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The role of laparoscopy in diagnosis and treatment of parenchymal organs injuries after abdominal trauma in own material

Rola laparoskopii w diagnostyce i leczeniu uszkodzeń narządów mięszowych po urazach jamy brzusznej w materiale własnym

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Summary

Introduction. Nowadays a significantly growing occurrence of multi-organ traumas is observed, which are in general caused most often by traffic accidents, agriculture accidents as well as a result of crime. Abdomen and parenchymal organs' traumas are very common and significant comorbidity in such cases.

Aim. The aim of the study was to present own material comprising cases of the surgical treatment of parenchymal organ damage after blunt and acute abdominal trauma with special emphasis on laparoscopy.

Material and methods. This study comprises 326 cases of parenchymal organ injuries, hospitalized and treated in 1st Department of General and Endocrine Surgery in years 2000 to 2015.

Results. Among examined population of patients, traumas of abdomen were most commonly caused by traffic accidents. The majority of parenchymal organs' injuries coexisted with other traumas, only 23.5% of them were isolated. All patients were diagnosed and treated. Laparoscopy was used as a method of diagnosis and treatment in 88 cases.

Conclusions. Abdominal traumas are important diagnostic and therapeutic challenge of the last years. Immediate and proper diagnosis and treatment significantly influences the survival and recovery rates for patients. There's also noticeable raise in use of laparoscopy as a diagnostic and therapeutic method.

Streszczenie

Wstęp. W ostatnich latach obserwuje się wyraźny wzrost występowania urazów wielonarządowych będących wynikiem wypadków komunikacyjnych, wypadków w rolnictwie i przemyśle, a także przestępstw z użyciem ostrych narzędzi. Wśród urazów wielonarządowych znaczną część stanowią urazy jamy brzusznej i narządów mięszowych.

Cel pracy. Celem pracy było przedstawienie materiału własnego w leczeniu chirurgicznym uszkodzeń narządów mięszowych po urazach tępych i ostrych jamy brzusznej ze szczególnym uwzględnieniem laparoskopii.

Materiał i metody. W pracy przedstawiono 326 chorych hospitalizowanych w I Klinice Chirurgii Ogólnej i Endokrynologicznej w latach 2000-2015 z powodu urazów narządów mięszowych jamy brzusznej.

Wyniki. Wśród badanej populacji najczęstszą przyczyną urazów jamy brzusznej były wypadki komunikacyjne. Większości urazów narządów mięszowych towarzy-

szyły obrażenia innych narządów, tylko 23,5% stanowiły urazy izolowane. Najczęściej obserwowano uszkodzenie wątroby, śledziony lub obu narządów jednocześnie. Pacjentów diagnozowano oraz wdrożono leczenie. U 88 chorych zastosowano laparoskopię jako metodę diagnostyczno-leczniczą.

Wnioski. Urazy jamy brzusznej stanowią istotny problem diagnostyczno-leczniczy obecnych czasów. Szybka i właściwa diagnostyka oraz wdrożenie odpowiedniego leczenia mają znaczący wpływ na przeżycie i powrót do zdrowia pacjentów. Coraz częściej wykorzystujemy laparoskopię jako metodę nie tylko diagnostyczną, ale również leczniczą.

INTRODUCTION

Abdominal injuries are an important medical challenge in the field of general surgery and emergency medicine. Injuries are the third most common cause of death in Poland after cardiovascular diseases and neoplasms and the first most common cause of death in young people under 40 years old (1). In Poland, there are approximately 3,5 million injuries per year and post-traumatic mortality is 78/100.000 that is approximately 30.000 people per year (2). One of the most common causes of injuries, apart from assaults and falls from heights, are traffic accidents. Annually there are approximately 40.000 injuries and 3.000 deaths in about 25.000 accidents (3). Worldwide, around 1,25 million people die each year due to traffic accidents (4). Statistics of Polish Police show that in the last decade the number of accidents and deaths caused by them decreased almost by half, but still remains very high (3).

Multi-organ traumas are associated with life threat, require urgent and proper diagnosis and treatment by a multidisciplinary team. Despite the development of emergency medicine, imaging diagnostic techniques and surgical procedures, as well as establishing a new standards for treatment of multiple organ injuries, their mortality rate is still high and varies from 15-30%.

Abdominal injuries are approximately 2% of all traumas and are also more frequent among men (5). Young people under 40 years old constitute 75% of total number of abdominal injury cases and 50% of them are isolated abdominal traumas. Other abdominal injuries accompany traumas of other parts of the body, including head, neck, chest and limbs (5). Among victims with multiple injuries, more than 20% have abdominal trauma and more than 50% patients who died at the scene of accident had confirmed damage of the abdominal organs.

The utmost cause of death as a result of multi-organ injury is a hemorrhagic shock with its complications. Blunt and penetrating traumas can be distinguished among all abdominal injuries. Blunt injuries are usually a result of traffic accidents, falls from height, assaults, while penetrating injuries often result from the crime with sharp tools or are effects of accidents in agriculture (6). As a result of injuries of abdominal organs, hemorrhage or intestinal perforation usually occur. Not only parenchymal organs

such as liver or spleen, which injuries are mostly accompanied by extensive bleeding into peritoneal cavity, but also gastrointestinal tract can be damaged.

Immediate and accurate diagnosis followed by implementation of appropriate treatment increase the chances of survival and enforces the recovery of the injured patient. In case of abdominal trauma, apart from physical examination, there are two major imaging diagnostic techniques: ultrasonography (USG) in FAST protocol confirms presence of blood/fluid in peritoneal cavity and computer tomography (CT), which allows additionally to visualize air, fluid and extravasating contrast agent inside the abdomen. Diagnostic puncture and lavage of peritoneal cavity can also be taken under consideration. Due to increasing popularity and availability of laparoscopy, it is also possible to apply this method in diagnostics of abdominal parenchymal organs' trauma, especially in inconclusive cases. The limitation is only the availability of equipment and efficiency of the surgical team in laparoscopic techniques.

Laparoscopy allows not only diagnostic, but also treatment of bleeding or damage to abdominal organs (7, 8). Despite advances in imaging techniques, diagnosis of abdominal injuries remains difficult, especially in patients with multiple injuries, unconscious and with craniocerebral injuries. At the appropriate time, unrecognized and thus incorrectly treated abdominal injuries may lead to early post-traumatic death (9) along with cranial and cerebral injuries.

AIM

The aim of the study was to present own material comprising cases of the surgical treatment of parenchymal organ damage after blunt and acute abdominal trauma with special emphasis on laparoscopy.

MATERIAL AND METHODS

During 15 years between 2000 and 2015, 326 patients with abdominal trauma were hospitalized in the Trauma Center and the 1st Department of General and Endocrine Surgery of the University Hospital in Białystok. Among patients hospitalized due to abdominal trauma, 128 (39.3%) were women and 198 (60.7%) men aged between 16 and 83 years old. The average age was 42.5 years old (fig. 1).

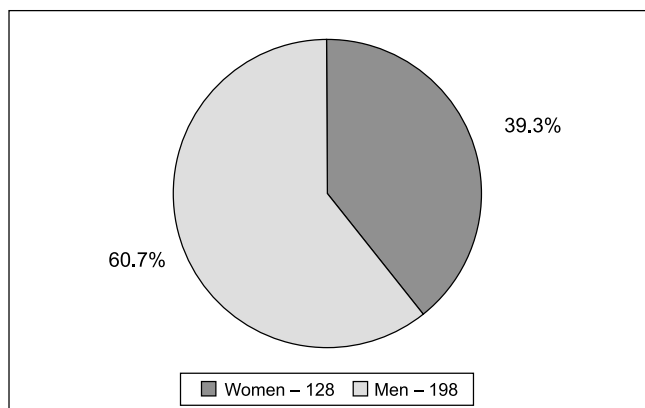


Fig. 1. Gender of patients hospitalized due to abdominal traumas

The mechanism of injury resulting in damage of parenchymal organs was analyzed. Also performed diagnostic methods were presented along with precise description of the type of damage to parenchymal organs, as well as the coexisting pathologies, applied treatment and its results.

RESULTS

Among 211 (64.7%) patients with parenchymal organs' injuries suffered a trauma as a result of traffic accidents. 64 (19.6%) patients were hospitalized due to penetrating abdominal trauma. A fall from height was the cause of injury in 26 (8%) patients. 25 (7.7%) patients were hospitalized after an assault (fig. 2 and tab. 1).

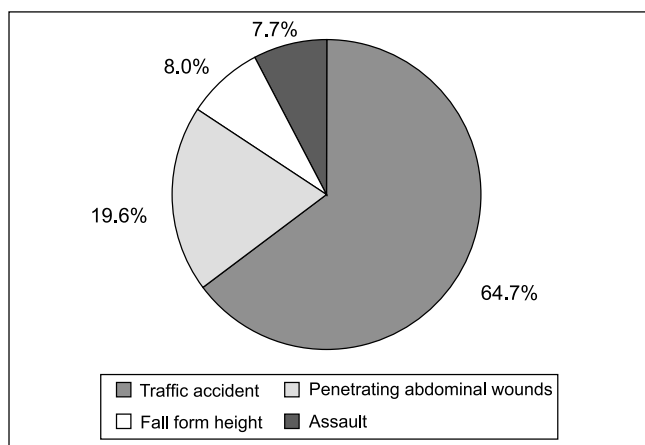


Fig. 2. Abdominal traumas mechanism

Tab. 1. Mechanism of abdominal injuries

Mechanism of abdominal injuries	Number of patients	
	n	%
Traffic injuries	211	64.7
Sharp tools wounds	64	19.6
Fall from height	26	8
Assault	25	7.7

Among 326 patients, only 77 (23.5%) had isolated abdominal trauma. In remaining 249 (76.5%) patients, a multi-organ trauma was diagnosed. Table 2 presents the types of damage associated with abdominal injuries.

Tab. 2. Co-traumas of parenchymal organs of the abdomen injuries

Co-traumas of parenchymal organs of the abdomen injuries	Number of patients	
	n	%
Craniocerebral trauma	85	26.1
Fracture:		
limbs	145	44.5
pelvis	26	8.0
spine	21	6.4
Thoracic injury	70	21.5

In the diagnostics of abdominal parenchymal organs' trauma, in addition to physical examination, imaging methods such as X-ray, ultrasound and computer tomography as well as diagnostic laparoscopy and laparotomy were used (tab. 3). Among 88 patients undergoing diagnostic laparoscopy, in 37 (42%) cases, conversion to laparotomy was necessary. The remaining 51 (58%) patients underwent laparoscopy as a diagnostic and therapeutic procedure. In 37 (11.3%) patients diagnostic and therapeutic laparotomy was performed without previous imaging diagnostics.

Tab. 3. Diagnostic procedures in abdominal injuries

Parenchymal organs injuries - diagnostics procedures	Number of patients	
	n	%
Abdominal USG	254	77.9
CT	209	64.1
Abdominal + thorax RTG	250	79.7
Peritoneal cavity puncture	21	6.4
Diagnostics laparoscopy	88	27.0
Conversion to laparotomy	37	42.0
Diagnostics-treatment laparotomy	37	11.3

Among 326 hospitalized patients, all had liver and/or spleen injuries. In 53 (16%) patients, simultaneous damage to both parenchymal organs was observed. In 129 (40%), only the liver was damaged. Spleen injury was diagnosed in 121 (37%) hospitalized patients, and subcapsular splenic hematoma in 23 (7%) patients (fig. 3). Figure 4 shows the deep spleen rupture of its lower pole in the CT scan. Figure 5 shows a computed tomography scan of a spleen contusion.

In 47 patients, in addition to trauma of parenchymal organs, injuries of other internal organs was observed. Most frequently gastrointestinal perforation occurred, that is in 23 (7.1%) patients. Most of-

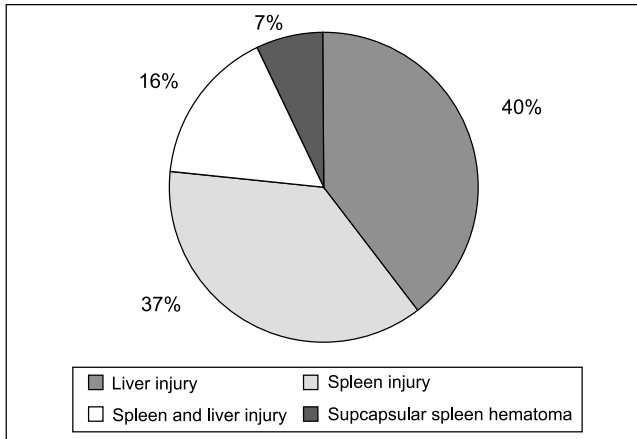


Fig. 3. Liver and spleen damages in own material



Fig. 4. Abdominal CT. Spleen contusion

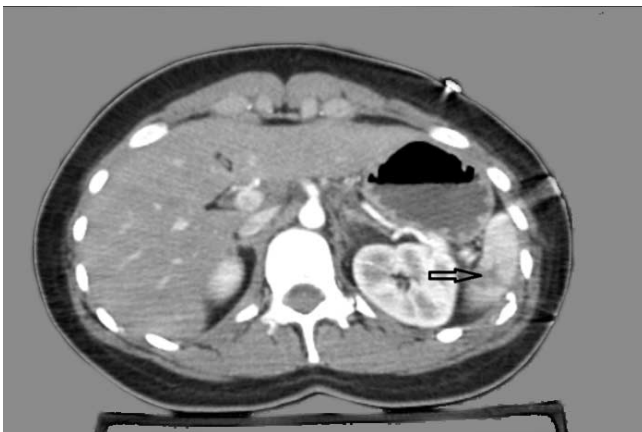


Fig. 5. Abdominal CT. Spleen contusion

ten the small intestine was perforated in 15 (4.6%) of those cases. In 14 patients, a kidney injury was observed, in 11 cases concerned the left side. Another 5 patients (1.5%) had a cardiac wound. The diaphragm rupture occurred in four cases – all related to the left side of diaphragm. In one traumatic rupture of the diaphragm the size of the fracture was over 6 cm, which led to the dislocation of the stomach to the chest. The pancreas tail injury was observed once (tab. 4). Coexisting bone damages was reported in 251 (77%) patients.

Tab. 4. Abdominal co-injuries of parenchyma organs traumas

Co-injuries of parenchymal organs traumas	Number of patients	
	n	%
Small intestine perforation	15	4.6
Left kidney injury	11	3.4
Cardiac wound	5	1.5
Large intestine perforation	4	1.2
Stomach damage	4	1.2
Diaphragm rupture on the left side	4	1.2
Right kidney injury	3	0.9
Pancreatic tail injury	1	0.3

Among 326 patients treated due to trauma of parenchymal organs, 291 (89.3%) underwent surgical treatment. In 98 cases splenectomies was performed, 21 cases of splenic ruptures was also treated. In 97 patients, hepatic injury was sutured, marginal resection of the right lobe of the liver was performed in 11 patients, partial resection of the left lobe in the next 2 patients, and 3 partial resections of the VI liver segment. In 3 patients, the “packing” of the liver was performed (tab. 5 and fig. 6).

Tab. 5. Surgical proceedings in injuries of parenchymal organs

Surgical proceedings in injuries of parenchymal organs	Number of patients	
	n	%
Splenectomy	98	30.1
Spleen rupture treatment	21	6.4
Liver damage suture	67	20.6
Marginal resection of right lobe of the liver	11	3.4
Partial resection of left lobe of the liver	5	1.5
Partial resection of VI segment of the liver	3	0.9
Resection of left lobe of the liver	2	0.6
Liver “packing”	3	0.9

Furthermore, damage associated with trauma of parenchymal organs was treated. In 13 cases the perforation of the small intestine was sutured, in two cases partial resection of the small intestine was necessary. In 4 patients perforation of the large intestine was sutured, in the another 4 cases stomach wounds were sutured. One right side nephrectomy was performed, and in 8 cases, the kidney damage was treated conservatively. One patient underwent partial resection of the pancreatic tail. In addition, 5 cardiac wounds were treated and diaphragm suturing was performed in 4 patients (tab. 6).



Fig. 6. Abdominal CT with contrast. Liver rupture. Active contrast extravasation

Tab. 6. Surgical proceedings in co-injuries of internal organs

Surgical proceedings in co-injuries of internal organs	Patients number	
	n	%
Small intestine perforation suture	13	4.0
Kidney injury treatment	8	2.5
Cardiac wound treatment	5	1.5
Large intestine perforation suture	4	1.2
Stomach wound suture	4	1.2
Diaphragm suture	4	1.2
Right nephrectomy	1	0.3
Partial resection of pancreatic tail	1	0.3

Among 326 patients hospitalized due to parenchymal organs' injuries, 35 were observed for a few days due to subcapsular hematoma of the spleen or superficial rupture of the liver. Patients had repeated control USG of the abdominal cavity in the following days of hospitalization. No surgery was necessary in any of those patients.

During the hospitalization, an indications for blood transfusion occurred in some cases. Among those 122 patients, pocked red blood cells (PRBCs) was transfused in the amount of 2 to 18 units, and 74 patients had fresh frozen plasma (FFP) transfused from 3 to 13 units.

From 326 patients hospitalized due to damage of parenchymal organs, 5 (1.5%) died, including 3 (0.9%) early deaths below 48 hours and 2 (0.6%) late deaths – after 48 hours. All death cases occurred in patients with multi-organ trauma, treated by interdisciplinary team (surgical, orthopedic, neurosurgical) and after 4-6 procedures.

DISCUSSION

Multi-organ injuries remain a diagnostic and therapeutic issue in Poland and in the world, especially

during the last decades. Abdominal injuries are important cause of morbidity and mortality. They occur in all countries of the world, regardless of the level of development and deserve the name of a pandemic. Around 16,000 people are injured every day around the globe as a result of trauma, which gives about 5.8 million deaths per year worldwide (10, 11). Injuries remain the most common cause of death and disability in children and young adults under 40 years old (2).

In Canada, mortality due to serious injuries is estimated at 71.5 per 100 thousand, in Germany it is 25 per 100 thousand, and in Poland it reaches 78 per 100 thousand (2, 12, 13). It is worth mentioning, that over 50% of victims of multiple organ injuries die before reaching the hospital (14). In Western Europe, also in Poland, in recent years, a decreasing frequency of accidents is observed (3). From an economic point of view, injuries are a direct source of medical costs, as well as costs resulting from disability of the injured (15, 16).

Abdominal injuries are divided into blunt and penetrating. The frequency of both varies depending on the region of the world and the political situation. In regions where military operations are conducted, with high percentage of crime and aggression, penetrating traumas are dominating. During peace, in developed countries, the predominance of blunt injuries is observed, most often as a result of traffic accidents, and less frequently falls from heights (17, 18). Only 50% of abdominal injuries are isolated injuries, the remaining 50% coexist with injuries of other parts of the body.

Because multi-organ injuries usually result from high energy affecting the whole body, it is not surprising that traffic accidents are the overwhelming cause of death and serious injury in Europe (19). In case of multiple injuries, the diagnosis of abdominal injuries brings difficulties, in particular, when accompanied by craniocerebral injuries, in unconscious patients, under the influence of alcohol. Transport to the hospital, immediate and proper diagnosis and later treatment directly correlate with patients' survival rates.

The preliminary assessment of a patient with abdominal trauma includes physical examination and ultrasonography in accordance with the FAST concept in order to diagnose bleeding into the peritoneal cavity. If the patient is hemodynamically stable, the most important diagnostic procedure to perform is computed tomography (20, 21). Currently, with the development of imaging techniques, diagnostic peritoneal lavage has a minor importance (22). Determining the therapeutic procedure takes into account the physiological parameters of the patient along with the complexity of individual injuries. Due to the wider use of laparoscopy, it is also possible to apply this method in the diagnosis and treatment of certain abdominal injuries.

It is possible to treat most of the injuries laparoscopically. The limitation is only the availability of equipment and the training of the surgical team in the laparoscopic technique (7, 8). World literature emphasizes the advantages of laparoscopy. It is safe, minimally invasive method of treating abdominal injuries with shorter time of hospitalization and recovery, less blood loss and a faster return to a normal diet (23, 24). According to South African surgeons, for hemodynamically stable patients diagnostic-therapeutic laparoscopy is an appropriate way to deal with abdominal injuries and possible conversion to laparotomy is not a complication, but rather a correct finalization of the therapeutic process in situations that require such procedure (25). In our study, among 88 performed laparoscopies 51 (58%) proved to be sufficient diagnostic and therapeutic procedures.

In Europe, most liver damage is caused by blunt injuries (17). The first-choice procedure depends on the type of liver injury. In case of extensive liver injuries, it is advisable for centers inexperienced in liver surgery to perform "packing" and transfer the patient to a specialist center. In our material, in 3 (0.9%) patients it was necessary to apply such procedure.

Among spleen injuries, usually parenchymal contusion and subcapsular hematomas are observed, in some rare cases spleen is disintegrated. Patient observation and thoughtful qualification for laparotomy and splenectomy is of huge importance, especially in

young people because of the spleen participation in the immune system. In all examined patients observed due to subcapsular spleen hematoma, deferred splenectomy was not necessary. Similar results have been confirmed in the literature (26-28). In high percentage of cases, parenchymal organs damage may be treated conservatively, in contrast to injuries of the gastrointestinal tract injuries.

CONCLUSIONS

In recent years, a significant increase in the occurrence of blunt and acute traffic injuries is observed along with parenchymal organs traumas, as well as crimes with the use of sharp tools. Efficient transport to Emergency Departments and fast, highly specialized imaging diagnostics allow immediate and reliable qualification of patients for emergency laparotomy or laparoscopy. Laparoscopy as a diagnostic and therapeutic procedure is performed more frequently, which allows treatment of smaller and earlier pathologies in order to avoid major surgical trauma. That allows the injured person to recover more quickly. In inconclusive cases and lack of laparoscopic equipment, one should remember about the possibility of performing diagnostic puncture and lavage of the peritoneal cavity. Extensive liver damage should be treated by performing the "packing" and transferring the patient to the reference center as soon as possible.

BIBLIOGRAPHY

- World Health Organization: Global Burden of Disease; http://www.who.int/healthinfo/global_disease/en.
- Narodowy Program Zdrowia na lata 2007-2015, dane GUS.
- Komenda Główna Policji Biuro Ruchu Drogowego: Wypadki drogowe w Polsce w 2016 roku. Warszawa 2017.
- World Health Organization: <http://www.who.int/mediacentre/factsheets/fs358/en/>.
- Adamczyk-Krupska D, Głuszek S: Standardy postępowania w urazach jamy brzusznej w warunkach szpitalnego oddziału ratunkowego (SOR). *Studia Med* 2009; 13: 7-14.
- Filip R, Filip D: Wypadki w rolnictwie – dynamika zmian w ostatniej dekadzie. Instytut Medycyny Wsi, Lublin 2007: 133-140.
- Wiewióra M, Sosada K, Piecuch J et al.: The role of laparoscopy in abdominal trauma – review in literature. *Wideochir Inne Tech Maloinwazyjne* 2011; 6(3): 121-126.
- Ertekin C, Onaran Y, Güloğlu R et al.: The use of laparoscopy as a primary diagnostic and therapeutic method in penetrating wound of lower thoracic region. *Surg Laparosc Endosc* 1998; 8: 26-29.
- Yanagawa Y: Studying patients of severe traumatic brain injury with severe abdominal injury in Japan. *J Emerg Trauma Shock* 2011; 4(3): 355-358.
- Krug EG, Sharma GK, Lozano R: The Global Burden of Injuries. *Am J Public Health* 2000; 90: 523-526.
- Murray CL, Lopez AD: Alternative projections of mortality and disability by cause 1990-2020. *Lancet* 1997; 349: 1498-1504.
- Karmali S, Laupland K, Harrop AR et al.: Epidemiology of severe trauma among status aboriginal Canadians: a population-based study. *CMAJ* 2005; 172: 1007-1011.
- Liener UC, Rapp U, Lampl L et al.: Incidence of severe injuries. Results of a population – based analysis. *Unfallchirurg* 2004; 107: 483-490.
- Driscoll P, Lecky F: Primary prevention is better than cure. *Emerg Med Australas* 2004; 16: 265-266.
- Van Beeck EF, Van Roijen L, Mackenbach JP: Medical costs and economic production losses due to injuries in the Netherlands. *J Trauma* 1997; 42: 1116-1123.
- Bastida JL, Aguilar PS, González BD: The economic costs of traffic accidents in Spain. *J Trauma* 2004; 56: 883-889.
- Smith J, Caldwell E, D'Amours S et al.: Abdominal trauma: a disease in evolution. *ANZ J Surg* 2005; 75(9): 790-794.
- Herbert HK, Hyder AA, Butchart A et al.: Global health: injuries and violence. *Infect Dis Clin North Am* 2011; 25(3): 653-668.
- Di Bartolomeo S, Sanson G, Michelutto V et al.: The regional study-group on major injury. Epidemiology of major injury in the population of Friuli Venezia Giulia – Italy. *Injury* 2004; 35: 391-400.
- Lechler P, Heeger K, Bartsch D et al.: Diagnosis and treatment of abdominal trauma. *Unfallchirurg* 2014; 117: 249-259.
- Huber-Wagner S, Lefering R, Qvick LM et al.: Effect of whole-body CT during trauma resuscitation on survival: a retrospective, multi-centre study. *Lancet* 2009; 373: 1455-1461.
- Liu M, Lee CH, P'eng FK: Prospective comparison of diagnostic peritoneal lavage, computed tomographic scanning, and ultrasonography for the diagnosis of blunt abdominal trauma. *J Trauma* 1993; 35: 267-270.
- Trejo-Ávila ME, Valenzuela-Salazar C, Betancourt-Ferreira J et al.: Laparoscopic Versus Open Surgery for Abdominal Trauma: A Case-Matched Study. *Laparoendosc Adv Surg Tech A* 2017; 27(4): 383-387.
- Miles EJ, Dunn E, Howard D et al.: The role of laparoscopy in penetrating abdominal trauma. *JSLs* 2004; 8(4): 304-309.
- Koto MZ, Matsevych OY, Motilall SR: The Role of Laparoscopy in Penetrating Abdominal Trauma: Our Initial Experience. *J Laparoendosc Adv Surg Tech A* 2015; 25(9): 730-736.
- Freiwald S: Late-presenting complications after splenic trauma. *Perm J* 2010; 14(2): 41-44.

27. Cocanour CS, Moore FA, Ware DN et al.: Delayed complications of nonoperative management of blunt adult splenic trauma. Arch Surg 1998; 133: 619-625.
28. Kaseje N, Agarwal S, Burch M et al.: Short-term outcomes of splenectomy avoidance in trauma patients. Am J Surg 2008; 196: 213-217.

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