It is ratified on meeting of chair surgical stomatology and maxillofacial surgery with plastic and reconstructive surgery of the head and neck «28» August 2019 Protocol № 1 28.08.2019 The head of chair Avetikov D.S.

METHODICAL INSTRUCTION FOR INDEPENDENT WORK OF STUDENTS DURING PREPARATION FOR PRACTICAL (SEMINAR) LESSON

<table>
<thead>
<tr>
<th>Academic subject</th>
<th>Surgical stomatology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module №</td>
<td>4</td>
</tr>
<tr>
<td>Topic of practical session № 12</td>
<td>Traumatic illness: pathogenesis, features at damages of maxillofacial area.</td>
</tr>
<tr>
<td>Year of study</td>
<td>IV</td>
</tr>
<tr>
<td>Faculty</td>
<td>Foreign Students Training (Stomatology)</td>
</tr>
</tbody>
</table>

Poltava – 2019
1. RELEVANCE OF THE TOPIC.
The knowledge of principles of medical sorting, volume of medical aid at stages of medical evacuation wounded. To organize rationally a medical aid for maxillofacial wounded. The important component of the knowledge of bases principles of examination of maxillofacial wounded. The knowledge of principles and positions of military-medical examination.

2. SPECIFIC AIMS:
2.1. To analyse clinical symptoms of traumatic shock.
2.2. To analyse clinical symptoms of hemorrhagic shock
2.3. To analyse clinical symptoms of crush syndrome is the systemic manifestation
2.4. To classify volume and the order (regime, system) of accordance of the aid for maxillofacial wounded at the stages of medical evacuation.
2.5. To treat (discuss) principles of the organization of a military-medical examination of maxillofacial wounded.
2.6. To analyze criteria of limitation (restriction) of suitability to military service of maxillofacial wounded.
2.7. To know the schema of registration of medical documents of military-medical examination of maxillofacial wounded.

3. BASIC KNOWLEDGE AND SKILLS NECESSARY TO STUDY THE TOPIC (INTERDISCIPLINARY INTEGRATION).

<table>
<thead>
<tr>
<th>Names of the preceding subjects</th>
<th>The obtained skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Special military preparation.</td>
<td>To validate (draw up) a primary medical card of the wounded, to carry out medical sorting wounded and sick at each stage of medical evacuation.</td>
</tr>
<tr>
<td>2. Medicine of accidents.</td>
<td>To organize the first medical, pre-medical and first medical assistance wounded at stages of medical evacuation.</td>
</tr>
<tr>
<td>3. General surgery.</td>
<td>To define a character of a gunshot wound, to examine the wounded. To determine a turn and the order of medical aid to the wounded, the order and the turn of evacuation of the victims.</td>
</tr>
</tbody>
</table>

4. TASKS FOR STUDENTS’ SELF-DIRECTED WORK DURING PREPARATION FOR THE CLASS.
4.1. The list of basic terms, parameters and characteristics which students should master while preparing for the class:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Medical sorting.</td>
<td>This distribution of wounded for groups.</td>
</tr>
<tr>
<td>2. Volume of medical aid.</td>
<td>Set of treatment-and-prophylactic actions which are given wounded and sick at each stage of medical evacuation according to fighting and medical conditions.</td>
</tr>
</tbody>
</table>

4.2. Theoretical questions for the class:
1. Concept "Shock".
3. Concept “Crush injury”.
4. Concept "Shock stages ".
5. The order of medical aid for maxillofacial wounded at each stage of medical evacuation.
6. The order of evacuation of the maxillofacial wounded from a stage of medical aid.
7. To fill in (fill out) a primary medical card of the wounded or the patient.
8. Scoping of medical aid to the maxillofacial wounded at a stage of the qualified medical aid.
9. A determination of the volume and the order of the medical aid to the maxillofacial wounded at a stage of the specialized medical aid.
10. The purposes and tasks of military-medical examination.
12. Criteria of definition of the convenience to military service of maxillofacial wounded.
13. The list of diseases which use during military-medical examination.
14. The medical documentation of military-medical examination.

4.3. Practical tasks for the class:
1. To fix skills of registration of the medical documentation of the surgeon - stomatologist and the medical documentation of examination of disability of the patient.
2. To impose a sling bandage on the mental region.
3. To execute manual pressing the general carotid.

THE CONTENTS OF THE THEME:

Shock

Shock is a state of organ hypoperfusion with resultant cellular dysfunction and death. Mechanisms may involve decreased circulating volume, decreased cardiac output, and vasodilation, sometimes with shunting of blood to bypass capillary exchange beds. Symptoms include altered mental status, tachycardia, hypotension, and oliguria. Diagnosis is clinical, including BP measurement and sometimes markers of tissue hypoperfusion (eg, blood lactate, base deficit). Treatment is with fluid resuscitation, including blood products if necessary, correction of the underlying disorder, and sometimes vasopressors.

Shock

Shock is a severe drop in blood pressure that causes a dangerous slowing of blood flow throughout the body. Shock may be caused by blood loss, infection, spine injury, or metabolic problems. Treatment may include any or all of the following:

- Stopping any blood loss
- Helping with breathing. This might be with a breathing machine.
- Reducing heat loss
• Giving IV fluids or blood
• Giving extra oxygen
• Prescribing medicines. This might be raise blood pressure.

**Bleeding**
Rapid blood loss from the site of surgery, for example, can lead to shock. Treatment of rapid blood loss may include:

• IV fluids or blood plasma
• Blood transfusion
• More surgery to control the bleeding

**Wound infection**
When bacteria enter the site of surgery, an infection can happen. Infections can delay healing. Wound infections can spread to nearby organs or tissue, or to distant areas through the bloodstream. Treatment of wound infections may include:

• Antibiotics
• Surgery or procedure to clean or drain the infected area

**Deep vein thrombosis**
A deep vein thrombosis is a blood clot in a large vein deep inside a leg, arm, or other part of the body. Symptoms are pain, swelling, tenderness, and skin redness in a leg, arm, or other area. If you have these symptoms, call your healthcare provider. Compression stockings are often used for treatment. They can also prevent DVTs.

**Pulmonary embolism**
The clot can break away from the vein and travel to the lungs. This clot is called a pulmonary embolism. In the lungs, the clot can cut off the flow of blood. This is a medical emergency and may cause death. Symptoms are chest pain, trouble breathing, coughing (may cough up blood), sweating, very low blood pressure, fast heartbeat, light headedness, and fainting. Treatment depends on the location and size of the blood clot. It may include:

• Blood-thinner medicines (anticoagulants) to prevent more clots
• Thrombolytic medicines to dissolve clots
• Surgery or other procedures

**Lung problems**
Sometimes lung problems happen because you don’t do deep breathing and coughing exercises within 48 hours of surgery. They may also happen from pneumonia or from inhaling food, water, or blood into the airways. Symptoms may include wheezing, chest pain, shortness of breath, fever, and cough.
**Urinary retention**
This means you aren’t able to empty your bladder. This may be caused by the anesthesia or certain surgeries. It is often treated by using a thin tube (catheter) to drain the bladder. This is kept in place until you have regained bladder control. Sometimes medicines to stimulate the bladder may be given.

**Reaction to anesthesia**
This is rare, but it does happen. Symptoms can range from mild to severe. Treatment of allergic reactions includes stopping specific medicines that may be causing the reaction. Give information for healthcare team about any allergies before the surgery to minimize this risk.

**Traumatic Shock.**
Shock may result from trauma, heatstroke, blood loss, an allergic reaction, severe infection, poisoning, severe burns or other causes. When a person is in shock, his or her organs aren't getting enough blood or oxygen. If untreated, this can lead to permanent organ damage or even death.

Signs and symptoms of shock vary depending on circumstances and may include:

- Cool, clammy skin
- Pale or ashen skin
- Rapid pulse
- Rapid breathing
- Nausea or vomiting
- Enlarged pupils
- Weakness or fatigue
- Dizziness or fainting
- Changes in mental status or behavior, such as anxiousness or agitation

**Hemorrhagic shock**
- Surgical control of bleeding
- Early transfusion of blood products

In hemorrhagic shock, surgical control of bleeding is the first priority. **Volume replacement** accompanies rather than precedes surgical control. Blood products and crystalloid solutions are used for resuscitation; however, packed RBCs, fresh frozen plasma, and platelets are being given earlier and in a ratio of 1:1:1 in patients likely to require **massive transfusion**. Failure to respond usually indicates insufficient volume administration or unrecognized ongoing hemorrhage. Vasopressors may be tried in refractory hemorrhagic shock but only after adequate blood volume has been
restored and hemorrhage controlled–giving vasopressors before that can worsen outcomes.

**Crush injury**

1. **Description of the problem**

**Crush injury** is a direct injury resulting from the crush.

Crush Syndrome is the systemic manifestation of muscle cell damage resulting from pressure or crushing.

Initially described by Bywaters and Beall in 1941 in a patient who initially appeared to be unharmed but subsequently died of renal failure.
Crush Injury: Compression of extremities or other parts of the body that causes muscle swelling and/or neurological disturbances.

Crush Syndrome: Crush injury with systemic manifestations. Systemic manifestations are caused by a traumatic rhabdomyolysis due to muscle reperfusion injury when compressive forces on the tissues are released. This can cause local tissue injury, organ dysfunction, and metabolic abnormalities, including acidosis, hyperkalemia, and hypocalcemia.

Clinical features
Some or all of the following clinical signs and symptoms may be present:

- Cardiovascular instability
  Hypotension and hypovolemic shock. This may be caused from the massive fluid shift from the extracellular fluid space into the damaged cells or associated injuries causing blood loss.
  Arrhythmia and negative inotropy secondary to hyperkalemia, hypocalcemia and hyperphosphatemia
  Cardiomyopathy
- Renal failure
  Secondary to circulatory shock and intravascular volume depletion leading to renal cortical ischemia.
  Release of myoglobin, urate, phosphate and purine by the muscle cells causes precipitation in the distal convoluted tubules, causing tubular obstruction.
- Metabolic acidosis with lactic acidosis
- Disseminated intravascular coagulopathy
- Hypothermia
- Myoglobinuria
- Skin injury and swelling
- Paralysis and paresthesia
- Pulses may or may not be present.
- Compartment syndrome
- Acute lung injury / ARDS

Key management points
Primary survey with focus on airway, breathing and circulation.

Establishing intravenous access and initiation of fluid resuscitation prior to releasing the crushed extremity, especially if the time of entrapment is > 4 hours.

If extrication is impossible short-term use of tourniquet on the affected limb is recommended until intravenous access can be obtained.

Acute limb amputation should be avoided until extrication is impossible.

Continue with fluid resuscitation while transfer to a medical facility is initiated.

Monitor the crushed limb for the 5 P’s: Pain, Pallor, Paresthesia, Pain with passive movement and Pallor.

Combat hypotension with aggressive hydration.

Prevention of renal failure is important. Alkaline diuresis and mannitol therapy is recommended. Hemodialysis is also recommended for acute renal failure.

Electrolyte abnormalities (hypokalemia / hypocalcemia / hyperphosphatemia) need to be monitored and treated accordingly.

Monitoring for cardiac arrhythmia is recommended.

Correction of acidosis with alkanization of the urine is critical.

Monitoring for compartment syndrome is also recommended. If present it should be treated with fasciotomy. Fasciotomies should not be performed if the compartment syndrome has been present for > 24 hours.

Open wounds should be treated with antibiotics, tetanus toxoid and debridement of necrotic tissue.

Hyperbaric oxygen therapy may be useful.

2. Emergency Management

The management of crush syndrome should focus on preventing the systemic complications of the syndrome. It is important to understand the pathophysiology of the process and treat accordingly.

Extrication

Extrication should be prompt as the time of entrapment of a limb is directly proportional to the development of crush syndrome. Basic Life Support measures should be started with assessment of airway, breathing and circulation, especially establishment of intravenous access. If possible, fluid resuscitation should be started prior to extrication, especially in limbs trapped > 4 hours. Attention should also be
focused on the possibility of concomitant injury (fractures, organ damage, spinal injury and obvious hemorrhage). High-flow oxygen should be started and the patient should be transferred to a medical facility as soon as possible.

Applying tourniquets for more than 2 hours may cause rhabdomyolysis and neurovascular damage, and hence the current consensus is to avoid using tourniquets. There are some theoretical benefits to applying tourniquets, especially in the patient in whom intravenous access cannot be obtained prior to extrication of the entrapped limb. Tourniquets may delay the onset of reperfusion syndrome in a crushed limb as well as control hemorrhage. But if applied, tourniquets should not be released before medical facilities are available.

All attempts should be made to preserve the crushed limb. Amputations should be considered only as a life-saving measure. If extrication is impossible, amputation prior to release of the crushing force would delay onset of reperfusion syndrome and the systemic effects of crush syndrome.

Fluid resuscitation

Intravenous access and fluid resuscitation is the mainstay of treatment. This should start before the start of extrication and reperfusion syndrome. Aggressive resuscitation using warm Normal Saline is recommended to reverse metabolic acidosis, improve coagulation cascade and prevent renal failure. Ringer’s Lactate should be avoided as it contains potassium. Dextrose should be avoided until resolution of shock and establishment of normovolemia. A Foley catheter should be inserted as early as possible.

Some general guidelines for fluid resuscitation:

• 1 to 1.5 l/h for young adults
• 20 cc/kg/h for children
• 10 cc/kg/h for elderly

Target urine output

• Adults: > 50cc / h
• Children: > 2cc/kg/h

Algorithm for managing crush injury

During Extrication

This may last 4-6 hours or longer. Start intravenous fluids (preferably Normal Saline) at 1L/h.

After Extrication:
Arrange for transfer to hospital.

Insert invasive monitoring (central line and arterial line) and Foley catheter. Monitor blood pressure and urinary output closely.

Continue resuscitation with normal saline at 1L/h.

Once normovolemia achieved, alternate with 5% dextrose solution.

Some general guidelines for fluid resuscitation:

- 1 to 1.5 l/h for young adults
- 20 cc/kg/h for children
- 10 cc/kg/h for elderly

Target urine output

- Adults: > 50 cc / h
- Children: > 2 cc/kg/h

After Hospital Admission:

Sodium bicarbonate (50 meq/L) is added to every second or third dextrose bottle to keep urine pH > 6.5. Monitor for target urine output at all times.

After Evidence of adequate urine output:

Start 20% mannitol (1-2 gm/kg body weight) over 4 hours.

Urine output needs to be maintained at 8 L/day (except in elderly) and may require infusion of 12 L/day.

Metabolic Alkalosis:

If arterial blood pH is > 7.45 (secondary to bicarbonate administration) acetazolamide can be given as an I.V. bolus of 500 mg.

Correct electrolyte abnormalities aggressively:

Hyperkalemia, hyperphosphatemia and hypocalcemia should be aggressively treated.

End Point:

Usually by Day 3 – myoglobin is eliminated from the urine.

CAUTION:

Mannitol should not be given to patients with anuria.
Blood osmolar gap should be maintained below 55 mOsm/kg (less than 1000 mg/d mannitol in blood).

Mannitol dose should be kept below 200 g/d (leads to acute renal failure in higher doses).

3. Diagnosis

**Diagnostic criteria**

Early diagnosis is crucial in patients, especially if they develop rhabdomyolysis. Patients who sustain soft tissue injury or ischemia–reperfusion injury are at risk of developing rhabdomyolysis, myoglobinuria, and renal failure. Patients may present with painful, swollen extremities and should be monitored for compartment syndrome. Physical examination is usually difficult and unreliable. Dark, tea-colored urine that is dipstick positive for blood despite the absence of red blood cells on microscopy is suggestive of myoglobinuria and rhabdomyolysis.

Patients who are believed to be at risk on the basis of history and physical examination should have their urine output monitored and serial serum creatine kinase levels drawn. Other labs of importance are serum blood urea nitrogen, creatinine, uric acid, potassium, phosphorus and calcium.

Release of myoglobin into the circulation is an important indicator of significant muscle injury. Normal levels are less than 85 ng/ml (but depends on normal laboratory values). Initially serum myoglobin values are higher than urine ones. Once myoglobin is cleared from the body these results are flipped. Thus it is best to follow both these values during the disease process. Creatinine phosphokinase values are a marker of muscle damage and can be very high in crush injuries.

**Normal lab values**

Laboratory derangements usually seen are:

- Creatine kinase $> 10,000$ U/L
- Oliguria (urine output) $< 400$ mL/24 hrs
- Blood urea nitrogen $> 40$ mg/dL
- Serum creatinine $> 2$ mg/dL
- Uric acid $> 8$ mg/dL
- Potassium $> 6$ meq/L
- Phosphorus $> 8$ mg/dL
Calcium < 8 mg/dL

Normal Values

Creatine kinase: 8-150 U/L

Blood urea nitrogen: 7-20 mg/dL

Serum creatinine: 0.5-1.4 mg/dL

Uric acid: 2.0-7.5 mg/dL

Potassium: 3.5-5.3 meq/l

Phosphorus: 2.5-4.8 mg/dL

Calcium: 8.8-10.3 mg/dL

Release of myoglobin into the circulation is an important indicator of significant muscle injury. Normal levels are less than 85 ng/ml (but depends on normal laboratory values). Initially serum myoglobin values are higher than urine ones. Once myoglobin is cleared from the body these results are flipped. Thus it is best to follow both these values during the disease process.

Creatinine phosphokinase values are a marker of muscle damage and can be very high in crush injuries.

**Diagnostic tests**

Serum and urine myoglobin

Creatinine phosphokinase

Standard urine dipstick (heme-positive urine in the absence of red blood cells suggests myoglobinuria. This test is positive only 50% of the time, and thus a normal urine dipstick does not rule out myoglobinuria).

4. Specific Treatment

Extrication

Extrication should be prompt as the time of entrapment of a limb is directly proportional to the development of crush syndrome. Basic Life Support measures should be started with assessment of airway, breathing and circulation, especially establishment of intravenous access. If possible, fluid resuscitation should be started prior to extrication, especially in limbs trapped > 4 hours. Attention should also be focused on the possibility of concomitant injury (fractures, organ damage, spinal
injury and obvious hemorrhage). High-flow oxygen should be started and the patient should be transferred to a medical facility as soon as possible.

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All attempts should be made to preserve the crushed limb. Amputations should be considered only as a life-saving measure. If extrication is impossible, amputation prior to release of the crushing force would delay the onset of reperfusion syndrome and the systemic effects of crush syndrome.

Metabolic alkalosis

If arterial blood pH is > 7.45 (secondary to bicarbonate administration), acetazolamide can be given as an I.V. bolus of 500 mg.

Electrolyte abnormalities

Hyperkalemia, hyperphosphatemia and hypocalcemia should be aggressively treated.

Analgesia

Pain is usually a late sign. (Early on crushed limbs are only mildly painful secondary to neuropraxia and may mask compartment syndromes.)

Other diuretics

Other diuretics (furosemide, dopamine, angiotensin converting enzyme inhibitors) have been used with very limited success.

Amiloride: is a potassium-sparing diuretic that inhibits sodium–hydrogen and sodium–calcium exchange. Reduction in intracellular calcium improves contractile and metabolic recovery during post-ischemic reperfusion.

Benzamil: An analogue of amiloride that is even more potent in its ability to block sodium calcium exchange

Calcium

Hypocalcemia is common. Administered calcium is rapidly sequestered in the injured muscle and does not correct serum calcium. Also, as the disease progresses and myocytes die, calcium is released into the systemic circulation, causing rebound hypercalcemia. Thus, correction of hypocalcemia and administration of calcium is not recommended unless required for cardiac arrhythmias and hyperkalemia.
Dialysis and Hemofiltration

Oliguria or anuria responsive to treatment, fluid therapy, volume overload, and a rising serum potassium (47 mEq/L) are indicators of the need for dialysis. Dialysis is usually required 2 or 3 times daily for 13–18 days to restore renal function and urine flow. All types of renal-replacement therapy (intermittent hemodialysis, continuous renal replacement therapy and peritoneal dialysis) should be considered depending on availability.

Sepsis

Sepsis is the major cause of mortality from crush injury. Wound infections, peritonitis or pneumonitis and open injuries should be treated aggressively and high-calorie feeding should be started to prevent nutritional deficiencies.

Hyperbaric oxygen therapy

Hyperbaric oxygen therapy prevents secondary injury and keeps partially injured tissue viable. It increases the amount of oxygen dissolved in plasma. Hyperoxia is thought to have several benefits. The diffusion radius is greater, supplying oxygen to underperfused tissue. It also causes vasoconstriction and reduces capillary transudate and interstitial edema, thus slowing the progression to compartment syndrome. It also prevents neutrophil adhesion and prevents secondary injury. It is directly bactericidal to anaerobic organisms. It also enhances fibroblast differentiation, collagen synthesis and angiogenesis, leading to increased wound closure rates in hypoxic tissues.

Topical negative pressure therapy

This has been shown to improve wound healing. It has been found in animal studies to significantly decrease levels of circulating myoglobin, and hence progression to myoglobinuric acute renal failure (ARF) and systemic crush syndrome are stopped.

Gastric pentadecapeptide BPC 157

This is an experimental drug that helps with wound healing. The mechanism of action is based on its ability to increase reticulin and collagen formation. Unfortunately this is not commercially available yet.

End Point

Usually by Day 3 – myoglobin is eliminated from the urine.

Fluid resuscitation:

- 1 to 1.5 l/h for young adults
- 20 cc/kg/h for children
- 10 cc/kg/h for elderly
Target urine output:
• Adults: > 50 cc / h
• Children: > 2 cc/kg/h

Sodium bicarbonate (50 meq/L) is added to every second or third dextrose bottle to keep urine pH > 6.5. Monitor for target urine output at all times.

20% mannitol (1-2 gm/kg body weight) over 4 hours.

If arterial blood pH is > 7.45 (secondary to bicarbonate administration) acetazolamide can be given as an I.V. bolus of 500 mg.

Kayexalate for hyperkalemia – maximum of 15G per day.

Patients who do not respond to hydration and forced diuresis usually require hemodialysis. Most patients who present with an initial serum creatinine of more than 1.7 mg/dL and up to one third of all patients with rhabdomyolysis require hemodialysis.

5. Disease monitoring, follow-up and disposition
   • Obtain initial serum CPK.
   • Monitor urine output hourly.
   • Monitor urine pH hourly.
   • Arterial blood gas every 4 hours
   • Serial electrolytes every 6 hours
   • BUN and creatinine every 8 hours
   • Compartment pressures every 4 hours
   • Invasive monitoring (central line and pulmonary artery catheter) may be required in patients with cardiac and pulmonary disease.

Intensive care support may be required for the complications of crush syndrome. Patients who become oliguric or anuric are likely to require dialysis. Patients with acute renal failure may require prolonged dialysis and may need follow-up.

Pathophysiology
The pathophysiology begins with muscle injury and muscle cell death.
• Immediate cell disruption.
- Direct pressure on muscle cells: The direct pressure causes muscle cells to become ischemic. Anaerobic metabolism ensues, generating lactic acid. Ischemia causes the cell membranes to leak.

- Vascular compromise: Large vessels are compressed, leading to loss of blood supply to muscle tissue.

- Injured muscle tissue releases toxins. The crushing force may serve as a protective mechanism, preventing these toxins from reaching the central circulation.

- Following extrication the toxins exert their effects systemically.
  
  Amino acids and other organic acids – acidosis, aciduria, and dysrhythmia

  Creatine phosphokinase – markers for crush injury

  Free radicals, superoxides, peroxides – formed when oxygen is reintroduced into ischemic tissue

  Histamine – vasodilation, bronchoconstriction

  Lactic acid – major contributor to acidosis and dysrhythmias

  Leukotrienes – lung injury (adult respiratory distress syndrome) and hepatic injury

  Lysozymes

  Myoglobin – precipitates in kidney tubules, especially in the setting of acidosis with low urine pH; leads to renal failure

  Nitric oxide – causes vasodilation, which worsens hemodynamic shock

  Phosphate – hyperphosphatemia causes precipitation of serum calcium, leading to hypocalcemia and dysrhythmias

  Potassium – hyperkalemia causes dysrhythmias

  Prostaglandins – vasodilation, lung injury

  Purines (uric acid) – may cause further renal damage

  Thromboplastin – disseminated intravascular coagulation

- Third spacing. Leaking cell membranes and capillaries cause intravascular fluids to accumulate in injured tissue.

- Compartment syndrome

- The time to injury and cell death varies with the crushing force involved.
Skeletal muscle can tolerate ischemia for up to 2 hours without permanent injury, reversible cell damage occurs by 2-4 hours and by 6 hours irreversible tissue necrosis starts.

Direct injury from the crushing forces results in cell membrane failure and opening of intracellular sodium and calcium channels.

This shifts calcium and sodium into hypoxic cells and damages myofibril proteins and results in worsened cell membrane dysfunction and release of ATP-inhibiting nucleases.

Crush injury may cause hypovolemia by hemorrhagic volume loss and the rapid shift of extracellular volume into the damaged tissues.

Acute renal failure is caused by hypoperfusion of the kidneys. This may be worsened by cast formation and mechanical blockage of the nephrons by myoglobin.

Reperfusion leads to increased neutrophil activity and the release of free radicals. Superoxide and hydrogen peroxide react to form the hydroxyl radical (OH), which damages cellular molecules and causes a lipid peroxidation. which leads to cell membrane destruction and cell lysis.

Reperfusion also releases potassium, phosphorus, and myoglobin. Myoglobin is responsible for the ARF that can occur with the syndrome.

Epidemiology
Rhabdomyolysis occurs in up to 85% of patients with traumatic injuries.

10–50% of patients with rhabdomyolysis develop ARF.

Patients with rhabdomyolysis-induced renal failure have a mortality of approximately 20%.

Mortality is higher in patients with multiorgan dysfunction syndrome.

Victims of natural disasters are reported to have a 20% incidence of crush injury.

40% of extrication survivors are reported to have crush injuries.

**Expert examination** of temporal disability caused by maxillofacial injuries in peaceful time.

The percentage of maxillofacial injuries among general dental out-patients ranges from 2.2 to 11.8%. Over the last few years this number has been noticeably growing. The percentage of temporal disabilities caused by maxillofacial injuries accounts for 16 to 21% of the total number of temporal disabilities.

Periods of disability of the injured:
<table>
<thead>
<tr>
<th>Fracture Type</th>
<th>Disability Period</th>
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<tbody>
<tr>
<td>Uncomplicated solitary mandibular fracture</td>
<td>25-28 days</td>
</tr>
<tr>
<td>in persons who do hard manual labour</td>
<td>40-43 days</td>
</tr>
<tr>
<td>Double mandibular fractures</td>
<td>29-32 days</td>
</tr>
<tr>
<td>in persons who do hard manual labour</td>
<td>44-47 days</td>
</tr>
<tr>
<td>Multiple mandibular fractures</td>
<td>30-50 days</td>
</tr>
<tr>
<td>In case of complex fractures</td>
<td>12-16 days</td>
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</tbody>
</table>

**Maxillary fractures**

This is a severe facial trauma. Clinical and labour prognoses for the injured are serious.

Periods of disability of the injured:

- In case of the fracture of alveolar process of maxilla
  - 7 days (to 10 days)
  - up to 10 days
- Fractures to the body of maxilla
  - 36-60 days
- Le Fort I fractures
  - 56 days
- Le Fort II fractures
  - 65 days
- Le Fort III fractures
  - 75 days
- The duration of disability for complicated fractures amounts to
  - 120-130 days

In case of complicated and multiple fractures of maxilla, disability is determined by a neurologist, otolaryngologist, ophthalmologist, or a trauma surgeon.

The period of disability depends on the type of fixation of bone fragments: in case of a surgical intervention – up to 76 days.

**Zygomatic arch fractures**

Clinical and labour prognoses are favourable. After reposition of bone fragments, outpatient treatment is indicated. Inpatient treatment in hospital is administered to those who are to have surgical fragments fixation or are to undergo maxillary sinusotomy (in case of penetrating injuries).

Periods of disability of the injured:

- In case of conservative modality of bone fragments fixation
  - 8-10 days
- In case of surgical fragments fixation
  - 15-20 days
- When maxillary sinusotomy is applied
  - 18-22 days

Nasal fractures-prognosis is favourable.

In case of nose deformity medical rehabilitation – plastic surgery - is indicated. Period of disability extends to 8-10 days, in some cases – 3-4 days until breathing is resumed and edema reduced.
Dislocation of temporomandibular joints.
Acute dislocation. Prognosis is favourable. Period of disability extends to 7-8 days, depending on the patient’s job (vocal load) - up to 14-21 days.

Chronic dislocation. Disability occurs during an acute attack of disease and period of disability coincides with that for acute dislocations and vocal load of a patient is taken into consideration.

Soft tissues traumas
In cases of soft tissue bruises and hematomas, disability is determined with regard to the profession of the patient, the degree of his outlook abnormality and dysfunctions - disordered mandibular function, dysphasia (speech disturbance), dysphagia, respiratory impairment. Disability is considered ongoing until functional recovery of maxillary dental system of the patient is achieved; it will take on average up to 7 days.

In case of injuries which are healed by primary intention, the period of disability of the injured depends on the affected site and its lengths, which determines functional and cosmetic disorders (abnormality of appearance, mouth opening, eating, vocal, breathing and sight disorders), which also depends on vocational recommendations (to avoid supercooling, heavy manual labour, wound contamination at work) and on the time to remove stitches - 5-6 days. Those patients whose job involves intensive manual labour, unfavourable weather conditions, dirtyness of a work place; upon removal of stitches are recommended to take an easy job for a month till the end of rehabilitation period.

In case of infected wounds being healed by secondary intention, the period of disability of the injured depends on the severity and extension of inflammation:

<table>
<thead>
<tr>
<th>Fracture Severity</th>
<th>Period of Disability</th>
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<tbody>
<tr>
<td>I – minor fractures</td>
<td>11-13 days</td>
</tr>
<tr>
<td>II – moderate fractures</td>
<td>29-31 days</td>
</tr>
<tr>
<td>III – severe fractures</td>
<td>30-77 days</td>
</tr>
</tbody>
</table>

MATERIALS FOR SELF-CHECK:
A. Questions for self-check:
Stitch the tongue at dislocation type of asphyxia.

Tracheostomy:
a) a line of a cut(section) of a skin;
b) a section of fascia;
c) the thyroid gland is displaced down.
Tracheostomy: a) fixing of a trachea; b) introduction of cannula for tracheostomy; c) a cannula in the trachea.

B. Tasks for self-check:
1. The military man has received a gunshot wound in a site of the maxilla. What kind of experts is necessary for wounded?
(The answer: the maxillofacial surgeon, a throat specialist, the oculist, the neurosurgeon).

C. Material for the test control. Test tasks with one right answer (α = П):
1. Kinds of medical aid in a wartime:
   A. The mutual aid, the first medical assistance, the specialized help.
   B. The first medical aid, the pre-medical aid, the medical aid, the qualified medical aid.
   C. The medical assistant's help, the medical aid, the qualified medical aid, rehabilitation.
   D. The first medical aid, medical aid, the surgical aid, the specialized aid.
   E. The first medical aid, the pre-medical aid, the first medical aid, the qualified medical aid, the specialized medical aid.
   (Correct answer: Е).
2. Where the first medical aid is given:
   A. On a battlefield.
   B. On a medical point.
   C. In a separate medical battalion.
   D. In separate medical group.
   (Correct answer: A).

D. Educational task of 3-rd level (atypical tasks):
1. The patient of 25 years with complaints: the limited opening of a mouth. A disease connects with a trauma. Objectively: the insignificant edema of soft tissues of a temporal region at the left side, opening of the mouth on 2,0-2,5 sm. The insignificant pain at palpation the TMJ at the left side, at loading on a chin - a pain in
the left TMJ. It is not defined a full closing of jaws. What additional methods of inspection is necessary for an establishment of the final diagnosis. (The answer: X-ray foto of the facial bones, X-ray of TMJ by Shooller).

2. The patient of 22 years, complains on уплощение persons in the bottom third at the left. Opening of a mouth freely, not painfully. Function of mimic muscles is not broken. From the anamnesis it is known, that the patient at children's age has transferred a left-hand osteomyelitis of the mandible. What kind of treatment is shown the given patient for restoration of her function? (The answer: a contour plastic).

3. The patient of 40 years has a bullet wound of the body of the mandible. Fracture with displacement of fragments and defect of the bone. There are absent molar and premolar in the given area. what method of treatment you will select for restoration ability to work of the patient? (The answer: a hardware method of treatment).

REFERENCES.

Basic:


Additional:
4. Electronic reserves:
   [https://books.google.com.ua/books?hl=uk&lr=&id=JaOwAAAAQBAJ&oi=fnd&pg=PP1&dq=Complex,+thermal+damages+of+maxillofacial+area.+employees+of+chair&ots=0O3hi27MFt&sig=1NXp6vmxx-Ae6i4YyWMB0MijAdM&redir_esc=y#v=onepage&q&f=false], 2015