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Clinical, operative and pathological correlations in fatal and near-fatal thoracic trauma in Nigerians

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Summary

A combined retrospective and prospective review of 248 chest trauma patients has been carried out at the University of Ilorin Teaching Hospital between 1979 and 1986. Eight and 12 of these patients respectively were so severely injured that they were certified dead on arrival in the Emergency Room or at varying periods during resuscitation but before definitive management. Ten others were subjected to major operation. The peculiar clinical features of this sub-group of 30 patients within the context of the entire series are analysed in detail and correlated with autopsy and operative findings in 20 and 10 patients respectively. Most (36.7%) of the severe injuries occurred in the 21–30 age group followed by children under 10 years of age (16.7%). When injuries are classified into life-threatening, potentially life-threatening and mild (including incidental pathology found at autopsy), the majority (95%) of autopsy cases sustained multiple trauma combining cranio-encephalic, abdominal, extremity and spinal injuries, in descending order, with chest trauma. Penetrating trauma constituted 50% of the thoracotomy group while all but one of 20 autopsy cases sustained blunt injuries. Multiple rib fractures including proximal ones were common. No major tracheobronchial or aortic disruptions were encountered while two cases of heart injury were seen. Suggestions are made towards decreasing the injury treatment interval, improving the general level of preparedness and diagnosis of visceral injury despite more obvious non-visceral trauma.

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Résumé

Une revue à double face (rétrospective et prospective) de 248 souffrants du trauma de la poitrine a été entreprise au centre hospitalo-universitaire d'Ilorin entre 1979 et 1986. Respectivement, huit et 12 de ces souffrrants étaient tellement gravement atteints qu'ils ont succombé à leur arrivée à la salle d'urgence sinon à divers stades de ranimation mais avant l'application d'un traitement définitif. Dix autres ont subi une thoracentèse d'envergure Les traits cliniques particuliers de ce sous-groupe de 30 souffrants dans le contexte de l'ensemble sont analysés, de façon détaillée, et mis en corrélation avec les trouvailles operatives et d'autopsie chez 20 et 10 malades respectivement. La plupart (36.7%) des atteintes graves se sont produites dans le groupe d'âge allant de 21 à 30 ans, suivi des enfants au-dessous de 10 ans (16.7%). Lorsqu'on classifie les atteintes selon les critères suivants: menaçent la vie, menaçent la vie potentiellement et de gravité modeste (dont pathologie incidentale découverte pendant l'autopsie), la plupart des cas soumis à l'autopsie (95%) avaient subi des traumas multiples impliquant en même temps des cranio-encéphaliques, abdominaux, des atteintes épinales et des extrémités des membres, en ordre descendant, doublés d'atteintes de la poitrine. Des traumas pénétrants ont constitué 50% du groupe de thoracentèse alors que tous les 20 cas d'autopsie (sauf un) avaient subi des atteintes superficielles. Des fractures multiples de la côte, dont celle de la paroi supérieure, étaient communes. Aucun dérangement trachéo-bronchique ou aortique n'a été enregistré alors que deux cas d'atteinte cardiaque ont été reconnus. Des propositions sont avancées à propos de réduire

l'intervalle de traitement des atteintes, l'amélioration du niveau général de préparation et le diagnostic d'atteintes viscérales en dépit des traumas non-viscéraux plus flagrants.

Introduction

Detailed clinico-pathological analysis of trauma in general and thoracic trauma in particular is uncommon in the African literature. A similar observation can be made as regards detailed operative correlation of clinico-pathological findings since a relatively small percentage of thoracically injured patients are subjected to thoracotomy. This paper presents the clinico-pathological and operative correlation of injuries sustained by a group of 30 fatal and near-fatal thoracic trauma patients selected from a combined retrospective (1979–82) and prospective (1983–86) series of 248 patients attending the University of Ilorin Teaching Hospital, Ilorin, Nigeria. The study was designed to define the pattern and severity of injuries in this group of patients, the adequacy or otherwise of diagnostic and therapeutic measures and areas where the level of preparedness in general and thoracic trauma care in particular need improvement to achieve greater patient survival.

Subjects and methods

During a 4-year retrospective period (1979–82) the clinico-pathological findings of thoracic trauma patients were reviewed. From the information collected a comprehensive protocol was drawn up for use in the 4-year prospective study period (1983–86). Documentation was carried out on admission, immediately before or after operation, upon discharge, death and at autopsy. Each injury was finally reviewed and retrospectively assigned a triage score using the following severity grades.

I Severe life-threatening injury requiring immediate surgical intervention.
II Potentially, but not immediately, life-threatening injury which required prompt but not immediate surgical intervention.
III Mild/moderate injury requiring no immediate surgical therapy or incidental pathology at autopsy that might complicate the hospital course.

The injury severity score was totalled up while discrepancy was noted between clinical and pre-operative diagnoses on the one hand and autopsy and/or operative findings on the other. The relationship between injury–treatment interval and outcome was also noted.

Results

The 30 subjects analysed in detail constituted 12.1% of 248 chest trauma subjects treated during the 8-year period.

Eight severely injured subjects were dead on arrival (DOA) to the emergency room while 12 others were alive on admission or arrival (AOA) but were dead at varying periods during resuscitation but before definitive treatment. The DOA and AOA subjects were attended to during the prospective study period while the operative experience spanned the entire 8-year period.

Age and sex distribution of subjects is shown in Table 1 while Table 2 shows frequency of triage scoring of the injuries derived from autopsy and operative findings. Most thoracic trauma victims, like all trauma victims in our institution, are in the 21–30 age group (36.7% of the entire series). The under 10-year-old group formed a poor second, while three subjects older than 50 (aged 70, 75 and 70) were pedestrians who were road traffic accident (RTA) victims.

The majority of patients sustained multiple traumas (Table 2) involving (in descending order of frequency) chest and head, chest and abdomen, and chest and limbs. The most frequent chest injuries were of Type I severity while Type III injuries were least frequent in the chest. Four subjects sustained thoracic trauma only.

Specific injuries are listed in Table 3 which contains one entry per injury type per patient. A few, however, suffered bilateral injuries of the same nature.

The aetiology of trauma in the 30 subjects is as follows.

Road traffic accidents. All the eight subjects who were DOA, 10 of 12 AOAs and four out of 10 subjected to major operations were involved in RTAs. A 6-year-old boy who died on arrival was a pedestrian victim of a RTA. He had a moderately severe pulmonary contusion

Table 1. Age and sex distribution of subjects with fatal and near-fatal thoracic trauma

	DOA			AOA			Major operation				
Age (years)	Male	Female	Total	Male	Female	Total	Male	Female	Total	Total	Percentage
0–10	1		1	1	1	2	2		2	5	16.7
11–20	1		1				2	1	3	4	13.3
21–30	2	1	3	5		5	3		3	11	36.7
31–40	1		1	2		2	1		1	4	13.3
41–50				2		2	1		1	3	10.0
>50		2	2		1	1				3	10.0
Total	5	3	8	10	2	12	9	1	10	30	100

Table 2. Severity of chest and combined injuries in fatal and near-fatal thoracic trauma

	Head	Neck	Spine	Chest	Abdomen	Limbs	Total
I	11		2	23	11		47
II	9	1	3	27	12	11	63
III	7			3	5	4	19
Total	27	1	5	53	28	15	129
DOA	8		1	8	6	3	8
AOA	10		3	12	5	7	12
Major operation		1	1	10	4		10
n	18	1	5	30	15	10	30

I Life-threatening injuries; II potentially life-threatening injuries; III mild injury/ incidental pathology.

and massive aspiration of recently ingested food at autopsy (Fig. 1). Three subjects with diaphragmatic tears in the operative group were involved in RTAs.

Penetrating injuries. Five subjects (one AOA, four from the operative group) sustained gunshot or stab wounds. A 25-year-old man with haemopericardium from a parasternal gunshot wound had no myocardial injury while a 9-year-old boy (AOA group) was shot with a home-made gun, sustaining tangential lingula injury and a through-and-through left ventricular wound. There was no valvular or septal damage. Injury–treatment interval was prolonged before arrival. A cervico-thoracic stab wound caused a left jugular–subclavian–innominate vein angle puncture which was successfully repaired in a 17-year-old boy. A 38-year-old man sustained combined blunt and sharp injuries when he fell off his motorcycle while a 25-year-old man sustained separate cervical thoracic and abdominal bullet injuries. Another 25-year-old patient sustained left thoracoabdominal multiple organ gunshot wounds.

Others. A 50-year-old palm wine tapper fell, fractured his spine and sustained left hemidiaphragm tear extending to the pericardium. A 2½-year-old girl in whose intermediate bronchus a screw had been impacted for 3 months prior to referral, required bilobectomy.

Eight DOA subjects sustained, in addition to chest trauma, head injuries of varying severity including cerebral contusion with or without scalp lacerations, intracranial haematomas and facial bone fractures. Frequency of abdominal visceral injuries in DOA subjects was as follows: spleen (three subjects), kidneys (three subjects), liver (three subjects), small and large bowel (one subject).

Of seven AOA subjects with intracranial haemorrhage, four had abdominal visceral injuries while three sustained both intracranial haemorrhage and skull fractures. Only one of the seven with intracranial haemorrhage had neither skull fracture nor intra-abdominal visceral injury in addition to chest injury. Single or double visceral injuries included liver (four subjects), with one adding splenic laceration and one each of adrenal and ileal injuries.

Eleven of 22 subjects in the AOA and operative groups had prolonged injury–treatment intervals. In at least eight (36.4%) the delay contributed to early death.

In addition to preliminary tube thoracostomy, pericardiocentesis and bronchoscopy, operative procedures performed fell into four categories. Cervico-mediastinal exploration was done once for jugular–innominate venous repair and cervico-mediastinal exploration for jugular vein bullet injury was combined with bilateral tube thoracostomy and laparotomy in a 25-year-old

Table 3. Nature of chest trauma

Trauma type	DOA group (n = 8)	AOA group (n = 12)	Operative group (n = 10)	Total subjects (n = 30)
Fractured ribs/sternum ± flail chest	4	6	3	13
Open chest wound	1	—	—	1
Ruptured diaphragm ± pericardium	—	—	5	5
Non-aortic mediastinal haematoma ± emphysema	1	3	—	4
Haemo/pneumo-thorax	3	3	4	10
Non-aortic vascular	—	—	1	1
Tracheo-bronchial	2	—	1	3
Pulmonary laceration/contusion	4	9	1	14
Sharp pericardial/heart injury	1	1	2	4
Blunt pericardial/heart injury	2	2	—	4
Total	18	24	17	59

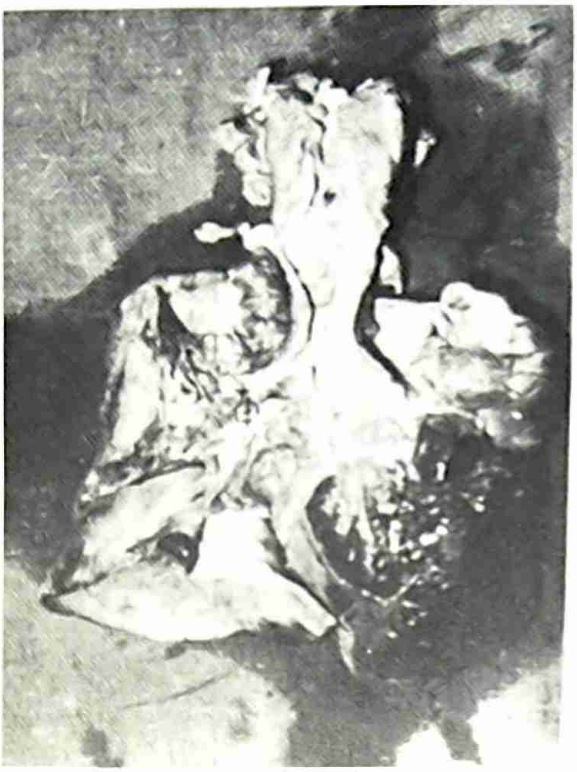

Fig. 1. Autopsy specimen from a 6-year-old pedestrian victim of a road traffic accident showing moderately severe pulmonary contusion and massive aspiration of recently ingested food.

policeman. Thoracotomy carried out following a parasternal bullet wound was concluded with evacuation of haemopericardium and partial pericardiectomy in another 25-year-old man who sustained parasternal gunshot wound. Bilobectomy for chronic bronchial obstruction and distal pulmonary consolidation was used in the 2½-year-old girl who inhaled a screw, while evacuation and decortication were done to release trapped lung following infected haematoma developing after combined blunt and penetrating chest trauma. Five other subjects with left diaphragmatic injuries had transthoracic repair (two subjects), thoracoabdominal repair of multiple injuries (two subjects) and transabdominal repair on another subject during the first author's vacation. Partial pericardial repair was also done in the latter subject.

Two subjects in the operative group died, giving a mortality of 20% in this group. Excluding DOA patients, our overall thoracic trauma mortality was, however, 12.1%.

Discussion

The thoracotomy rate for civilian thoracic trauma is generally low. It is approximately 10% in more developed countries [1] where it is understandably higher for series dealing with heart and major vascular injuries [2–6] and combat experience [7–10]. In the developing countries of Africa, thoracotomy rates are comparatively lower for civilian and combat experience [11–14], except for the 20% rate reported by Adebonojo *et al.* [15]. However, that series and others [16–18] generally report low mortality rates. Thus there is scanty literature dealing with detailed clinico-pathological or operative correlations of trauma [19,20] which can be of diagnostic, therapeutic and preventive value. This is in contradistinction to large operative and clinico-pathological series in developed countries [21–23]. This paper attempts to bridge the information gap on patients with fatal and near-fatal injuries.

Several trauma severity scoring systems in use in the literature include anatomic index and injury severity [24,25], trauma index rating [26,27], triage index [27], and 'seri-index' based on severity of injury to particular organs and morbidity–mortality categories [28]. These scoring systems are predictive in nature, and, except for the last two, prospectively used. Our simple injury severity scoring system used in this analysis is based on the principles of triage, is used retrospectively and does not interfere with clinical decisions and patient management. The exercise provides clinico-pathological details that raise general and specific levels of preparedness for trauma care. This in turn is likely to improve patient survival.

It is generally assumed that factors of ignorance, limited resources and poor communications affect the number of severely injured AOA subjects taken to medical centres in developing countries. Pertinently, traumatic aortic ruptures and tracheobronchial disruptions are not reported in the African series cited above except for one case of ruptured bronchus cited by Mendis [14]. However, the usual clinical features associated with these injuries

on the basis of Western experience, e.g. multiple trauma and proximal rib fractures [5, 29–31] are not infrequently found in our patients. The first author witnessed head-on collision accidents involving four unharnessed drivers and front-seat passengers included in our autopsy series. None of these sustained the dreaded injuries. It seems that prolonged injury–treatment interval and diagnostic limitations do not adequately explain their rarity. If found, however, the situation is not entirely hopeless in certain centres where the clamp/repair method and use of heparinized shunts for traumatic aortic rupture can replace extracorporeal circulation, as shown by others (32–34).

It is noteworthy that our small series included gunshot and stab wounds of the heart and major veins (Table 3). Without prompt treatment few of these can survive, as has been illustrated by the death of one of those referred from a distant hospital. Prolonged injury–treatment delay was also recorded in 50% of the combined DOA–AOA groups. It is noted, however that prolonged injury treatment interval is well documented in blunt diaphragmatic and heart injuries [1, 35–38]. Contrast studies are diagnostic in doubtful cases of diaphragmatic injuries (Fig. 2). There are no standard guidelines for myocardial contusion.

Patients with bilateral triple flail chest wall segments, extensive pulmonary haemorrhage and massive traumatic airway obstruction in this series appear clearly unsalvagable. An analysis like this helps appreciation of how clearly injuries fall into one category or the other.

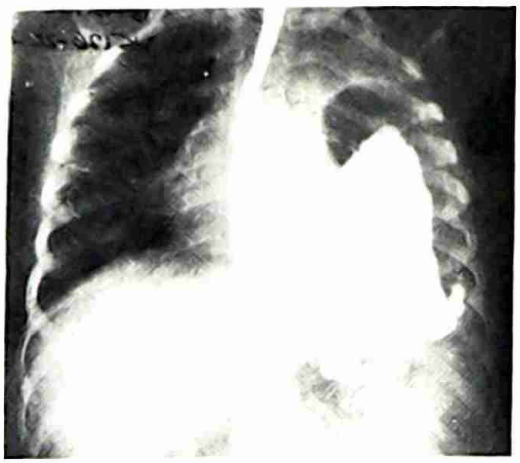

Fig. 2. Contrast study in a case of diaphragmatic injury: the contrast filled stomach is partially displaced into the left hemithorax.

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References

1. Nealon TF Jr, Ching NPH. Trauma to the chest In: Sabiston DC Jr, Spencer FC, eds. Gibbon's Surgery of the Chest. Philadelphia: WB Saunders, 1976:306–23.
2. Borja AR, Lansing AM, Randsell HT Jr. Immediate operative treatment for stab wounds of the heart. Experience with fifty-four consecutive cases. J Thorac Cardiovasc Surg 1970;59: 662–7.
3. Beall AS Jr, Gasior RM, Bricker DL. Gunshot wounds of the heart. Changing patterns of surgical management. Ann Thorac Surg 1971; 11:523–31.
4. Reul GJ Jr, Mattox KL, Beall AC Jr, Jordan GL Jr. Recent advances in the operative treatment of massive chest trauma. Ann Thorac Surg 1973;16:52–63.
5. DeMeules JE, Cramer G, Perry JF Jr. Rupture of aorta and great vessels due to blunt thoracic trauma. J Thorac Cardiovasc Surg 1971;61:438–42.
6. Tavares S, Hankins JR, Moulton AL, *et al.* Management of penetrating cardiac injuries: the role of emergency room thoracotomy. Ann Thorac Surg 1984;38:183–7.
7. Brewer LA III. Wounds of the chest in war and peace: 1943–1968. Ann Thorac Surg 1969;7:387–408.
8. McNamara JJ, Messersmith JK, Dunn RA, Molot MD, Stremple JF. Thoracic injuries in combat casualties in Vietnam. Ann Thorac Surg 1970;10:389–401.

9. Grover FL. Treatment of thoracic battle injuries versus civilian injuries. Ann Thorac Surg 1985; 40:207–8.
10. Zakharia AT. Cardiovascular and thoracic battle injuries in the Lebanon war. Analysis of 3,000 personal cases. J Thorac Cardiovasc Surg 1985;89:723–33.
11. Anyanwu CH, Swarup AS. Chest trauma in a developing country. Ann R Coll Surg Engl 1981;63:102–4.
12. Bassey OO, Akinsanya BA, Elebute EA. Wartime injuries of the chest. W Afr Med J 1970;19: 3–7.
13. Grillo IA. Missile thoracic trauma in the Nigerian civil war 1967–70. Nig Med J 1972;2: 93–6.
14. Mendis NKG. Chest injuries in civilian practice. Ghana Med J 1970;9:279–82.
15. Adebonojo SA, Grillo IA, Osinowo I, Adebo OA. The spectrum of thoracic and cardiovascular surgery in Nigeria. E Afr Med J 1982;59: 451–64.
16. Anyanwu CH, Iwatt AT. Traumatic cardiothoracic injuries in Eastern Nigeria. In: Adeloye A, ed. Care of the Injured. West African College of Surgeons, Ibadan: Caxton Press 1977:144–9.
17. Grillo IA. Nigerian civil war wounds experience at a military base hospital. J Nig Med Assoc 1970;7:32–40.
18. Jallah EM. Management of thoracic trauma in Liberia. In: Adeloye A, ed. Care of the Injured. West African College of Surgeons, Ibadan. Caxton Press 1977:150–3.
19. Hunpono-Wusu OO. Disorders which shorten life among Nigerians: a study of mortality patterns in the age group 15–44 years in Kaduna, Nigeria. Trop Geogr Med 1976;28:343–8.
20. Kale OA, Aina KA. Pattern of injuries in 455 persons killed in road traffic accidents. W Afr J Surg 1976;1:171–3.
21. Davis JH. Thoracic trauma as seen by the medical examiner. In: Daughtry DC, ed. Thoracic Trauma. Boston: Little, Brown and Co., 1980:261–72.
22. Kemmerer WT, Eckert WG, Gathright JB, Reemtsma K, Creech O Jr. Patterns of thoracic injuries and fatal traffic accidents. J Trauma 1961;1:595–9.
23. Sevitt S. Fatal road accidents in Birmingham, times of death and their causes. Injury 1973;4: 281–93.
24. Champion HR, Sacco WJ, Lepper RL, Atzinger EM, Copes WS, Prall RH. An anatomic index of injury severity. J Trauma 1980;20:197–202.
25. Hedges JR, Sacco WJ, Champion HR. An analysis of prehospital care of blunt trauma. J Trauma 1982;22:989–93.
26. Champion HR, Sacco WJ, Carnazzo AJ, Copes W, Fouty WJ. Trauma score. Crit Care Med 1981;9:672–6.
27. Champion HR, Sacco WJ, Hannan DS, *et al*. Assessment of injury severity. The triage index. Crit Care Med 1980;8:201–8.
28. Anderson B, Syphax B, Leffall LD Jr. Clinical appraisal of patients with abdominal and thoraco-abdominal trauma. J Natl Med Assoc 1974;66:192–7.
29. Kirsh MM, Orringer MB, Behrendt DM, Sloan H. Management of tracheobronchial disruption secondary to nonpenetrating trauma. Ann Thorac Surg 1976;22:93–101.
30. Albers JE, Rath RK, Glaser RS, Podder PK. Severity of intrathoracic injuries associated with first rib fractures. Ann Thorac Surg 1982;33: 614–18.
31. McBride LR, Tidik S, Stothert JC, Barner HB, Kaiser GC, Willman VL, Penington DG Primary repair of traumatic aortic rupture. Ann Thorac Surg 1987;43:65–7.
32. Kirsh MM, Kahn DR, Crane JD, *et al*. Repair of acute traumatic rupture of the aorta without extracorporeal circulation. Ann Thorac Surg 1970;10:227–36.
33. Donahoo JS, Brawley RK, Gott VL. The heparin coated vascular shunt for thoracic aortic and great vessel procedures: a ten-year experience. Ann Thorac Surg 1977;23:507–13.
34. Mattox KL, Holzman M, Pickard LR, Beall AC Jr, DeBakey ME. Clamp/repair: a safe technique for treatment of blunt thoracic aorta. Ann Thorac Surg 1985;40:456–62.
35. Hood RM. Traumatic diaphragmatic hernia. Ann Thorac Surg 1971;12:311–24.
36. Wincek RG Jr, Wilson RF, Steiger S. Acute injuries of the diaphragm: an analysis of 165 cases. J Thorac Cardiovasc Surg 1986;92:989–93.
37. Liedtke AJ, DeMuth WE. Non-penetrating cardiac injuries: a collective review. Am Heart J 1973;86:687–97.
38. Beresky R, Klinger R, Peake J. Myocardial contusion: when does it have clinical importance? Curr Surg 1986;43:419–20.

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