

## PERIOPERATIVE MANAGEMENT AT THE PATIENT WITH HEPATIC TRAUMA

Ruslan Baltaga<sup>1</sup>, Gheorghe Rojnovceanu<sup>2</sup>, Tatiana Ambrosii<sup>1</sup>, Serghei Şandru<sup>1</sup>

1 – Department of Anesthesiology and Intensive Care No 1 Valeriu Ghereg State University of Medicine and Pharmacy Nicolae Testemiţanu, Chişinău, Republic of Moldova.

2 – Department of Surgery No 1 Nicolae Anestediadi State University of Medicine and Pharmacy Nicolae Testemiţanu, Chişinău, Republic of Moldova.

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### ПЕРИОПЕРАТИВНЕ ВЕДЕННЯ ПАЦІЄНТА З ТРАВМОЮ ПЕЧІНКИ

**Р. Балтага, Г. Рожновеану, Т. Амбросій, С. Шандру**

Печінка є другим паренхіматозним органом, що найбільш часто уражається при тупій травмі живота, і, можливо, найпоширенішим органом, що пошкоджується проникною травмою. Травма може бути легкою і не діагностуватися, або виявлятися і лікуватися консервативно. Можливий важкий перебіг, коли рани печінки можуть кровоточити до самої смерті. Найважливішим етапом є діагностика, і в залежності від ступеню тяжкості, неоперативна терапія є основним методом лікування травми печінки, якщо дозволяють умови. Пацієнти з важкою травмою печінки, особливо з гемодинамічної нестабільністю, повинні бути прооперовані якнайшвидше. Також необхідно здійснити всі заходи для запобігання ускладнень.

**Ключові слова:** травма печінки, периопераційне ведення, ускладнення.

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Liver is the second most common solid organ frequently injured by blunt trauma and could be the commonest organ injured by penetrating trauma. The injury can be mild and goes undetected or detected and treated conservatively. It can be severe where the liver wounds can bleed until death. The most important step is diagnosis and depending upon the degree of severity, non – operative therapy is the main treatment method for hepatic trauma if conditions permit. For severe hepatic trauma patients, especial with hemodynamic instability, they should be operated as soon as possible. It is also necessary to carry out all the measures to prevent complications.

**Key words:** hepatic trauma, perioperative management, complication.

### Introduction

The liver is the most common damaged organ in abdominal trauma. Approximately 15% – 20% of abdominal injuries refer to hepatic trauma [1]. Hepatic injury takes the third place in abdominal injury and 80% – 90% of hepatic injuries are blunt ones [2].

Liver injury can be mild when the trauma affects less than 25% of one lobe, moderate when the trauma affects between 25 and 50% of the lobe, and severe when the trauma affects more than 50% of the lobe. American Association for Surgery of Trauma (AAST) proposed the standard classification of hepatic trauma. According to the classification, level I – II hepatic trauma is called minor hepatic trauma, accounting for 80% – 90% of all hepatic trauma. Level III – VI is called serious hepatic trauma, with the mortality of 10%, and if patients have multiple injuries, the mortality may be elevated to as high as 25% [3]. Early death is caused by hemorrhage, and late death from sepsis. Clinical signs suggestive of liver injury following abdominal trauma include 7 – 9 rib fractures, elevation of the right hemidiaphragm, right pleural effusion, pneumothorax, and sensitivity of the right hypochondrium. In patients with solitary liver injury and stable hemodynamics, conservative therapy shows lower morbidity.

In recent years, new types of diagnosis and management of abdominal trauma, such as ultrasonography, new generations of computed tomography, laparoscopy, and the possibility to select patients for non-operative management accelerate the identification of lesions that can cause severe disorders and offer new treatment possibilities [4].

The primary purpose in the treatment of severe abdominal injuries is the maintenance of life, the management is divided into four sequential phases: resuscitation, evaluation, initial management and definitive treatment.

#### ***Clinical case***

Patient D., aged 26, is hospitalized urgently after a thoraco-abdominal trauma by fire – arm. When hospitalized, it presents a grave general state, CGS – 12 points, RR – 26, Ps – 110 beats/min; BP – 60/20 mm Hg. Auscultative diminished breath on the left, abdomen without bloating, pain in the epigastrium and on the left flank.

*Local status:* gunshot wound about 1.5 cm in the left 6 intercostal space on the medioclavicular line (the entrance hole), paravertebral on the right at the Th11 level – 3x2.5 cm wound (the exit hole) with moderate external bleeding.

*Emergency intervention:* Thoracocentesis is performed in the 7 intercostal space on the left, medium median laparotomy. *The inspection found:* crushed liver S2,3 wound; two transfixing wounds of the anterior wall of the stomach 1.8x1.9cm; crushed wound of the upper pole of the spleen, rupture of the diaphragm 6x3.5cm; hemoperitoneum about 2500ml. Initial flow unimomentally on the chest drain about 1000 ml, with continuous bleeding.

*Damage control measures* are practiced: Pringle maneuver, provisional hemostasis by applying the hemostatic clips on the lienal hilus, anterior thoracotomy in 5th space on the left with resection of the lingual segment by mechanical suture, atypical liver resection, splenectomy, suture of the diaphragm.

*Anesthetic management:* Total intravenous anesthesia was performed with ketamine, fentanyl, myoplegia and 100% VPA O2. The volemic repletion performed in three venous lines (two central) in a total volume of 6500 ml, of which 1500 erythrocyte mass, 1750 fresh frozen plasma (FFP), 1000 ml colloids and 2250 crystalloids. MBP maintained between 60-75 mmHg with adrenaline support in doses 0.05 µg / kg / min and dopamine 15 µg / kg / min. Intraoperative diuresis 300 ml.

Postoperatively, the patient transferred to the intensive care unit for mechanical ventilation. The postoperative period evolves without complications.

The patient is discharged on the 14th postoperative day.

## Discussion

The operative versus non-operative strategy depends on the presence of other injuries and medical comorbidities, hemodynamic status of the patient and grade of liver injury (Table 1.).

*Resuscitation of patients with abdominal trauma.* Resuscitation is performed according to ATLS (Advanced Trauma Life Support) standards: keeping the airways free, urgent volume resuscitation, ventilator and circulatory support, bleeding control. Effective venous access must be installed and volemic resuscitation must begin immediately. Blood collection and blood group determination, sending to the laboratory to determine red blood (erythrocytes, hemoglobin, hematocrit), leukocytes, blood gas analysis, urea, creatinine, and electrolyte concentration. The insertion of a nasogastric catheter and a urinary catheter is indispensable [5].

Liver injury should be suspected at patients with blunt and penetrating abdominal trauma in the right hypochondrium and epigastric area. Diagnosis can be difficult in patients who have disturbed consciousness or have lesions of the skull or spinal cord.

### *Preoperative evaluation*

Identifying the mechanism of trauma is very important, presenting information about the forces that were involved and the potential injuries. In addition, the signs and symptoms of the patients, the response to the treatment must be obtained from the medical personnel involved in the patient's transport. Patients without consciousness, or those with obvious lesions in the regions adjacent to the abdomen, are assumed to have an abdominal injury until proven otherwise. Injury of the lower region of thorax, either blunt or penetrating, may result in intra-abdominal lesions, which should be suspected even if patients do not have obvious signs of abdominal injury [5]. Liver or lymphatic injury should be suspected if patients have lower rib fractures. The hematomas caused by the seat belt concomitant with T12 / L1 fractures [4], lumbar spine fractures are commonly associated with intestinal perforation. The probability of an intra-abdominal injury increases significantly when the speed is greater than 20km / h,

**Table 1.** Liver Organ Injury Scale

Grade		Description
I	hematoma	subcapsular, <10% surface area
	laceration	Capsular tear, < 1 cm parenchymal depth
II	hematoma	Subcapsular, <10%-50% surface area; intraparenchymal, <10 cm in diameter
	laceration	1-3 cm parenchymal depth, <10 in Length
III	hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma
	laceration	>3cm parenchymal depth
IV	Hematoma	Parenchymal disruption involving 25%-75% of hepatic lobe or 1-3 Couinaud segments within a single lobe
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe >3 Couinaud segments within a single lobe
	Vascular	Juxtahepatic venous injuries; ie, retrohepatic vena cava/central major hepatic vein
VI	Hepatic avulsion	

the age of more than 75 years, and the presence of head, legs and chest injuries even at low speeds. Urinary tract injury is suspected in case of severe blunt trauma to the lower region of abdomen and penetrating trauma of the abdomen [6].

#### *Clinical examination*

Inspection of the abdomen, lateral parts, lumbar region, perineum for excoriation, hematomas, lacerations and bleeding must be performed. This requires removing the clothes, but it is important for patients to be covered again to prevent heat loss. The hematomas that correspond to the sign of the seat belt may be obvious at the hospital, but they usually appear after a few hours after the trauma. Patients with the seat belt sign are more commonly associated with intra-abdominal injury than patients without this sign. The distention of the abdomen may be present but is not a characteristic sign (two liters of intra-abdominal fluid increases the abdominal circumference by 1.9 cm) [7].

Auscultation and percussion of the abdomen are unlikely to provide useful information; it is almost impossible to hear the sounds of percussion during the resuscitation process in the traumatized patient.

The abdomen should be palpated for pain, tenderness and defensiveness and must be examined in all regions. Sensitivity is the most eloquent sign for an abdominal injury. Defense and rebound sensitivity are associated with peritoneal irritation, caused by blood or gastric components. However, even large amounts of blood can cause extremely small irritations and very subtle signs upon examination. The patient may have the Kehr sign, pain in the left shoulder secondary to diaphragmatic irritation by the blood after a spleen rupture, however, altered consciousness, associated lesions and medications may alter the objectivity of these signs [7].

Rectal examination includes the presence of unchanged blood and sensitivity, which may indicate bleeding in the lower digestive tract or peritoneal irritation. A small part of the patients will have a distended or rigid abdomen; however, if the abdomen examination is ambiguous, it is necessary to perform additional and special investigations as quickly as possible and targeted on the type of trauma [7].

#### *Investigations*

Abdominal trauma is often underdiagnosed, as well as intra-abdominal bleeding is not always recognized. Studies emphasize the need for rapid and targeted investigation of the abdomen.

The Focused Assessment with Sonar for Trauma (FAST) is based on the ultrasonographic examination allows examination of intra-abdominal and pericardial fluids. FAST examination is fast, portable, non-invasive and can be performed even during resuscitation. This type of exam was accepted as a first-degree investigation into abdominal trauma. It has been shown that the use of the FAST examination reduced the number of CTs and the peritoneal diagnostic lavage in specialized centers [8].

The unstable patient with a positive FAST should be directed to the laparotomy; however, the negative FAST examination should at least be repeated or complementary examinations should be performed when the FAST examination is not conclusive, especially in penetrating trauma when the FAST has a sensitivity of only 50% [9].

Computed tomography is the first-line investigation in stable traumatized patients. It allows accurate assessment of the abdomen and retroperitoneal space, and is gaining popularity in the investigation of patients with blunt trauma and penetrating ballistic trauma to evaluate the path and type of intervention if necessary.

Computed tomography allows visualization of specific organs, which allows the use of a conservative treatment protocol in patients with small lesions of the liver, spleen and kidneys. However, CT has variable sensitivity in evaluating cavity organs. The sensitivity of the diagnosis and the accuracy may be related to the experience of the investigating technician and the clinician interpretation[10]. CT is not suitable for investigating unstable patients, which can be rapidly decompensated for during the procedure [11].

Diagnostic laparoscopy is the most common and effective method of investigating abdominal cavity in stable patients after a thoraco-abdominal trauma caused by a white weapon, and allows to avoid a laparotomy. If penetration is evident then laparotomy is necessary because it is difficult to safely exclude all laparoscopic intra-abdominal lesions [6].

Laboratory tests – dynamic evaluation of hemoglobin and hematocrit are used in common with other signs to identify a subsequent loss of blood. Increased leukocyte count is a normal response to trauma, but an increase in leukocyte dynamics may indicate an inflammatory process in the abdominal cavity secondary to cavity organ injury, infection of the wound or sepsis in advanced stages [12].

#### *Anesthetic management*

The purpose of anesthetic management in patients with abdominal trauma are:

1. Restoration and maintenance of normal hemodynamics:
  - a. In case of hypotension, firstly liquids, then vasopressors
  - b. Frequent evaluation of baseline deficits, hematocrit and diuresis
  - c. Additional titration of the anesthetic if BP allows
2. Reduction of the hypothermia:
  - a. Monitoring of body temperature
  - b. Administration of heated fluids
  - c. Patients should be covered and to warm the room
4. To limit blood loss and coagulopathy:
  - a. To encourage the surgeon to stop blood loss
  - b. Frequent monitoring of hematocrit, ionized calcium, platelets and coagulogram
  - c. Administration of calcium after using large quantities of product containing citrate
5. Limiting complications of the other systems:
  - a. Monitoring intracranial pressure, maintaining cerebral perfusion pressure more than 70 mmHg
  - b. Monitoring the peak inspiratory pressure; vigilance in the case of the pneumothorax
  - c. Monitoring of diuresis
  - d. Monitoring of the peripheral pulse

In addition to physiological instability, analgesia and anesthetics should be administered only if the patient becomes hemodynamically stable enough to tolerate anesthetics. Anesthetics used for induction in abdominal trauma (Table 2.)

Anesthesia can be maintained with both inhalational and intravenous anesthetics, as well as propofol, the need for opioid use is frequently required.

All volatile anesthetics cause depression of myocardial contractility depending on the dose. Deflurane, isoflurane and sevoflurane maintain heart rate better than enflurane and halothane. There are no absolute contraindications to the use of inhalational anesthetics, however halothane and sevoflurane should be better avoided because of potential liver and renal injury.

**Table 2.** Anesthetics used for induction in abdominal trauma

Anesthetic	Dose	Comments
Etomidate	0,2mg/kg	Elective anesthetic in induction at traumatized patients. Hemodynamic stability even in the elderly. Repeated doses can cause adrenal suppression.
Ketamine	1-2mg/kg	Higher doses release endogenous catecholamines and may cause hypertension and tachycardia; however, ketamine causes myocardial depression, which can cause hypotension in severely hypovolemic patients.
Thiopental	0,5-1,0mg/kg The dose to non-traumatized 4mg/kg	Even if the standard induction dose is 3-5 mg / kg in hypovolemic patients, a lower dose is required (myocardial depression and systemic vasodilation are dose dependent).
Propofol	0,25-0,5mg/kg The dose to non-traumatized 2mg/kg	Even though propofol has many benefits when given to certain patients, it has relative contraindications for traumatized and hypovolemic patients.

### *Fluid management*

Hemorrhage and intravascular volume play a critical role in the morbidity and mortality of trauma patients. Isotonic crystalloids (0.9% NaCl, Lactated Ringer) are the solutions used in the initial resuscitation of traumatized patients. Advantages of isotonic solutions: they are cheap, always valid, non-allergic and effective in restoring blood volume. They are easy to keep and administer; can be used concurrently with other medicines, can be quickly heated to body temperature. Disadvantages include the inability to carry oxygen, they do not contain coagulation factors, and the intravascular half-life is limited.

Colloids are used for rapid expansion of plasma volume. Like crystalloids, colloids are always valid, easy to store and administer, and relatively inexpensive. Colloids do not carry oxygen or facilitate coagulation; the dilution effect is the same as for crystalloids. Recent studies have shown that colloids have no greater benefit than crystalloids in resuscitation [13].

### *Transfusion in abdominal trauma*

The ATLS guidelines say that blood transfusion is required in patients who remain in shock after administering 2 l of crystalloids. Transfusion in critically ill patients requiring mechanical ventilation should be started when Hb is <70 g / l. Administration of blood products in proportion of 1 unit of erythrocyte mass: 1 unit of FFP: 1 unit of platelet mass. Studies have shown that the implementation of a massive transfusion protocol has a greater benefit in the evolution of the patient, compared to the resuscitation by the physician guided by the laboratory data [14].

### *"Damage control" surgery*

"Damage control" is the term assigned to a short surgery in unstable patients, with severe lesions with metabolic disorders (coagulopathy, hypothermia and acidosis) in which initial long-term intervention is dangerous. Short-term surgery is associated with increased survival and decreased morbidity even if the integrity of the organs, especially the liver, has not been completed [15].

The stabilization period usually takes place in the intensive care unit (ICU). After transport to the ICU, it is necessary to continue fluid resuscitation, control of coagu-

lopathy and normalization of acidosis. Reoperation is planned over 12 to 48 hours. Re-intervention after 72 hours is associated with higher morbidity and mortality. Complications include abscess formation, development of sepsis caused by foreign bodies in the abdomen, necrosis of tissue, remaining blood and bile. Other complications include ARDS, jaundice, hepatorenal syndrome, disseminated intravascular coagulation syndrome, biliary peritonitis and postoperative bleeding [15, 16].

#### *Postoperative management*

The postoperative period in the ICU includes monitoring and prevention of bleeding and shock, coagulopathy, hypothermia, abdominal compartment syndrome, acute lung injury (ARDS), deep vein thrombosis, pulmonary embolism, sepsis, late complications as omitted lesions (hemorrhage or infection), dehiscence of anastomosis with peritonitis, wound infection, intestinal ischemia or occlusion, abscesses and fistula formation [12] and early enteral feeding.

#### *Conclusions*

The management of trauma poses in definitive the attention in treating also the physiology and decision can be more effective when both anatomy of injury and its physiological effects are combined. The basic principle of operation is to control the trauma and choose the optimal operative method „damage control” according to the general condition informed by surgical exploration.

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