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Emergency Management Of Thoraco-abdominal Trauma; A Study Of 275 Injury Patients

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The purpose of this paper is to consider the patient with thoracoabdominal trauma, and to analyze the injuries of 275 patients occurring in a four year period, 1953-1956. Crushing injuries to the chest and upper abdomen, chest trauma, penetrating wounds and severe upper abdominal injuries will be discussed. It can be seen that for the moment attention will be directed to the thoracic and abdominal viscera. It will be recalled that, in injuries to the chest, abdominal organs may be injured, and vice versa; in upper abdominal injuries the thoracic contents or diaphragm may be damaged.

In order to emphasize the fact that certain injuries result in injury to multiple organs, we have utilized simple drawings. The path of a bullet is illustrated in Fig. 1, the effect of multiple stab wounds is shown in Fig. 2, and the result of a heavy crushing force is shown in Fig. 3.

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Ponka and Antoni

Figure 3
Heavy objects crushing the patient against a wall, or falling on the patient, or automobile accidents, are likely to result in multiple organ injuries, as well as rib fractures.

Obviously, the first concern is the preservation of the life of the patient. Extensive and severe multiple injuries require the presence and intensive activity of two or more doctors until the acute problem is under control. Since the patient can survive but a few minutes without oxygen, an airway must be provided at once. This may require only supporting the lower jaw in an unconscious patient, or aspiration of secretions in the nasopharynx, or it may call for tracheostomy, depending upon the needs of the patient. Closure of “sucking wounds” of the chest must be immediate, thus avoiding a fatal pneumothorax.

The maintenance of circulation is also of the greatest importance. Bleeding must be stopped at once. This can be done, in some instances, with direct pressure applied over a sterile gauze pad. Strangely, this simple expedient is so often overlooked. Pressure dressings will control bleeding from oozing areas; tourniquets may be used for periods of approximately two hours if major arteries in the extremities are not readily accessible for clamping. Continuing loss of blood into the thorax or abdomen must be stopped even if the condition of the patient is poor, for it will never improve if exsanguination continues.

While the airway is being provided, and bleeding is being controlled, intravenous fluids are given, and arrangements for transfusing the patient are proceeding hastily. Plasma, or plasma expanders, are given to those patients whose blood volume is dangerously low, while whole blood is being secured. Hemorrhage demands replacement of the red cell mass.

During the above period the patient’s pulse, blood pressure, respirations and temperature should be recorded, and retaken at short intervals as indicated by the needs of the particular patient. There is no substitute for such objective evaluation of the vital function of a seriously injured patient.
Thoraco-Abdominal Trauma

Once the patient is breathing, and has a satisfactory blood pressure, we begin a careful appraisal of the patient's injuries. A careful history is helpful.

Falls from great heights, severe automobile accidents, and crushing injuries usually result in multiple-organ injuries. Fig. 3. These are most serious. Accompanying head injuries are of serious prognostic significance. Remember that patients injured in falls may be diabetics, alcoholics, hypertensives, epileptics, or psychotics. At times the patient cannot be of help; he may be unconscious, or seriously injured and unable to give an account of what occurred. Hence, any information gained from informed sources is helpful and appreciated. The entire patient is carefully scrutinized, but of course the injured parts are subject to special attention. The patient must be disrobed completely for proper examination. This obvious detail is too often overlooked. X-ray studies must not be ordered too quickly, for they are not life-saving.

Morphine continues to be most useful in controlling pain and lessening apprehension. Nevertheless, respiratory depression is an undesirable side-effect which can be serious if the dosage is too large or repeated at short intervals. Morphine should not be given if its administration would add confusion to the attempted differential diagnosis. Anoxia may result in extreme restlessness, even mania. Morphine, in this instance, may further depress respiration and end in disaster.

Thoracic injuries of interest here are multiple rib fractures, (Fig. 4) injury to the lung, hemothorax, pneumothorax, hemopneumothorax, and associated injuries of the liver, spleen, or kidney, stomach or pancreas or heart.

Severe chest trauma with bilateral rib fractures produces paradoxical movement of the thoracic wall. This causes serious disturbances in intrathoracic pressure, and hence in the pulmonary exchange of air, as well as in filling of the heart.

These disturbed functions vary directly with the severity or degree of the paradoxical motion. Pneumothorax, hemothorax, or bronchial obstruction may be additional complicating factors present. In the management of such injuries we must do the following promptly:

1. Provide an unobstructed airway.
2. Aid in expansion of the lung.
3. Provide an intact thoracic wall if there is an open pneumothorax.
4. Stabilize the chest wall against paradoxical respiration.
5. Combat hypotension.

Penetrating wounds may cause hemorrhage and pneumothorax. Sucking wounds should be treated at once with an occlusive dressing or surgical closure. Hemothorax may be remedied by thoracentesis or thoracotomy and placement of an underwater thoracotomy tube. Small amounts of hydrothorax, pneumothorax, or hemothorax, not embarrassing respiration, may be observed carefully.

Tension pneumothorax develops whenever air enters the pleural space on in-
Rib fractures are often multiple, especially in falls, automobile, or crushing injuries. Greater direct force is necessary to fracture the upper ribs because they are better protected. The lowermost ribs are relatively mobile, and are fractured only when subjected to severe direct trauma. When the lower ribs are fractured, injury to the spleen, liver and kidneys, must be suspected. In our experience with 275 injured patients ribs 4-10 inclusive are fractured most frequently, as indicated in this illustration.

Expiration, only to be retained on expiration. The intra-pleural pressure increases, the mediastinum is displaced to the opposite side, further interfering with pulmonary function. This also has an adverse effect on cardiac function. Here, either aspiration of the air, or thoracotomy tube drainage are corrective. Pain should be controlled by intercostal block, or opiates. Strapping tends to restrict motion of the thoracic cage, and we do not generally use this method for control of pain. Codeine is a good analgesic for simple rib fractures.

It should be remembered that subcutaneous emphysema is an indication of one of the following:

1. Puncture of the lung, pleura.
Thoraco-Abdominal Trauma

2. Ruptured trachea.

3. Ruptured esophagus.

We feel that such patients should have relief of the pneumothorax which usually accompanies the above injuries, but which may be difficult to demonstrate because the subcutaneous air presents a confusing picture on x-ray examination.

Cardiac tamponade, caused by bleeding into the pericardial sac, is another emergency situation. Hypotension, distended neck veins, rapid thready pulse, suppressed heart sounds, and an enlarged heart shadow are the important findings in this condition. Pericardial tap should be done at once, and if aspiration does not correct the situation, then surgery becomes necessary to stop the bleeding. Here ill-advised over-transfusion may result in fatalities when such patients are managed by the uninitiated.

We wish to emphasize that wounds involving the chest, whether penetrating or not, may damage the liver, kidneys, spleen, pancreas, or stomach. Conversely, wounds involving the upper abdomen may result in laceration of the diaphragm or lung. Upon subsequent abdominal section an open pneumothorax is produced. The implications as to need of endotracheal anesthesia are obvious. In wounds that have penetrated the lower chest or upper abdomen, persistent hypotension, abdominal tenderness or rigidity, absent bowel sounds, peritoneal fluid, or pneumoperitoneum, indicate the need for laparotomy. Penetrating upper abdominal wounds demand surgical intervention as soon as the patient's condition will permit. Lacerated viscera must be repaired promptly. Anesthesia is generally best administered by way of an endotracheal tube in this group of patients.

More treacherous are the closed abdominal wounds. Here the surgeon must possess a high index of suspicion, and he must follow these patients most carefully if the usual high morbidity and mortality rates are to be avoided. Marked tenderness, rigidity, pallor, rapid pulse, hypotension, absent bowel sounds, elevated white cell count are most significant findings. Abdominal x-ray may show pneumoperitoneum, or peritoneal fluid.

With the above findings surgery is carried out as soon as the condition of the patient is satisfactory. In doubtful cases we advise surgery, for it is well known that such patients die of peritonitis if neglected. We salvaged two patients in one year having closed abdominal wounds. One had a perforated duodenum, the other a perforated ileum.

It is well known that following abdominal injury the fixed viscera, (liver, kidneys, spleen) are more commonly injured. Lacerations of the intestinal tract are likely to occur at the points of attachment to the posterior abdominal wall, as, for instance, the jejunum near the ligament of Trietz, the ileum near the cecum, and the sigmoid. A distended viscus, such as a full bladder or intestine, is in greater danger of injury than if it were collapsed. Pre-existing disease also increases the danger of rupture.

At surgery the opening in the viscus is closed after the contents of the peritoneal cavity have been aspirated. Great care should be taken to remove all particulate matter.
Small openings in the large bowel may be closed with drainage. Larger lacerations of the colon may require exteriorization of the colon or colostomy proximal to the laceration. Early surgery is the key to success. The surgical exploration must be painstakingly thorough.

At times, injury to the spleen may produce a confusing picture. Whenever the spleen is lacerated and bleeding continues, the need for surgery becomes apparent. The usual clinical signs and symptoms include abdominal and left shoulder pain, palpable mass in the left upper abdomen, and abdominal distension. Of course, we look for the rapid pulse and falling blood pressure. Roentgen examination may reveal increased density in the left upper abdominal quadrant, obliteration of the splenic shadow, elevation of the left diaphragm, displacement of the stomach toward the right, or evidence of fluid in the peritoneal cavity. Greater discrimination is necessary in order to avoid missing those cases of delayed rupture of the spleen, i.e., those cases occurring forty-eight or more hours after injury. Such patients must be observed at close intervals. Treatment is splenectomy.

It is apparent that severe lacerations of the liver need more exacting treatment than mere packing. This method may act as a wedge and the remaining portion of the liver is further disrupted. (Fig. 5.) The better approach to severe liver lacerations includes:

1. Better exposure of the liver, using a thoraco-abdominal approach where needed. We believe that this approach should be used more frequently.
2. Suture ligature of individual arteries, veins and bile ducts with fine silk sutures.
3. Adequate approximation of the liver surfaces after using oxycel or gelfoam judiciously.
4. Multiple drains are important.

It is important to remove hopelessly devitalized liver fragments. Remember that the liver has a great capacity for recovering following trauma.

The kidney should also be considered in this group of injuries. Hematuria is an important finding. Intravenous pyelography is done in these cases first. If there is poor visualization by this technique, then retrograde pyelography is carried out. Hematuria alone is treated conservatively, whereas hemorrhage and severe damage to the kidney require surgical intervention. Simple drainage and oxycel packing are used in suitable cases. Falling blood pressure, rapid pulse and falling hemoglobin or hematocrit values suggest need for surgery. Nephrectomy is done if the kidney cannot be salvaged.

In any of the above patients paralytic ileus may be an annoying complication. The use of a Levine tube is most helpful. Restriction of oral intake, heat applied to the abdomen, enemata, and use of the rectal tube, will generally correct the ileus. In some instances a Miller-Abbott tube must be employed. Delay in insertion of this tube is not an uncommon error. Hydration is accomplished by use of intravenous fluids.
Crushing wounds over the liver, or falls from great heights, may result in stellate lacerations of the liver. This drawing emphasizes that “packing” the liver with hemostatic materials may act as a wedge, further disrupting the friable liver. Forceful packing of liver lacerations with packing of any type is not recommended.

Finally, we wish to emphasize that in severely injured patients the knowledge and assistance of several doctors is necessary. This is obvious, since several diagnostic and therapeutic procedures must be going on at the same time. Consultation with the various specialties is readily available and valuable and should be utilized whenever needed.

PROGNOSIS: It is apparent from TABLE 1 that the prognosis in thoraco-abdominal injuries becomes more grave as the number of organs injured increases.

In severe crushing injuries, automobile accidents, bullet wounds, and falls from great heights, the prognosis is grave because multiple organs are injured. Eleven patients expired. Five were unable to survive because of extensive blood loss secondary to injuries of the liver, spleen, kidney and multiple fractures. Four patients had severe head injuries and died as a result of cerebral damage. One patient died of peritonitis, another of pulmonary embolus.
**Ponka and Antoni**

**Table I**

INCIDENCE OF ASSOCIATED VISCERAL INJURIES IN 275 PATIENTS (1953-1956)

<table>
<thead>
<tr>
<th>No. of Patients</th>
<th>Expired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spleen</td>
<td>18</td>
</tr>
<tr>
<td>Kidney</td>
<td>6</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>6</td>
</tr>
<tr>
<td>Intestine</td>
<td>5</td>
</tr>
<tr>
<td>Liver</td>
<td>5</td>
</tr>
<tr>
<td>Stomach</td>
<td>4</td>
</tr>
<tr>
<td>Multiple Injuries</td>
<td>50</td>
</tr>
</tbody>
</table>

Patients with Multiple Injuries.

**SUMMARY**

In the emergency management of major trauma there are several very important and consistent features. In order that these may not be lost in a lengthy treatise, we would prefer to summarize them as follows:

1) In major trauma the *preservation of life* is our first consideration. An *adequate airway* and *maintenance of circulation* are our first objectives in supporting life.

2) X-ray examination should not be generally carried out until the patient is out of danger and his respiratory and circulatory functions have been stabilized.

3) In injuries of the chest we should provide an unobstructed airway, expand the lung, make the thoracic wall intact, drain the pleural cavity, relieve pain by intercostal block, and combat infection.

4) In injuries of the *lower chest* or upper abdomen we must not forget injuries to *adjacent organs* or viscera.

5) The spleen is a treacherous organ in traumatic cases. Delayed rupture may occur after 48 hours with disastrous results.

6) Abdominal injuries in which there has been penetration demand surgical intervention as soon as the general condition of the patient permits. If continuing hemorrhage is suspected, delay in surgical intervention must not be tolerated.

7) Thoraco-abdominal incisions should be used more often in repair of large liver lacerations. Individual suture ligation or arteries, veins and bile ducts is of great import.

8) Ileus can be an annoying complication after severe trauma to the chest, abdomen, or pelvis.

9) In our emergency management of these cases several surgeons often work as a team, since the urgency of the situation demands the knowledge and application of more than one specialty group, viz., orthopedics, neurosurgery, urology, plastic surgery, thoracic, and general surgery.