CHEST WALL AND LUNG INJURIES

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Objectives

- importance of chest trauma to orthopaedic trainees
- review of
  - aetiology
  - assessment
  - acute management
- ARDS / long bone fixation
- role of emergency thoracotomy
Excluded topics

- definite management (where different from acute)
- scapula / clavicle and Th. Spine injuries
- cardiac trauma
- technique of thoracotomy
AIM

- Review of well known- but nevertheless vital- facts and strategies
- recent publications
- introduction for our guest speakers dealing with chest injuries in ITU and Cardiothoracic Unit
Why is chest trauma important to us?

- senior members of ‘trauma team’
- 40 deaths / d < 30y
- 50 % fatalities include chest injuries
- 25 % die as a result of chest trauma
“MANAGEMENT OF 240 CASES OF PENETRATING THORACIC INJURIES”
- 76 % - ICD
- 9 % Thoracotomy (1 - A/E)

UK Register 1993/94: 70 Thoracotomies for haemothorax

10 - 15 % need thoracotomy
TRAUMAPHOBIA

“..trepidation, apprehension and disquietude of a surgeon when asked to care for an acutely injured patient..”
Hippocrates [5th cent. B.C.]

“..if thou examinest a man having a wound in his chest,..perforating the manubrium of his sternum, thou shouldst press the manubrium with thy fingers, although he shudders exceedingly.

Thou shouldst bind it with fresh lint the first day; thou shouldst treat it afterwards with grease, honey and lint until he recovers.”
What is our management of chest trauma

- Classification
- Aetiology
- Assessment
- **Acute** management

- of common chest wall and lung injuries
Classification - topographic

- 1. Chest wall
- 2. Pleural space
- 3. Pulmonary parenchyma
- 4. Mediastinal structures

[Winchell 1995]
Aetiology

**Blunt (\(>95\%\))**
- high velocity
- low velocity
- crush

RTAs: 67%

[Injury, 1996]

**Penetrating**
- stab
- missiles
  - gun
  - impalement
  - blast

[Westaby, 1990]
Airbags

Kuner, 1995, Unfallchirurgie

“PROTECTIVE AIRBAGS IN RTAs: CHANGE IN INJURY PATTERN AND REDUCTION IN SEVERITY OF INJURIES”
Assessment (and simultaneous Management) - Primary Survey

A [ + C Spine]

B

C

D

E
Airway

- => establish/ maintain airway

NB sternoclavicular joint dislocation
Breathing

- >>> restore mechanics of ventilation, Oxygen, Pain relief, stabilise chest wall

- ABGs

NB Tension Pneumothorax, Open Pneumothorax, Flail Chest
Circulation

- control external haemorrhage
- pulse, BP, PP, Neck veins, skin
- cardiac monitor
- iv lines/bloods, inotropic support, massage, pericardiocentesis, Thoracotomy

NB massive haemothorax, cardiac tamponade
Assessment - Secondary Survey

- History: MOI, seatbelts
- Wounding instrument
- PMH: AMPLE +
- Associated Injuries
  - HI - 51%
  - Limbs - 38%
  - Abdomen - 21% [Glinz 1986]
Clin. Examination:
- ‘read ‘ the chest , ? ext.injury
- **look**: breathing pattern / depth / symmetry
  E / E of bullets etc.  DON’T PROBE!
- **listen**: absent BS
- **feel**: bones , crepitus , stability
- **percuss**
Imaging - CXR

- 100 cm supine ap
- systematic:
  - chest wall / bones
  - pleural space
  - parenchyma / trachea / bronchi
  - mediastinum
  - diaphragm

NB tubes / lines mark E / E
Chest wall Injuries
Rib fractures

- common, blunt, clinical diagnosis
- 1-3: + C-spine / Abdo / HI / vessels
- 7-9: + Spleen/ liver, posterior: high energy
- ! elderly. 150 ml / rib

Management:
- Analgesia
Sternum fractures

- Significant blow, 5%
- 5-30% Mortality => assoc. chest injuries
- Diagnosis: clinical, lat. X-ray

Management:
- Analgesia, 24 h Obs, ?ORIF
- ECG, pa CXR

[Heyes 1993]
Open Pneumothorax *

- Large defect in chest wall => equilibration between intrathoracic and atmospheric pressure
- Impalement / RTA / Shotgun
- Ineffective ventilation [least resistance]

Management
- Sterile occlusive dressing with ‘flutter valve effect’
Flail Chest *

- discontinuity between one segment and rest of chest wall => severe disruption of resp. movement
- 20% of severe blunt injuries.
- multiple rib fractures
- underlying contusion and hypoventilation => atelectasis / pneumonia
clinically: paradoxical chest movement

Management:
- adequate ventilatory support, careful monitoring, oxygen, fluid resusc., analgesia
- Mortality 2% (non-ventilated)
- 19% (ventilated) patients
Pleural Space Injuries
Pneumothorax

- lung laceration; blunt / penetrating
- clin: decreased BS, hyperresonance, crepitus, subcut. emphysema

Management:

- ICD
  - >1.5 cm at 3rd c-c junction
  - <1.5 cm and IPPV, GA or COAD etc

[Westaby 1990]
Tension Pneumothorax*

- "one-way-valve" Air leak => forcing air into thoracic cavity without escape => complete collapse of lung
- PEEP, blunt / penetr. trauma, subclav. cath
- **clinical**: 'Air hunger', mediastinal/ tracheal shift, absence of BS, distended neck veins, cyanosis
Tension Pneumothorax *

Management

- immediate decompression
- large bore needle 2.ICS midclavicular
- re-assess
- ICD
Haemothorax

- Blood in pleural space, invariably associated with 50 - 70% of chest injuries
- Chest wall vessels > parenchyma > large vessels
- Clin: asymptomatic -> in extremis
- CXR: 500 - 1000ml can go unnoticed!
Management:

- ICD  EXCEPT : Aortic Transsection

Thoracotomy

- > 2 l on insertion
- > 300 ml/h - 4h
- > 150 ml/h - 4h > 60y
- haemodynamic instability

[Parry 1996]
Parenchymal Injuries
Pulmonary Contusion

- Interstitial haemorrhage -> alveolar collapse -> ventilation / perfusion mismatch

-> refractory hypoxaemia

- Rib fractures / flail chest / severe blunt trauma

- Clin: resp. distress

- CXR: ill defined infiltration of alveolar / interstitial edema < 1h in 70% of pts.
Management:
- continuous monitoring
- supportive, depending on ABGs
  -> ventilation
Mediastinal Lung Injuries
Tracheobronchial injuries

- uncommon
- clin: dyspnea, stridor, subcut. emphysema
  Tension pneumothorax

Management:
- tracheostomy
- ICD (1-2), selective intubation
- refer for urgent Bronchoscopy and surgery
Rupture of Diaphragm

- 4% of thoracic injuries, Left side
- Diagnosis: CXR
- Cave: simultaneous haemothorax

Management:
  - gastric tube
  - ICD - apical [Glinz 1986]
Tube - Thoracostomy or Intercostal Drain (ICD)
**Technique**
- 5th ICS (nipple), anterior to midaxillary
- LA. 36 F - tube
- Transverse above lower rib
- ‘gloved’ finger/blunt insertion
- Connect, suture
- CXR

**Indications**
- Pleural space injuries
- Bronchial injuries
- Severe lung injury
  - Transfer
  - GA / PEEP
ARDS and long bone fractures
Pathophysiology

- rapid onset of respiratory deficiency and arterial hypoxaemia in patients suffering from a variety of critical illnesses
- Direct / Indirect lung injury + shock / hypoxia => cellular / humoral response => endothelial damage
- lungs: Oxygen diffusion, compliance, stiff
1. Johnson 1985

INCIDENCE OF ARDS AND EFFECT OF EARLY OPERATIVE FRACTURE STABILISATION

=> 5-fold increase of ARDS if delay > 24h
2. Pape 1992

EFFECTS OF VARIOUS IM METHODS OF FEMUR STABILISATION ON LUNG FUNCTION IN MULTIPLE INJURIES

...in the ‘borderline patient’, e.g. with lung contusion

=> either unreamed early procedure or ExFix and delayed stabilisation
3. Pape 1993

INFLUENCE OF THORACIC TRAUMA AND PRIMARY IM NAILING ON THE INCIDENCE OF ARDS

=> early nail beneficial in NTT patients
=> higher ARDS rate in TT pts. after early reamed nail
4. Van Os / Goris 1994

IS EARLY OSTEOSYNTHESIS SAFE IN MULTIPLE TRAUMA PATIENTS WITH SEVERE THORACIC TRAUMA AND PULMONARY CONTUSION?

=> severe thoracic trauma is no CI for early fixation
5. van der Made et al., 1996

“INTRAMEDULLARY FEMORAL OSTEOSYNTHESIS: AN ADDITIONAL CAUSE OF ARDS IN MULTIPLY INJURED PATIENTS?”

=> group 1 chest trauma + nailed femur

  group 2 chest trauma -----> no diff!

  group 3 nailed femur

“ARDS AND MORTALITY FOLLOWING THORACIC INJURY AND A FEMORAL FRACTURE EITHER TREATED BY IM NAIL OR PLATE”

=> no difference in ARDS following either procedure
Management of long bone fractures in the presence of severe lung injury

- early fixation is of advantage
- no evidence to prefer ‘unreamed’ procedures
- general measures to prevent ‘ARDS’ appear equally important
Emergency Thoracotomy
ATLS: ‘Thoracotomy’

- qualified surgeon
- NOT in pulseless pts and blunt trauma
- Indications:
  - evacuation of tamponade
  - direct control of haemorrhage
  - open cardiac massage
Rohman 1983

- I - stable -> investigate
- II - profound shock, conscious -> OR
- III - vital signs in transit, now absent, gasping -> ER
- IV - DOA
Roxburgh 1996

- review of ‘urban jungle’ in USA / South Africa

=> in group III patients: + heart / vessel injury; vital signs in transit, no BP, gasping

=> “SCOOP AND RUN!”
# Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>n</th>
<th>Survivors</th>
<th>Comment</th>
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<tbody>
<tr>
<td><strong>Mattox 1974</strong></td>
<td>273</td>
<td>140</td>
<td>valuable abandon peri.cent -&gt; OT</td>
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<tr>
<td><strong>Purkiss Edinb. 1994</strong></td>
<td>16 (9 at scene)</td>
<td>none</td>
<td>abandon</td>
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</table>
Should we open chests?
Conclusion

Sir Percival Pott 1773

“no part of surgery is thought to be so easily understood as that relating to fractures and injuries. Even the most in-expert deems himself perfectly qualified and is affronted by an offer of instruction on a subject with which they thought themselves well acquainted…”
Thank you!