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MAJOR TRAUMA – THE IMPORTANCE OF THE FIRST HOURS

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ABSTRACT

Trauma is the leading cause of death in persons under the age of 40. In addition to direct tissue lesions, typical complications e.g., shock, airway obstruction in the unconscious, or life threatening rise of the intracranial pressure, are common and often determine the survival of the patient. Today, a number of extensive diagnostic and therapeutic anesthesiological, surgical and radiological procedures are used in the management of severely traumatized patients starting already with the care on the site of the accident. They permit optimal functional results and better survival of the severely injured. The importance of these procedures, applied especially in the early stage of trauma, is stressed. Attention is focused on special problems i.e., craniocerebral trauma, the trauma of the chest, the abdomen and the extremities, in an attempt to give the inexperienced emergency medical service physician insight into the practical problems of management of the severely injured in the early stage of trauma.

Key words: major trauma, early phase

SAŽETAK

Trauma je glavni uzrok smrti u osoba mladih od 40 godina. Uz neposredne ozljede tkiva, tipične komplikacije kao npr. šok, začepljenje dišnih putova bolesnika u nesvjestici ili za život opasan porast intrakranijalnog tlaka prilikom kraniocerebralne ozljede uobičajene su i često određuju preživljavanje bolesnika. Već na mjestu nesreće, u današnje se doba koristimo određenim brojem dijagnostičkih i terapijskih postupaka u zbrinjavanju teško ozlijeđenog bolesnika. To omogućava postizanje optimalnih funkcionalnih rezultata i veće preživljavanje teško ozlijeđenih. Naglašena je važnost primjene tih postupaka osobito u ranoj fazi traume. Pozornost je usmjerena na posebne probleme kao npr. na kraniocerebralnu traumu, traumu prsnog koša, trbuha i udova u pokušaju da se neiskusnom liječniku hitne medicinske pomoći omogući uvid u praktične probleme obrade teško ozlijeđenih u ranoj fazi traume.

Ključne riječi: teška trauma, teške ozljede, rana faza

INTRODUCTION

Trauma is the leading cause of death in persons under the age of 40. This so called "disease of our time" carries a high mortality and morbidity. Several complications such as sepsis, pneumonia, adult respiratory distress syndrome (ARDS) and multiple organ failure (MOF) are common after severe trauma. Possibly the greatest advance in the last decades has been the development and implementation of organized trauma care delivery systems and the designation of trauma facilities. Optimal initial resuscitation, stabilization and early surgical management significantly reduce morbidity, mortality and the overall costs associated with major trauma. In some countries, sophisticated prehospital emergency care systems exist, allowing medicalized advanced trauma life support. One of the most critical issues in this regard is the prevention of secondary injuries, to which, for example, the brain is most remarkable. The controversy surrounding prehospital care (scoop and run versus initial stabilization in the field) still remains.

EPIDEMIOLOGY OF TRAUMA

In the USA between 140,000 and 150,000 fatal injuries, representing an overall death rate of 60 per 100,000 population, occur yearly.

America's most reviled armed conflict, the Vietnam war, resulted in the death of "only" 57,000 Americans over a 10 year period.[1]

In the Netherlands, about 6,000 inhabitants (one out of every 2,300) die as a result of injury and about 130,000 to 150,000 patients are admitted to a hospital each year following an accident.

In an interesting study from Sweden, 89% of men interviewed reported at least one injury that

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restricted their activity for one day or more, necessitated medical attendance, or, in case of head injury, resulted in unconsciousness.

In Belgium in 1986, injuries were the cause of 73% of all deaths in young patients (age 15–24). Trauma is the leading cause of death in young people and the main cause of hospital admission for those under 35 years of age. More children die from trauma than from all the other causes combined. There is substantial evidence now that injured patients die unnecessarily both before and after admission to the hospital. It has been estimated that up to 30% of the seriously injured patients die of potentially preventable causes.

Death after trauma occurs at three distinct time periods. The first group, which comprises about 50%, dies within seconds or minutes of the accident, due to severe brain injury, spinal cord lesions, or lesions to the great vessels or the heart.

Airway obstruction contributes to many of these deaths in this phase. The prognosis of this group of immediate deaths can be improved through prevention (speed limits, helmets, seat belts, alcohol and drug ban), and improvement of prehospital care.

A second rise in mortality occurs 1 to 4 hours after trauma, generally in hospital. This second group, the early deaths, constitutes 30 to 35% of all trauma deaths. This period is called "the golden hour", since most of the preventable trauma deaths are found in this group. Major hemorrhage from thoracic trauma, liver and spleen injuries, major vessels or multiple pelvic fractures, is the principal cause of death in this phase.

The remaining 20% of trauma related deaths occur more than one week following the injury. These patients die from sepsis and/or multiple organ failure[1] (table 1).

Table 1. Time related trauma deaths (Adapted from Lauwers LF. Trauma: the first few hours. In: Course Concepts and developments in Emergency medicine: 1992: 1-16.)

SEC-MIN (ON SITE)	FIRST HOURS (ED)	WEEKS (IT)
• Brain	• Epi/Subdural hematoma	• Sepsis
• Cord	• Hematopneumothorax	• MOF
• Heart	• Pelvic fractures	
• Aorta	• Long bone fractures	
	• Spleen	
	• Liver	

ED=emergency department
IT=intensive therapy
MOF=multiple organ failure

Traumatic injuries are initially categorized as blunt, penetrating and thermal. A major difference between most European countries and the USA is the higher number of penetrating injuries in the latter.

IMMEDIATE CARE

One of the major advances in the last decades has been the development of organized trauma care delivery systems and designated receiving trauma facilities. Patients do better in trauma centers. Mortality and morbidity rates are much lower in designated trauma centers.

Both the optimization of prehospital care and the creation of trauma centers are needed to improve overall trauma management and survival.

In my opinion, the key features of medical emergency teams are that they are hospital based and hospital controlled. The key to success in rural EMS is the intensive involvement of well educated physicians. One such team is needed for at least every 250,000 inhabitants and each team should have a call-to-road-response-time of less than three minutes. These teams should consist of at least one senior physician experienced in emergency medicine, accompanied by one experienced nurse. Such teams need about one to five interventions a day to keep up with the expertise. In large rural areas, these teams should be transported by helicopter to the patient.

Prehospital management of the severely traumatized patient should be based on the principle of the three R's: the right patient at the right time to the right hospital.

At the emergency department (ED), the definitive treatment of traumatic shock requires the localization and control of the source of ongoing blood loss. In most instances this will require immediate surgery and any delay should be avoided. As with endotracheal intubation and artificial ventilation, the threshold for diagnostic peritoneal lavage in blunt abdominal trauma should be low. It is a safe and sensitive diagnostic tool saving many lives.[1]

IMPORTANCE OF EARLY INTERVENTION

In the definition of the emergency medicine's goal, the term "early" occupies a central place. The importance of the time factor has been illustrated by earlier and recent research, demonstrating that mortality (early and late) and morbidity (mainly sepsis and MOF) are largely determined by the oxygen deficit accumulated during the acute phase of the trauma or illness.

Using dogs subjected to different degrees of hemorrhage, Guyton and co-workers demonstrated that survival was determined by the cumulative oxygen deficit.[2,3] Whenever the dogs accumulated an oxygen debt of less than 100 ml/kg of body weight, the survival was 100%; whenever the oxygen

debt reached a value of more than 140 ml/kg of body weight, the survival was zero.

The importance of the time factor in the early management of polytrauma is demonstrated by the data presented by Kugler: 85% of all polytrauma deaths are still alive in the first five minutes after the accident; the help delivered during the first ten minutes lowers the mortality for about 20%.[4]

Shoemaker and co-workers, after demonstrating that survival in patients after an acute injury was typically correlated with a grater-than-normal capacity for oxygen transport, found that three patient groups could be differentiated according to the outcome and the degree of oxygen debt.[5] Patients who reversed their oxygen debt early after acute injury, survived without organ failure and without the need for intensive care; patients who stopped accumulating oxygen debt within 12 to 24 hours after injury developed organ failure but survived after a period of intensive therapy; and patients who continued to accumulate an oxygen deficit beyond 24 hours after injury did not survive, despite a prolonged period of intensive therapy. Multiple organ failure is the cause of death of more than 75% of late deaths after trauma,[6] and sepsis is certainly implicated in many of these deaths, but the occurrence of either of these complications is largely determined by the oxygen debt accumulated in the early phase of polytrauma.[7]

Preventive measures like speed limit, optimal signalization, educational measures, frequent police controls and a more restrictive penalty system for delinquents, could lower permanently the incidence of traffic accidents in the jeopardized group – male drivers of cars or motorcycles, aged 18–24, drunk, mostly between 10 and 12 p.m. on weekends.[8]

THE TRAUMA CARE SYSTEM

At the site of the accident, the first witness has to recognize the nature of the emergency, alert the emergency medical service (EMS) and provide first aid, aiming at the maintenance of adequate tissue oxygenation. The effectiveness of the first witness depends on public education. Teaching people to recognize life-threatening conditions, to apply the ABCs of resuscitation, and to alert the EMS system must be an integral part of the general education programs, according to the principle that schools are for teaching.[8-10]

Unfortunately, the experience of our EMS teams is that bystanders are extremely passive, even aggressively trying to force the EMS team to leave with the patient before completing the preparations for transport. Once the emergency is recognized, the public must have access to a national or regional telephone number to activate the EMS system. Ideal medical care for trauma victims is a multifaceted discipline requiring around-the-clock availability of highly trained specialists in emergency medicine. After arriving on the scene, the EMS team should take care of the patients at the scene and during transport. Further diagnostic and therapeutic work should be done at the emergency department. When indicated, undelayed surgery and/or intensive therapy should be performed.

THE ROLE OF THE PHYSICIAN

Despite controversies about the involvement of physicians in the EMS, in the panel discussion at the 7th World Congress on Emergency and Disaster Medicine in Montreal, in May 1991, a conclusion was reached that physician's involvement in EMS is desirable at three different levels:

– off-line, involving the organization of EMS;

– on-line, involving the quality assurance of prehospital care;

– and finally, in the field, providing actual patient care in a selected number of trauma cases and other emergencies.

Indirect evidence for the benefit gained from the presence of a properly trained physician in the prehospital phase is also offered by Rommens et al.[11-13]

They reviewed the medical charts of all patients who died after major trauma, either during transport or in the emergency department, first for the year 1986 alone, and than for 1986 through 1988 combined. Two important conclusions can be drawn from this retrospective study. First, having an emergency physician present at the scene can significantly improve the prognosis of a patient with major trauma. Second, the prognosis of a major trauma patient, who is transported directly to a first level trauma center, is better than the prognosis of a patient who is transported to the nearest hospital and only later to a trauma center.

The physician's presence is essential not only for quality assurance, but also because of the skills and judgment he or she brings, both to the scene and to the outlying hospitals, and because of the physician to physician contact involved in the interhospital transfer. Helicopter intervention is considered best when one-way road transport is estimated to exceed one hour.

PREHOSPITAL TRAUMA PROTOCOL (table 2)

The prehospital trauma care protocol is based on a multidisciplinary approach that is periodically revised. It assigns specific tasks to the emergency physician (EP), the trauma surgeon (TS), the anesthesiologist (ANES), the neurologist (NEURO), the radiologist (RAD), and the emergency technician (ET) or emergency department nurse (EDN). The EP is in charge of the coordination of all activities called for in the application of the protocol.

Table 2. The prehospital phase of the trauma protocol

FIRST PRIORITY
- Airway control
- airway obstruction: oral endotracheal intubation under direct laryngoscopy with immobilization of the head (EP+ET)
- if patient is agitated or bites but is ventilating adequately, blind nasotracheal intubation (EP)
- Determine respiratory frequency (ET)
- Provide controlled ventilation if the patient is unconscious, in shock or in hypoventilation (EP+ET)
- Perform thoracocentesis midclavicular, second intercostal space if tension pneumothorax and/or subcutaneous emphysema present (EP)

SECOND PRIORITY
- Evaluation of cardiac activity
- carotid and femoral pulses (EP+ET)
- CPR if indicated (EP+ET)
- ECG monitoring (ET)
- systolic blood preasure control (ET)
- IV access and fluid substitution (EP+ET)
- minimum 14 gauge canula
- maximum access time 2 min
- Ringer lactate (maximum 2 l)
- plasma substitute (maximum 2 l)

THIRD PRIORITY
- Cervical collar if unconscious or suspicion of cervical trauma (ET)
- Glasgow Coma Scale (EP+ET)/Trauma Score (ET)
- Immobilization on vacuum mattress (ET)
- Sterile dressing of wound and stanching of hemorrhage (ET)
- Repositioning and immobilization of fractures in pneumatic splints (EP+ET)
- Announcement of arrival of trauma victim(s) at the ED (EP)

EP=emergency physician
ET=emergency technician
CPR=cardiopulmonary resuscitation
ECG=electrocardiogram

IN-HOSPITAL TRAUMA PROTOCOL (table 3)

The latter part of the "First Golden Hour" will be spent in the emergency department. Here, as in the prehospital phase, a strict trauma protocol must be in place around the clock.

This protocol dictates the sequence of actions to be performed, as well as the team member in charge of each action. Specific task identification is as important as the protocol per se in determining the time necessary to complete the entire protocol, and in getting the patient in as good a condition as possible for the operating theater.

The in-hospital trauma protocol can be divided into two major parts. The first part (sections 1 to 5 in table 3) concerns the primary evaluation and resuscitation and must lead to life-saving surgery whenever surgery is the only way to control ongoing hemorrhage. The second part (sections 6 to 10) concerns secondary evaluation; it starts when oxygen transport to the tissues is adequate and leads, when indicated, to emergency surgery and/or intensive therapy (Delooz H.H.)

Table 3. The in-hospital phase of the trauma protocol (for all patients, also for secondary transfers)

1. General evaluation

1.1 Ventilatory pattern, frequency and symmetry, consciousness, color and temperature of the extremities, active movement of four limbs, pulse and blood pressure
(EP+TS+NEURO+RAD+EDN)

1.2 Reevaluation of all prehospital invasive techniques (endotracheal intubation, IV, thoracocentesis) (EP or ANES)

1.3 Blood sampling and additional IV access (minimal 14 gague)

1.4 Typing and crossmatch (TS+EDN)

2. Neurologic evaluation

2.1 Pupils, Glasgow Coma Scale (GCS), active movements, Babinski reflexes (NEURO)

2.2 GCS 8: sedation/anesthesia-muscle relaxation, controlled ventilation (EP or ANES+EDN)

3. Patient in SHOCK (=cold, clammy, pale or cyanotic extremities)

3.1 Extra IV access (EP or ANES or EDN)
- plasma substitute
- packed red cells (0-neg)
- top priority blood typing and crossmatch (ANES)

3.2 Call senior surgical staff (TS)

3.3 Central venous line: basilic vein - internal jogular vein (subclavian vein)
(EP or ANES+EDN)

4.1 Gastric tube (EDN+ANES)

4.2 Rentgenograms in therapy room (RAD+EDN+TS+ANES):
- rentgenogram of thorax in anterior/posterior position
  Special attention: diaphragm and mediastinum are not ideally visualized in lying position
- rentgenogram of cervical spine (including C7-Th1)
  Special attention: pull on arms
- pelvis
- other rentgenograms to be taken later in radiology lab

4.3 Thoracocentesis for pneumothorax:
midaxillary line - 5th intercostal space (TS+EDN)
Special attention: careful auscultation of the thorax before insertion

4.4 Bladder catheter (EDN)
Special attention: if pelvic fracture and/or lesion at the level of the external genital area:
TS must perform catheterization or decide on suprapelvic puncture

5. IF SHOCK PERSISTS and external blood loss is not evident

5.1 NOW perform abdominal paracentesis (TS):
- infuse 500 ml saline solution at body temperature if paracentesis is negative, leave material in place

5.2 Decision on lifesaving surgery to be made by senior surgical staff on available evidence

6. If circulatory status is stabilized

6.1 Complete examination of the patient (TS+NEURO+EP)

6.2 If patient is unconscious and was in shock, perform abdominal ultrasonography and/or abdominal paracentesis (RAD+TS)

6.3 Determine indication for neurologic technical investigations:
CT scan of the scull (NEURO)

6.4 Determine indication for other technical investigations:
arteriography, CT scan of spine, pelvis...
(TS+EP)

6.5 Determine indication for consultations:
ophtalmoglogy, otorhinolaryngology, maxillofacial surgery... (TS+EP)

7. Agitation and restlessness often indicate cerebral hypoxia: sedation and muscle relaxation may be indicated
- after neurologic evaluation
- reversible sedation/anesthesia and immobilization (ANES or EP)

8. Arterial line
- for BP monitoring and repeated blood sampling
- radial artery, brachial artery, femoral artery (ANES)

9. Urgent surgery is decided on by surgical staff, consulting anesthesiologist (TS+ANES)

10.1 Tetanus prophylaxis (EP)

10.2 Prophylactic antibiotic therapy, if indicated (ANES or TS)

EP=emergency physician
TS=trauma surgeon
NEURO=neurologist
RAD=radiologist
ANES=anesthesiologist
EDN=emergency department nurse

SPECIAL PROBLEMS IN MAJOR TRAUMA

CRANIOCEREBRAL TRAUMA (CCT)

The mortality of patients with severe head injury ranges from 30 to 40%; among the survivors a considerable number remain moderately to severely disabled.[14-20]

The prognosis of the patient with multiple trauma usually depends upon the type of brain injury.[15] The primary brain lesion produced by trauma cannot be influenced: therefore, emergency medical care must avoid or ameliorate secondary brain injury.

Hypoxemia, hypercarbia and arterial hypotension are the most common causes of secondary brain damage after head injury.[19, 21-23] These secondary insults may arise also from a variety of other causes, e.g., traumatic arterial disruption, cerebral vasospasm and increased intracranial pressure (ICP). Prolonged episodes of arterial hypotension are particularly deleterious for the injured brain.

The most crucial factor for success is time that will be determined by the speed of the emergency medicine system, the efficacy of early diagnostic work up of cerebral and non cerebral pathology, and the immediate availability of a neurosurgeon and a trauma surgeon. Despite the available diagnostic procedures in the hospital, the clinical neurologic examination of the patient with severe head injury in the prehospital phase as well as in the ongoing care, has the priority.

The Glasgow Coma Scale enables the objective assessment of the state of consciousness[24] (table 4). Furthermore, the size and reaction of the pupils, the pulse and blood pressure as well as the respiratory pattern should be noted. The initial stabilization of respiratory and cardiac function is of paramount importance. The airway should be cleared and endotracheal intubation performed at the first suspicion of inadequate respiratory effort or depression of protective airway reflexes.[25] Indications and risks of an endotracheal intubation are noted in table 5 and 6.[26]

Table 4. Glasgow coma scale[36]

Eye opening	
Spontaneous	=4
To voice	=3
To pain	=2
None	=1
Verbal response	
Oriented	=5
Confused	=4
Inappropriate words	=3
Incomprehensible words	=2
None	=1

Motor response	
Obeys command	=6
Localizes pain	=5
Withdrawal (pain stimulus)	=4
Flexion (pain stimulus)	=3
Extension (pain stimulus)	=2
None	=1

Table 5. Indications for intubation of polytraumatized patients

- cardiopulmonary resuscitation
- airway obstruction
- coma, GCS less than 8 points
- respiratory insufficiency
- shock (II and III degree)
- chest trauma with hypoventilation
- diagnostics with analgosedation

GCS=Glasgow coma scale

Table 6. Intubation risks in polytraumatized patients:

- to short time to recognize the predictors of intubation complications
- full stomach
- cervical spine injuries
- injures to the soft tissues of the neck
- already existing illness
- midface injuries
- chest injuries
- burns (face and neck)
- smoke inhalation
- hemodynamic instability

The beneficial influence of early intubation and controlled artificial ventilation on neurological outcome in severe head injury is proven.[27] The method of choice should be either the "rapid sequence induction" with the Sellick maneuver or the fiberoptic intubation in awake patient. Extreme retroflexion of the head should be avoided because of possible injuries to the cervical spine. Sufficient sedation should be performed to prevent critical rise of ICP during intubation. The most common drugs are thiopentone, benzodiazepins, ethomidate and lidocain.[28,29] Muscle relaxation should be used only by experienced and only in conditions where sufficient assistance is guaranteed and the equipment for eventual complications is available.

Controlled hyperventilation with pCO_2 values between 30 and 35 mmHg lowers the ICP and should be instituted beyond the level of 20 mm Hg of ICP for a period longer than 15 minutes. Marked hypocarbia (pCO_2 below 25 mmHg) can lead to vasoconstriction of cerebral blood vessels and to a fall in cerebral blood flow.[30] The effectiveness and the outcome of long term hyperventilation are assessed different.[31]

Even in severe head trauma, the blood loss is not severe except in case of a massive hemorrhage from the scalp vessels or scull fractures.[32] Therefore, low systolic pressure values always rise the suspicion of blood loss elsewhere.

Intravascular volume expansion may be needed to replace the blood loss and to keep the cerebral perfusion pressure above 60 mmHg, and the amount is more important than the choice of IV fluids.[33] Since hypoosmotic solutions can aggravate the cerebral edema,[34] only isoosmotic solutions should be used. Glucose solutions should be avoided for three reasons:

– free water increases the cerebral edema

– patients with severe head trauma already have increased blood sugar values because of the "stress response"

– the negative influence of hyperglycemia on neurological outcome after head injury is proven.[35]

To reduce ICP, head and trunk elevation up to 30° (reversed Trendelenburg position) in neutral position of the head is recommended. Head and trunk elevation of more than 30° leads to a rise of ICP.[36] Although very simple and very effective, this measure is often forgotten and is performed by the EMS only in 20% of patients with head injury.[37]

DRUG THERAPY

In the prehospital phase, barbiturates and benzodiazepins as well as strong analgesics are recommended for sedation of restless patients.

The controversy about dexamethason in the therapy of severe head injuries remains. Recommendations for high dosage therapy with corticosteroids[38-40] are based upon experiments on animals[41] and a double blind study[42] proving the short time benefit by reduction of cerebral water content and vasogenic edema. On the other hand, a long term benefit in the outcome, quality of life, duration of unconsciousness or maximal rise of ICP has not been proven.[43] Furthermore, an initial high dose of dexamethason up to 100 mg IV seems to do no harm and can be recommended.

Osmotic diuretics, e.g., glycerin, sorbit and mannit need an intact blood-brain barrier to develop their full efficacy. As this is rarely guaranteed in severe head trauma, the application of osmotic diuretics in the early phase of head injury should be avoided.[44]

THORACIC TRAUMA

The mortality after thoracic trauma reaches from 25 to 75% depending on the involvement of multiple additional organ injuries.[45] In 80% of thoracic trauma victims injuries to other regions of the body are present, in about 30% there is an associated head injury.[46]

About 30% die from head injury, 37% of cardiorespiratory insufficiency and about 50% from shock.[47]

In most Western European hospitals, thoracic injuries are due to blunt trauma (more than 90%) and are related to road traffic accidents (more than 70%). Rib fracture is the most common sign of a direct blow to the chest. Penetrating injuries include stab wounds, gunshot wounds and impalement on a foreign body. More than 80% of all penetrating chest wounds cause hemothorax and nearly all cause pneumothorax.[48] The majority of the injuries can be managed appropriately with oxygenation, intravenous fluid replacement and tube thoracostomy. The current indications for chest tube thoracostomy include traumatic hemothorax, pneumothorax and hemopneumothorax. Nevertheless, the insertion of a thoracostomy tube is not without any danger. Even in the controlled emergency center environment, trocar chest tubes have been inserted into virtually every intrathoracic organ and many of the upper abdominal organs. Therefore, the only conceivable condition for tube thoracostomy in the prehospital situation is a tension pneumothorax. The best location for urgent tube thoracostomy is in the midaxillary line at the level of the male nipple. This rather high location avoids injury to the diaphragm and organs beneath it. In the field, this drain is connected to the Heimlich valve or the glove finger, in the hospital environment the underwater seal system is usually employed. In my opinion, the massive tension pneumothorax is easy to recognize, and the chest tube thoracostomy can be sufficiently trained on corps. In the past 10 years not a single thoracotomy was performed by our EMS physicians.

Therapy of penetrating wounds includes closure of any open wound (first by occlusive dressing), and insertion of a chest tube for the control of pneumothorax and hemothorax.

During the management in the emergency department, the obligatory chest x-ray does not show the liquid level of the hemothorax when taken in the supine position.

In 70% of patients, rentgenographic changes occur within one hour after injury. In the remaining 30% there may be a time lapse of 4 to 6 hours between the time of injury and the appearance of radiographic abnormalities.

Therefore, it is sometimes useful to repeat the chest x-ray during the management in the emergency department. An upright chest film can show an intrathoracic accumulation of more than 200 ml of blood, and a supine film may miss collections of up to one liter.[48]

ABDOMINAL TRAUMA

Unrecognized injury to intraabdominal contents, remains a distressingly frequent cause of preventable death. In about 10% of all trauma related deaths the blunt or penetrating abdominal trauma is the main cause of death.[49,50]

More than a half of all patients with blunt abdominal injury has at least one other system injury.

The appropriate management of abdominal trauma depends on a careful initial evaluation, the timely use of diagnostic procedures, and vigorous therapy directed at immediate life threatening problems.

Blunt trauma is the most common mechanism of injury to the abdomen, related mostly to the consequences of motor vehicle accidents. In peace, most penetrating abdominal injuries are caused by knife wounds.

The evaluation of patients with abdominal trauma is critical, because errors in the choice or interpretation of tests, and delays from unnecessary studies can have profound effects on the outcome of the patient. Patients presenting with refractory hypotension, uncontrollable external hemorrhage, viscera extruding from a wound, free abdominal air or other acute states, all require immediate surgery.

Abdominal injury may be diagnosed very easily when there is damage to the abdominal wall and abdominal contents are protruding or are obviously injured. Patients with blunt abdominal trauma are often difficult to evaluate, especially when polytraumatized and/or unconscious.[51-53] Sometimes, the only indication of intra-abdominal bleeding will be the shock or postural hypotension.

Physical examination of the injured abdomen after blunt trauma is less informative and potentially more misleading than for any other body system involved in major trauma.

Inspection for ecchymoses and abrasions, signs of peritoneal irritation or gastric distension can be useful but unreliable. Gentle pressure over the lover ribs establishes whether or not rib fractures are present: there is a 20% chance of splenic injury and a 10% chance of hepatic injury with fractures of the left and right lower six ribs respectively. The flanks should be palpated and the iliac crest and symphysis pubis compressed to establish the possibility of a pelvic fracture (massive blood loss!). Rectal examination is mandatory.

Hematological and blood chemistry values are of limited use immediately following blunt abdominal trauma, but the baseline tests are important because subsequent changes may be the first sign of an occult injury. Hematocrit reflects the balance of acute blood loss, the endogenous plasma refill and the administration of crystalloids. A leukocytosis following blunt abdominal trauma is common and generally nonspecific. Urine analysis should be an integral part of the work-up for all patients with blunt abdominal trauma, to detect otherwise asymptomatic urological trauma.

Radiology can be helpful in detecting associated thoracic or diaphragmatic injuries, free intraperitoneal or retroperitoneal air, rib, pelvic or vertebral fractures. Major kidney ruptures are invariably associated with gross hematuria that clearly requires an early pyelogram.

Repeated analyses of the results with the diagnostic peritoneal lavage have documented an excellent sensitivity and a low false negative rate.[52-55] With the use of either open or closed technique in patients with classic indications, complications have been very rare.

The advantages of ultrasonography are: noninvasiveness, it can be performed by residents in the emergency department, it examines the thorax and retroperitoneum in addition to the peritoneal cavity and confirms the presence of a hemoperitoneum in five minutes. As a noninvasive, any time repeatable procedure, it should be performed whenever injury of the intra-abdominal structures is suspected. In about 80% of cases it is possible to establish the presence of blood in the peritoneal cavity.[51,52,55] It is of course limited in the assessment of acute hollow visceral perforation. Peritoneal lavage cannot be replaced entirely by sonography as the diagnostic method of choice in blunt abdominal trauma.

CT is indicated in hemodynamically stable patients with a known injury to the spleen, liver, kidney or pancreas when non-operative management is chosen.

Abdominal aortography and splanchnic angiography are rarely warranted for the evaluation of acute abdominal trauma.

For the diagnostic work-up in the hospital, in the case of blunt abdominal trauma, peritoneal lavage and ultrasonography, with a "hit rate" of almost 100%, will be the most important aids when it comes to deciding on the need for surgery.

INJURIES TO THE LOCOMOTORY SYSTEM

Clinical signs of injuries to the locomotory system are the deformation of the limb, pain, swelling, wounds, eventually with protruding parts of bones. The signs of injury to the spinal column are often overseen.

Open fractures and wounds should be covered by sterile dressings on the site of emergency and not be uncovered until the definitive surgical procedure. Especially the hospital germs are dangerous in causing infections.

In his study on 199 open fractures, Rojczyk found out that open fractures without a sterile dressing had the infection rate five times higher than the covered ones.[56]

The reposition before the immobilization should be performed with a strong traction along the axis. This diminishes the pain and prevents further injuries to the nerves and blood vessels. The most favourable immobilization means for transport, in cases of limb fractures, is the application of inflatable, "chambered" splints, or the bedding of the victim on individually moldable, evacuable mattresses.[57]

CONCLUSIONS

The initial management of the severely traumatized patient on the spot, requires the identification of possible life threatening complications: Airway, Breathing, Circulation/Cortex. A free airway is mandatory and oxygen should reach the brain.

Endotracheal intubation and, when necessary, artificial ventilation should be instituted. A multiple trauma patient is a spinal cord trauma victim until proved otherwise.

Hypovolemic shock should be treated as early as possible and at least one large bore (12 - 14 gauge) IV line should be placed and fluid replacement should be started. Traumatic shock and hypovolemia are often underestimated although they are responsible for the fatal outcome in as many as 30% of the patients. A patient in traumatic shock need not be unconscious. A conscious and cooperative patient misleads the emergency physician often to undertake inadequate measures on the spot.[58]

It lasts often hours (maximum 8-10 hours) before the fall of the hemoglobin value reflects the whole extension of blood loss.[59]

Measurable blood pressure alone does not reflect the severity of a developing shock. The pulse quality and skin signs are more suitable.[60] Therefore, in the early phase of polytrauma neither the hemoglobin value nor the systolic pressure are reliable factors in predicting the real blood loss.

The data on the preventable death in the management of major trauma presented by Champion and Washington,[61] show the importance of lifesaving surgery – the decision should be brave and fast, especially in patients with hemodynamic instability despite massive fluid replacement (table 7).

Table 7. Causes of preventable deaths in trauma victims

• life saving surgery delayed	42%
• life saving surgery not performed	40%
• mistakes in organization	8%
• other	10%

Concluding, the outcome of trauma victims depends on the rapid access to the EMS, examination on the spot, free airway, aggressive fluid replacement, team work in the emergency department and a brave and expeditious surgeon.

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