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Blunt chest trauma

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Summary

A retrospective study was conducted at the cardiothoracic surgical unit of the University College Hospital, Ibadan on all consecutive, blunt chest injury patients treated between May 1975 and April 1999. The period of study was divided into 2 periods: May 1975 – April 1987, May 1987 – April 1999. The aim was to determine the pattern of injury, the management and complications of the injury among the treated. Blunt chest trauma patients were 69% (1331 patients) of all chest injury patients (1928 patients) treated. Mean age for the 2 periods was 38.3 ± 15 years and 56.4 ± 6.2 years, the male : female ratio was 4 : 1 and 2 : 1 respectively. The incidence of blunt chest trauma tripled in the second period. Blunt chest trauma was classified as involving bony chest wall or without the involvement of bony chest wall. Majority of the blunt chest injuries were minor chest wall injuries (68%, 905 patients), 7.6% (101 patients) had major but stable chest wall injuries, 10.8% (144 patients) had flail chest injuries. Thoracic injuries without fractures of bony chest wall occurred in 181 patients (13.6%). Seven hundred and eighty-seven patients (59.1%) had associated extra-thoracic injuries, in 426 patients (54.1%) two or more extra-thoracic systems were involved. While orthopaedic injury was the most frequent extra-thoracic injury (69.5%) associated with blunt chest trauma, craniospinal injury (31.9%) was more common injury among the patients with severe or life threatening chest trauma. The most common extra-thoracic operation was laparotomy (221 patients). Nine hundred and seventy patients (72.9%) had either closed thoracostomy drainage or clinical observation, 361 patients (27.1%) had major thoracic surgical intervention (emergent in 134 patients, late in 227 patients). Most of the severe lung contusion that needed ventilatory care (85 patients) featured among patients with bony chest wall injury, 15 were without chest wall injury. Majority of patients 63.2% (835 patients) had no significant complications, 486 patients (30.8%) of 1321 survivors had 741 complications. The commonest complications were atelectasis (201 patients) and pleural space complications (263 patients). Overall mortality was 36.2% (154 patients) among 426 patients. We conclude that majority of blunt chest trauma can be managed by simple procedures with minimal complications. Severe soft tissue chest injuries can occur without bony chest wall fractures.

Keywords: *Blunt chest trauma, Pattern of injury, Outcome.*

Résumé

Une ètude retrospective a etè conduite consecutivement aux patients souffrant des blessures douleureuses a la poitrine, a l 'unite de chirugie cardiothoracique du centre universitaire hospitalier(UCH), Ibadan traites de Mai 1975 a Avril 1999. Cette étude était divisé en 2 périodes : Mai 1975 a Avril 1987 et Mai 1987 a Avril 1999 management et less complications de la blessure parmi les patients traitès. Les traumatismes des douleurs de poitrine representatient 69% des blessures de poitrine chez les patients traites(1928 patients). L a moyenne d age des 2 groupes etaient de 38.3 = 15 and et 56.1%± 6.2 ans , la proportion male/female était 4 :1 et 2 :1 respectivement.L incidence des traumatismes des douleurs de poitrine triplait dans la seconde periode. Le traumatisme etait classe comme : cage thoracique squelettee,ou cage thoracique normal. La majorite des blessures de la poitrine etaient reduites aux blessures de la cag thoracique 68% (905 patients), 7.6%(101 patients) etaient severe, mais avec les blesures de la cage thoracique stable, 108% (144 patients) avaient les blessures de la poitrine fragile. Les blessures thoraciques sans fracture des os de la cage thoracique apparaissent chez 181 patients (13.1%), 59.1% (797 patients) avaient des blessures extrathoraciques associees, 54% (426 patients) , deux ou plus des systemes extrathoraciques etaient attaches. L a blessure orthopédiques etait la plus frequente blesure extrathoracique(69.5%) associes aux traumatismes de doulers de la poitrine, la blessure cranio-epiniere(31.9% etait plis commune chez les patients aux traumatisme de poitrine aigu . L opération extrathoracique commune etait la laparotomie(221 patients). Neuf cent soixante dix patients(72.9%) avaient soit un drainage thorocostimique ou l' obsrervation clinique. 361 patients(27.1 %) avaient une intervention chirugicale thoracique majeur(134 patients en emergence). Quatre-vingt-cinq patients avec une cage thoracique mince avaient des cas de congetion pulmonaire severe ayant droit aux soins ventilatoires et quinze patients n avainent pas des blessure pulmonaires. La majorite des patients (63.2%) n avaient pas des complications significant , 30.1% des survivants avaient des complications. Les complications communs inclus : l ateleectasie,(201 patients), complications de l espace pleurale (263 patients). Le taux de mortalité était de 36.4 % .Nous avons conclu que la majorité de traumatisme des douleur de poitrine peut etre managé par des simples procédures , avec moins des complicatoions des blessures des tissues internes dans la poitrine chez les patients sans fracture de la cage thoracique.

Introduction

Although trauma is known to be the leading cause of death in the first four decades of life, statistics regarding the true incidence of chest trauma are scanty [1] It has been estimated that 20 to 25% of trauma deaths, and approximately 16,000 deaths per year, are attributable to thoracic injuries[2]. Blunt trauma from motor vehicle accidents has accounted for 70 to 80% of thoracic injuries [3].

When considering blunt chest trauma, the victims' age is an important variable. Children have elastic, flexible chest-walls, which protect them from bony chest-wall injuries but expose the thoracic viscera to the force of impact. Thus children are at high risk for significant intra-thoracic injuries [4]. Elderly patients have brittle chest-wall and are subject to significant injury to underlying viscera from relatively low energy trauma. Hence old people suffer a significant mortality rate, from minor chest-wall injuries [5].

The purpose of this retrospective report is to present the pattern of blunt chest injuries, their management and complications among patient treated in the past 24 years.

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Materials and methods

During the 24 years period of evaluation (from May 1975 to April 1999), the patients treated by the cardiothoracic unit of the University College Hospital Ibadan, Nigeria consisted of the acutely injured or patients who have had initial resuscitation at various referring centers. The data were extracted from the following sources: the patient's case file, the inventory of all our unit's admissions and treatments, review of the units weekly service activities, a review of the operative log books and post-mortem records. No one source was complete. Duplicate entries were eliminated and where differences were found they were approximately adjudicated.

The management of patients at the emergency departments of the University College Hospital Ibadan included: the triage, the initial restoration of blood volume, creation and maintenance of patient airways, and treatment of associated injuries. Multi-disciplinary approaches were initiated by appropriate referrals. The standard method of initial managements of chest trauma patients in our unit over this period included: Initial closed thoracostomy tube drainage for all patients with relevant clinical signs. Chest-X-rays were taken later when patients were stable. Chest drainages were considered excessive when 250 mls of blood or more were drained for 3 consecutive hours or = 1000 mls at the time of institution of intercostal tube. Airleaks were considered for surgical intervention when pleural space suction was associated with respiratory distress. Conservative respiratory care included oral or parenteral analgesics, intercostal nerve blocks, supplementary oxygen, and pulmonary toilet. Selective ventilatory support was carried out as determined by an attendant anaesthetic team.

Data extracted for analysis included demographics, mechanism of injury, type of thoracic injury, associated extrathoracic injury, methods of management and outcome. For the analysis of the mechanism of injury and the population injured, the period of study was divided into two 12 year interval. The patients were divided into those with bony chest-wall injury and those without bony chest-wall injury. Those with bony chest-wall injury were subdivided into 3 groups: minor, major and flail groups. The minor group were those brought in haemodynamically stable, the major were haemodynamically unstable but have relatively stable chest wall and the flail had unstable chest-wall with paradoxical motions.

Results

General

Two thousands, seven hundred and ninety two consecutive cases of thoracic injury were treated during the 24 year period: 1928 patients had sufficient data for analysis. One thousand three hundred and thirty one patients (69%) had blunt thoracic trauma. The remaining 597 (31%) had penetrating chest injury.

Three hundred and sixty-nine patients had blunt thoracic injuries in the first period (between May 1975 and April 1987) and 962 patients in the second period (between May 1987 and April 1999). The age range was 6 to 89 years (mean of 38.3 ± 15 years) for the first 12 years, and 2 to 76 years (mean of 56.4 ± 6.2 years) for the second 12 years. This age pattern is illucidated in the frequency distribution of age by percentage shown in the figure. Older age groups are involved in the recent 12 years. There were 295 males to 74 female in the first period compared to 642 to 320 in the second period. The respective ratio of male to female among the patients with blunt thoracic injury was 4:1 and 2:1. There was no alteration in the pattern of the mechanism of injury (Table 1) between the 2 periods. There was an increase in number of patients with chest injury during the second period. Majority (96.7%) of the patients were brought by non-ambulance conveyances.

Table 1: Mechanism of injury

	1975 - 1987 n (%)	1987 - 1999 n (%)
Motor vehicle crash	191 (51.7)	577 (60.0)
Motor cycle crash	98 (26.6)	136 (14.1)
Pedestrian	60 (16.3)	227 (23.6)
Falls	11 (3.0)	8 (0.8)
Others	9 (2.4)	14 (1.5)

Pattern of thoracic injuries

Nine hundred and five patients (68%) of the patients who had blunt chest trauma had minor chest-wall injury (Table 2). Eight hundred and forty- seven patients had rib fractures. The rib fractures were associated with clavicular fractures in 69 patients, with scapular fractures in 23 patients, with sternal fractures in 10 patients. In all these and in 593 other patients, rib fracture was associated with haemothorax (HmThx), pneumothorax (PnThx) or hydropneumothorax (HmPnThx). Isolated rib fracture occurred in 152 patients (16.8%) and in association with blunt diaphragmatic rupture in 14 (1.5%) patients. Rib fracture was the commonest blunt chest-wall injury and was most frequently associated with pleural injury (76.8%). It was bilateral in 10% of the patients and there was an average of 2 – 5 rib fractures per patient. The sternal fractures were not associated with cardiac morbidity.

Table 2: Minor chest-wall injuries in 905 patients.

	Number of patients n (%)
Thoracic	
Fractured ribs± clavicle, sternum, scapular	905 (100)
Bony injuiry with HThx, PThax< PH Thx.	6.95 (76.8)
Rib fracture	152 (16.8)
Sternal fracture alone	58 (6.4)
Pulmonary contussion	137 (15.1)
Diaphragmatic rupture	14 (1.5)

HThx - Haemothorax; PThx - Pneumothorax; HPThx - Haemopneumothorax

One hundred and one patients (7.6%) had major chest-wall injury which involved an average of 6 – 10 rib fractures per patient. The rib fractures were bilateral in 25 patients (24.8%) and were associated with 8 sternal, 11 clavicular (bilateral 4) and 9 scapular fractures (Table 3). The bony injury was associated with detectable HmPmThx in 85.1% (86 patients).

One hundred and forty four patients (10.8%) had flail chest injuries (Table 4) Pleural injury was the commonest associated thoracic injury.

Thoracic injuries without fractures of bony chest-wall occured in 181 patients (13.6%). The pattern of injuries among the patients of this group is shown in Table 5. The majority of these injuries were haemothoraces or haemopneumothoraces

Table 3: Major chest-wall injuries in 101 patients

	Number of patients n (%)
Fractured ribs± clavicle, sternum,. scapular	101 (100)
Bony injury with HPThx (detectable)	86 (85.1)
Soft tissue injury	93 (92.1)
Pulmonary contusion/haematoma	41 (40.6)
Diaphragmatic rupture	35 (34.7)
Lung laceration	18 (17.8)
Tracheobronchial	7 (6.9)
Cardiac	5 (5.0)
Tracheo-bronchoesophageal	3 (3.0)

Table 4: Flail chest injuries in 144 patients

	Number of patients n (%)
Unilateral flail	129 (89.6)
Bilateral flail	15 (10.4)
Associated thoracic injuries	
Haemothorax, haemopneumothorax	103 (71.5)
Pulmonary contusion	68 (47.2)
Diaphragmatic rupture	25 (17.4)
Pulmonary laceration	12 (8.3)
Aortic injury	5 (3.5)
Tracheobronchial	3 (2.1)

Table 5: Thoracic injuries without fractures of bony chest-wall in 181 patients

	Number of patients n (%)
Thoracic	
Haemothorax, haemopneuothorax	115 (63.5)
Pulmonary contusion	84 (46.4)
Diaphragmatic rupture	20 (11.0)
Cardiac contusion	9 (5.0)
Great vessels	6 (3.3)
Tracheobronchial	5 (2.8)
Pulmonary laceration	2 (1.1)

Table 6: Pattern of soft tissue injuries

Soft tissue injured	Total	Chest-wall injured n (%)	Non chest-wall injured n (%)
Pulmonary	32	30 (93.8)	2 (6.2)
Diaphram	94	74 (78.7)	20 (21.3)
Pulmonary contussion	330	246 (74.5)	84 (25.5)
Tracheobronchial	15	10 (66.7)	5 (33.3)
Aortic/Great vessels	11	5 (45.5)	6 (54.5)
Cardiac	14	5 (35.7)	9 (64.3)

(63.5%). The pattern of soft tissue injury in patients with bony chest-wall compared with those without bony chest-wall injuries are shown in table 6. Injuries to heart and great vessels were more frequent in the absence of bony chest-wall injuries while other intra-thoracic injuries were commonly associated with bony chest-wall injuries.

Associated extra-thoracic injuries

Out of 1331 blunt chest injury patients, 544 patients (40.9%) had no associated extra-thoracic injury. Seven hundred and eighty seven patients (59.1%) had associated extra-thoracic injuries of which 426 patients (54.1%) had two or more extra-thoracic systems involved.

Associated extra-thoracic injuries are listed in table 7. Orthopaedic injury was the most common extra-thoracic injury (69.5%) associated with blunt thoracic trauma while cardiospinal injury (31.9%) was more common among the patients with severe or life threatening chest trauma.

Table 7: Associated extra-thoracic injuries

	No. of patients n (%)
No associated extra-thoracic injury	
Chest-wall injured	521 (39.1)
No chest-wall injured	23 (1.7)
Orthopaedic	547 (69.5)
Extremetics	497
Pelvic	68
Craino-spinal	251 (31.9)
Head injury (Concussion, contusion)	201
Spinal	97
Abdomina	221 (28.1)
Spleen	98
Liver	75
Kidney/ureter/bladder	62
Bowel/mesentry	51
Pancreas	35
Stomach	8

Four hundred and seventy- seven extra-thoracic surgical procedures were required in the management of 421 patients. The most common operation was laparotomy (221 patients) followed by orthopaedic (129 patients) and neurosurgical procedures (71 patients).

Treatment of thoracic injury

Nine hundred and seventy patients (72.9%) needed either closed thoracostomy tube drainage as definitive treatment or only clinical observation; 361 patients (27.1%) had major thoracic surgical intervention. The thoracic indications for surgery, operative approaches and outcome of surgery are listed on table 8. Majority (229, 62.9%) of the operated patients had late surgery, while 134(37.1%) had more emergent surgery.

All of the 137 patients with pulmonary contusion among the patients with minor bony chest-wall injury had only conservative care of their respiratory system. Eighty-five of the 109 (77.9%) with pulmonary contusion needed ventilation at some point during treatment. These 85 patients represented 35% of 245 patients with severe bony chest injury. Fifteen patients (17.4%) of 86 patients with pulmonary contusion among patients without bony chest-wall injury needed same care.

Table 8: Indications for surgery in blunt chest trauma and outcome

Indications	Operative approach	No. of patients n	Deaths n
Immediate resuscitative	T	4	4
Emergency (within 24 hrs)			
Diaphragmatic	T	50	6
	L, T	13	6
	L, S	2	2
	T, L	1	-
Haemorrhage	T	48	10
Tracheobroncheal	T	15	3
Late (after 24 hours)	L	1	-
Clotted haemothroax	T	77	-
Epyema thoracis	T	72	-
Fibrothorax	T	69	-
Diaphragmatic	T	7	-
Tracheo-broncho-oesophageal fistula	C, L	2	2

T - thoracotomy: L,T = Laparotomy followed by Thorocotomy; L, S = Laparotomy and sternotomy; T, L = Thoracotomy followed by Laparotomy; L = Laparotomy; C, L = Cervical exploration and Laparotomy

Table 9: Complications among 486 patients with blunt chest trauma

	Number n
Arelectasis	201
Empyema thoracis	104
Fibrothorax	82
Clotted Haenothorax	77
Respiratory insufficiency	65
Haemorrhage/shock	48
Pneumonia	42
Pulmonary embolism	41
Wound complication	38
Sulphremic abscess/sepsis	17
Genitourinary	13
Renal failure	4
Tracheal-Osophageal fistula	2
Tracheal stenosis	3
Lung abscess	3
Aorto-bronchial fistula	3

Morbidity and mortality:

There were 10 acute deaths (defined as deaths within, 6 hours of admission). Majority (835 patients, 63.2%) of the 1321 survivors in this series had no significant complications. This group was made up of patients with minor bony chest-wall injury. Four hundred and eighty six (30.8%) of the survivors had 741 complications listed in Table 9. Atelectasis, pleural space complications and pulmonary sepsis were the commonest complications. The overall mortality of 154 patients (36.2%) was incurred among the 426 patients with major bony chest-wall injury, flail chest and some patients without bony chest-wall injuries. The causes of death are listed in Table 10. Severity of extrathoracic injury and associated pulmonary injury were the main determinants of mortality among our patients.

Table 10: Causes of death in 154 patients with blunt injury

Artiology	Number
Multiple injury	101
Respiratory failure	65
Central nervous systemic injury	45
Shock/haemorrhage	24
Sepsis/abscess	17
Tracheo-bronchial injury	3
Trascheo-Oesophageal fistula	2

Discussion

Blunt trauma to the chest is commoner than penetrating chest trauma in our study, with the most frequent causes being motor vehicle accidents, motor cycle crash and pedestrian accidents. There has been no perceptible alteration in the pattern of the mechanism of injury in the studied population but the number of patients treated has tripled in the past twelve years. This may be related to increased number of vehicles and road users than before. There has been higher economic demands and/or poor maintenance of the vehicles in the country also during the later 12 years of this study. Older patient population and increase in female population among the patients with chest injury in the recent 12 years further corroborate the role of economic demand in increased incidence of accidents.

Majority of the patients in this study were transported by non-ambulance conveyances. This we believe affected not only the pattern of injuries but also the severity of injuries. Many reports now emphasise the role of rapid transportation and improved pre-hospital management of trauma victims as important factors in more frequent arrival at treatment centers of moribund trauma victims who otherwise might have died at the scene [6-9].

Majority of patients with blunt thoracic trauma in this study (86.4%) have chest wall injuries. This compares well with 71% [2] and 75.3% [3] in the major reviews. However, the types of chest wall injuries from our study were 68% minor, 7.6% major and 10.8% flail corresponding values elsewhere are 24%, 34% and 13%2. Chest injury without bony chest-wall injury occurred in 13.6% of our patients, the frequency is between 12% to 52% in the literature [4].

While most of the thoracic soft tissue injuries occurred in association with bony chest-wall injury, the absence of rib fractures or other bony thoracic injuries does not preclude presence of serious parenchymal injuries [10,11]. In our analysis, more than 50% of great vessel injuries, about 64% of cardiac contusions, 33.3% of tracheobroncheal injuries, 26% of pulmonary contusion and 21% of diaphragmatic injuries occurred in the absence of bony thoracic injuries. Findings similar to ours have been reported among various population groups [10,11,14]. The proportions of the different soft tissue involved differ among the groups and age is not a significant factor in determining the extent of soft tissue involvement [3,11]. Whether this injury occurs because the energy of the impact is not dissipated through fractures or because a specific type of kinetic force predisposes the patient to soft tissue injury is

unclear. A high index of suspicion is essential in early diagnosis of these set of thoracic injuries based on history, mechanism of injury physical examination and appropriate diagnostic studies [12].

Most of the patients with blunt chest trauma have an array of associated injuries[3]. The frequency of isolated chest injuries have ranged between 16.3% [3] to 31.4% [4], corresponding value from our study is 40.9%. The frequency of extra-thoracic injuries from the same series ranged between 68.6% [4] to 85% [3] and corresponding value from our study was 59.1%. This discrepancy is probably related to a large population of minor chest injury in our series. Severe chest injuries in our series have higher frequencies of two or more extra-thoracic systems injured. This finding further corroborate the reports that blunt chest trauma victims regardless of age are subject to polytrauma [3,13]. While head injuries were reported as most frequently associated with blunt chest trauma [2,14], we found orthopaedic injuries as most frequent and craniospinal injuries as next most commonly associated with severe blunt chest injuries. The fact that abdominal injuries are the most frequent extra-thoracic indication for surgery [14] is also supported by our findings. All these associated injuries contributed significantly to the mortality as reported elsewhere [23,14].

Most of the lung contusion in this series were managed conservatively. The combination of lung contusion and bilateral flail constitute the highest indication for selective ventilatory care and the highest mortality was incurred in this same group when they have associated extra-thoracic injury. This has been the experience of others [15,16] therefore the types of associated injuries and their severity should help to decide for early ventilatory assistance. The current advice is that patients with isolated flail chest injuries do not require ventilatory support unless the flail is bilateral, there are severe associated extrathoracic bone fractures and blood loss requiring blood transfusions [14,17].

Intercostal tube is an important interim and definitive management of violation of pleural space. As an interim care it helps to monitor haemothorax and pneumothorax for timely surgical intervention. Majority of blunt trauma patients do not require more than this.

Our experience with emergency room thoracotomy has been sporadic. However it has a limited place in blunt chests trauma. It might be effective in treatment of ruptured cardiac chamber or severe lung laceration [7,8]. Blunt traumatic cardiac arrest is a relative contra-indication to emergency thoracotomy [7-9]. We employed early thoracotomy for the treatment of some of the patients classified as immediately and potentially life threatening sequelae of blunt chest trauma. Late thoracotomy was mainly employed in our series in the treatment of sequelae of incomplete pleural blood evacuation and other late sequelae of acute chest trauma. These accord well with general practice [19 - 22].

The complications we identified in 436 patients (36.7%) among 1321 survivors we treated were within the range of 36% to 66%14 reported in the literature. Atelecsasis and empyema thoracis were the most common complications in our analysis. Chest tube is painful and interferes with coughing and deep breathing. The longer it is in place, the more likely it is to contribute to the development of other thoracic complications such as ateleutasis and pneumonia [22]. Empyema thoracis complicating post-trauma pleural drainages are related to prolonged presence of the tube and contamination of pleural space content [23,24]. Both of these factors are common occurrences during management of chest trauma patients.

In patients with associated multiple skeletal injuries, early immobilization of the fractures by either external or internal fixation and early mobilization of the patient are essential adjuncts to post-operative care of respiratory system in the multiply injured [25].

The factor most often associated with mortality was multi-system injury. The combinations of significant multi-system injury with shock or/and respiratory insufficiency adversely affected survival in our study. The presence of flail chest, pulmonary contusion and sepsis were found to account for another subgroup of late mortality (defined as deaths after 72 hours of admission).

Primary determinants of adverse outcome in a study included associated injuries and blood loss, while bilateral flail chest and age were contributory factors[17]. Another report implicated severity of thoracic injury, presence of shock, fall from heights, and the combination of pulmonary contusion and flail chest[14]. On the whole, severity of injury [12], both thoracic and extra-thoracic factors determine the mortality. We conclude that majority of blunt chest trauma in our environment can be managed by simple procedures with excellent outcome. Majority of blunt chest trauma patients have bony chest injury and absence of bony chest wall injury does not preclude severe thoracic soft tissue injury.

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