INITIAL TREATMENT OF SEVERELY INJURED ATHLES

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Introduction.

The vast majority of the injuries seen in ski sport do not threaten the lives of the athletes. Overall statistics of sport injuries and skiing injuries in particular show that about 80 % of the athletes suffer minor injuries (Abbreviated Injury Scale 1 and 2). This means that the majority do not suffer from sequelae after the injuries. There are, however, in every sport, situations that might lead to high energy trauma. Such situations might result in severe or life threatening single injuries or multi-trauma to the athletes. Even if the number of fatalities and permanent disabilities are rare, it should be an obligation to the responsible organization to give recommendations for initial treatment at the scene of the accident. The first minutes of treatment after a severe injury are of utmost importance in reducing the medical consequences of the accidents.

Based upon many years of experience with athletes at an international level and daily work as head of a university hospital trauma department I have set down some guidelines. They correspond to the current international norms for the primary care and treatment of severely injured victims of accidents of any type. The guidelines must be looked upon as basis to contribute to secure the initial treatment of our injured athletes at the level of quality that is required in today's emergency medical care.
The guidelines are based upon the survey of 205 international published articles concerning treatment of severe injuries.
In this edition a chapter on the general principles of examination and treatment is worked out. Detailed guidelines on the treatment of the different types of injuries is seen the later chapters. A minor chapter concerning the initial management of athletes with head injuries is added, due to the fact that this management is important and some times difficult.
Along with a proper initial prehospital treatment, hospitals with a high qualification in trauma care should take over the treatment. A close cooperation between the medical staff of sports Organizers and the hospital based medical care must be established.

Oslo August 2016

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GENERAL PRINCIPLES

Main aims:

Save life
Initial examination, stabilization and treatment of the patient
Reduce sequelae
Transport the patient to hospital or a trauma center if possible, as fast and as safely as possible. The time of transportation, type of injury and injury severity are decisive for the prehospital treatment to be carried out immediately.

"Load and go":
If a trauma center is less than 20 minutes away, basic stabilization at the scene of the accident should take place. This is particularly the case for penetrating injuries. Initial stabilizing of the patient is carried out including establishing free airways, oxygen supply and try to stop major blood loss.
If the transportation time to the Trauma Centre is more than 20 minutes, the patient should be examined more thoroughly, and be thoroughly stabilized before the start of the transportation.

Initial assessment at the sight of the accident

The accident site must be secured. The ambulance, helicopter or other adequate devices of transportation must be alarmed as soon as possible. The hospital or the trauma center should be informed as soon as possible, enabling them to start the preparation of their part of the treatment of the patient. Important points to be aware of for further information to the hospital are mechanism of trauma, time of the accident, the patients name, age, sex and general condition as to respiration, circulation, level of consciousness, visible physical injuries, estimated time of arrival at the hospital.

Evaluation and primary treatment before longer transportation (more than 20 minutes)

Life threatening factors are to be evaluated and treated in the following priority:

A airway (free airways, stabilizing of the neck)
B breathing (ventilation)
C circulation (circulation control or external bleeding)
D disability (neurological status including Glasgow Coma Scale)
E exposure (after evaluation of the patient; NB! avoid hypothermia)

A Free airways, stabilizing of the neck.
Ensure that the patient has a free airway, oxygen supply; stabilize the neck if injury to the neck is suspected (unconscious patient, patient with neck pain), intubation or narcosis if necessary by an anaesthesiologist "in the line" by stabilizing the neck

B Ventilation.
Evaluate the respiratory movements; check for pneumothorax, and deal with this by adequate cannulation if the patient has insufficient ventilation.

C Circulation.

Control external bleeding. Evaluate the status of circulation. Stop major external bleeding. In the case of amputation, put on a compression bandage. Remember elevation of the bleeding part of the body. If possible establish intravenous infusion through two major venflons.

Hypotensive - intravenous fluid resuscitation is necessary for patients in shock with unknown focus of bleeding. In young patients with penetrating injuries, the blood level should be raised only sufficiently to make the patient conscious. A palpable pulse of the arteria radialis, that means a systolic blood pressure of 80-90 mm Hg, gives a sufficient pressure of perfusion. If there is an additional severe head injury, the situation is complex. A cerebral perfusion pressure has to be prioritised if the overall situation allows it (trauma room).

D Neurological status.

Carry out Glasgow Coma Scale evaluation. Follow the level of consciousness from the moment of the accident until the patient is left in the hospital. If GCS above 8 it is indicated to give narcosis/intubate the patient. Hyperventilation can become necessary if there are serious signs of increasing intracranial pressure.
Infusion of Mannitol 1 mg per kilogram bodyweight within 20 minutes.

E External evaluation of the patient avoid hypothermia.

Make a quick evaluation of the total injuries. Isolate the patient from cold surroundings as soon as possible. Give pre-warmed infusion if possible. Cover wet clothing to reduce the heat loss. Wet clothing is to be removed only when the patient is in warm surroundings. Volume treatment - use two major intravenous cannulas. Do not waste time by putting in a central venous catheter initially. In case of heavy volume demand, vena saphena magna should be used, approach by malleolus medialis.

Proposal for intravenous infusions:

Ringer Acetate 1000 ml + 1000 ml.
Macrodex/NACL 500 ml + 500 ml.

By hypoperfusion this is given rapidly intravenously. If the patient after these infusions is still unstable it means that there is still av bleeding, and that the blood loss is more than 2-3 liters. In such situations there is no time to lose only “load and go”, trying to stabilize the pressure during the transportation.

Severely injured children:

Evaluation and resuscitation of multi-traumatized children:
Follow the same general principles as for adults. Oxygen should be given. Manipulation of the airways might easily lead to spasm of the larynx which is extremely dangerous. Intubation must be carried out only by extremely well qualified personnel. Dilatation of the ventricle might occur, and aspiration might be indicated.

Monitoring:
Be aware of the danger of bradycardia. This might be due to poor oxygenation, insufficient ventilation or hypovolemia. Cannulation of the veins in children might be difficult. Remember therefore the possibility of intra-osseous cannula. When there is a need for volume therapy 10-20 ml per kilogram Ringer Acetate should be given. Thereafter 10 ml per kilogram per hour.

General principles for transportation, monitoring and documentation:

All initial treatment has to be secured and must not be lost during the transportation. The patient must be continuously monitored and evaluated as to level of consciousness, respiration and circulation. The clinical assessment is the most important of all. ECG, SpO2 and BP are to be monitored if possible during the transportation. A copy of the patient's journal written at the scene of the accident and during transportation, along with an oral report, has to be given to the trauma team at the arrival of the hospital/trauma center.

HEAD INJURY

It is important to prevent hypoxia, hypercarbia and hypotension.

Mechanism of trauma

Severe head injuries seen in sports take place mainly in high velocity sports such as alpine skiing, motorsports including water motor sports, boxing, and less popular sports such as ski jumping and freestyle skiing. Violent contusion to the head with deceleration and rotation forces are frequently causes of severe injuries.

Diagnosis

A proper assessment of the mechanism of trauma is necessary for evaluation of injuries. Examination must include evaluation of the neurological status including the level of consciousness, paresis or other peripheral neurological findings, dilatation of one or both of the pupils, ophthalmoscopy, signs of fractures of the cranium or its base (periorbital haematoma, blood or fluids from ear, nose, throat etc.)

Necessary treatment of severe head injuries

As the primary injury can rarely be treated at the site of the accident, basic primary care procedures must be carried out. For this reason it is of utmost importance that adequate ventilation and circulation are maintained, but it may also be necessary to induce narcosis.

There has to be a low threshold for intubation. The Glasgow coma score is often used as a guideline for neurologically induced respiratory deficiencies. If the patient's focal neurological findings are deteriorating, intubation with pre-oxygenation must be considered as a possibility. Cerebral perfusion pressure has to be above 70 mm hg (cpp = map - icp). This means that systolic blood pressure must be greater than 100 mm hg.

NB! Be aware of and avoid hypertensive reactions in connection with intubation or other types of manipulation.

Intubation

Crash intubation with pre-oxygenation.
Priming 2 - 3 minutes before intubation with one or more of the following medications should be considered in patients with proper autorespiration.

NB! Beware - Danger of respiratory depression.

* Pancuronium 0,01 mm/kg (decreases the ICP response to Sxamethonium).
* Fentanyl 3-5 mg/kg (decreases endogenous stress response to intubation).
* Diazepam 0,1 - 0,15 mg/kg (decreases ICP response).
* Alternatively,Didazolam 0,07 mm/kg (decreases ICP response).
  (Midazolam in the presence of Hypovolemia may cause a dangerous hypotension).
* Lidocaine 0,5 mg/kg (decreases ICP response to intubation).

Inititiation of narcosis: one of the following drugs:
* Thiopentone sodium 3 - 5 mg/kg - obs! status of circulating volume.
* Fentanyl 5 - 10 mg/kg.
* Ketamine 1 - 2 mg/kg - if the patient is hypotensive (has to given very slowly to avoid shunting and fall in the oxygen saturation).

Muscle relaxation:
* Suxamethonium 1 - 1,5 mg/kg (good ventilation can buffer increase in ICP).
*Pancuronium or other not depolarizing drugs of the maintenance.

Intubation technique:
For oral intubation apply jaw thrust. One may also apply slight pressure on the cricoid process as well as slight extension of the cervical column (beware cervical trauma). If necessary, nasal intubation can be used if there is bleeding in the mouth, throat or for other reasons where oral intubation is difficult.

Further treatment:
Hyperventilation (150 ml/kg/min). With signs of rising ICP and deteriorating focal neurological findings which do not respond to controlled ventilation give:

* Mannitol (150 mg/ml) 0,25 - 0,5 g/kg, repeating after 2 hours.

With a patient- hospital transport time of more than 30 minutes the bladder should be catheterised.
Antibiotic (penicillin, sinacef or keflin - if there are signs of basal skull fractures or other open fractures in the region.
Volume substitutes are to be given, but avoid intravenous infusions containing glucoids (which could increase the intracerebral pressure –hemaxel is a good alternative).
During transportation:
To avoid unnecessary movement of the neck, a rigid cervical collar should be used. The collars must not compress neck veins or arteries and must allow access to the trachea.
The head and chest should be elevated to about 30 degrees, maintain analgesia, sleep and relaxation with medicaments. Respond to changes in circulation and blood pressure. Avoid cramps Use headset to decrease noise in helicopter or light plane flights.

Primary treatment of less severe head injuries

The patient should lie on his side; proper history and examination as above. Continuous observation and evaluation.

A record must be kept of the neurological status before any medication or narcosis.

Continuous observation of:
Blood pressure, pulse frequency (with monitor), pulse oximetry, status of the pupils, level of consciousness (Glasgow coma scale), respiratory frequency. For those intubated, control the respiratory pressure, status of ventilation volume (respirometrics by use of ventilators).

Rapid and safe transportation to the nearest neurosurgical unit is essential. Communication with a neurosurgeon is recommended if flight time to a neurosurgical unit is too long and admission to a nearby minor hospital may be necessary in emergency situations.

SPINAL INJURIES

Main aim

Prevent secondary injuries due to pressure against or dislocation of the medulla or spinal nerves.

Mechanism of trauma

High velocity sports including those with rapid acceleration, deceleration and rotation of any part of the spine. Injuries are seen in sports like motor sports, contact sports, alpine skiing, freestyle skiing and ski jumping. Injuries are also seen in wrestling, boxing and gymnastics.

The majority of the injuries to the spine result from trauma or excessive movement of the spine in the following mechanisms:
Flexion, extension, rotation, lateral bending, compression and distraction. These forces can cause vertebral fractures, dislocations, subluxations, cord contusions or vascular damage.

Initial assessment

The maintenance of the airways, breathing and circulation remains the primary necessity. It is possible to provide adequate ABC care while focusing on limiting spinal movements. Once stabilised, the patient should be transported immediately.

Management begins with an assessment of the accident scene and mechanism of injury. Since most spinal injured patients have been involved in trauma, the rescuer must ensure that the accident scene is safe before initiating primary care. Hospital personnel must learn to pay attention to reports from first responders, either over the radio or upon arrival at the emergency department when advice on the use of spinal motion restriction techniques are given. Similarly when examining ambulatory patients, hospital personnel must endeavour to understand the mechanism of injury in order to appropriately assess the need of initiating spinal motion restrictions.

Airways

The critical component of airway maintenance is to ensure an open and clear airway.

Open the airway if breathing is absent or if the patient is unable to sustain his own airway. The level of training of the first responder will naturally decide the sophistication of airways management available to the patient.

Hyperextension of the head as a method for opening the airway should only be used when all other methods have failed. Have suction available in case of vomiting.

Breathing

Assess not only the presence of breathing, but also the rate and depth of respiration.

Hypoxia is a major factor in cord damage. Administration of oxygen should begin as soon as possible.

Circulation

A. If CPR is indicated, attempt to perform with a minimum of cervical movement, realizing however that the maintenance of ABC (including managing major bleeding) takes priority over spinal care.

B. As a minimum safety procedure, one can tape the head to the backboard during CPR. Taping alone reduces flexion, lateral flexion and rotation until proper spinal care can be instituted. Ensure that the patient's body is secured to the backboard in such a way that the neck is pivoted.

Disability, neurological examination

Follow your local protocol and conduct a neurological examination to determine the level of consciousness and extent of neurological damage. The use of the Glasgow coma scale is an essential part of neurological examination in addition to determination of the level of lower spinal injuries.

It is important to conduct as thorough an examination as possible to determine the presence of additional injuries.

In general, secure adequate ventilation and circulation and prevent hypothermia. Due to peripheral dilatation of vessels below an eventual spinal injury, the danger of hypothermia may be severe and even life-threatening. It is important to adequately clothe the patient, set up a warm infusion and after having secured the injured region, move the patient to a warm and safe environment.

Oxygen can be given at a rate of 6 - 10 liters per minute by mask. If necessary oral intubation must be carried.

Follow your local protocols for volume substitution.

NB! Hypotension and bradycardia may occur due to absence of sympathetic stimulation in spinal injury.
Beware also hypertensive emergencies.

Principles of spinal motion restriction

A. Most patients should be placed with their head and neck in a neutral position.

B. Neutral segmental alignment is beneficial for 2 main reasons.

1. Neutral positioning allows maximum space for the cord within the vertebral column. This is important because oedema and the resultant pressure may contribute to a cord hypoxia. Allowing maximum space for the cord reduces the potential for pressure injury.

2. Neutral position is generally accepted to be the most stabile position for the spine. Instability of the spine makes movement at the injury site more likely. Movement in the cervical spine changes the diameter of the cord and vertebral column, thus potentially causing additional pressure, increasing oedema, vertebral movement and the possibility of cord transection.

C. Radiographic examination is the only true way to determine the neutral position. Prehospital providers must estimate this position using good judgement based upon trained observation.

D. To estimate neutral position place the patient so the gaze is perpendicular to the long axis of the spine.

E. Maintain this position manually during treatment and ensure it remains consistent through out-motion restriction procedures. Consider the use of padding under the occiput in adults. Consider also the use of torso padding for children to assist the maintenance of the neutral position.

F. Moving a patient into neutral alignment is contra-indicated if movement causes neck or back pain or if resistance is met. In this event the patient should secured and transported in this position.

Cervical collar

Cervical collars must restrict motion safely and effectively. Safe motion restriction means that a correctly sized and applied collar does not alter the neutral segmental alignment of the vertebra. Cervical collars do not completely immobilize the head and neck by themselves. They limit motion during patient movements, as well as reduce the effect of compression forces. Cervical collars are but one component of a motion-restriction system and should not be used alone. No collar will function correctly, unless it is sized and applied properly.

Body restraining systems should prevent movement in the following directions:

1. Laterally or side to side.
2. Anteriorly or up from the board/stretcher.
3. Axial - Head to foot or loading and unloading of body weight during braking and acceleration.

Adults

Most adults will be put into extension when allowed to lie supine on a backboard - even with a cervical collar in place. To prevent extension, it may be necessary to place an amount of padding under the occipital area for support. This will also increase patient comfort.

Infants

Smaller children have large heads in relation to their body size. Supine placement will cause cervical flexion in many cases. To prevent this place an appropriate amount of padding under the shoulders and upper torso. When in doubt pad under the torso of an infant as it is always possible to add padding under the head in case of hyperflexion. This is generally seen in children aged 7 and under.

Only when the head is secured with a cervical collar, cervical motion restriction device and the body is appropriately restrained to a rigid spinal support device/vacuum mattress, should the manual motion restriction be released.

Transfer to a rigid spine support device.

The log-roll manoeuvre.

This procedure should only be carried out if the procedure is accepted as being standard medical treatment in your own country. The patient is rolled onto their side, a board is placed along the patient and then the patient rolled on the board. It is possible to cause movement of the lumbar spine and quite possibly the thoracic and cervical areas while log-rolling a patient. Keep this in mind and pay particular attention to eliminate as much of this motion as possible.

The flat lift

A second method of transfer is the flat lift. To perform this rescuers slide their hands under the patient, lift up and position the board under the patient. It it important to have enough personnel to properly perform this manoeuvre.

Scoop-type stretcher

This device works like a clam shell. Two halves are placed under the patient and then linked together. The patient is then lifted to a back board device and restrained. Most scoop stretchers are open along the spine, consequently they do not provide adequate spinal support and thus it is used in conjunction with a rigid board or other spinal support equipment.

Extraction situations

Patients with stabile vital signs who are trapped should be extricated using a vest type extrication device or a short back board (for example motor sport injuries). Patients in a critical condition, who are in need of rapid transport should be removed using a rapid extrication technique. This technique should be reserved for patients who have vital signs that are deteriorating.

Transportation and observation

In case of deteriorating neurological findings, rapid transportation to the nearest qualified hospital should be provided using helicopter or fixed wing plane. Observation during transport requires control of ventilation, circulation and retesting of neurological findings. Test the motor and sensory function in the limbs. Diagnostic testing of the level of injury has to be repeated every 15 minutes.

Infusions **Methyl prednisolone (solumedrol) has been documented to have effect on partial spinal injuries. It has to be administered in doses of 30 mg/kg to patients with neurological findings if transport to hospital takes more than one hour.**

Mannitol (150 mg/ml) 0,25 - 0,5 g/kg can be given to patients with neurological findings.

PRIMARY TREATMENT OF FRACTURES

(Except skull and spine)

Main aims

Prevent secondary damage, secure safe transportation, reduce the patient's pain, prevent later complications.

Mechanism of trauma

Fractures can occur in almost all sports. High velocity sports such as motorsports and winter sports can lead to situations where fractures occur. The majority of the fractures seen in sports are not life threatening. In spite of this they are, from an emergency medical point of view, of importance. Major fractures, mainly on the limbs, may under certain circumstances be a consequence of almost every type of physical activity.

Diagnosis

History of accident and trauma.
Signs of fractures, such as dislocation, malalignment, shortening of the limb in addition to pain and swelling.
Evaluate circulation distal to the limb injury.
Evaluate motor and sensory functions distal to the injury.

Priority

Thoracic, abdominal and CNS injuries must be treated before major fractures.

Primary treatment

Proper oxygenation, ventilation and circulation must be secured in accordance with accepted guidelines.
Analgesics may need to be given, eg. Morphine up to 0.3 mg/kg (careful with hypovolemic patients).
Antibiotics have to be given with open fractures, eg. Sinacef 20 - 25 mg/kg (= 1,5 gram for adults of 70 kg).

Volume Substitution

Heavy blood loss can occur with fractures of the pelvic and femoral region and this can lead to hypovolemia. Before reduction of the fracture or immediately afterwards, intravenous infusion via intravenous catheter must be instituted. Volume substitutes such as dextran or hemaxel should be started. If the accident occurs outside in a cold environment, prewarmed intravenous fluids should be given.

Reduction of fractures

Primary reduction at the accident site has to take place, otherwise there is a risk of reduced circulation distal to the fracture and a danger of skin and other soft tissue necroses and neurological damage. If an anesthesiologist is present, complete reduction can be carried out, by using, for example:Ketamine 0.25 - 0.5 mg/kg (if one choses to give premedication, diazepam 0.1 - 0.15 mg/kg or didazolam 0.07 mg/kg can be used).

In the absence of an anesthesiologist, a more refined reduction should not be attempted.

Stabilizing fractures

With fractures of the femur and the proximal part of the leg traction splints should be used, eg. Sager splint, Thomas splint, Donway splint. A traction load of approx. 10% of the patient's weight can be applied.

Pelvic fractures

In the case of severe bleeding, follow your local protocol. It is of utmost importance to exclude rupture of the diaphragm as well as the presence of intrathoracic or intra-abdominal injury. The earlier use of anti-shock trousers could be risky for these reasons. Careful external compression with broad bands/bandages can be used. This also gives some degree of stabilization and will reduce the pain.

Other major fractures:

Stabilize with vacuum or traction splint.

Observation

Observe blood pressure and pulse frequency particularly with fractures of the pelvic and femoral regions. Evaluate circulation distal to the injury, evaluate the neurological situation distal to the injury.

Prevent hypothermia.

Transport the patient to the nearest hospital qualified to treat these types of injuries. A transport vehicle capable of manouvering in the area of the accident is essential. Suitable transport to hospital facilities must also be available.

PRIMARY CARE OF THORACIC INJURIES

Main aim

Maintain oxygenation, ventilation, circulation, reduce the patient's pain, secure safe transportation to the nearest qualified hospital.

Mechanism of trauma

Thoracic injuries take place mainly in high velocity sports. Minor thoracic injuries are seen in almost every sport. In this connection, however, they are of minor importance as they do not threaten the patients' lives.

Many multi-traumatized patients have serious thoracic injuries. The combination of thoracic and cerebral lesions is particularly serious, due to the reduced oxygenation arising from a thoracic injury combined with the reduced circulation often found in a cerebral lesion.

Severe thoracic injuries are rarely seen in sports. When they occur they do so in high speed sports and in sports with intrinsic penetration danger. Examples of these sports are alpine skiing or less frequently freestyle skiing and ski jumping, motor sports and stick sports (eg. hockey, ice hockey) as well as others where there is a risk of contact with penetrating obstacles eg. javelin, water skiing, fencing, injuries from tree branches etc.

Deceleration injuries arise from falls or violent contact with fixed obstacles such as goalposts, trees etc. Compression between mechanical parts of a vehicle or between a vehicle and the ground is also possible. Such injuries, though rare, are reported in bobsleigh and luge.

Diagnosis

Inspection:
Dyspnoea, bloody expectorate, haemoptysis, visible thoracic wall injuries - open or closed, major haematomas, asymmetrical respiration, paradoxical respiration, sucking lesions.

Palpation:
Unstable parts of the thorax; fractures of ribs, claviculae or sternum; pain on palpation; subcutaneous emphysema with crepitation; evaluate the jugular veins; evaluate the radial pulses bilaterally in order diagnose aortic damage.

Percussion:
Percuss for hyper-resonance (pneumothorax) and dullness (haemothorax, haemopericardium).

Auscultation:
Reduced respiratory sounds, inequality between the two sides, murmurs.

Types of injury

Rib fractures:
Always look for a pneumothorax, haemothorax and tension pneumothorax. Isolated fractures of the ribs can impair breathing. There might be indication for giving analgesics with rib fractures.

Multiple rib fractures can lead to a flail chest (thus causing asymmetrical respiratory movement), pneumothorax, lung contusion (observe signs of low oxygen saturation).

Patients with flail chest should be transported with the injured side down to reduce eventual paradoxical movement. Oxygen should be given by mask and an i.v. catheter used to secure circulation (beware circulatory overloading of lung injuries).

The patient must be intubated immediately.

Suspected pneumothorax:
Evaluate the possibility of inserting a thoracic drain at the injury site or in an emergency room at the venue.

Controlled oxygenation, circulation analgesics (or intercostal blockade) if necessary, oxygen on mask.

Closed pneumothorax:
Diagnosis: impaired respiratory sounds, hyper-resonant percussion, no penetrating injuries.

Treatment: with adequate oxygen saturation, some dyspnoea and stable circulation, a thoracic drain may be inserted, but this is seldom indicated at the site of the accident.
With reduced oxygen saturation and increasing dyspnoea and/or unstable circulation:
A thoracic drain may be inserted in the fourth intercostal space in the mid-clavicular line.
Connect the drain, if possible, to a Heimlich's valve.

Open pneumothorax:

Diagnosis:
impaired respiratory sounds, hyper-resonant percussion, sucking air sounds from the wound.

Treatment
The opening should be covered with a sterile tight bandage. Intubation may be indicated before transportation.

Tension pneumothorax:

Diagnosis**:**
Pneumothorax as above, increased dyspnoea, unconsciousness, neck vein congestion, tachycardia, hypotension, mediastinal displacement (percussion findings).

Treatment
Immediately depressurize by inserting a cannula in the fourth intercostal space close to the mid-clavicular line.

Haemothorax

Diagnosis: Reduced respiratory sounds on auscultation, reduced percussion resonance.
Often seen in combination with pneumothorax.

Treatment at the site of the accident**:**
With shock symptoms without neck vein congestion: Volume therapy
With increasing dyspnoea, intubation and ext. thorax drainage
With manifest shock, evaluate circulation and organize rapid transportation (danger of rupture of aorta or other major internal haemorrhage).

Lung contusion

Diagnosis: Often in combination with other thoracic injuries such as:

- Multiple fractures
- Haemothorax
- Pneumothorax

Signs - Bloodstained expectorate

Treatment
Intubation might be necessary by increasing dyspnoea and signs of falling oxygen saturation.

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Injuries of the Trachea and bronchus

Diagnosis
Always in combination with pneumothorax, often tension pneumothorax.
Often subcutaneous emphysema, bloodstained expectorate and dyspnoea.

Treatment
Thoracic drainage, intubation, even tracheostomy.

Penetrating cardiac lesions

Diagnosis
Must always be evaluated as a possibility when there is a penetrating injury of the upper part of abdomen or thorax region.

Penetration by thin, sharp obstacles such as ski poles, tree branches may lead to:

- Hypotension
- Tachycardia
- Neck vein congestion
- Paradoxical pulse: Fall in the blood pressure with spontaneous inspiration.

Treatment
If transportation to the nearest hospital or acute emergency room takes more than half an hour, set in a catheter in the precordial

With shot-gun injuries (biathlon, shooting) there may be major intrathoracic bleeding, requiring intensive intravenous infusion therapy via legs and arms; rapid transportation.

Aortic rupture

Diagnosis
Total rupture - fatal.
Partial rupture - Hypotension/shock, retrosternal or interscapular pain.
Other signs of thoracic injuries:
Difficulty in swallowing, low voice (hoarseness).

NB! Cardiac tamponade
Asymmetric blood pressure/pulse
Difference between upper and lower limbs

Treatment
Cannulation with cardiac tamponade, substitution of lost volume, rapid transportation to the nearest qualified hospital.

ABDOMINAL INJURIES

Mechanism of trauma

Blunt abdominal trauma may arise with rapid deceleration, thus causing contusions as a result of contact with fixed obstacles. Sports where these kind of injuries are seen are alpine skiing, ski jumping, freestyle, bicycling, motor sports, as well as team sports like soccer, handball and boxing.

Penetrating injuries are seen in sports where the abdominal region comes violently into contact with sharp objects as in track and field sports, bicycling, alpine skiing (and in some cases cross county skiing) and the motor sports.

Main goals

Secure adequate oxygenation and ventilation, evaluate the need for intubation.
Substitution of a lost blood volume via wide bore intravenous catheters, use Macrodex (high molecular weight Dextran) with promiten (average molecular weight Dextran) or Ringer acetate.

In case of major bleeding with irreversible shock and increasing abdominal swelling:
prepare for rapid transportation, if possible by helicopter.

Diagnosis

Inspection: Signs of external injuries, grazing, subcutaneous bleeding. Haematomas over the liver, spleen, kidneys.

Penetrating wounds

Inspection
Increasing abdominal swelling.

Palpation
Guarding, Pain - in the conscious patient.
Swelling.
Unstable pelvic girdle.

Auscultation
Presence or absence of normal intra-abdominal bowel sounds.

Percussion
Reduced percussion sounds on both sides (increasing bleeding).

Types of injury

Rupture of spleen, liver and kidneys.

Diagnosis
Signs of shock.
Low blood pressure, rapid pulse, pale skin, constriction of peripheral vessels.

Palpation
Pain and guarding in particular with bleeding in the liver and spleen. Increasing abdominal volume is extremely dangerous sign and indicates major bleeding.
Haematuria - may indicate kidney rupture.

Treatment
Established at least 2 intravenous infusion points.

NB! Start slowly to prevent a rapid rise in the blood-pressure with consequent increased bleeding. It is of utmost importance not to disturb the natural coagulation by heavy i.v. infusions.

Intravenous substitution of lost volume by Macrodex or Ringer acetate.
Rapid transportation to the nearest hospital.
With major bleeding be prepared to load up and go immediately.

Pelvic fractures

Diagnosis
Symptoms of severe shock:
Instability or pain by compression of the pelvic girdle.

Treatment
as above.

Rupture of parts of the gastrointestinal tract

Diagnosis
Might in some cases not be initially diagnosed
Rupture of the small intestine can give symptoms similar to those of peritonitis. Rupture of colon often causes pain and guarding initially.
Injuries of the pancreas are often overseen due to lack of clinical findings in the initial phase.

Treatment
Routine stabilization treatment with Oxygen
Intravenous infusion as above
Eventual analgesics (morphine i.v.)

NB The history of trauma is of the utmost importance. In the case of high energy trauma to the abdominal region, severe intra-abdominal lesions must always be suspected. Asymptomatic patients must also be evaluated.

NB Because of this hidden danger, all high energy abdominal injuries should be admitted to hospital for observation.

Rupture of diaphragm

Diagnosis
Impaired respiratory sounds, loss of percussion resonance over lower lung region.
Dyspnoea, hypoxia.
Abdominal pain.
Often seen with other severe injuries in the thoraco-abdominal region.

Treatment
Secure oxygenation and ventilation. Intubation before transportation
Substitution of lost volume
Treatment of severe pain

NB Do not insert thoracic drain.

PENETRATING INJURIES

Diagnosis
Open wounds in the abdominal wall.
May accompany a penetrating wound of thoracic region below the 6th intercostal space (along with injuries of the diaphragm).

Treatment
Close the wounds with a sterile bandage.
Volume substitution
Analgesics if necessary in conscious patients
Do not use G-suit (anti-shock trousers - this has been removed from most modern protocols).
Load up and transport patient to the nearest hospital for further diagnosis and treatment.

HYPOTHERMIA

Most winter and some summer sports take place in weather conditions that may lead to hypothermia. This may be due either to temperature, the humidity or the wind chill effect. The lowering effects of the wind on temperature have frequently been ignored by organizers of winter competitions; as a result severe cases of hypothermia have been reported in athletics. A summary of signs and symptoms now follows.

TEMPERATURE:	**SIGNS AND SYMPTOMS:**
36-35°C	Shivering, sensation of cold
35-33°C	Violent shivering, sluggish thinking, poor coordination with loss of hand control, confusion, mood changes, pale skin with reddish or pink areas may be seen.
33-30°C	Shivering replaced by muscular rigidity, confusion, semiconsciousness, dilated pupil. Later bullae will develop.
30-29°C	Stupor, rigidity, slow pulse and respiration. The peripheral portion of the limbs, head and unprotected parts of the body will have obvious signs of local lesions such as bullae, wounds or necrotic areas (depending on the lapse of time).
28-26°C	Unconsciousness, arrhythmias, an imperceptible pulse and blood pressure Shallow respiration. Cardiac monitoring is necessary, if possible by an ECG to detect if ventricular fibrillation is present which if not treated rapidly an adequately will cause death.

Treatment

Few authors have reported survival when a core body temperature of 19°C was recorded.
Mild hypothermia - the patient is brought into a warm room, given warm drinks, changed into warm clothes and covered with blankets.
Moderate hypothermia: A patient with moderate hypothermia between 34-30°C, must be resuscitated by a warm bath initially at a temperature of 26°C, increasing to 42°C over a period of 7-8 minutes. The patient should be encouraged to drink warm fluids, and if possible warm moisturised air should be inhaled. Moderate and severe hypothermia may be exacerbated by afterdrop i.e. the core body temperature continues to fall even when the patient has been removed from the cold to a warmer area. Hayward and Steiner report promising advances using a central rewarming technique when the patient breathes warm air and oxygen. It appears to be more effective in decreasing the effect of afterdrop than rewarming in a bath from 26-40°C.
Severe hypothermia: A patient with severe hypothermia, with fixed dilated pupils, impalpable pulses, unrecordable blood pressure with a core temperature below 30°C, should be taken to hospital as soon as possible. A helicopter preferably, or otherwise the fastest means of transportation should be provided from the arena of training field. Cardiac monitoring should be established as soon as possible because of dangers of cardiac arrest(7.8,11,16,17)
Rapid central rewarming by humidified oxygen, and warm air using a breathing bag should be started. Cardiac massage and defibrillation are not necessary if the core temperature is below 30°C. Unless ventricular fibrillation occurs, the patient should be handled as little and as gently as possible to avoid precipitating ventricular fibrillation. A thermometer that can record - 18°C should be available. Intra-oesophageal and rectal electronic thermometers are more accurate and reliable.

PORTABLE EMERGENCY MEDICAL EQUIPMENT AT SPORTS VENUES

SLED UNIT

The sled unit should contain:

1. Mounted Oxygen tank, 2.5 L with regulator		1
2. Immobilisation unit		1
3. Survival sheet, a la	1	
4. Person warmer	1	
5. Infusion warmer, capacity 3L		1
6. Scoop stretcher		1
7. Aluminium blanket		1
8. Stretcher mattress		1

STRETCHER UNIT

The stretcher unit should contain:

1. Immobilisation unit		1
2. Survival sheet	1	
3. Woolen blanket		1
4. Aluminium blanket		2
5. Stretcher mattress		1
6. Mounted Oxygen holder, 2.5 L w/clip		1

BANDAGE UNIT:

Large bandage scissors, curved Ig 180mm		1
Thermal blanket		1
Triangular sling		5
Compresses, 100x 100mm, sterile		10
Compresses, 200x 300mm, sterile		2
Single gauze kit, 170x 170mm		4
Single gauze kit, 200x 260mm		2
Tourniquet, 20 x 40 cm		1
Duoderm sheets	2	
Watergel 5 x 5 cm		5
Watergel 5 x 15 cm		5
Watergel 10 x 10 cm		2
Elastoplast, 6 x 1000 mm, roll		1
Skin/bandage Plaster, 25 x 1000 cm, roll		1
Gauze, 100mm		5
Tube gauze, head/leg		4
Safety Pins		6
Forceps, disp., sterile		3
Protective gloves, nonsterile, pair		5

Nasal tampon	2
Pencil	1
Pencil, skin red/blue	1
Injury card with plastic coat	10

INFUSION UNIT:

Infusion liquid must be stored in plastic containers. Glass is not allowed. Infusion liquid must be stored in a specially designed, insulated, heating unit. Infusion liquid should have a temperature around 37 C, and as near physiological temperature as possible. Infusion liquids should not be warmer than physiological temperature.

Hyperbaric pressure cuff	1	
Tourniquet with velcro	2	
(must also have a device for children)		
Infusion set, w/drop chamber, 1.8 m	2	
Infusion set, without drop chamber, 800mm	2	
Clamp, infusion set	20	
Cannula, injection, paperpack, 0.8 x 40mm		15
Venflon infusion cannula 1.0 mm	2	
Venflon infusion cannula 1.4 mm	4	
Venflon infusion cannula 1.7 mm	4	
Butterfly, 0.6 mm	3	
Syringe, 10 ml	2	
Syringe, 2 ml	2	
Elastoplast, 25 mm	1	
Thermopacks, small	1	
Splint, 15 x 25 cm	1	
Sterile swabs	10	

VENTILATION UNIT:

Respiration bag, with valve	1
Silicone facial mask, child	1
Silicone facial mask, adult	1
with neck fastener	1
Mouth To Mouth mask	3
Simple suction unit, manual	1
Nasogastric tube, ch 25, sterile	1
Tongue Depressor no 3	1
Tongue Depressor no 2	1
Tongue Depressor no 1	1

AIRWAYS UNIT:

Magill's forceps	1
Manual suction unit	1
Suction catheter, ch 10	2
Suction catheter, ch 16	2
Nasogastric tube, ch 25, sterile	1
Laryngoscope	1
blade, adult, w/halogen bulb	1
blade, child, w/ halogen bulb	1
Laryngoscope batteries, reserve	2
Laryngoscope bulbs, Halogen, reserve	2
Endotrachealtube with cuff nr 9	1
Endotrachealtube with cuff nr 7	1
Endotrachealtube with cuff nr 5	1
Endotrachealtube with cuff nr 4	1
Endotrachealtube with cuff nr 3	1
Arterial forceps	1
Mandrin for tubes 1 4	1
Mandrin for tubes 4 7	1
Tongue Depressor no 3	1
Tongue Depressor no 2	1
Tongue Depressor no 1	1
Cuff syringe, 10 ml, disp., sterile	2
Gauze swabs, pack of 5	1
Sticking plaster, 25 mm, silk	1
Safety pins	6
Tracheostomy set	1
Xylocain gel 2%, 20 ml	1 tube

CPAP UNIT
(Continuous Positive Airways Pressure)

CPAP venturi unit, adjustable	1
CPAP tube/mask/fastener/filter	1 of each
PEEP valve, 7.5 mm	1
Oxygen catheter	1

OXYGEN UNIT: portable

Oxygen tank, 2.5 L, w/regulator	1
Silicone respiration bag with valve	1
Silicone facial mask, adult	1
neck fastener	1
Tongue suppressor no 2	3
Manual suction unit	1

PHARMACEUTICAL UNIT:

NB. doping substances

Atropine sulphate (Atropin) 1.0 mg/ml	1	ml	x	2

Catastrophy drenaline 0.1 mg/ml	5 ml x 2
Adrenaline 1 mg/ml	1 ml x 2
Morphine chloride 10 mg/ml amp.	1 ml x 2
Nitroglycerine sublingual tabl. 0.5 mg	5 tabl.
Terbutaline sulphate, 0.5 mg/ml	1 ml x 2
Theophylline 30 mg/ml	10 ml x 1
Buscopan 20 mg/ml	1 ml x 2
Diazepam 5 mg/ml /rectal	2 ml x 1

Metoclopramide 5 mg/ml	2	ml	x	20

Fortralin supp., a 50 mg	5
Ampicillin 2G Hettegl.	1
Flamazine (sulfadiazine) cream, 50 mg tube	1 tube
Flumethasone/clioquinol Ear drops, 7.5 ml	1 bottle
Glucose 120 mg/ml, 50 ml bottle	1
Blood sticks, sugar, ketones	1 box
Lancets, disposable, paper packed	3
Sterile water, 50 ml, bottle	1

MEDICAL EQUIPMENT UNIT:

Large bandage scissors, curved Ig 180mm	1
Compresses, 100x 100mm, sterile	5
Gauze swabs, sterile, pack of 5	2
Pencil, skin red/blue	1
Patient trauma cards	
Cannula, injection, paperpack, 0.8 x 40mm	10
Cannula, injection, paperpack, 0.6 x 25mm	5
Intracardiac needle	1
Intraosseous needle	1
Syringe, 10 ml	2
Syringe, 2 ml	3
Scalpel, no.10, sterile, disp	1
Blade, scalpel, no 10, disp., sterile	6
Needleholder, sutures, 160 mm	1
Arterial, clamp, curved 130 160 mm	2
Arterial, clamp, straight 130 160 mm	2
Stethoscope with membrane	1
Sphygmomanometer	1

SPORTS UNIT:

Sports ice, small	3
Warm packs, large	2
Sports tape 5 cm	3 roll
Tensoplast 5 cm	1 roll
Tensoplast 10 cm	1 roll
Elastic tape 80 mm	2 roll
Elastic tape 100 mm	2 roll

IMMOBILISATION UNIT:

Rigid Cervical collars, set of 6 sizes	1 set
Vacuum mattress w/pump	1
Vacuum splints w/pump	1 set
Traction splint, lower extremity	1 set

EMERGENCY BELT PACK .

Small bandage scissors,curved Ig	1
Pocket knife, small	1
Thermal blanket	1
Forceps, disp., sterile	1
Nasal tampons	1
Triangular sling	1
Compresses, 100x 100mm, sterile	5
Compresses, 200x 200mm, sterile	2
Large bandage, 200 x 400 mm	1
Single gauze kit, 170x 170mm	1
Combination bandage	1
BandAid 60 x 1000 m, roll	1
Elastoplast, 25 x 1000 mm, roll	1
Elastic bandage, 80 mm, roll	1
Elastic bandage, 100 mm, roll	1
Tube gauze, head/leg	1
Safety Pins	6
Protective gloves, nonsterile, pair, L	5
Pencil	1
Notebook	1
Patient trauma cards w/plastic wallets	5
Mouth to mouth mask	1
Pencil torch w/halogen bulbs	1

For doctors and nurses:

Stethoscope	1
Tongue Depressor no 3	1
Tongue Depressor no 1	1

CERVICAL COLLAR UNIT:

Rigid Cervical collars, 6 sizes with mandibular/ occipital support and tracheotomy entry port.	1 set

EMERGENCY ROOM MEDICAL EQUIPMENT AT SPORTS VENUES

Arena Emergency rooms

Each arena should have two emergency rooms, one emergency room for athletes and team members and one for the general public.

The following services should provided:

1. Emergency first aid, including treatment of acute life threatening situations
2. Treatment of diseases and injuries
3. Simple prescriptions
4. Storage function

Which types of equipment should be available:

1. Standard Office Furniture
2. Emergency medical equipment
3. Infusion liquids for patient treatment/storage
4. Pharmaceuticals for patient treatment
5. Disposables
6. Patient treatment modules
7. Wheelchair/Transport chair

1 Standard Office Equipment:

Stretcher unit	1
Surgical lamp with wheels	1
Office table	1
Stool	1
Chairs	2
Washing basin with elbow control	1
Liquid soap bottle	1
Paper towel box	1
Waste paper bucket	1
Toxic waste container	1
Mirror	1
Wheeled defibrillator table for emergency equipment, 2 trays	1
Wheeled table for surgical instruments	1
Wall cabinet for Instruments and disposables	1
Wall (lockable) cabinet for pharmaceuticals	1
Shelves	2
Refrigerator	1
Telephone	1
1	
Lamp, surgical, capacity 500 lux	1
Boxes, trays for storage	10
Curtain rail	1
Curtain	1
Telephone	1

2 Emergency medical equipment

Defibrillator	1
ECG	1
Manual suction unit	1
Ventilator, portable, w/tubes/mask and quick release attachment	1
Oxygen tanks, 10 L, with wall attachment	2
Oxygen tank trolley	2
Portable Oxygen units, 2.5 L/ w/regulator	1
Pressure reducing valve with adjustable and volume reducing controls	2
Portable Oximeter/Pulsemeter	1
Nebuliser, automatic	1
Immobilisation kit	1
Infusion liquid warmer, capacity 10 L	1
Oto/Ophthalmoscope	1 set
Thermometer,(auricular) w/strips	1 set
Suture kit	5 set
Sphygmomanometer	1 unit
Stethoscope with diaphragm	1 unit
Patella hammer with pin and brush	1 unit

3 Infusion liquid:

Minimum 10 Litres:

Glucose, 1000 ml	2
Ringers 1000 ml	6
Plasma expanders 500 ml	2
Calcium Bicarbonate 500 ml	2
Mannitol 150mg/ml 500 ml	2

4 Wall cabinet for Pharmaceuticals:

NB. doping substances

SoluCortef set 5 x 100mg bottle	1 set
Atropine sulphate (Atropin) inj., 0.6 mg/ml	1 ml x 10
Catastrophe Adrenaline inj., 0.1 mg/ml	1 ml x 10
Adrenaline inj., 1 mg/ml	1 ml x 10
Morphine chloride 10 mg/ml amp.	1 ml x 10
Nitroglycerine sublingual tabl. 0.5 mg	100 tabl.
Furosemide, inj., 10 mg/ml	2 ml x 10
Terbutaline sulphate inj., 0.5 mg/ml	1 ml x 10
Terbutaline sulphate turbohaler	3 boxes
Salbutamol inhalation aerosol, 200 dosages	3 boxes
Salbutamol inhalation liquid, 1 mg /ml	2.5 ml x 60
Ipratropium bromide inhalation liquid 0.25 mg/ml, 20 ml bottle	1 bottle
Theophylline inj., 30 mg/ml	10 ml x 5
Noscapine mixture, 100 ml bottle (for cough)	5 bottles
Noscapine tabl. 50 mg	100 tabl.
Buscopan inj., 20 mg/ml	1 ml x 10
Diazepam 5 mg/ml /rectal	2 ml x 5
Buprenorphine, 0.2 mg tabl.,	10 tabl.
Metochlopramide inj., 5 mg/ml	2 ml x 20
Xylocaine inj., 5 mg/ml	20 ml x 3
Xylocaine Spray, 80 G	1 bottle
Xylocaine Gel, tube, 10 G	10 tubes
Urinary catheter, size 14	5 units
Urinary catheter set, disposable	5 units
Chlorhexidine, 0.1%, 250 ml bottle	4 bottles
Fortraline, supp., a 50 mg	10 units
Cafergot Comp supp.,	10 units
Paracetemol tabl., 500 mg	100 tabl.
Paracetemol supp., 1 G	10 units
Ampicillin 250 mg/Bottle	2 bottles
Phenoxymethyl Penicillin tabl.	660 mg 100 tabl.
Trim. Sulfatabl	100 tabl.
Pivampicillin tabl., 350 mg	50 tabl.
Ophtalent Eye salve, 1%, 200 mg tube	20 tubes
Chloramphenicol Eye drops, 10 ml.	2 bottles
Canesten salve, 30 G	1 tube
Fucidin salve	1 tube
Fucidin bandages, 10 x 10 cm,	1 set
Flamazine, 50 mg tube	6 tubes
Hydrocortisone salve a 30 G	2 tubes
Flumethasone/clioquinol Ear drops, 7.5 ml	2 bottles
Xylometazoline nasal spray 1 mg/ml, 10 ml	4 bottles
Magnesium Hydroxide/Mag.Carb. tabl	20 tabl

AntiDiarrhoea mixture	4 bottles
Lactulose mixture, 200 ml bottle	1 bottle
Loperamide capsules, 2 mg, 16 tabl./pack	2 packs
Glucose 500 mg/ml, 50 ml	3 bottles
Glucose 50 mg/ml, 100 ml	3 bottles
Ibuprofen tabl., 600 mg	50 tabl
Sterile water, 50 ml	5 Bottles

Saline, 9mg/ml, 50 ml units	5 units
Paracetemol Codeine tabl.,	100
Tetanus vaccine capsules	5 units
Naproxen Entero tabl., 500 mg,	100 tabl.
Nitrazepam, 5mg	100 tabl
Urine sticks, Leucocytes, protein, sugar, ketones	1 box
Blood sticks, sugar, ketones	1 box
Lancets, disposable	1 box
Eye bath glass, plastic, disposable	5 units
Eye bath liquid, bottle, 1 L,	2 bottles

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