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A 10-year retrospective review of chest trauma in Hospital Universiti Sains Malaysia

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Abstract:
Background: *Globally chest trauma accounts for 10% of trauma admission and 25% of trauma deaths. Outcome of chest trauma depends on causes and mechanism of the injury, pattern of lesions and presence of associated injuries.*
Objective:*To study the aetiology, injury pattern, management and outcome of chest trauma in Hospital Universiti Sains Malaysia (HUSM), Kelantan,Malaysia.*
Methods: *Records of 504 patents admitted from January2003 to December 2012 who fulfilled the inclusion criteria were retrospectively reviewed. Demographic data, details of aetiology, mechanism and pattern of injury,associated injury,management including ICU admission ,ventilation requirement and outcome including length of stay(LOS) and mortality was analysed .*
Results: *412 patients (82.0%) were males. Most frequent injury was fracture rib. Out of 11thoracotomies performed (2.2%), 8 were caused by penetrating injury. Overall hospital LOS was 1 to 94 days with a mean of 10.2 days (SD=12.4).Mortality occurred in 35 patients (6.9%). Associated extrathoracic injuries, ICU admission and ventilation requirement significantly affected LOS and mortality.* ***Conclusion****-Road Traffic Accident (RTA) is the main cause of chest trauma in Kelantan. Greater than 5 ribs fracture indicated severe injury. Presence of extrathoracic injuries, ICU admission and requirement for artificial ventilation correlated well with the outcome.*
Keywords: *Chest trauma, Injury pattern, Mechanism, Management, Outcome*

I. Introduction

The American Academy of Science describes trauma as the "neglected disease of modern society"[1]. In the year 2013 alone, 814,663 patients were admitted for trauma in 758 hospitals across the USA ,with an overall mortality of 4.47%. Most common causes are falls and road traffic accidents(RTA). 21% of these admissions were for thoracic trauma[2]. It has been estimated that by the year 2020, 8.4 million people will die each year from injury –mostly through RTA [3]. Besides this civil strife, violent crimes against society and wars have periodically contributed to the trauma incidence. Trauma is the third most common cause of admission to hospital in Malaysia and the fifth leading cause of death[4]. In a study in Klang Valley hospitals, chest injuries accounted for 36.6% of fatalities among motorcyclists[5].

Most common mechanism for chest trauma is blunt injury and penetrating injury. The spectrum of lesions produced ranges from simple chest wall contusion to vital organ injury[6]. The vast majority of chest trauma can be conservatively managed. However a few cases of penetrating trauma will require thoracotomy for management [7]. Patients at high risk for major chest injury should be identified early to avoid unnecessary morbidity or mortality[8]. Since most chest trauma is preventable, it is important to understand the aetiology, injury pattern, and management protocols. Local literature on such data is , however, meagre . In this retrospective review of chest trauma in Hospital Universiti Sains Malaysia over a 10 year period from January 2003 to December 2012, we aim to study the aetiology, injury pattern, management and outcome of these patients.

II. Methodology

This retrospective record review was conducted in the Surgical department of Hospital Universiti Sains Malaysia (HUSM), Kubang Kerian ,in the state of Kelantan, Malaysia. Records were traced manually from the Medical Records department with the help of ICD-10 coding (S20-29). Missing records and those with incomplete data were excluded.

Ethical approval was obtained from the Research Ethics Committee of HUSM. Anonymity and confidentiality of patients was preserved by not including names or identifying details in the proforma prepared.

All patients who were hospitalised due to chest trauma between January 2003 and December 2012, with the criteria of intrathoracic injury and clinically significant rib cage injury including single rib fracture were included. Excluded were patients who were brought dead to the Emergency Department, patients who did

not complete their treatment in HUSM, isolated laryngeal or spinal injury, esophageal and tracheal injury resulting from ingested or aspirated foreign body,and nontraumatic injury from burns ,smoke or electric shock.

A total of 504 patients who fulfilled the above criteria were included in the study. Data collected and entered into the proforma consisted of demographics, causes and mechanisms of injury, pattern of lesions, presence of associated injuries,management and outcome including length of hospital stay(LOS) and mortality.

Statistical analysis of data was done using SPSS ver. 20 (IBM®,USA). Categorical variables were expressed as absolute values (n) and relative frequencies (%), and analysed using Pearsons Chi squared test and Fishers exact test. Numerical variables were expressed as mean and Standard Deviation (SD) and analysed using independent samples t –test and one-way ANOVA. A p-value of <0.05 was considered significant . Power of the study was 80% with Confidence Interval (CI) of 95%.

III. Results

This is a 10 year retrospective record review from January 2003 to December 2012 conducted in HUSM, which is a major teaching hospital in Kelantan,Malaysia. We included a total of 504 patients with thoracic injuries.

3.1 Demographics : Ages ranged from 1 to 89 years with a mean age of 39.67 years(SD=20.50). 412 patients were males and 92 were females with a male to female ratio of 4.5:1. 76 patients (15.1 %) had underlying co-morbids on admission . These included hypertension , DM (Diabetes Mellitus), heart disease, stroke, bronchial asthma, and COAD (Chronic Obstructive Airway Disease). Some had more than one co-morbid.

3.2 Cause and mechanism of injury: Commonest cause of injury was involvement in RTA (Road Traffic Accident), making up 84.3% of the cases, followed by falls (11.5%), and assault (4.2%). As for the mechanism of injury,489(97.0%) of the patients had blunt trauma , whereas only 15 patients (3.0%) had penetrating injury from either assault or stab. 2 cases of gunshot wound were excluded from the study due to missing data . Most of the patients who had RTA and falls, sustained blunt injuries (99.8% and 94.8% respectively). Out of 21 patients who were involved in assaults 11(52.4%) sustained penetrating injury (p-value <0.001) **Table I.**

TableI:Mechanism of Chest trauma in relation to aetiology

Variable	Mechanism ,n(%)		X2 –stat	P value
	Blunt	Penetrating		
Aetiology			189.53	<0.001
RTA	424(99.8%)	1(0.2%)		
Fall	55(94.8%)	3(5.2%)		
Assault	10(47.6%)	11(52.4%)		

Fisher exact test

3.3 Patterns of Injury: The most frequent injury was fracture of ribs seen in 76.2% of the patients, followed by pneumothorax (30.8%) ,lung contusion (26.2%), and haemothorax (18.5%). Other injuries were relatively rare – flail chest was diagnosed in 11 patients (2.2%), lung laceration in 4 patients(0.8%), cardiac and diaphragm injury in 2 patients (0.4%) respectively and 1 patient (0.2%) with tracheobronchial injury.**Fig.1**

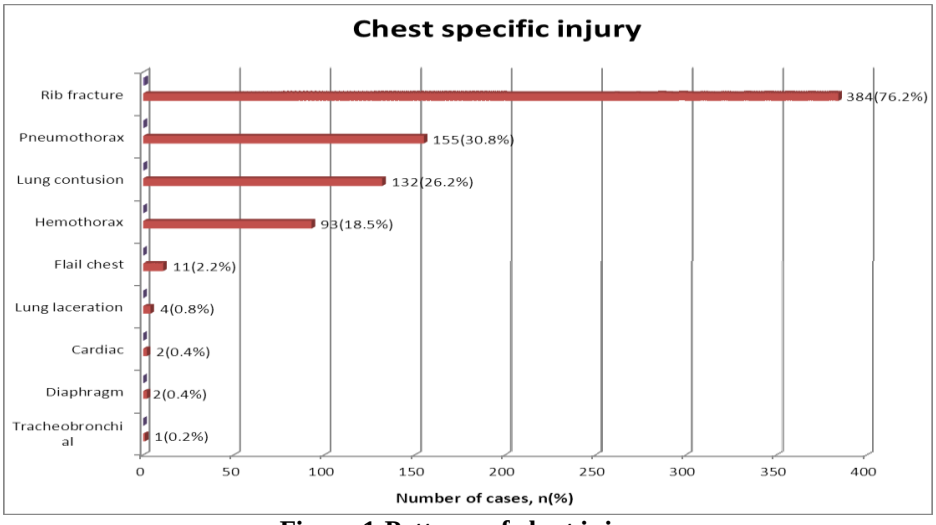

Figure 1:Patterns of chest injury

Of the patients with fractured ribs, 49.6% had 1-2 ribs involved ,42.1% had 3-5ribs fractured , and 83.% had more than 5 ribs fractured . Number of fractured ribs showed significant correlation with the complications of pneumothorax , lung contusion and haemothorax ,p-value<0.001.**Table II.**

Table II. : Number of fracture ribs in relation to severity of chest injury

Fracture Rib	Pneumothorax n(%)	Haemothorax n(%)	Lung Contusion n(%)
> 5 ribs	14(43.8%)	11(34.4%)	9(28.1%)
3-5 ribs	55(34.0%)	38(23.5%)	36(22.7%)
1-2 ribs	36(18.8%)	15(7.9%)	26(13.6%)
X 2-Stat	23.117*	25.116*	55.703*

Chi square test, *p-value<0.001

366 patients (72.6%) had associated extra thoracic injuries. Most common was musculoskeletal (54.4%) involving vertebral spine, pelvis and long bones . 154 patients (30.6%) had neurotrauma and 58 patients(11.5%) had intraabdominal injury as the common association .**Fig.2.**

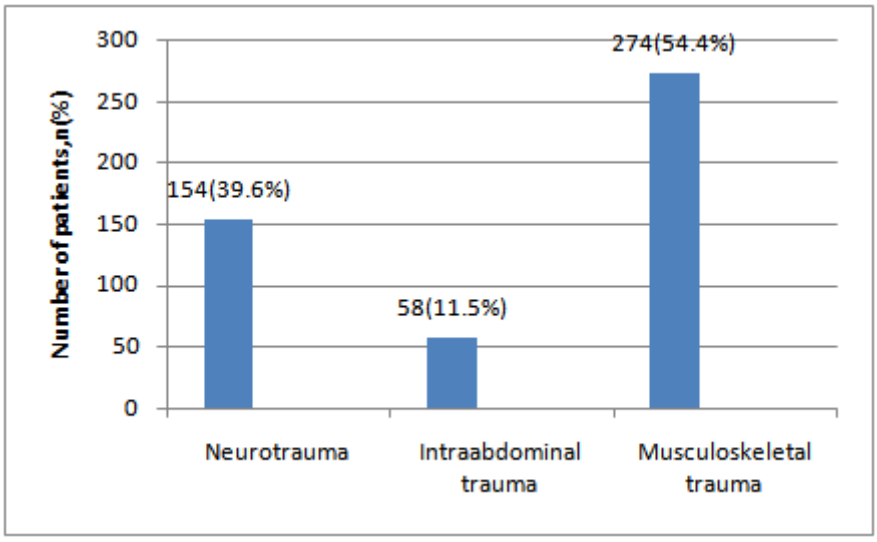

Figure 2:Associated Extrathoracic Injuries

3.4 Management: 315 patients (62.5%) were managed conservatively, 178 patients (35.3%) required chest tube insertion and only 11 patients (2.2%) underwent thoracotomy. Indications for thoracotomy in 8 patients(53.3%) was for penetrating chest trauma which is significantly higher than 3 patients (0.6%) with blunt chest trauma who required thoracotomy (p-value<0.001). **Table III**

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Table III :Management of chest trauma in relation to mechanism of injury

Variable	Management, n(%)			X2-stat	P value
	Conservative	Chest tube	Thoracotomy		
Mechanism					
Blunt	313(64.9%)	173(35.4%)	3(0.6%)	191.33	<0.001
Penetrating	2(13.3%)	5(33.3%)	8(53.3%)		

Chi square test

3.5 Outcome: Overall LOS (length of stay) ranged from 1 to 94 days with a mean stay of 10.2 days(SD=12.4). Univariate analysis shows significant higher LOS for the paediatric age group 15.4 days (SD=17.3) than patients belonging to other age groups (p-value<0.001). Patients who had no rib fracture had significant higher LOS 13.5 days(SD=15.7) than patients with fractured ribs(P=0.003). **Table IV**

Table IV: Predicting factors contributing to hospital LOS(days)

Variable	LOS, mean(SD)	f-stat	P-value
Age group		7.879	<0.001
Paediatric	15.4(17.329)		
Adolescent	14.06(16.021)		
Adult	9.34(11.284)		
Elderly	6.65(5.933)		
Rib Fracture		4.704	0.003
Nil	13.52(15.712)		
1-2 ribs	8.15(9.607)		
3-5 ribs	10.15(12.484)		
>5 ribs	9.81(10.325)		

One-way ANOVA

. In this study, longer LOS was significantly associated with the male sex(P=0.005),patients without underlying comorbidities (P=0.009),patients who had extrathoracic injury on admission (p-value<0.001),patients admitted to ICU (p-value<0.001),and patients who required artificial ventilation(p-value<0.001). Blunt chest trauma patients stayed longer than penetrating chest injury patients ,LOS 10.2 days (SD=12.5) vs LOS 9.7 days(SD=4.4) .However this was not significant (P=0.073) .**Table V**

Table V: Predicting factors contributing to hospital LOS (days)

Variable	LOS ,mean(SD)	t-stat	P-value
Gender		-1.233	0.005
Male	10.49(13.311)		
Female	8.73(6.737)		
Comorbid		-1.820	0.009
Yes	7.79(7.604)		
No	10.59(13.016)		
Mechanism		0.159	0.073
Blunt	10.18 (12.554)		
Penetrating	9.67(4.386)		
Extrathoracic Injury		6.284	<0.001
Yes	12.22(13.716)		
No	4.72(4.594)		
ICU admission		10.309	<0.001
Yes	18.72(17.173)		
No	7.04(8.106)		
Ventilation		10.285	<0.001
Yes	18.97(17.580)		
No	7.14(8.042)		

Independent samples t-test

Overall mortality in this study was 35 patients(6.9%).**Table VI.** Mortality rate was higher in males than in females 7.3% vs 5.4% (P=0.529). Elderly patients (12.7%) had the highest mortality (P=0.116). Patients with underlying comorbidity had higher mortality than patients without comorbids 7.9% vs.6.8% (P=0.724). Patients with blunt thoracic trauma had higher mortalty than patients with penetrating chest injury 7.2% vs. 0% (P=0.614). In this study however these factors were not found to be significant predictors of mortality. Patients with fractured ribs had significant higher mortality rate than patients with no rib fracture.Mortality increased with the number of broken ribs. In patients with >5 ribs fracture ,mortality was 18.8%(P=0.038). Significant higher mortality was also noted in patients who suffered extrathoracic injury 8.7% (P=0.010), those who were admitted to ICU 22.2%(p-value<0.001), and patients requiring artificial ventilation 26.4%(p-value<0.001).

Table VI: Predicting factors contributing to mortality

Variable	Mortality ,n(%)		X2-stat	P value
	Alive	Dead		
_Gender			0.397	0.520
Male	382(92.7%)	30(7.3%)		
Female	87(94.6%)	5(5.4%)		
Age group			5.908	0.116
Paediatric	32(94.1%)	2(5.9%)		
Adolescent	87(96.7%)	3(3.3%)		
Adult	281(93.4%)	20(6.6%)		
Elderly	69(87.3%)	10(12.7%)		
Comorbids			0.125	0.724
Yes	70(92.1%)	6(7.9%)		
No	399(93,2%)	29(6.8%)		
Mechanism			1.154	0.614
Blunt	454(92,8%)	35(7.2%)		
Penetrating	15(100.0%)	0(0.0%)		
Rib Fracture			8.451	0.038*
Nil	110(92.4%)	9(7.6%)		
1-2 ribs	182(95.3%)	9(4.7%)		
3-5 ribs	151(93,2%)	11(6.8%)		
>5 ribs	26(81.2%)	6(18.8%)		
Extrathoracic Injury			6.692	0.010*
Yes	334(91.3%)	32(8.7%)		
No	135(97.8%)	3(2.2%)		
ICU admission			66.601	<0.001*
Yes	105(77.8%)	30(22.2%)		
No	364(98.6%)	5(1.4%)		
Ventilation			101.101	<0.001*
Yes	95(73.6%)	34(26.4%)		
No	374(99.7%)	1(0.3%)		

Chi square and Fisher exact test (mechanism)

IV. Discussion

This is a retrospective study of 504 patients with chest trauma admitted from January 2003 to December 2012 in the HUSM, in the state of Kelantan,Malaysia . The mean age was 39.6 years with a male to female ratio of 4.5:1. This is in agreement with other studies[8-11]. It is probable that males and younger ages are more active and mobile,with increased risk of trauma. .

97% of patients had blunt injury as the common mechanism mainly due to RTA. Only 3% in this study had penetration as the mechanism , resulting from assaults and civil strife. This conforms to the findings in other studies[8,9,12,13]. However Albadani from Yemen reports penetrating injury as the commonest mechanism of chest injury. He attributes this to the ownership and use of guns in his country [14] . Table I. In our study, though blunt injury was common it did not significantly influence the morbidity or mortality .

76 patients(15.1%) had comorbids on admission, in the form of DM, heart or lung disease .However this did not significantly influence the mortality.This is contrary to the findings of others who found comorbidity had significantly affected the outcome in their patients[15,16]. Probably the patients in our study received earlier attention due to the awareness, or most patients died earlier due to their injuries rather than their comorbids.

The commonest injury seen in this study was fracture rib (76.2%) Fig.1.The complications from fracture ribs ranged from pneumothorax, haemothorax, and lung contusion.There was significant correlation between number of fracture ribs and the underlying complication.Table II. The greatest effect was noted when >5 ribs were fractured leading to a mortality of 18.8%.This is in agreement with the findings in other studies[13,17-19]. In the presence of underlying comorbidity , and advancing age of these patients , even the most minor impact could result in the death of the patient[15,19]. Children can suffer severe chest injury in the absence of fracture rib ,due to the pliant nature of their ribs[17,20].

Most chest injuries can be conservatively managed with observation, adequate analgesia, monitoring, and bed rest, as was done in 375 of our patients. Tube thoracostomy is indicated for drainage of pneumothorax, haemothorax or after thoracotomy.It is considered generally safe, if done properly, and in sterile manner [17]. In

this study 176 patients(35.3%) required tube thoracostomy.There was no major complication. 46.6% of patients in Demirhans study required tube thoracostomy[12]. There is general agreement that thoracotomy is not mandatory in chest injury in the absence of definite indication[8,11,12,21]. 11 patients (2.2%) in this study required thoracotomy. Table III. 8 of these patients(53.3%) had penetrating trauma resulting in massive haemothorax, persistent air leak, or haemodyanamic instability, and 3 patients(0.6%) had blunt trauma as the mechanism of injury,. The management of flail chest remains controversial [17]. Fixation of fractured ribs is advised in the course of thoracotomy for intrathoracic injury as was done in one of our 11 patients(2.2%) with flail chest. Huber in a German study found the incidence of pulmonary laceration to be as high as 12%, and quotes a high mortality figure of 44% from another Japanese study[22]. In our study 4 patients (0.8%) had laceration of lung which was successfully repaired. Penetrating cardiac injury carries a high mortality , mainly due to delayed transport of the patient to the hospital. In a retrospective study Rhee reports an overall survival of 19.3% among patients who were successfully transported [23] . 2 patients (0.4%) in this study had laceration of the right atrium ,successfully repaired. Traumatic diaphragmatic injuries are easily missed. A high index of suspicion especially when associated IA injury is present and relevant investigation like CXR or CT will help to confirm the diagnosis [24]. 2 patients (0.4%) had diaphragmatic rupture both repaired at laparotomy done for IA injury . Tracheobronchial injuries though rare have high risk of death from hypoxia[25].1 child in our study presented with complete rupture of the left main bronchus , which was successfully repaired.

366 patients (72.2%) in this study had extrathoracic associated injuries mainly musculoskeletal.(Fig.3) This is similar to the findings of others[8-10]. However some studies report neurotrauma rather than musculoskeletal to be the more common association. This is probably due to prevailing local factors or geographical factors[26,27]. For example in countries where wearing helmets is not compulsory ,higher incidence of neurotrauma is to be expected. Extrathoracic associated injury should be suspected in the initial survey itself to initiate management and confirmed in the secondary survey . Studies have shown that the presence of extrathoracic associated injury had significant impact on the outcome in chest trauma[8-10,28]. In our study the length of hospital stay (LOS) was 12.2 days(SD=12.4) (p-value<0.001) and mortality was 8.7%(p-value=0.010), when extrathoracic injury was present on admission. Procedures like craniotomy or craniectomy,fixation for fracture limb ,pelvis ,spine etc, and laparotomy for intraabdominal injury, will add to the overall outcome in such patients.

LOS is a surrogate marker for morbidity [29]. In agreement with other studies significantly longer LOS was noted in male patients (p-value<0.005), associated extrathoracic injury(p-value<0.001) , admission to ICU (p-value<0.001), and requirement for artificial ventilation(p-value<0.001)[8,28]. We did not find older ages ,and fracture ribs as factors influencing LOS . Soderlund also did not find any factors correlating with LOS[30] .He attributed this to the practice of early discharge and early referral to other hospitals due to lack of available beds in his center. . On the other hand in our study children with chest injury had longer mean LOS (15.4 days)(p-value<0.001). It is well known that children can present with severe injury even in the absence of fracture ribs ,requiring greater attention in the management which prolongs their stay[17]Table IV,Table V.

Overall mortality for chest trauma is quoted between 2.2% and 33% in various studies[8,10,21,26,27]. In our study the overall mortality of 6.9%(n=35) lies well within the reported range. Contrary to the findings of others we did not find male gender,older ages,comorbidity and mechanism of injury to be significant risk factors for mortality in our study[26,31]. In agreement with the study of Al-Koudmani ,we found number of fractured ribs especially when >5 , presence of associated injury, admission to ICU and need for artificial ventilation to be good predictors for mortality(p-value<0.001) [20] TableVI.

V. Conclusion

Our study was retrospective in design with limitations of missing data or case files. Also we did not use scoring systems as this is not the practice in our Institution. Various scoring systems like Abbreivated Injury Score (AIS), Injury Severity Score(ISS), Trauma Revised Injury Severity Score(TRISS),Modified Early Warning Score(MEWS)have been used in other centers to define extent and severity of injury, predict the development of complications , and standardise the management[9,11,21]. Multicentric prospective trials which include scoring systems are needed to give a more thorough perspective of chest injury.

In conclusion ,RTA was found to be the commonest cause of chest trauma in the Kelantan region. Most patients with chest injury can be treated conservatively. The number of rib fractures indicates the severity of chest injury. Presence of associated injury, ICU admission and need for artificial ventilation are good indicators of LOS and mortality. It is hoped stricter enforcement of traffic rules and safety measures will help to reduce the incidence of RTA.

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