# RETROSPECTIVE REVIEW OF CHEST TRAUMA IN HOSPITAL UNIVERSITI SAINS MALAYSIA OVER 10-YEAR PERIOD

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## I. ACKNOWLEDGEMENTS

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## IV. LIST OF ABBREVIATION

| | |
|---|---|
| ARDS | Acute Respiratory Distress Syndrome |
| CI | Confident Interval |
| COAD | Chronic Obstructive Airway Disease |
| CT Scan | Computed Tomography Scan |
| CXR | Chest X-ray |
| ECG | Electrocardiogram |
| HUSM | Hospital Universiti Sains Malaysia |
| ICD | International Classification of Diseases |
| ICU | Intensive Care Unit |
| LOS | Length of Stay |
| PEEP | Positive End Expiratory Pressure |
| RTA | Road Traffic Accident |
| SD | Standard Deviation |
| USM | Universiti Sains Malaysia |

## V. ABSTRAK

LATARBELAKANG: Trauma pada dada merupakan trauma yang penting di seluruh dunia dengan 10% kemasukan ke hospital dan 25% kematian. Jenis dan tahap keterukan trauma pada dada yang berbeza dalam subset pesakit dengan pelbagai jenis kecederaan berkaitan menyebabkan hasil yang berbeza.

OBJEKTIF: Untuk mengkaji corak, etiologi, pengurusan dan hasil trauma pada dada di Hospital Universiti Sains Malaysia (HUSM) selama tempoh 10 tahun daripada Januari 2003 hingga Disember 2012.

KAEDAH: Ini merupakan kajian retrospektif selama 10 tahun yang dijalankan di HUSM daripada Januari 2003 hingga Disember 2012. Ia melibatkan 504 pesakit yang dimasukkan ke wad pembedahan di HUSM semasa tempoh kajian. Kriteria kemasukan ke hospital termasuk kecederaan intra-torasik dan kecederaan sangkar rusuk yang secara klinikalnya, signifikan. Kriteria singkir untuk kajian ini termasuk pesakit yang tiba dan meninggal dunia di bilik kecemeasan, pesakit yang tidak menghabiskan rawatan di hospital kami, kecederaan larinks dan tulang belakang yang terpencil. Kecederaan esofagus dan trakea akibat menelan atau menyedut bahan asing dan kecederaan bukan traumatic pada dada (terbakar, kejutan elektrik, etc). Data diambil daripada rekod perubatan dan dianalisa mengikut umur, jantina, komorbiditi, mekanisma dan etiologi trauma, kecederaan torasik dan ekstra-torasik, kemasukan ke unit rawatan rapi (ICU), ventilasi mekanikal, pengurusan, lama masa tinggal di hospital (LOS) dan kematian.

KEPUTUSAN: Sejumlah 504 pesakit sesuai dengan kriteria serta di mana 412 pesakit adalah lelaki (82.0%). Kebanyakan etiologi yang kerap adalah kemalangan jalan raya

(RTA) (425 kes; 84.3%). Jenis trauma dada yang paling kerap adalah patah rusuk (384 kes; 76.2%). Risiko untuk kecederaan intratorasik meningkat secara signifikan apabila jumlah kepatahan meningkat. Terdapat 11 (2.2%) torakotomi yang dilakukan dalam tempoh masa kajian di mana 8 daripadanya disebabkan oleh cedera tembus. Tempoh masa tinggal di hospital (LOS) secara keseluruhan adalah di antara 1-94 hari dengan purata 10.2 hari (SD=12.4). Sebanyak 35 kematian dicatatkan (6.9%). Kecederaan ekstratorasik, kemasukan ke Unit Rawatan Rapi dan keperluan ventilasi memberi kesan secara signifikan terhadap jangka masa tinggal di hospital dan kematian.

KESIMPULAN: Kemalangan jalan raya merupakan penyebab utama trauma dada di Kelantan. Jumlah patah rusuk melebihi daripada 5 merupakan petanda terbaik tahap keterukan kecederaan. Kecederaan ekstratorasik, kemasukan ke Unit Rawatan Rapi dan keperluan ventilasi merupakan peramal terbaik untuk melihat hasil trauma pada dada.

## VI. ABSTRACT

BACKGROUND: Chest trauma is an important trauma globally accounting for about 10% of trauma admission and 25% of trauma death. Different types and severity of chest trauma in different subsets of patients with varying associated injuries result in different outcomes.

OBJECTIVE: To study the pattern, aetiology, management, and outcome of chest trauma in Hospital Universiti Sains Malaysia (HUSM) over 10-year period from January 2003 till December 2012.

METHODS: This is a 10-year retrospective study, which was conducted in HUSM from January 2003 till December 2012. It involved 504 patients who were admitted to surgical ward HUSM during the study period. The hospitalization criteria include intra-thoracic injury and clinically significant rib cage injury. Exclusion criteria for this study include patients who arrived dead in the emergency room, patients who did not complete their treatment in our hospital, isolated laryngeal or spinal injuries, oesophageal and tracheal injuries due to foreign body swallowing or aspirating and non-traumatic injuries to the chest (burns, electrical shocks, etc). The data was retrieved from medical record and analyzed concerning age, gender, comorbid, mechanism and aetiology of the trauma, thoracic and extra-thoracic injuries, intensive care unit (ICU) admission, mechanical ventilation, management, hospital length of stay (LOS) and mortality.

RESULTS: A total of 504 patients met the inclusion criteria, where 412 were males (82.0%). The most frequent aetiology was road traffic accident (RTA) (425 cases; 84.3%). The most frequent type of chest trauma was rib fracture (384 cases; 76.2%).

The risk for associated intrathoracic injuries increased significantly as the number of rib fracture increase. There were 11 (2.2%) thoracotomies performed during the study period where 8 of them were caused by penetrating injury. Overall hospital length of stay (LOS) ranged from 1-94 days with mean of 10.2 days (SD=12.4). Mortality was observed in 35 patients (6.9%). Associated extrathoracic injuries, ICU admission and ventilation requirement were significantly affect hospital LOS and mortality.

CONCLUSIONS: RTA is the main cause of chest trauma in Kelantan. The number of rib fractures more than 5 is a good indicator of the severity of the injury. Presence of extrathoracic injuries, ICU admission and ventilation requirement have been found to be a good predictors for outcome of chest trauma.

# 1 INTRODUCTION

It is estimated that by the year 2020, about 8.4 million people will die every year from injury. The injuries from RTA will be the third most common cause of disability worldwide and the second most common cause in the developing country (Murray and Lopez, 1997). In 2001, over 18,000 patients attended the Johannesburg Hospital Trauma Unit with 1715 resuscitations for trauma, where majority of them associated with RTA. There are typical injury patterns in which multisystem injury almost always a must rather than the exception. In 1990, about 5 million people died all over the world as a result of injury (Murray and Lopez, 1997). Optimal care of severely injured patients needs a multidisciplinary approach starting from the point of injury to a rehabilitation structure in order to return the patient to their maximum potential level of function within a society.

In Malaysia, trauma is the third cause of admission to hospital and fifth cause of death (Sabariah, 2009). Globally, 10% of all trauma admissions result from chest injuries and 25% of trauma-related deaths are attributable to chest injuries (Lema *et al.*, 2011). In a local study done by Pang et al at Klang Valley hospitals, chest injuries accounted for 36.6% of fatalities among the fatally injured motorcyclist (Pang, 1999). The aetiology and pattern of chest trauma that vary from one part to the other part of the world have been reported in literature mainly because of variations in infrastructure, civil violence, wars and crime. RTA is the most common cause of chest trauma in most literatures.

Based on the research, patients frequently presented with injuries by both blunt and penetrating injuries. This include a spectrum ranging from simple chest wall

contusion to severe vital organ injuries (Flint, 2008). Most patients admitted with chest trauma were managed conservatively. Only a few will need a thoracotomy, which is usually performed in a higher proportion of patients who sustained penetrating chest trauma (Karmy-Jones, 2001). The accurate identification of a patient at high risk for major chest injuries is necessary to avoid delays that may contribute to significant morbidity and mortality (Lema *et al.,* 2011). Both aggressive management of the chest trauma and prompt treatment of associated injuries are essential for optimal patient outcome. Majority of chest trauma is preventable. A clearer understanding of the aetiology, injury patterns and outcome of these patients is important for establishment of prevention strategies and treatment protocols. Such data is lacking in our centre, as there is no local study that has been done before.

# 2 LITERATURE REVIEW

## 2.1 MECHANISM OF CHEST TRAUMA

There are 2 main mechanism of chest trauma, which are blunt and penetrating.

### 2.1.1 BLUNT CHEST TRAUMA

Blunt chest traumas are seen quite frequently in civil populations. The major reasons for blunt chest trauma are RTA with an incidence of 60-70% (Liman, 2003). The chest wall and the soft tissues are the most commonly affected by blunt traumas. Although most of the bony thorax fractures are benign entities and can be managed as out-patient, trauma limited to the thoracic cage itself may cause profound pathophysiological alterations, which may be fatal if not properly treated (Grimes, 1972).

Blunt forces applied to the chest wall can cause injury by three mechanisms, which are rapid deceleration, direct impact and compression (Cogbill, 2000). These injuries can cause not only localized fractures to the ribs, sternum and scapula, but also injury to the underlying lung parenchyma, cardiac, aorta and great vessels, diaphragm, trachea-bronchial and other extrathoracic injuries such as intra-abdominal injury, orthopaedic and neurotrauma. Pulmonary dysfunction observed after severe blunt thoracic injury is probably secondary to underlying pulmonary contusion. Aspects of the patient’s past medical history that are particularly significant include tobacco use, previous surgical operations and underlying comorbid with metabolic (diabetes mellitus) and pulmonary conditions (chronic obstructive airway disease). This information may clearly affect definitive treatment decisions (Balkan, 2002).

### 2.1.2 PENETRATING CHEST TRAUMA

Penetrating chest trauma is increasingly common as urban unrest and regional conflicts escalate. The aetiology are multiple which include gunshots, high velocity missiles and knives. Penetrating chest trauma must always be considered as potentially lethal injury because the extent of intra-thoracic injuries can be difficult to predict. However, it did not significantly affect the outcome of chest injury in term of mortality as reported in the literatures (Mefire, 2010; Lema *et al.*, 2011).

Stab wounds to the chest can present anywhere in the spectrum between solitary peripheral injury to the chest wall, or lung injury requiring only tube thoracostomy, to a severe haemorrhagic shock and death from massive haemothorax, cardiac wounds or cardiac tamponade. Stab wounds and other low velocity penetrating chest traumas may injure only the internal mammary artery or intercostal artery and classically present with a slightly delayed onset of haemorrhagic shock (Hwang, 2013).

Gunshot wounds and shrapnel injuries have a combination of both blunt and penetrating trauma components, with a wide area of adjacent tissue at risk. The magnitude of destruction resulting from the secondary shock wave occurring with high velocity gunshot and shrapnel injuries may not be initially apparent. In this type of injuries, sequential monitoring for progression of injury is required with complete evaluation of all organs and tissues adjacent to the site of injury (Hwang, 2013).

## 2.2 CHEST SPECIFIC INJURIES

### 2.2.1 RIB FRACTURES

Rib fractures are reported as the commonest pathologies associated with chest injury (35–40%) (Calhoon, 1992). In case series conducted by Liman et al, the incidence of rib fractures was 35.3% in which 68% of these patients were hospitalized. Although some authors have suggested that patients with rib fractures require hospitalization not only for their associated injuries but also for pain control and pulmonary complications (Ziegler, 1994), there is not an immediate indication for hospitalization for the patients with rib fractures.

The presence of more than two rib fractures is an indicator of severe injury. Liman et al reported that the number of ribs fracture could be significantly related with the presence of haemothorax or pneumothorax (Liman, 2003). This is supported by another study done by Al-Koudmani et al (Al-Koudmani *et al.*, 2012). Mortality rate was 0.2% in patients with no rib fractures versus 4.7% in patients with more than two rib fractures (Liman, 2003). Lee reported that mortality doubles (1.8 versus 3.9%) for patients with three or more rib fractures compared to those with no rib fractures (Lee, 1990). The presence of first or second rib fracture has also been reported to be indicative of severe trauma. Poole reviewed all series of fractures of first and second ribs and found a 3% risk for aortic injury and a 4.5% risk for brachiocephalic vessel injury (Poole, 1989). However, no association was reported between victims of trauma with or without rib fractures and aortic injury (Poole, 1989; Lee, 1990). Al-Koudmani et al, as in their study also reported that the number of ribs fracture were significantly related with mortality, hospital LOS, thoracic, and extra-thoracic injuries

(Al-Koudmani *et al.*, 2012). Flagel et al reported the increase of mortality, pneumonia, acute respiratory distress syndrome (ARDS), pneumothorax, empyema, ICU length of stay and hospital LOS for each additional rib fracture on over 730,000 patients (Flagel, 2005).

In adults, the incidence of rib fractures was related to the high energy transfer sustained in high-speed motor vehicle accidents (Sırmali, 2003). The incidence of rib fractures in the elderly group was attributed to their higher incidence of osteopenic changes, leading to a more serious outcome of blunt chest injury, and consequently high mortality (Lee, 1990). The higher prevalence of osteoporosis in the elderly predisposes them to rib fractures as a result of more trivial chest trauma than any other age group. Children's rib fractures are less frequent than adults because they have more elasticity of their bones than adults, however when rib fracture occurs it indicates severe trauma in children and usually associates with high rates of thoracic and extra thoracic injuries (Al-Koudmani *et al.*, 2012). The serious consequences of blunt chest trauma in the paediatric group were related to the mechanical strength of the ribs and thoracic cavity in children, which are easily fractured by high-speed trauma (Ceran, 2002). Ribs in children are pliable and flexible, which predisposes them to intrathoracic injuries once they sustain chest trauma (Ceran, 2002).

### 2.2.2 LUNG CONTUSSION

Lung contusion or "bruise" to the lung parenchyma is typically characterized by interstitial and alveolar oedema, haemorrhage and resultant alveolar collapse. It is common potentially lethal chest trauma, which is the result of direct trauma to the

lung parenchyma. It is usually associated with bony trauma to the chest involving rib, scapula, thoracic spine, or clavicle fracture. Typically, there is a central zone of haemorrhage with a variable sized peripheral ring of oedema. These lesions often have adequate perfusion but decreased ventilation. The consequent ventilation-perfusion mismatch can results in severe hypoxaemia (Mary, 2012).

Following blunt chest trauma, the area of lung contusion usually occurs adjacent to the site of chest impact. Overall, chest wall compliance is a major determinant of the energy transmission from the chest wall to the underlying lung parenchyma. Children have very compliant chest walls and typically sustain significant lung contusions with no rib fracture. With increasing age, the thoracic wall becomes less compliant and rib fracture become more frequently associated with lung contusion (Sattler, 2002).

Lung contusion is identified on chest radiograph as a focal area of patchy parenchymal consolidation. The findings are typically peripheral and non-segmental and it tends to occur adjacent to fractured ribs. Patients with pulmonary contusion should be admitted for close serial observation and should be intubated if they show clinical signs of respiratory fatigue, tachypnea or hypoxia (Sattler, 2002). This is further supported by Trinkle et al, which showed early intubation and application of positive end expiratory pressure (PEEP) can decreased the size of pulmonary contusion (Trinkle, 1973).

### 2.2.3 PNEUMOTHORAX

A traumatic pneumothorax can result from either penetrating or blunt chest trauma. With penetrating chest trauma, the wound allows air to enter the pleural space directly through the chest wall or through the visceral pleura from the tracheobronchial tree. With blunt trauma, a pneumothorax may develop if the visceral pleura is lacerated secondary to a rib fracture or dislocation. Sudden chest compression abruptly increases the alveolar pressure, which can cause alveolar rupture. Once the alveolus is ruptured, air enters the interstitial space and dissects toward either the visceral pleura or the mediastinum (Light, 1995). Diagnosis of pneumothorax is done by thorough clinical examination and investigations. However, clinical interpretation of the presenting signs and symptoms is crucial for correctly diagnosing and treating the condition. Typically, this injury is diagnosed and treated during the primary survey. Once diagnosis is made, chest drain insertion is usually indicated to drain air in the pleural cavity. However, some traumatic pneumothorax can resolve spontaneously without any surgical intervention for drainage. Toydemir et al had reported that mild pneumothorax less than 20% of total hemithorax volume, fractured rib number less than three and the absence of associated major injuries as a criteria for conservative management of traumatic pneumothorax (Toydemir, 2010).

Tension pneumothorax develops when a disruption involves the visceral pleura, parietal pleura, or the tracheobronchial tree. The disruption occurs when a one-way valve forms, allowing air inflow into the pleural space, and prohibiting air outflow. The volume of this nonabsorbable intrapleural air increases with each inspiration. As a result, pressure rises within the affected hemithorax cause ipsilateral lung collapses and hypoxia. Further pressure causes the mediastinum shift toward the contralateral

side and compresses both, the contralateral lung and the vessels entering the right atrium of the heart. This leads to worsening hypoxia and compromised venous return (Light, 1995). If a tension pneumothorax is suspected clinically, treatment is necessary before radiographs can be taken. A wide bore needle introduced into the affected hemithorax will release any air under tension and is life saving. A wide bore intercostal tube is introduced laterally and directed to the apex of the pleural cavity. A second drain may be introduced basally to drain blood (Bailey, 2000).

### 2.2.4 HAEMOTHORAX

Haemothorax is the accumulation of blood in the pleural cavity as a result of traumatic and non-traumatic (spontaneous) causes. Clinical severity of haemothorax depends on the amount, rate and aetiology of bleeding into the pleural cavity, the presence of associated pathologies such as pneumothorax and whether it becomes chronic or not (Akay, 2002). Haemothorax is classified based on amount of bleeding into the thoracic cavity. Minimal haemothorax is defined when bleeding is 300 ml or less, while medium grade haemothorax is defined when bleeding is in between 300 to 1000 ml. Massive haemothorax occurred when bleeding is more than 1000 ml. Majority of haemothorax cases after penetrating and blunt trauma are accompanied by other organ injuries and mortality increases in such cases, significantly (Akay, 2002). Causes of haemothorax in both blunt and penetrating thoracic injuries may due to injury to the lung parenchyma, vascular structures in thorax, heart or abdominal organs with a ruptured diaphragm. It results most commonly from intercostal arteries, veins and lung parenchyma (Oguzkaya, 2003).

Drainage of haemothorax is essential because re-expansion of the lacerated lung compresses the torn vessels and reduces further blood loss. Drainage will also allow the mediastinal structures to return to the midline and relieve compression of the contralateral lung. A dense fibrothorax with the possibility of an added empyema will develop, if haemothorax is left untreated. The procedure is similar to drainage for pneumothorax but a wide bore tube (>28 Fr) is required and a basal drain is sometimes necessary (Bailey, 2000).

Thoracotomy is indicated when massive haemothorax or persistent bleeding is present. Traditional criteria indicating the necessity to proceed with urgent thoracotomy are 1500 mL of blood evacuated on initial placement of tube thoracostomy, persistent drainage of blood 150 mL/h to 200 mL/h for 3 consecutive hours and requirement of persistent blood transfusion to maintain haemodynamic stability (Mowery *et al.*, 2011).

### 2.2.5 FLAIL CHEST

Flail chest occurs when several adjacent ribs are fractured in two places either on one side of the chest or either side of the sternum. The flail segment moves paradoxically, which is inwards during inspiration and outwards during expiration. This will result in reducing effective gas exchange and subsequently cause poor oxygenation to the underlying lung parenchyma and paradoxical movement of the flail segment. The underlying lung injury with loss of alveolar function may result in deoxygenated blood passing into the systemic circulation. This will creates a right-to-left shunt and prevents full saturation of arterial blood (Bailey, 2000).

In the absence of any other injuries and if the segment is small and not compromising respiration, the patient may be monitored in a high-dependency unit with regular blood gas analysis and adequate analgesia until the flail segment stabilizes. In the more severe case, endotracheal intubation may be required with positive pressure ventilation for up to 3 weeks, until the fractures become less mobile (Bailey, 2000). Although recently surgical interventions have been reported to reduce the mortality and morbidity rate by some authors (Ahmed and Mohyuddin, 1995; Tanaka, 2002), operative fixation still not yet been widely accepted (Battistella, 1994). Liman et al as in their study prefer performing surgical interventions only when thoracotomy is required for another indication and fixation by mechanical ventilation only in case of respiratory insufficiency (Liman, 2003).

It is evident while studying different literatures (Richardson, 1982; Clark, 1988; Freedland, 1990; Lardinois, 2001) that the treatment of flail chest still remains controversial. Before 1956 it consisted primarily of external chest wall stabilization (Freedland, 1990). From 1956 to 1975 early intubation and ventilatory support or tracheostomy were emphasized, while after 1975 there has been an increasing effort to treat selected patients without ventilatory assistance (Richardson, 1982; Freedland, 1990). Since Trinkle's classic study (Trinkle, 1975) describing the pathophysiology of flail chest not on the basis of paradoxical respiration but of the underlying pulmonary contusion, the strategy consisted of avoidance of fluid overload, vigorous pulmonary toilet and systematic analgesia.

### 2.2.6 DIAPHRAGMATIC INJURY

The mechanism for diaphragmatic rupture is high-speed blunt abdominal trauma with a closed glottis. The sudden rise in intra-abdominal pressure breaches the weekest part of the abdominal wall, namely the diaphragm. This occurs much more commonly on the left hemidiaphragm because the right is protected by the liver (Bailey, 2000). Diaphragmatic rupture can be diagnosed by chest x-ray (CXR), ultrasound or computed tomography scan (CT scan). However, the diagnosis is not easy because its specificity and sensitivity are low. Shah et al reported that 43.5% cases of diaphragmatic rupture were diagnosed before surgery 41.4% during surgery or autopsy, and 14.6% after surgery (Shah, 1995).

Surgery is necessary for treatment, and an immediate operation is required if it is diagnosed in the early stage. The surgery can be performed through the chest, abdomen, or thoracoabdomen, and the priority of the surgery is decided based on the urgency of pathologic processes. The left side of the diaphragm is restored easily in laparotomy with severe abdominal injuries. However, additional thoracotomy may be needed because injuries on the right side could be hidden by the liver (Ilgenfritz, 1992). Thoracotomy is recommended over laparotomy to restore the diaphragm if it is diagnosed late or it is found in a chronic condition (Hwang *et al.*, 2011). Surgeries through the thoracoabdomen were mostly performed to treat organ injuries in the chest and abdomen.

### 2.2.7 TRACHEO-BRONCHIAL INJURY

Injuries to major airways are not frequently seen as the patient rarely survives the insult leading to major airway disruption. Tracheo-bronchial injuries reported in 1-3% of trauma victims in the literature whereby most of these cases die before arriving at a hospital (Kiser, 2001). There is usually a combination of surgical emphysema, haemoptysis and pneumothorax. Chest drainage in spite of the addition of suction, fail to re-inflate the lung and a persistent air leak may be present. Injury to the trachea need considerable force and usually less than a quarter of patients survive to reach hospital. The injury can be caused by direct trauma or as a result from high intratracheal pressure against a closed glottis. The exact pattern of signs will depend on the site of the injury and whether or not the pleura has been breached (Bailey, 2000). Blunt and penetrating injuries account for the majority of cases, however iatrogenic injuries such as mediastinoscopy, transtracheal oxygen therapy, and mechanical ventilation have been reported (Lee, 1997). Other uncommon causes are razor slash, strangulation, electrical injuries, burns, and caustic injuries. Penetrating injuries occur most commonly in the cervical trachea (75%) followed by the thoracic trachea (25%) (Lee, 1997). Stab wounds or gunshot wounds may injure major bronchi and are almost always associated with other injuries, especially injuries to the great vessels (Kelly, 1985).

### 2.2.8 CARDIAC INJURY

Major injuries to the heart from blunt trauma are usually fatal and the patient rarely survives long enough to reach hospital. Most victims of heart injuries die at the scene

of accident, even patients who arrive at hospital alive have mortality rate up to 50% (Mustafa, 2009). The injuries, which are encountered in the accident and emergency department, are myocardial contusion, chamber rupture and valve blow out. Myocardial contusion must be suspected when the sternum is fractured. Myocardial damage from trauma will give an electrocardiogram (ECG) pattern similar to myocardial infarction with possible elevated cardiac enzymes. In severe trauma there may be arrhythmias and signs of heart failure (Bailey, 2000). Chamber rupture is thought to occur if the ventricle is compressed just before systole at the point of maximal diastolic filling. Chamber rupture is likely to be fatal, so those that do survive are likely to have an atrial rupture (Bailey, 2000). Rupture of the mitral or tricuspid valve may not be immediately apparent, but a loud pansystolic murmur should arouse suspicion. Mortality rate mainly depends on the nature of the injury and the hemodynamic status upon arrival (Rodrigues *et al.*, 2005; Mustafa, 2009).

## 2.3 EXTRATHORACIC INJURY

The presence of associated extrathoracic injuries is an important determinant of the outcome of chest trauma patients. Associated extrathoracic injuries increase the risk of complications in patients with chest injuries. The main common associated extrathoracic injuries as described in most literatures are musculoskeletal trauma, neurotrauma and intraabdominal injury (Somcharit, 2010; Hanafi *et al.*, 2011; Lema *et al.*, 2011; Al-Koudmani *et al.*, 2012). The mortality rate for isolated chest injuries has been reported to range from 4 to 8%. This value increases to 13-15% when another organ system is involved and to 30-35% when more than one organ system is involved (Mayberry, 1997). Early detection and treatment of associated extrathoracic

injuries is important in order to reduce mortality and morbidity associated with chest injuries (William, 1996).

## 2.4 MANAGEMENT OF THORACIC INJURY

Generally can be divided into three main option of treatment:

- Conservative management
- Tube thoracostomy
- Thoracotomy

### 2.4.1 CONSERVATIVE MANAGEMENT

Adequate pain relief for proper ventilation and effective cough with regular respiratory physiotherapy are the important measures for conservative management of chest trauma. The intravenous use of non-steroid and non-opiate anti-inflammatory drugs is quite widely used, although their side effects are their main drawback. Loco-regional techniques include intercostal nerve block, epidural analgesics (fentanyl, morphine and buprenorphine), local anesthetics (bupivacaine, ropivacaine) or a combination of both, thoracic paravertebral block and much less frequently, intrathecal opioids. However, the use of epidural analgesia is limited due to the high number of patients with associated injuries in other organs, particularly head and spinal column injuries (Carrier *et al.*, 2009).

Chest tube insertion is not a routine treatment for traumatic pneumothorax due to

chest trauma if the amount of pneumothorax is less than 20% of thoracic volume. Occult pneumothorax and small pneumothorax seen on CXR can be treated conservatively. As reported in the literature, criteria for conservative management in chest trauma include pneumothorax less than 20% of total hemithorax volume, fractured rib number less than three, and absence of associated major injuries (Toydemir, 2010).

### 2.4.2 TUBE THORACOSTOMY

The rationale for using tube thoracostomy in the treatment of many chest injuries, including simple pneumothorax and haemothorax, is well established. Al-Koudmani et al had reported that tube thoracostomy was the main treatment modality for the majority (56%) of their patients (Al-Koudmani *et al.*, 2012). It is effective in draining the pleural space and provides the definitive treatment in the great majority of thoracic trauma patients. It is also effective for obtaining rapid re-expansion of the injured lung, complete evacuation of the pleural space and monitoring for any continued heavy blood loss following insertion. Chest tube insertion can be performed under local anesthesia within a short time, and does not need too much experience. Although insertion of a chest tube is a simple procedure it may have morbidity and even mortality from complications due to lung perforation, nerve or blood vessel damage, and post-insertion complications due to chest tube kinking or clotting, pneumonia, empyema, or abscess formation. In a study including 123 chest tube inserted patients, it was suggested that tube thorocostomy is associated with significant morbidity and extended hospitalizations, and may be partly related to

inappropriate training of all individuals dealing with trauma care (Deneuville, 2002).

### 2.4.3 THORACOTOMY

The indications for thoracotomy in blunt chest trauma are based on specific preoperative diagnoses. These include pericardial tamponade, tear of the descending thoracic aorta, rupture of the mainstem bronchus, and rupture of the esophagus. In penetrating chest trauma, indications for thoracotomy are clotted haemothorax, large air leak with inadequate ventilation or persistent lung collapse, drainage of more than 1500 mL of blood on initial insertion of chest tube, continuous haemorrhage of more than 200 mL/h for ≥ 3 consecutive hours, oesophageal perforation and pericardial tamponade (Schwartz's, 2006).

Thoracotomy is more commonly performed in penetrating trauma rather than blunt trauma. Mefire et al reported in their study where the rate of thoracotomy is higher in penetrating chest injuries (Mefire, 2010). Al-Koudmani in their study, reported only 5.7% of their patient underwent thoracotomy, whereby intrathoracic haemorrhage was the main indication of early thoracotomy. Late thoracotomies were performed to evacuate clotted haemothorax, or to repair diaphragmatic injuries in most cases (Al-Koudmani *et al.*, 2012).

# 3 OBJECTIVE

## 3.1 GENERAL OBJECTIVE

To study the pattern, aetiology, management, and outcome of chest trauma in HUSM over 10-year period from January 2003 till December 2012

## 3.2 SPECIFIC OBJECTIVES

3.2.1 To determine socio-demographic, aetiology and management of chest trauma in HUSM

3.2.2 To determine associated factors that contribute to the outcome of chest trauma

# 4 METHODOLOGY

## 4.1 DESIGN

This is a retrospective record review involving all chest trauma patients admitted to HUSM from January 2003 till December 2012.

## 4.2 SETTING

The study was conducted in the department of surgery of HUSM, which is a public university teaching hospital located in Kubang Kerian, Kota Bharu, Kelantan.

## 4.3 REFERENCE POPULATION

All chest trauma patients

## 4.4 SOURCE POPULATION

All chest trauma patients admitted to HUSM from January 2003 till December 2012 who fulfills all the inclusion criteria and exclusion criteria. All the list of patient is obtained from record unit using International Classification of Diseases (ICD) 10 coding. ICD is the standard diagnostic tool for epidemiology, health management and clinical purposes. It is used to classify diseases and other health problems recorded on many types of health and vital records including death certificates and health records. All form of chest trauma cases is coded under S20-S29.

## 4.5 INCLUSION CRITERIA

- All patients who were hospitalized due to chest injuries between January 2003 and December 2012
- The hospitalization criteria were:
    - intra-thoracic injury
    - clinically significant rib cage injury (even one rib fracture)

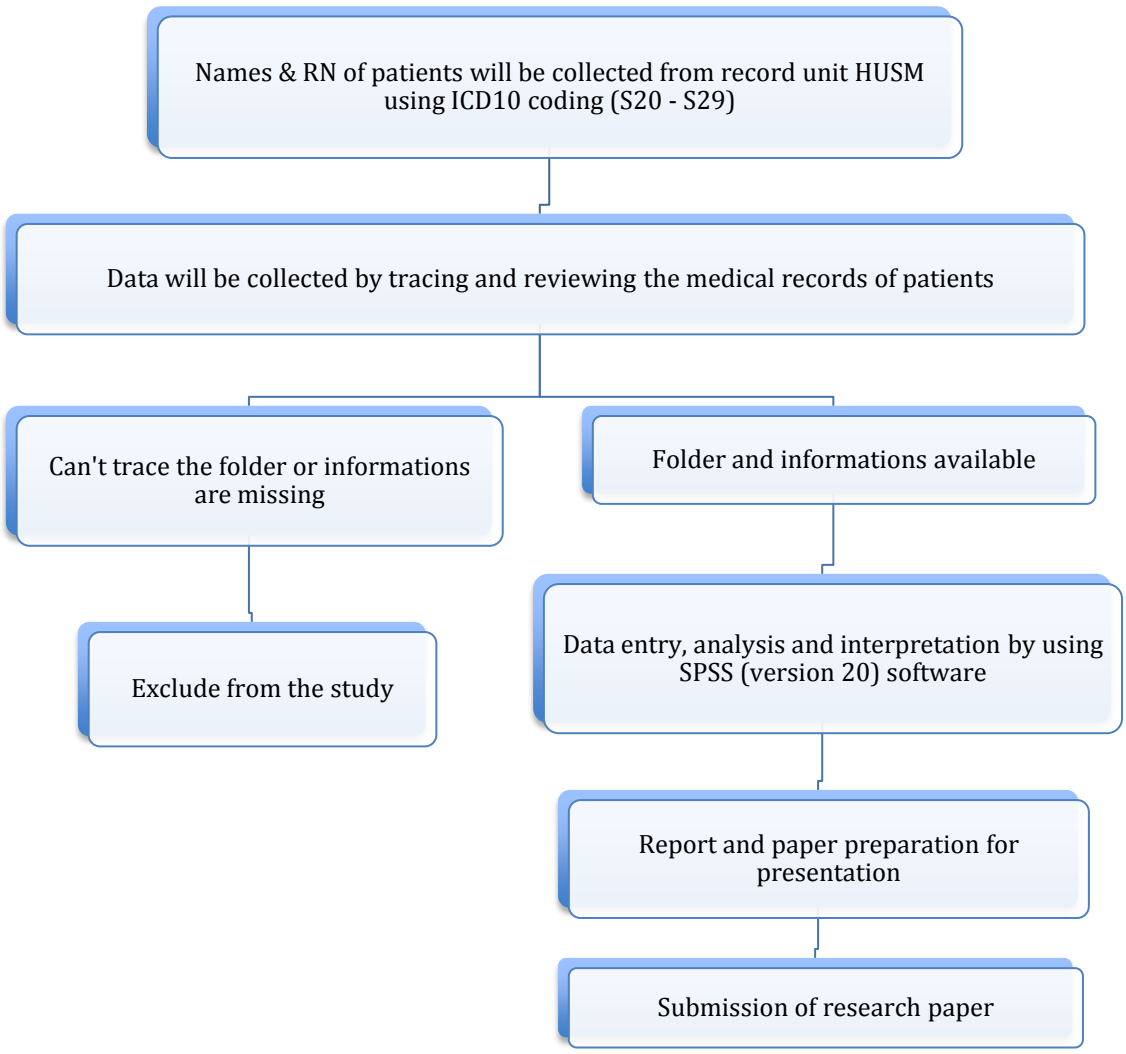
## 4.6 EXCLUSION CRITERIA

- Patients who arrived dead in the emergency room
- Patients who did not complete their treatment in our hospital
- Isolated laryngeal or spinal injuries
- Oesophageal and tracheal injuries due to foreign body swallowing or aspirating
- Non-traumatic injuries to the chest (burns, electrical shocks, etc.)

## 4.7 SAMPLING METHOD

All eligible patients during the study period from January 2003 and December 2012 who fulfill the inclusion and exclusion criteria will be included. The list of patients extracted from the record unit HUSM using ICD 10 coding (S20-S29). The records were traced manually from the record unit HUSM. The missing case notes and incomplete data collection were excluded from the study.

## 4.8 FLOW CHART



## 4.9 SAMPLE SIZE CALCULATION

Sample size calculation was calculated using single proportion formula and the study by Lema et al 2011

$$N = p(z/\Delta)2p(1-p)$$

Where: N = Number of patients constituting the minimum sample size

p = % male patient with chest trauma = 0.793

z = 95% confidence interval = 1.96

$\Delta$ = 5%

That: $N = 0.793(1.96/0.05)2 \times 0.793(1-0.793)$

$= 200$

to anticipate 20% possibility of incomplete data, the calculated minimum sample size is 240

However purposive sampling method was employed in which all patients with chest trauma who fulfills all the inclusion and exclusion criteria admitted in the surgical department during the study period were included in the study.

## 4.10 DATA COLLECTION, ENTRY AND STATISTICAL ANALYSIS

All the data collected will be entered into a database. Based on reviews from many literatures and our preliminary data from other studies regarding chest trauma enabled us to decide on factors to analyse for this retrospective review. The statistical analysis will be done using the SPSS version 20 programme. Categorical variables were expressed as absolute (n) and relative (%) frequencies. They were analyzed using Pearson's Chi-square test and fisher exact test. The numerical variables were expressed in mean and standard deviation (SD) and analyzed using Independent sample t-test and one-way ANOVA. A p-value less than 0.05 was considered as statistically significant. The power of this study was set at 80% and confidence interval (CI) was 95%.

## 4.11 ETHICAL ISSUE

The researcher ensured that confidentiality and anonymity of patients were maintained by not divulging their names in the report.

## 4.12 ETHICAL APPROVAL

Ethical approval was sought for conducting the research from the Research Ethics Committee of Universiti Sains Malaysia (USM). The approval letter is attached in Appendix B. Before carrying out the study, permission was also sought from the management of HUSM.

# 5 RESULT

## 5.1 SOCIO-DEMOGRAPHIC DATA

A total of 504 patients with chest trauma managed in the surgical department during the study period were enrolled. Males were 412 and females were 92 with the male to female ratio of 4.5:1 (figure 1).

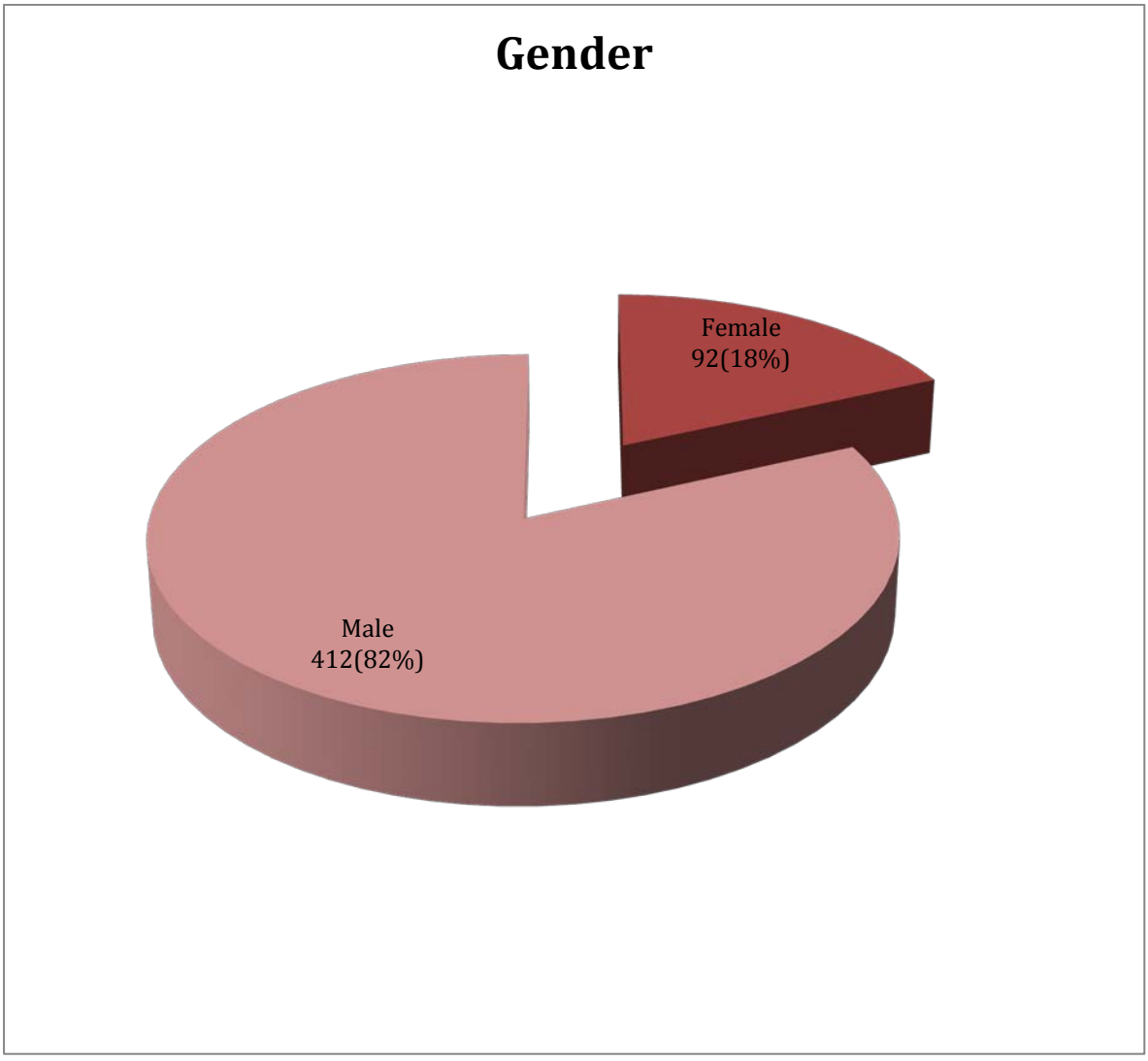



**Figure 1: Percentage of gender among 504 patients with chest trauma**