The Intensive Care of Chest Injuries

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Summary

This is a survey and assessment of all patients with chest injuries admitted to the Intensive Therapy Unit at St Luke's Hospital during a period of thirty months from January 1984 to June 1986. Cases of simple uncomplicated rib fractures admitted to ITU for observation are excluded. Out of the total of 21 patients, 12 suffered other major trauma besides the chest injury. The management of chest injuries and their complications are discussed.

Introduction

The Intensive Therapy Unit at St Luke's Hospital is a 10 bed unit catering for all critically ill patients on the islands of Malta and Gozo. Out of 1300 patients admitted to the ITU for intensive resuscitation, monitoring and treatment during the study period, these 21 patients represent 1.6%.

Results

Of the 21 patients, 19 (90%) were male and 2 (10%) were female. The ages ranged from 5 to 75 years, but 57% were under 40 years with the highest incidence in the twenties age group (6 cases) Fig. 1.

18 patients (86%) had a blunt chest injury. 3 patients were suffering from penetrating chest wounds Fig. 2.

i) **Blunt injuries**: 18 patients

Seventeen patients had rib fractures (8 bilateral) and two patients had a fractured sternum. They have been subdivided into two main groups.

a) chest wall alone: 3 patients.

Two of these needed long term ventilation while the other required antibiotics and physiotherapy for pulmonary atelectasis. No deaths were recorded.

b) chest wall and thoracic visceral involvement: 15 patients.

Most patients fell into this group and the visceral injuries are shown in Table 1.

left pleural collection which resolved spontaneously while the two patients with firearm injuries required thoracotomy for persistant intra-thoracic bleeding. At operation one patient had a torn azygos vein and pulmonary lacerations. The other patient was bleeding from intercostal and subscapular vessels and lacerations of the left upper lobe. All three patients survived their injury.

Mortality

Of the three patients who died, two suffered multiple injuries following falls from a height. A 24 year old female psychiatric patient sustained a cervical spine fracture, head injury and fractures of the pelvis, ankle and wrist after falling a height of 16 meters. Initial resuscitative measures failed to correct hypovolaemic shock and she was submitted to emergency laparatomy as intra-abdominal bleeding was suspected. At operation there was no major bleeding site but the patient died soon after. A post mortem declared the cause of death as being due to hypovolaemia from multiple injuries incompatible with life.

A 71 year old alcoholic patient fell backwards a height of 3 metres. He had an occipito-temporal fracture with severe contusion of the cerebellum and both frontal lobes, multiple fractured ribs with a flail segment, and intra-abdominal haemorrhage from a lacerated spleen. He required splenectomy and needed ventilation. He died within 17 days post-op., having developed pancreatitis with paralytic ileus, bilateral bronchopneumonia and renal failure.

A 40 year old female driver was involved in a car crash and on admission was semi-conscious with extensive subcutaeneous emphysema on both sides of the chest extending into the neck, right arm and abdomen. She had a fractured mandible with intra-oral haemorrhage. A chest X-ray revealed fractures of the right 4th to 8th ribs and left 2nd rib. A large right pneumothorax was also present. Apical and basal right intercostal drains were inserted. Emergency tracheostomy was done in view of the fractured mandible and compromised airway. Twenty-four hours later, the patient became dyspnoeic and required ventilation with a high concentration of Oxygen (less than 60%) to maintain adequate PaO_2 The right pneumothorax persisted, and she developed adult respiratory distress syndrome (ARDS or shock lung), bilateral bronchopneumonia with septicaemia and a small left pneumothorax. In spite of intensive treatment with antibiotics, methy-

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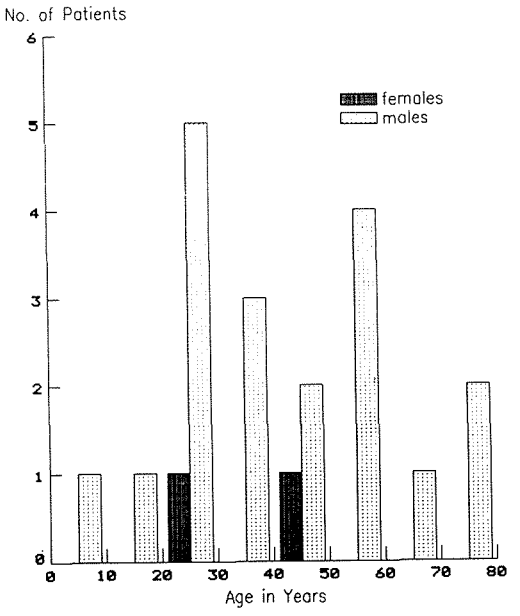

Fig. 1 Age and sex distribution of patients with chest trauma.

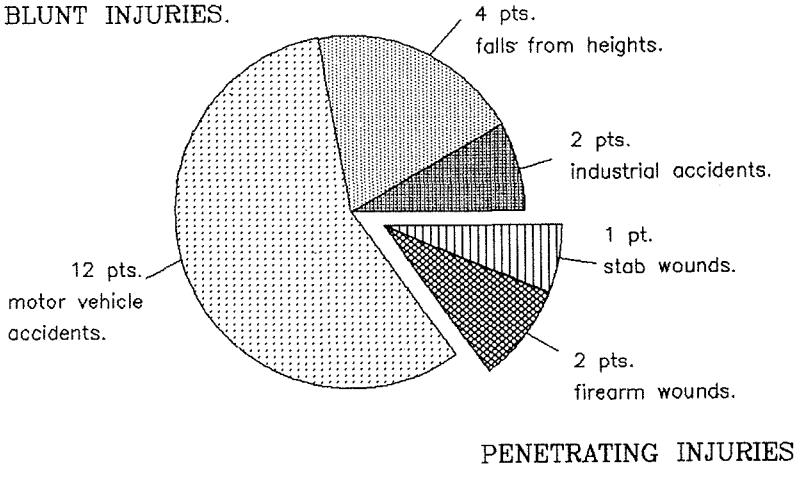

Fig. 2 Category of injury; Blunt and Penetrating (exploded sector).

Table 1

INJURY	Number of Patients
HAEMOTHORAX	12 (2 bilateral)
PULMONARY CONTUSION	5
PNEUMOTHORAX	3 (2 bilateral)
HAEMOPNEUMOTHORAX	2
MAJOR VESSEL TEAR	2
PNEUMOMEDIASTINUM	1
RUPTURED DIAPHRAGM	1

Different types of thoracic visceral involvement. Some patients sustained more than one type.

prednisolone and ventilation with 100% oxygen and positive end-expiratory pressure (PEEP) of up to 10 cm H_2O, her PaO_2 deteriorated to levels below 35mm Hg. She died of respiratory failure 25 days after admission. At post mortem the lungs were described as heavy, firm and rubbery. There were lacerations of the upper and middle lobes of the right lung with no evidence of a major bronchopleural fistula.

Discussion

Patients with a possible chest injury should be seen and assessed by a senior member of the surgical admitting team. Particular attention should be given to chest pain on inspiration and the presence of central cyanosis or dyspnoea. Crepitus over the rib cage denotes fractured ribs, while surgical emphysema is a sure sign of injury to lung or respiratory tract. If the patient is in severe shock, haemothorax with possible large vessel injury and cardiac tamponade from haemopericardium should be considered. An immediate chest X-ray may show the extent of the damage to the thoracic cage and confirm the presence of air or blood in the plerual cavity Fig. 3. Widening of the mediasti-

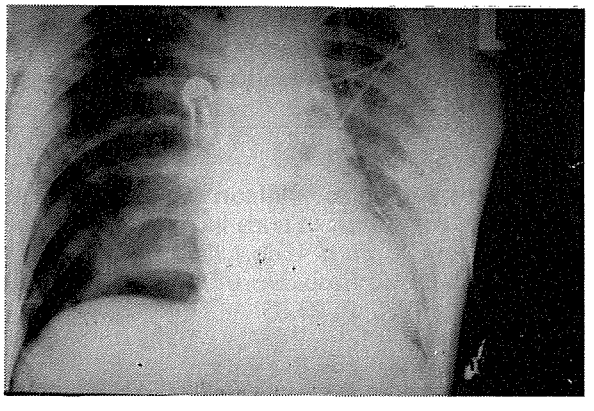

Fig. 3 Chest X-Ray of 26 year old man with (R) pneumothorax, (L) haemothorax, pneumomediastinum and surgical emphysema with pectoral muscle fibers showing in contrast.

Widening of the mediastinum could be an early sign of pericardial effusion or injury to the thoracic aorta. Mediastinal emphysema and a ruptured diaphragm result in typical chest X-ray appearances and should not be missed[1, 2]. In our experience this initial assessment has been extremely important in detecting patients who needed active surgical management of their chest injury. Fourteen patients required the insertion of intercostal drains with under-water seal. The more compact Heimlich flutter valves were used only to facilitate patient transport.

Besides the two patients with penetrating wounds, two others required emergency surgery for their thoracic injury. A 25 year old male involved in a motor cycle accident was admitted in hypovolaemic shock, with subcutaneous emphysema over the left upper chest and a pulseless left upper limb. Chest X-ray showed a fracture dislocation of the left sternoclavicular joint, fractures of the first rib and a left haemothorax. As more than three litres of blood were drained within minutes of the insertion of a left intercostal tube, major vessel trauma was diagnosed and the patient submitted to urgent thoracotomy. Lacerations of the left subclavian vein were repaired and an actively bleeding left internal thoracic artery ligated. The flail segment of the chest was stabilised with several nylon sutures.

A 5 year old boy whose abdomen was crushed under the wheel of a heavy vehicle was admitted with tenderness in the left hypochondrium. He had decreased breath sounds over the left chest with shift of the apex beat to the right. A chest X-ray revealed a ruptured left hemidiaphragm with herniation of the stomach into the chest Fig. 4

At laparotomy a lacerated spleen was removed; the stomach was reduced into the abdomen and the diaphragm repaired. The child also had a right pleural effusion and a transient paraplegia of uncertain origin.

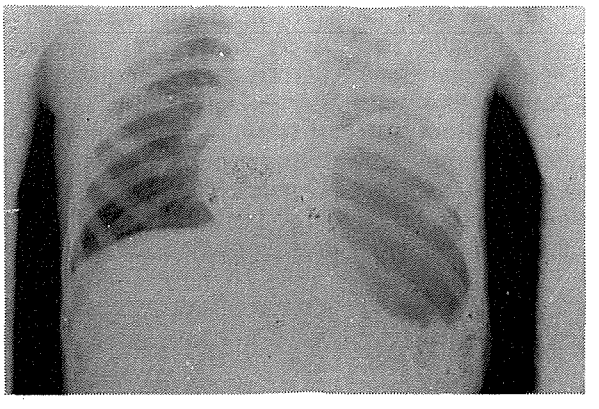

Fig. 4 Chest X-Ray of young boy with a ruptured (L) hemidiaphragm and herniation of the stomach into the chest cavity.

Management of Flail Chest

Of the seven patients admitted with a flail segment, four required mechanical ventilation; one patient had the flail chest stabilised at thoracotomy for major vessel injury, whilst the other two were treated by intercostal nerve blockade, physiotherapy and appropriate antibiotics. Patients were ventilated if tachypnoeic, dyspnoeic and blood gas analysis showed a PaO_2 less than 60mm Hg or a

$PaCO_2$ more than 60mm Hg. There is no apparent correlation between the size of the flail chest and the need to ventilate. Patients with flail chests do not usally have impaired ventilation, the $PaCO_2$ being in the range of 23-42mm Hg. Respiratory distress is due to a falling PaO_2 occuring as a result of ventilation/perfusion abnormalities brought about by pulmonary contusion, decreased cough and accumulation of secretions causing atelectasis. Mechanical ventilation is therefore indicated in cases of pulmonary tissue damage rather than chest wall instability and should be discontinued when normal gas exchange has been restored[3].

Long term ventilation is often complicated by severe infection and should not be undertaken lightly[4]. Chest infection ranging from mild basal atelectasis to a fulminant bilateral bronchopneumonia with septicaemia was the commonest complication (15 cases). The more severely affected were the patients on long term ventilation all of whom had positive sputum cultures. By far the commonest pathogen cultured was Pseudomonas aeruginosa; others included Klebsiella, Proteus, Serratia, Strep. faecalis, Haemophilus influenzae and ß-haemolytic Streptococci. The principal antibiotics used were Cefotaxime and Gentamicin. Azlocillin, Mezlocillin and Netilmycin were used as second line drugs. Virtually all organisms cultured from ventilated patients were resistant to Ampicillin. Intensive chest physiotherapy, with postural drainage, bagging, percussion and cough stimulation, was the cornerstone of management in these cases, both before and after infection. Daily replacement of the ventilator tubings and humidifier was lately introduced to further delay the onset of infection. One patient, a 19 year old male, involved in a car accident developed pyothorax following splenectomy, right nephrectomy and partial hepatectomy for traumatic rupture of these organs. He also had multiple fractured ribs with pulmonary contusion. He recovered after surgical drainage of the pyothorax.

ARDS developed and was diagnosed in one case who suffered from multiple lacerations of the lungs. Management included IPPV with PEEP and methylprednisolone (30mg/kg IV six hourly). Applying PEEP in these cases can help gas exchange and correct hypoxaemia allowing the use of a lower FiO_2, preferably less than 0.5, as early as possible. However, the use of high dose steroids is still controversial. Since complement activation is thought to play a key role in the pathophysiology of ARDS, it has been accepted that steroids might interrupt the chain of events leading to the clinical picture. On the other hand, it is possible that they may encourage infection. Most authors would agree to using steroids in one or two large doses, considering the severity of the disease and the absence of any detrimental effects[5].

References

1. **Davidson K.G., Caves P.** Trauma Care. Grune & Stratton 1981 pg 284-306.
2. **Coppel D.L.** Medical Management Of The Critically Ill. Grune & Stratton 1978 pg 386-397.
3. **Shackford S.R., Smith D.E., Zarins C.K.** The Managment Of Flail Chest: a comparison of ventilatory and non-ventilatory treatment. A J Surg 1976; 132: 759-762.
4. **Thompson G.A., Wilson T., Collins R.E., Broadley J.A.** Chest Injuries In A District General Hospital. An R C Surg. (Eng.) 1982; 64: 117-120.
5. **Bier A.** Adult Respiratory Distress Syndrome. Hospimedica 1985; 3: 29-35.