Management of Penetrating Neck Trauma

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Grand Rounds Presentation
Types of Weapons

- Low velocity – knives, ice picks, glass
- High velocity – handguns, shotguns, shrapnel

\[ K = \frac{1}{2}mv^2 \]
Guns
Ballistics

Yaw

Precession

Nutation
Ballistics
Ballistics

FIG. 73-1. Cavitation effects of a bullet wound to soft tissue.
Anatomy

Anatomy

Zone III

Zone II

Zone I
Incision for Neck Exploration:
Incisions for Neck Exploration:

- Common Carotid Arteries
- Right Subclavian Vessels
- Extension for Innominate Artery
- Emergency control of right subclavian and innominate arteries
- Distal left subclavian vessels
- Flap-innominate, proximal left subclavian and left common carotid arteries
- Emergency control of proximal left subclavian artery
- Innominate artery, proximal left common carotid
Incidence and Mortality

**TABLE 1.**
Mortality of Penetrating Neck Trauma in Wartime and Current Civilian Practice

<table>
<thead>
<tr>
<th></th>
<th>No. of Injuries</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Civil War</td>
<td>4,114</td>
<td>15%</td>
</tr>
<tr>
<td>Spanish-American War</td>
<td>188</td>
<td>18%</td>
</tr>
<tr>
<td>World War I</td>
<td>594</td>
<td>11%</td>
</tr>
<tr>
<td>World War II</td>
<td>851</td>
<td>7%</td>
</tr>
<tr>
<td>Current civilian practice</td>
<td>3%–6%</td>
<td></td>
</tr>
</tbody>
</table>


**TABLE 2.**
Distribution of Neck Injuries

<table>
<thead>
<tr>
<th>Vascular injury</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial</td>
<td></td>
</tr>
<tr>
<td>Carotid, common and int.</td>
<td>168(6.7)</td>
</tr>
<tr>
<td>Subclavian</td>
<td>57(2.2)</td>
</tr>
<tr>
<td>Carotid, external</td>
<td>51(2.0)</td>
</tr>
<tr>
<td>Vertebral</td>
<td>33(1.3)</td>
</tr>
<tr>
<td>Innominate</td>
<td>11(0.4)</td>
</tr>
<tr>
<td>Venous</td>
<td></td>
</tr>
<tr>
<td>Internal jugular</td>
<td>225(9.0)</td>
</tr>
<tr>
<td>Subclavian</td>
<td>44(1.7)</td>
</tr>
<tr>
<td>Innominate</td>
<td>12(0.4)</td>
</tr>
<tr>
<td>Aerodigestive</td>
<td></td>
</tr>
<tr>
<td>Larynx and trachea</td>
<td>253(10.1)</td>
</tr>
<tr>
<td>Pharynx and esophagus</td>
<td>240(9.6)</td>
</tr>
<tr>
<td>Neurologic</td>
<td></td>
</tr>
<tr>
<td>Spinal cord</td>
<td>76(3.0)</td>
</tr>
<tr>
<td>Brachial plexus</td>
<td>48(1.9)</td>
</tr>
<tr>
<td>Hypoglossal nerve</td>
<td>14(0.5)</td>
</tr>
<tr>
<td>Vagus nerve</td>
<td>10(0.4)</td>
</tr>
<tr>
<td>Phrenic nerve</td>
<td>7(0.28)</td>
</tr>
<tr>
<td>Facial nerve</td>
<td>6(0.2)</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Thoracic duct</td>
<td>20(0.0)</td>
</tr>
<tr>
<td>Total</td>
<td>1,275</td>
</tr>
</tbody>
</table>

*Data from references 6–21.*
Initial Management

Airway
Breathing
Circulation
Examination

Intubation vs. Surgical Airway
IV access, Immediate Exploration
Determine weapon trajectory
Signs of Injury:

Vascular

Shock, Profuse bleeding, Evolving stroke, Expanding hematoma, hemothysis, hematemesis, unequal pulses, bruits or thrills
Signs of Injury:

**Larynx/Trachea**
- Subcutaneous emphysema,
- Hoarseness,
- Respiratory distress,
- Stridor

**Esophagus**
- Neck pain,
- Blood in saliva,
- Fever, Odynophagia
Management of the Stable Patient:

The Old Standard:

Wound Penetrates Platysma?

Yes  No

Immediate Neck Exploration  Observation/Discharge

Laryngoscopy  Esophagoscopy
The Old Standard:

- Based on wartime experiences
- Fogelman *et al* (1956) showed that immediate neck exploration led to better outcomes in study group for vascular injuries.
- Led to rate of negative neck explorations in > 50%
- Arteriogram slowly began to gain acceptance as screening tool before exploration, especially for zone 1 and 3 injuries (hard to detect on physical).
Arteriogram

- Zone 1 and Zone 3 vascular injuries are difficult to visualize by physical exam, making arteriogram useful in these patients.
- Flint *et al* (1973) reported absence of P.E. findings in 32% of pts. with major zone 1 vascular injury.
- Arteriogram can be accompanied by embolization.
A Newer Algorithm

Mansour et al 1991 retrospective study
Newer Algorithm (Mansour)

- 63% of the study population was in the observation group.
- Entire study population had a mortality of 1.5%, similar to those in more rigorous treatment protocols.
- Similar results obtained in other large studies with similar protocols (e.g. Biffi et al 1997).
- Still uses the Arteriogram in asymptomatic patients with zone 1 injury.
Points of Controversy:

- Most trauma surgeons accept observation of select patients similar to the Mansour algorithm.
- Study by Eddy et al questions the necessity for arteriogram/esophagoscopy in asymptomatic zone 1 injury (use of P.E. and CXR resulted in no false negatives).
- Other noninvasive modalities than arteriogram exist for screening patients for vascular injury.
CT scan

- Can aid in identifying weapon trajectory and structures at risk.
- Should only be used in stable patients.
- Gracias et al (2001) found that use of CT scan in stable patients was able to save patients from arteriogram indicated by other protocols 50% of the time and avoid esophagoscopy in 90% of tested patients who might otherwise have undergone it.
Duplex Ultrasonography

- Requires the presence of reliable technician and radiologist.
- A double blinded study by Ginsburg et al (1996) showed 100% true negative, 100% sensitivity in detecting arterial injury, using arteriography as the gold standard.
Management of Vascular Injuries:

- Common carotid: repair preferred over ligation in almost all cases. Saphenous vein graft may be used. Shunting is rarely necessary. Thrombectomy may be necessary.
- Internal carotid: Shunting is usually necessary
- Vertebral: Angiographic embolization or proximal ligation can be used if the contralateral vertebral artery is intact.
- Internal Jugular: Repair vs. ligation.
Esophageal Injury:

- Best detected by combination of esophagoscopy and esophagram in symptomatic patients.
- Injection of air or methylene blue in the mouth may aid in localizing injuries.
- Close wounds in watertight 2 layer fashion.
- Controlled fistula with T-tube or exteriorization of low non-repairable wounds.
- Small pharyngeal lesions above arytenoids can be treated with NPO and observation 5-7 days.
- All patients should be NPO for 5-7 days.
Laryngeal/Tracheal Injury

- Thorough Direct Laryngoscopy for suspicious wounds
- Tracheotomy for suspected laryngeal injury
Conclusions

- Mandatory neck exploration is no longer considered acceptable
- ABC’s
- Physical Exam is probably the most useful diagnostic tool.
- Intervention should be directed to sites of possible injury
- Non-invasive diagnostic modalities should be considered.