

# Intraoperative Surgical Hemostasis Tactics in Case of Combined Injuries of Parenchymal Organs Abdominal Cavity

Umedov Xushvaqt Alisherovich

Assistant of the Department of Surgical Diseases No. 2, Samarkand State Medical University, Uzbekistan

**Abstract** In recent years, there has been a steady increase in injuries around the world. Man-made and natural disasters, local military conflicts, transport and industrial accidents in 50-60% of cases of all injuries lead to combined and multiple damage to the organs and systems of the human body, and, as a result, to high sanitary losses in the first hours and days. The main problem is the diagnosis and treatment of a combined closed abdominal injury, accompanied by shock against the background of massive intraperitoneal bleeding in case of liver and spleen injuries. Hospital mortality in this variant of pathology ranges from 17.3 to 72.7%. Currently, the issues of surgical treatment tactics of spleen and liver injuries are not fully resolved. The search for optimal options, as well as technical advancement of organpreserving operation techniques involving parenchymal organs, remains relevant. This depends on the structural features of these organs, availability of the methods of local hemostasis listed in this paper and surgeon's knowledge and manual skills. Moreover, at present, hemostatic application agents are widely introduced into clinical practice, parenchymal bleeding caused by superficial planar injuries of parenchymal organs being the main indication for the use of these agents.

**Keywords** Liver injury, Modeling, Parenchymal organ, Abdominal surgery, Clinical surgery, Bleeding

## 1. Introduction

In recent years, there has been a steady increase in injuries worldwide. Man-made and natural disasters, local military conflicts, transport and industrial accidents in 50-60% of cases of all injuries lead to combined and multiple damage to organs and systems of the human body, and, as a result, to high sanitary losses in the first hours and days. [1,2]. The main problem is the diagnosis and treatment of combined closed abdominal trauma, accompanied by shock against the background of massive intra-abdominal bleeding with damage to the liver and spleen [3,4]. Hospital mortality in this variant of pathology ranges from 17.3 to 72.7% [6].

The urgency of the problem, according to [5,7], is due to the continued growth of combined abdominal trauma, while a large number of complications (45.7-69.9%) and high mortality (16.2- 69.5%), according to the authors, are associated with the lack of rational generally accepted surgical tactics for damage to parenchymal organs [9,10].

In blunt abdominal trauma, liver damage occurs in 10 to 17% [8,11].

Among the closed injuries of the abdominal organs, ruptures of the spleen account for 16-30% [9,10,12].

According to the literature, liver injury in abdominal injuries is observed in 56.0-66.8% of cases [10]. The complicated course of the postoperative period is noted in 37.0-45.0% of cases [12], and the level of postoperative mortality in isolated liver injuries is 30-36%, and in combined 39-44% [14]. In recent years, there has been a tendency to increase the frequency of liver damage, which is primarily due to an increase in the number of occupational injuries.

## 2. Methods and Materials

The main cause of the unfavorable outcome of liver and spleen injuries is intra-abdominal bleeding, therefore, the choice of an adequate method of hemostasis and timely surgical intervention is of particular importance. The survival rate of patients operated on within 2 hours from the moment of injury to parenchymal organs is 85%; in those operated on within 6 to 12 hours is 23%, and in those operated on after 12 hours, the survival rate is random. The surgeon's tactics in case of damage to parenchymal organs is determined by the nature of their injuries and should be aimed primarily at ensuring effective hemostasis. Diagnosis of liver and spleen damage is difficult due to the polymorphism of the symptoms of parenchymal lesion and requires a large number of examination methods for a comprehensive assessment of the severity of the patient's

condition. Thus, a FAST diagnostic protocol based on the assessment of the presence/absence of fluid in the abdominal cavity by ultrasound has been developed and introduced into clinical practice, computed tomography is also used, and the Moore formula and the Algov shock index are used to assess the volume of blood loss. In cases where contact with patients is difficult due to the severity of his condition, combined trauma (chest injury, severe fractures of the pelvic bones and / or spine, coma with traumatic brain injury, when clarification of complaints and anamnesis is impossible, and the mechanism of injury does not exclude the possibility of damage to the abdominal organs), the implementation of invasive diagnostic techniques

such as diagnostic video laparoscopic (DVL) revision of the abdominal cavity. Of course, indications for DVL are not limited to the above list of conditions, they also include penetrating wounds of the anterior abdominal wall in the absence of indications for laparotomy; blood loss of less than 500 ml of blood, etc. [14,15]. Modern clinicians are guided by the classification of parenchymal organ injuries, adopted in 1994 by the American Association of Surgeons and Traumatologists - American Association for the Surgery of Trauma (AAST), supplemented by an abbreviated injury scale - Abbreviated Injury Scale (AIS), which was developed earlier (in 1971) as a method for quantifying and comparing various types damage to parenchymal organs (Table 1) [16].

**Table 1.** Classification of damages of parenchymatous bodies of AAST and scale of AIS

Severity of injury of a liver	Type of damage	Damage morphology	Scale points AIS
I	Hematoma	Subcapsular stable, occupies less than 10%	2
	Gap (wound)	depth less than 1 cm without bleeding	
II	Hematoma	subcapsular stable, occupies less than 10-50% central stable less than 2 cm in the diameter	2
	Gap (wound)	depth is less than 3 cm, length is less than 10 cm, bleeding	
III	Hematoma	subcapsular stable, occupies less than 50% of a surface	3
		subcapsular unstable any diameter	
		subcapsular with a gap and bleeding	
		the central stable more than 2 cm in the diameter	
	central unstable any diameter		
Gap (wound)	глубина более 3 см / depth is more than 3 cm		
IV	Hematoma	the central hematoma with a gap and bleeding	4
		destruction of a parenchyma of 25-50% of a share (I-III segment)	
V	Gap (wound)	destruction of a parenchyma of more than 50% of a share (more than three segments)	5
	Vascular damages	yukstaliver damages (lower vena cava, portal vein, hepatic arteries, bilious channels)	
VI	Vascular damages	lead of body	6

**Table 2.** Algorithm of inspection and treatment of patients at injuries of a liver of varying severity (on Coccolini F., Catena F., Moore E.E., et al., 2016; with modifications)

Severity on AAST	Hemodynamics	KT-research	Treatment of the first stage
I- II	stable	It is applied	Conservative
III	stable	It is applied	Conservative
IV-V	stable	It is not applied	Operation
I-VI	not stable	It is not applied	Operation

There are clinical cases when the severity of the injury on the AAST scale does not correspond to the physiological status of the victim. Moreover, in the last thirty years, thanks to the improvement of diagnostic techniques and devices, as well as treatment tools, there has been a significant change in the algorithm for managing liver injuries with a significant improvement in outcomes, especially in closed mechanical injuries. In the process of deciding on the choice

of optimal tactics, along with determining the severity according to the AAST classification, it is necessary to assess the hemodynamic status of the patient and the combined injuries. (Table 2) [12].

In fact, in clinical practice, the decision on surgical or non-surgical treatment is based on the clinical condition of the victim and the presence of combined injuries, and, to a lesser extent, on the severity of the AAST liver injury scale. Moreover, in some cases, the condition of patients determines their immediate delivery to the operating room, without being able to determine the severity of liver damage before surgery; this confirms the paramount importance of assessing the clinical condition of the patient. Ultimately, the treatment of injury requires the identification of the morphology of the injury and its physiological consequences [13]. However, according to the protocols of the World Society of Emergency Surgery (WSES) of 2016, hemodynamic stability may be maintained in some patients with a high

AAST score (i.e., grade IV-V ruptures with damage to more than 75% of the liver lobe parenchyma or more than three Quinault segments within one lobe of the liver), and such victims can successfully treat nonoperatively. In fact, such tactics are very risky and require constant monitoring of the patient in the intensive care unit with monitoring of blood pressure and indicators of biochemical blood analysis, coagulogram, hemoglobin levels, as well as massive infusion therapy, including blood and its components [14].

On the other hand, "mild" liver damage accompanied by hemodynamic instability often needs to be operated on. All this confirms the fact that the division of liver damage into small and large should take into account not only the anatomical classification of AAST, but most importantly, the hemodynamic status and the presence of combined injuries. The extended Trauma Care Protocol defines an "unstable" patient as having: blood pressure <90 mmHg and pulse rate >120 beats. in particular, signs of vasoconstriction of the skin (cold, moist skin, decreased capillary response time), impaired consciousness and/or shortness of breath [10]. The management of such patients is carried out according to the "Damage control" protocol and during surgical interventions, such a patient is shown to tampon a liver wound, ligation of large vessels [11]. An increase in the effectiveness of liver tamponade is also possible through the use of local hemostatic drugs. Local hemostatics based on blood clotting factors ("Tissucol Kit"), collagen ("Hemostatic collagen sponge", "Tachocomb", "Avitene", "D-Stat"), gelatin ("Surgifoam", "FloSeal"), cellulose ("Surgicel") are actively used in elective surgery. to stop capillary or parenchymal bleeding and are not effective in liver injuries with damage to large vessels as the main method and means of stopping bleeding, but are appropriate as an additional [21].

Most of the victims with liver injury have grade I, II or III severity (examination of such patients is examined not only according to the protocol FAST, but they are also shown to perform R-graphy of the abdominal and thoracic cavities, computed tomography with contrast) damage, which does not require surgery, such patients are amenable to conservative treatment. The absolute conditions for conservative therapy are the stability of hemodynamics, the absence of peritonitis and the possibility of abdominal examination. On the contrary, almost 2/3 of the victims with IV-V degree of damage showed surgical treatment in the volume of laparotomy with further determination of tactics and necessary techniques based on the intraoperative picture [15].

Modern application hemostatic materials are a fairly wide range of medical devices, which are divided into several groups based on the following criteria:

- according to the form of release (sponges, powders, gels, adhesives, pastes, solutions and powders);
- according to the material of manufacture (depending on the form of release (collagen, chitosan, gelatin, cellulose, alginates, wax, etc.);
- according to the presence of additional chemically

active substances / medicines;

- by field of application (injuries and wounds of parenchymal organs, stopping bleeding in gynecology, vascular surgery, otorhinolaryngology, etc.) [16,17].

Hemostatic sponges, plates and powders are used during surgical intervention to eliminate bleeding from parenchymal organs. First of all, this is due to the convenience of using these forms during surgery. Despite the fact that most application hemostatics have been developed for use outside the body cavities, they are the most widely used received in abdominal surgery as an additional means of stopping parenchymal bleeding. However, the range of use of these drugs is quite narrow (which is described in detail in the following parts of this work). Unfortunately, hemostatic implants are relatively new and not yet completely perfect means of treatment, having the following disadvantages such as displacement of the hemostatic implant relative to the bleeding area of the organ due to its low adhesive properties, which leads to the onset of repeated bleeding. There is also an open question about the difficulty in using sponges of significant size to cover a large area of the injured organ surface in endoscopic surgery without additional expansion of the trocar openings and or performing a minilaparotomy incision for implant insertion [18].

### 3. Results

In case of spleen injuries of I and II degrees of severity of damage on the AAST scale [20], he considers conservative management and angioembolization to be the most optimal ways to achieve hemostasis. According to the author, in case of damage to the spleen gate, more than three damage to peripheral vessels, damage to more than 50% of the organ parenchyma, proximal embolization should be resorted to, and in case of single damage to peripheral vessels, distal embolization is sufficient [19]. Performing splenoraphy for the purpose of hemostasis encounters significant difficulties due to the eruption of sutures with the development of even more bleeding. In this regard, various methods of strengthening the stitches were used. In particular, a strand of a large omentum, various plastic materials, including a hemostatic sponge, were used as a lining material for splenoraphy. In some cases, the wound was closed with a plastic material that was fixed to the surface of the damaged spleen with a catgut mesh. These methods of hemostasis in spleen injuries of 4 degrees of severity of liver and spleen injuries and for each degree offered its own version of hemostasis. The severity of the liver injury was determined taking into account the degree of damage: I – superficial wounds up to 2 cm deep, II – wounds from 2 cm deep to half the entire thickness, III – wounds more than half the thickness of the organ and through tears. In case of injuries of I-II degree, wounds were sutured with hemostatic U-shaped sutures made of absorbable material to the full depth. Hemostasis of injuries with grade II and III ruptures was

performed by ligation of the right renal vessels and tamponade of the wound. The artery was ligated if its temporary compression led to cessation or a significant decrease in the intensity of bleeding. For grade I spleen injuries, the Tachocomb collagen sponge was used and reliable hemostasis was achieved, and for grade II and III injuries, splenectomy should be performed to achieve hemostasis, followed by autotransplantation of spleen tissue into the large omentum.

With superficial tears of the liver of the I class of damage, according to the AAST classification, it is enough to apply a collagen sponge "Tachocomb", with deep ruptures with damage to the liver parenchyma, U- or Z-shaped suturing should be applied, only with absorbable suture material (catgut or vicryl), with extensive damage of the III class, the sutures described above can be applied and in addition you can apply a gauze tamponade of the "cigar" type. The collagen plate "Tachocomb" has proven itself in case of surface tears spleen of class I, and in case of extensive damage of class III, splenectomy is advisable [20]. The method of hemostasis in case of combined damage to the liver and spleen. The essence of the method is as follows. After laparotomy and evacuation of blood from the abdominal cavity, splenectomy is performed according to general surgical rules. The liver wound is preemptively tamponed with a hemostatic sponge, then a wedge-shaped graft, identical in size to the liver wound, is cut out of a less damaged fragment of the removed spleen. The peripheral part of the graft is not decapsulated. To achieve hemostasis in case of ruptures of the spleen, along with its suturing, ligation of segmental lobular arterial vessels is also possible, if necessary, with fixation (frenolienopexy, gastrolienopexy). In case of deep ruptures, along with suturing, external compression of the organ can be used to achieve final hemostasis. In subcapsular hematomas with damage to the parenchyma of the organ, preference should be given to minimally invasive methods of treatment. In case of crushed wounds and ruptures located along the edge of the organ, in the area of the poles and occupying an entire lobe or segment, it is recommended to perform atypical resection of the corresponding area. Splenectomy with implantation of splenic fragments is indicated for deep wounds in the area of the gate, multiple ruptures of the spleen. Intraoperative methods of stopping bleeding in elective surgery of parenchymal abdominal organs.

In case of planned organ-preserving operations on the liver for oncological diseases, one of the key methods of surgical treatment is extensive liver resection (ORP). However, ORP is a high-risk operation due to the occurrence of massive intraoperative bleeding. ORPS are usually divided into anatomical (typical) and atypical. In anatomical liver resection, an indispensable point of the surgery technique is the ligation of the main vessels and ducts in the portal and caval gates of the liver, and the separation of the liver parenchyma itself is performed in low-vascular zones (lobectomy, segmentectomy, hemihepatectomy). Atypical

resections are performed without strict consideration of the intraorgan architectonics of vessels and ducts, without preliminary ligation of the vascular secretory pedicle and the main point is the hemostatic suture. Anatomical liver resection is currently considered the standard of liver surgery, as it reduces the risk of massive blood loss, damage to the main vascular structures of the opposite lobe of the liver, and also avoids sequestration of the liver parenchyma.

In case of ruptures of the spleen along the diaphragmatic surface, it is necessary to pinch the vascular pedicle before application and hold it for the entire period of fixation. Splenectomy is recommended for hemostasis of central ruptures of the spleen. Separately, we will consider the use of such a method as electrocoagulation (diathermocoagulation), which is widely used by practicing surgeons for virtually any type of bleeding (especially parenchymal) due to its accessibility and effectiveness. However, the use of electrocoagulation has negative consequences for the injured organ, as it causes additional damage to the parenchyma and causes the development of inflammation in the area of contact of the coagulator branches and organ tissues, despite the pronounced hemostatic effect. In the postoperative period, the formed scab, due to its fragility, can collapse or deform due to the presence of peristalsis or contact with nearby organs, as well as become the basis for the formation of intra-abdominal / organ abscesses and, as a result, this can lead to a deterioration in the prognosis for the patient.

## 4. Conclusions

The intraoperative stopping of bleeding from parenchymal organs of the abdominal cavity (liver, spleen) is a difficult task for a surgeon. This is due to the peculiarities of the structure of these organs, it depends largely on the availability of the methods of local hemostasis listed in this article and the degree of mastering the manual skills of the surgeon. Hemostatic applicative agents (implants) are also being widely introduced into clinical practice, the main indication for the use of which is mainly parenchymal bleeding caused by superficial planar injuries of parenchymal organs. In such cases, additional suturing of the organ tissue is not required, hemostasis is achieved by applying implants. In cases with operations that injure parenchymal organs (such as hemihepatectomy), when there is a significant area of bleeding parenchyma, the use of such drugs is also an important part of surgery, but rather refers to an additional technique, rather than the main method of stopping bleeding. In case of closed abdominal injuries and subsequent therapeutic measures aimed at providing effective surgical hemostasis, it remains important to have special local hemostasis agents in a medical institution, such as a collagen plate, a hemostatic sponge, etc. The choice of the technology of this hemostasis should be determined by the intraoperative situation and be strictly personalized.

---

## REFERENCES

- [1] Akstilovich I.Ch. Splenic artery and its topographic anatomical relationship with the pancreas. Topical issues of operative surgery and topographic anatomy: materials of the international scientific and practical conference, dedicated to To the 50th anniversary of the Department of Operative Surgery and Topographic Anatomy / ed. Col.: Yu. M. Kiselevsky (ed.) [et al.]. – Grodno, 2011. – pp. 7-9.
- [2] Alimov A.N. Organ-preserving method of surgical treatment of rupture of the spleen in closed abdominal trauma. Surgery. The magazine named after N.I. Pirogov. - 2013. - No. 9. - pp. 39-43.
- [3] Azizov M.J. The state and ways of preventing road traffic injuries in the Republic of Uzbekistan // Bulletin of Emergency Medicine. - 2010. - No.2. - p. 7.
- [4] Andersson R., Gustavsson T., Alwmark A Splenic artery ligation for traumatic rupture of the spleen. // Acta Chir. Scand. – 2015. – № 151(8). – P. 709–710.
- [5] Backus C.L., Park A.E., Matthews B.D. Mini-laparoscopic splenectomy // J. Laparoendosc. Adv. Surg. – Tech. A. – 2000 Oct. – № 10(5). – P. 259–262.
- [6] Bongard F.S., Lim R.C. Surgery of the Traumatized Spleen. // World J. Surg. – 2015. – № 9(6). – P. 391–397.
- [7] Bonariol L., Massani M., Caratozzolo E., Management of grade III-IV blunt liver traumas: a comparative, observational study. Minerva Chir. 2015; 70(1): 13–15.
- [8] Gavrishchuk Ya.V., Kazhanov I.V., Tulupov A.N. et al. Minimally invasive treatment of a victim with a damaged spleen // Bulletin of Surgery named after I.I. Grekov, 2019. -N 4. -pp. 58-60.
- [9] Gorsky V.A. The use of fibrin-collagen substance in damage to the spleen / [et al.] // Surgery. The magazine named after N.I. Pirogov. – 310 2013. – № 12. – Pp. 73-77.
- [10] Duchesne J.C., Kimonis K., et al. Damage Control Resuscitation Combination With Damage Control Laparotomy: A Survival Advantage. J Trauma. 2010; 69(1): 46–52. Available from: <https://dx.doi.org/10.1097/ta.0b013e3181df91fa>.
- [11] Ibragimov F.I. Features of treatment tactics for combined abdominal and pelvic injuries // Surgery, 2018. -N 10. -pp. 34-38.
- [12] Ikramov A.I., Khadjibaev A.M. Organization of emergency medical care for traumatological patients in the Republic of Uzbekistan // Bulletin of Emergency Medicine. - 2010. - No.2. - p. 6.
- [13] Korita V.R., Sidorenko M.G. Injuries of the duodenum in abdominal trauma // First aid doctor, 2018. -N 3. -pp. 28-31.
- [14] Klevno V.A., Maksimov A.V. Clinical and morphological analysis of erroneous diagnosis of chest and abdominal trauma // Vyatka Medical Bulletin, 2019. -N 3. -pp. 31-35.
- [15] Maslyakov V.V. The influence of the chosen surgery for spleen injury on the quality of life of operated patients in the long-term postoperative period / V.V. Maslyakov // Fundamental research. - 2010. – No. 6. – pp. 70-75.
- [16] Maslyakov V.V. Injury of the spleen: the main factors determining the possibility of performing organ-preserving operations / V.V. Maslyakov, Yu.G. Shapkin, Yu.V. Chalyk // Endoscopic surgery. - 2011. – Vol. 17, No. 1. – pp. 3-5.
- [17] Makhovsky V.V. The state of the problem and ways of optimizing organ-preserving tactics in spleen surgery / V.V. Makhovsky // Vopr. reconstruction and formation. surgery. - 2014. – Vol. 17, No. 3 (50). – pp. 42-55.
- [18] Torsten B. Atlas of sectional human anatomy on the example of CT and MRI sections.: in 3 volumes / B. Torsten B. Meller, E. Reif. Trans. from English, Under the general Ed. G.E. Trufanov, N.V. Marchenko. – 2nd ed. – M.: MED press-inform, 2013. vol. 2: Internal organs. – 2013. – 262 p.
- [19] Silaev M.A. Removal of the spleen in splenomegaly in hematological patients // Surgery. The magazine named after N.I. Pirogov. - 2012. – No. 8. – pp. 55-59.
- [20] Mustafakulov I.B. Severe combined abdominal trauma. J critrev; 2020: 2214–2221.