment with tube thoracostomy is the major modality of management and with empyema thoracis as the most common complication encountered in this condition.

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Conflicts of interest

There are no conflicts of interest.

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