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Medicine

BLUNT ABDOMINAL TRAUMA AND PERITONEAL ADHESIONS

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ABSTRACT
INTRODUCTION. THE CONTINUALLY CHANGING OF THE MEDICAL FIELD AND ADVANCES IN DIAGNOSIS AND MANAGEMENT OF MULTIPLE TRAUMA PATIENTS HAVE, RECENTLY, DETERMINED A CONSERVATIVE APPROACH FOR MOST CASES OF BLUNT ABDOMINAL TRAUMA. THE PRESENT STUDY AIMS TO DETERMINE THE IMPACT OF BLUNT ABDOMINAL TRAUMA UPON THE PROCESS OF PERITONEAL ADHESION FORMATION.
MATERIAL AND METHOD. THE PURPOSE OF THIS RETROSPECTIVE STUDY IS TO EVALUATE THE PREVALENCE AND SEVERITY OF INTRAABDOMINAL ADHESIONS IN EMERGENCY LAPAROTOMY IN PATIENTS WHO HAD NT BEEN OPERATED BEFORE AND HAD A HISTORY OF BLUNT ABDOMINAL TRAUMA. 10 PATIENTS WHO UNDERWENT EMERGENCY LAPAROTOMY IN THE SURGICAL DEPARTMENT OF "SFÂNTUL PANTELIMON" HOSPITAL FROM BUCHAREST, BETWENN JANUARY 2015-DECEMBER 2016 WERE ENROLLED IN THE STUDY. THE SEVERITY OF INTRAABDOMINAL ADHESIONS WERE EVALUATED USING ZŰHLKE CLASSIFICATION. THE OVERALL ADHESION RATIO FOR THIS STUDY GROUP WAS FOUND TO BE 80%.
RESULTS AND CONCLUSIONS. THE MAIN CAUSE FOR BOWEL OBSTRUCTIONS SECONDARY TO INTRABDOMINAL PERITONEAL ADHESIONS IS REPRESENTED BY PREVIOUS INTRAABDOMINAL SURGERY. IN PATIENTS WITH NO SURGICAL HISTORY, INTRAABDOMINAL ADHESIONS HAVE RARELY BEEN ATTRIBUTED TO BLUNT ABDOMINAL TRAUMA.

KEYWORDS: INTRAABDOMINAL ADHESIONS, BLUNT TRAUMA, COMPLICATIONS, PREVENTION.

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INTRODUCTION

Peritoneal adhesions after abdominal surgery or trauma, pathological bonds that abnormally join abdominopelvic organs to each other, or to the abdominal wall or diaphragm, still represent a major surgical dilemma.

Intra-abdominal adhesions represent an under- researched problem, the medical literature containing neither an official definition of adhesions nor a recognized standardized classification for clear assessment of their cause, extent and severity. Also, references related to peritoneal adhesions following penetrating or blunt abdominal trauma are scarce. One of the reasons for the little attention the peritoneal adhesions have been received in the medical literature, can be represented by the lack of effective prevention. 20 studies from the past 10 years regarding peritoneal adhesions after blunt or penetrating abdominal trauma were found using PubMed searching system.

A large autopsy series of abdominal adhesions, which included 752 subjects, showed that over 44% had adhesions, among which 67% had prior surgery, with 33% having no history of surgical interventions, possible causes mentioned being tuberculous peritonitis, intra-abdominal or pelvic inflammatory disease and trauma. A higher incidence of adhesions was noticed after multiple laparotomies[7].

Against that backdrop, the aim of the present article is to increase the clinicians' awareness of adhesions and their consequences, offering an overview of the etiopathogenesis of adhesions in the actual context of the conservative management of blunt abdominal trauma.

The purpose of the retrospective study is to evaluate the prevalance and severity of intraabdominal adhesions in patients not operated before, with a history of blunt abdominal trauma.

MATERIAL AND METHOD

10 patients with surgical indication to laparotomy (trauma or surgical emergencies), admitted at the General Surgery Department of the "Sfântul Pantelimon" Emergency Clinical Hospital, an academic hospital of the University of Medicine and Pharmacy "Carol Davila" in Bucharest, Romania, were enrolled in this single-center, retrospective investigation, between January 1st 2015 and December 31st 2016, including a 3 months follow-up interval.

Inclusion criteria were: age over 18 and under 75 years old, no prior surgical intervention, personal history of blunt abdominal trauma treated using conservative methods and no peritoneal faecal contamination or sepsis at the moment of the surgical intervention.

Exclusion criteria were: patients under 18 or over 75 years old, requiring a simultaneous intervention, pregnancy or participation in other clinical investigations, peritonitis or sepsis, prior surgery and no history of blunt abdominal trauma.

The primary endpoint of the study is to estimate the prevalence of peritoneal adhesions after blunt abdominal trauma with evaluation of the extent, severity and treatment options.

Thus, we aimed to evaluate the prevalance and severity of intraabdominal adhesions in emergency laparotomy patients, not operated before and with a history of blunt abdominal trauma treated conservatively. The severity of intraabdominal adhesions were evaluated using Zühlke classification.

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[7] Weibel M-A, Majno G. Peritoneal adhesions and their relation to abdominal surgery. A postmortem study. *Am J Surg*. 1973;126:345-353

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Patients were treated, as well as written informed consent for each procedure adopted was collected, according to the usual clinical practice. The study protocol conforms to the ethical guidelines of the "World Medical Association (WMA) Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects" adopted by the 18th WMA General Assembly, Helsinki, Finland, June 1964 and amended by the 64th WMA General Assembly, Fortaleza, Brazil, October 2013. Approval by the institutional review committee was obtained, since this study retrospectively analyzed patients' data.

Data were recorded regarding demographics, diagnosis, duration of hospital stay, complications and mortality. The analysis of the data was made using Microsoft Office Excel 2013 software.

RESULTS

The distribution of urban/rural and male/female variables was similar within the study group, with a median age of 63 years old.

6 patients out of the study population had a history of grade I-III splenic trauma, 2 patients presented grade I-II hepatic trauma and 2 cases of zone 2 retroperitoneal hematoma, for whom non-operative management was the choice treatment (table 1).

Table 1. Types of traumatic lesions in the study population.

Traumatic lesions	**Grade I-III splenic trauma**	**Grade I-II hepatic trauma**	**Retroperitoneal hematoma**
Nº of patients	6	2	2

The moment of the traumatic injury can be referred within a large interval, from 20 years to 7 months prior to the admission in our surgical department.

Cases with history of peritonitis, sepsis or intra-abdominal inflammatory disease were excluded from the study.

The comorbid conditions existing in the study population were cardiovascular in 3 cases, 2 with hepatic comorbidity and 2 patients with type II diabetes (figure 1).

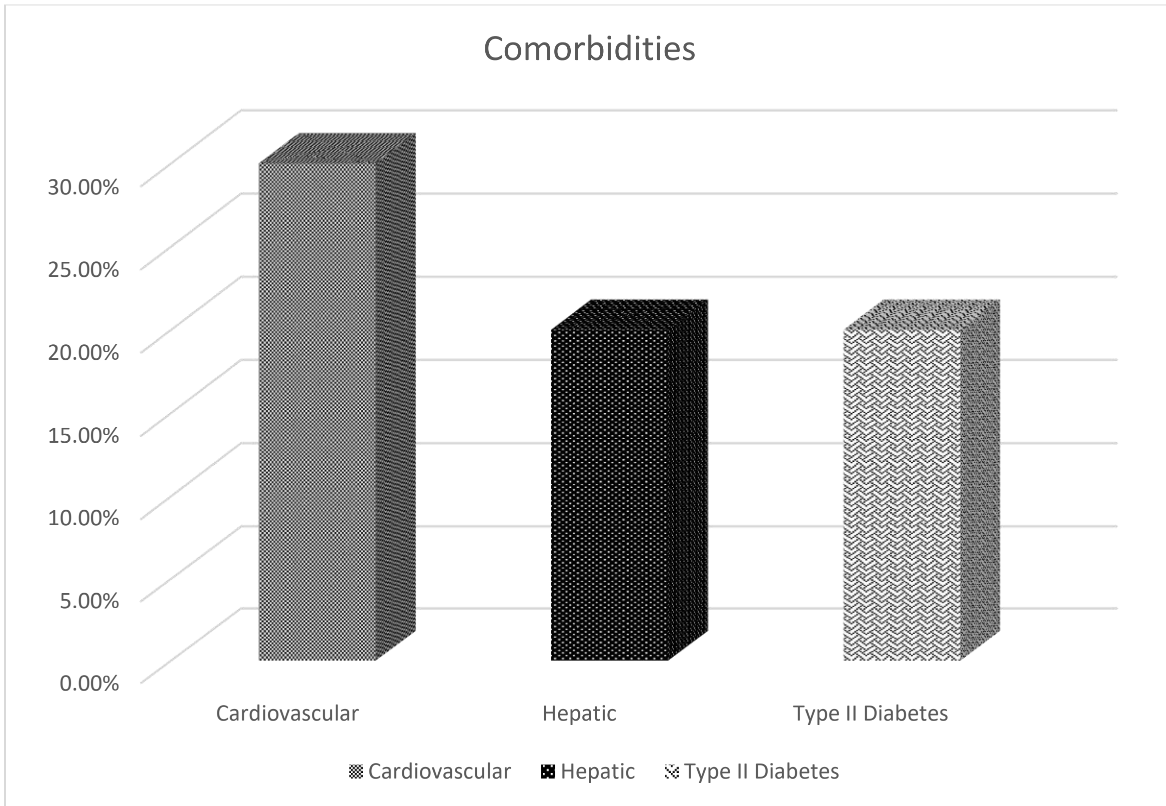

Figure 1. Comorbidities existing in the population of the study.

Regarding the surgical indication for laparotomy or laparoscopy, the present study included 5 patients with bowel obstruction (SBO) as a complication in the evolution of the peritoneal adhesion syndrome, 3 patients with acute cholecystitis and 2 cases of stage 0-III colorectal cancer (table 2).

Table 2. The surgical indications within the study group.

Surgical indication at admission	**Small/ large bowel obstruction**	**Acute cholecystitis**	**Colorectal cancer**
Nº of patients	5	3	2

7 out of 10 patients underwent laparotomy, with laparoscopy for the rest of the population (figure 2).

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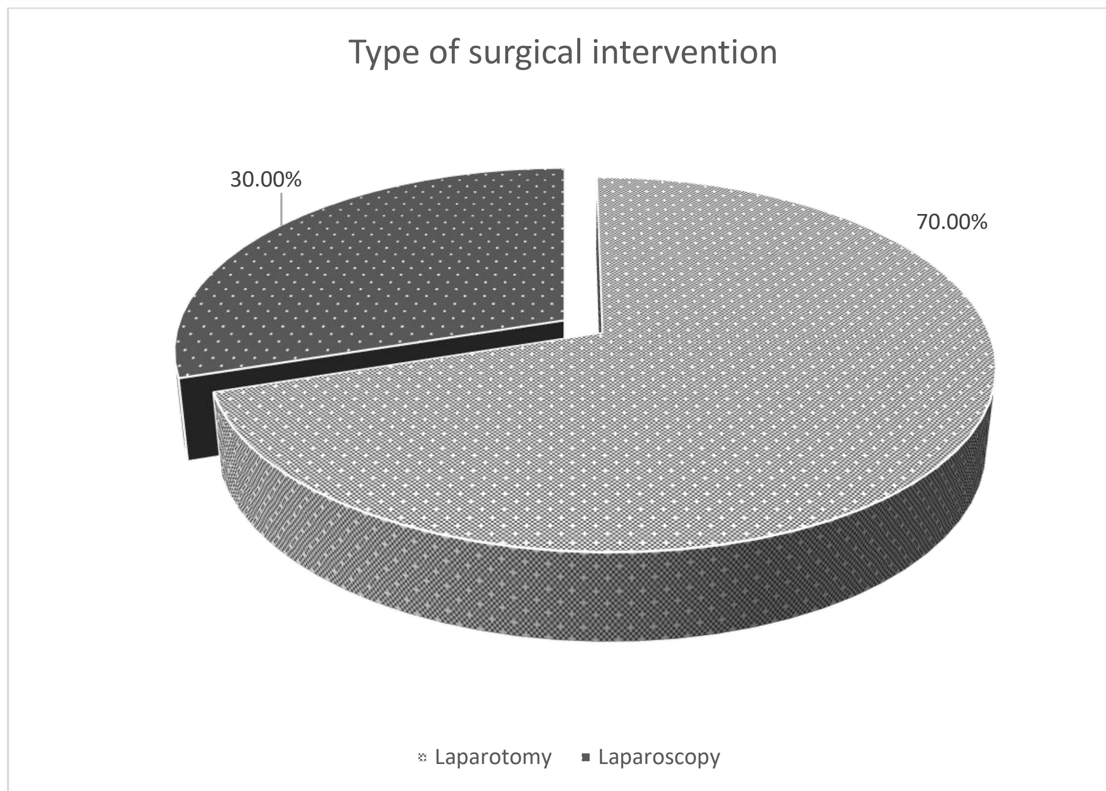
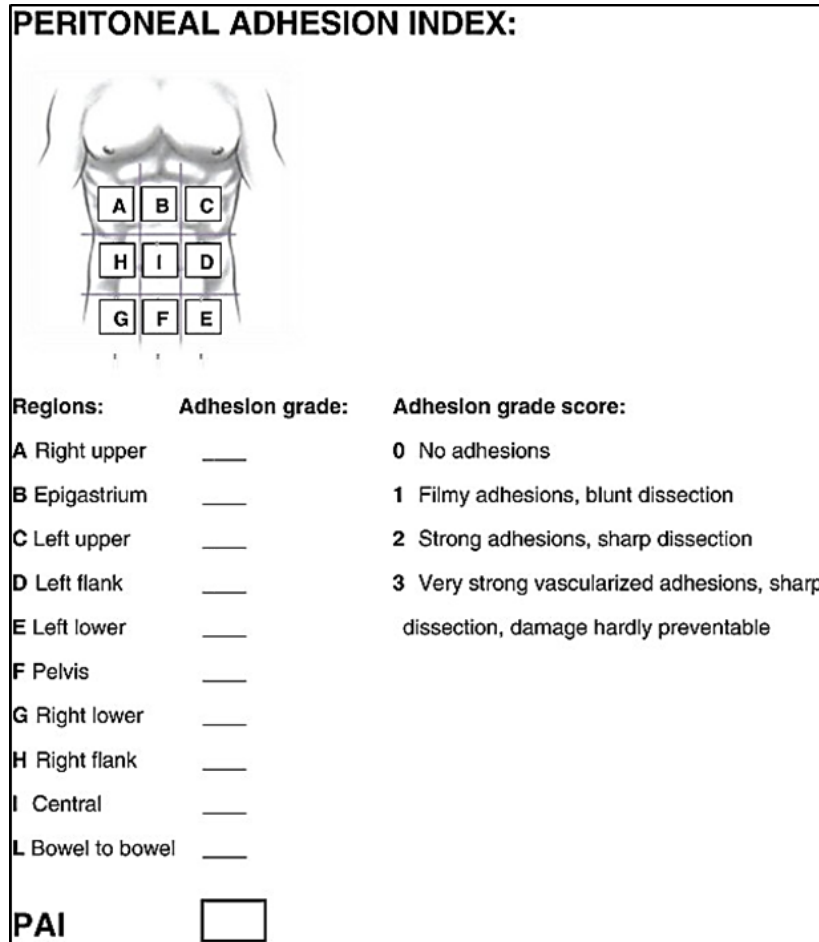


Figure 2. Type of surgical intervention within the study population.

The average duration of the surgical intervention was 2h 45 minutes.

At the time of the surgical intervention, aspects regarding severity, distribution and histopathology of the peritoneal adhesions were analyzed based on the scores proposed by Coccolini et al. in 2013 (figure 3. Peritoneal adhesion index), Mazuji and Zhülke (table 3 and 4)[8].

[8] Coccolini et al. Peritoneal adhesion index (PAI): proposal of a score for the "ignored iceberg" of medicine and surgery. *World Journal of Emergency Surgery* 2013, 8:6; Mazuji M., Fadhlih A. Peritoneal adhesions: prevention with povidone and dextran 75. Arch Surg, 1965, 91: 872-874



PERITONEAL ADHESION INDEX:

A B C
H I D
G F E

Regions:	Adhesion grade:	Adhesion grade score:
A Right upper	____	0 No adhesions
B Epigastrium	____	1 Filmy adhesions, blunt dissection
C Left upper	____	2 Strong adhesions, sharp dissection
D Left flank	____	3 Very strong vascularized adhesions, sharp dissection, damage hardly preventable
E Left lower	____	
F Pelvis	____	
G Right lower	____	
H Right flank	____	
I Central	____	
L Bowel to bowel	____	

PAI

Figure 3. Peritoneal adhesion index proposed by Coccolini et al.[9].

Table 3. Mazuji macroscopic classification of adhesions[10].

Mazuji classification	**Description**
Grade 0	No adhesions
Grade 1	Filmy adhesions: easy to separate by blunt dissection without hemorrhage

[9] Coccolini et al. Peritoneal adhesion index (PAI): proposal of a score for the "ignored iceberg" of medicine and surgery. *World Journal of Emergency Surgery* 2013, 8:6

[10] Mazuji M., Fadhlih A. Peritoneal adhesions: prevention with povidone and dextran 75. Arch Surg, 1965, 91: 872-874

Grade 2	Stronger adhesion: blunt dissection possible, at most 50% of adhesions require sharp dissection for separation; beginning of vascularization
Grade 3	Stronger adhesion: at least 50% of adhesions require sharp dissection for separation; clear vascularization.
Grade 4	Serosal injury
Grade 5	Full thickness injury

Table 4. Zuhlke histopathological classification of adhesions.

Zhülke classification	
Grade 1	Loose connective tissue, cell-rich, old and new fibrin, fine reticulin fibers
Grade 2	Connective tissue with cells and capillaries, few collagen fibers
Grade 3	Connective tissue firmer, fewer cells, more vessels, few elastic and smooth muscle fibers
Grade 4	Old firm granulation tissue, cell-poor, serosal layers hardly distinguishable

According to Coccolini and Mazuji scores, most of the patients included in the research presented grade 1-3 peritoneal adhesions located, predominately, in the supramesocolic compartment, 3 patients with no peritoneal adhesions at the moment of the surgical intervention (for a stage 1 colorectal cancer or during laparoscopic cholecystectomy), 4 patients having grade 1 adhesions, 2 cases with grade 3 and 1 cases with grade 4 (figure 4-6).

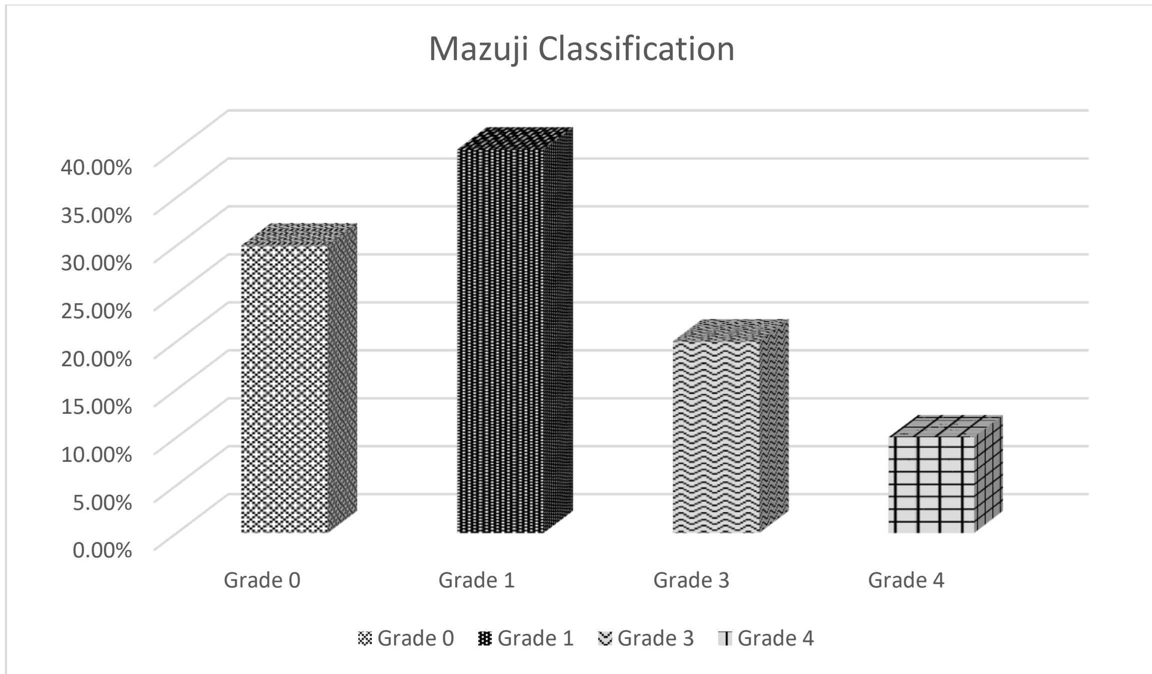


Figure 4. Classification of cases, according to the macroscopic aspect of the adhesions, using Mazuji score.

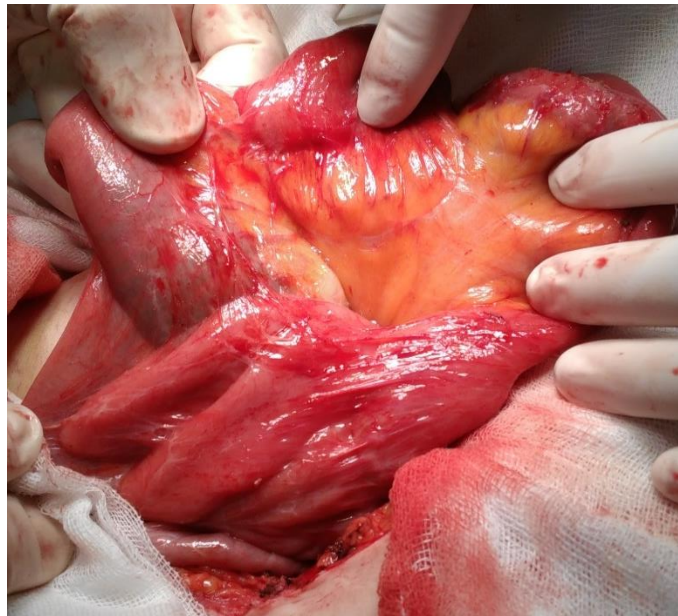


Figure 5. Macroscopic aspect of grade 4 adhesions during laparotomy for SBO (Mazuji score).

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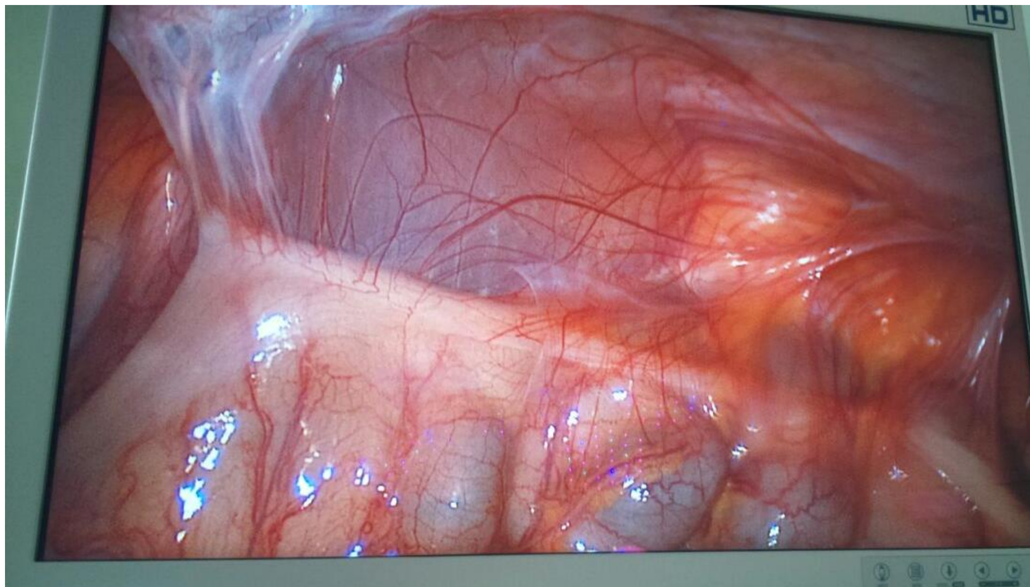

Figure 6. Macroscopic aspect of grade 2-3 adhesions during laparoscopic cholecystectomy (Mazuji score).

Judging by the results shown in the previous figure, it can be concluded that not all the patients with history of blunt abdominal trauma and no surgical interventions included in the study, presented peritoneal adhesions, 7 out of 10 cases presenting intra-abdominal adhesions.

Considering the results of the present case-series a starting point for future research, it can be estimated that the prevalence of peritoneal adhesions after blunt abdominal trauma managed non-operatively, on long and short term, can be approximated at 70%.

According to the histopathological analysis, 5 cases presented loose or firmer connective tissue, grade 1-3 according to Zuhlke scoring, and 2 cases with grade 4 adhesions, with old firm granulation tissue, cell-poor and hardly-distinguishable serosal layers (table 5).

Table 5. Classification of cases, according to the microscopic aspect of the adhesions, using Zuhlke score.

Zuhlke scoring system	**Number of patients**
Grade 1-3	5
Grade 4	2
Total	7

Blunt or sharp dissection was used for separation in all cases that presented peritoneal adhesions at the moment of the surgical intervention. All 5 cases of bowel obstruction secondary to peritoneal adhesion were treated using adhesiolysis. The 3 patients admitted for acute

cholecystitis, that were enrolled in the study, underwent laparoscopic cholecystectomy and for the 2 cases with colorectal cancer, Hartmann procedure was used, with no neoadjuvant therapy.

The immediate postoperative complications taken into consideration in the present study were: ileus, SBO, fever, intraabdominal hematoma or abscess, seroma at the surgical wound and sepsis.

In the study group, 2 patients suffered from prolonged ileus, 2 patients had fever for over 48h and one patient presented seroma.

The length of the hospital stay was an average of 13 days.

Late complications of the postoperative peritoneal adhesion syndrome are known to be infertility in women, chronic abdominal pain and intestinal obstruction. Among the patients included in the present study, 2 suffered from chronic abdominal pain, during the 3 months follow-up interval.

DISCUSSION

At least one of the following factors must exist before it can be considered that peritoneal adhesions, with ICD-10-AM code K66.0, K56.5, N73.6 or N99.4, are the cause for a fatal evolution of the patient: (a) intra-abdominal or pelvic surgery at least two days before the clinical onset of peritoneal adhesions; (b) peritonitis at least two days before the clinical onset of peritoneal adhesions; (c) a disease from the specified list of inflammatory diseases involving the peritoneum or peritoneal cavity at least two days before the clinical onset of peritoneal adhesions; (d) a perforation of the peritoneum at least two days before the clinical onset of peritoneal adhesions; (f) penetrating trauma to the peritoneum or major blunt trauma to the abdominopelvic region at least two days before the clinical onset of peritoneal adhesions; (g) a bacterial or fungal infection involving the peritoneal cavity at least two days before the clinical onset of peritoneal adhesions; (h) therapeutic radiation for cancer, where the abdominopelvic region was in the field of radiation, at least four weeks before the clinical onset of peritoneal adhesions; (i) having received a cumulative equivalent dose of at least 20 Sieverts of ionising radiation to the abdominopelvic region at least four weeks before the clinical onset of peritoneal adhesions; (j) intraperitoneal chemotherapy or intraperitoneal dialysis at least two days before the clinical onset of peritoneal adhesions; (k) a primary or secondary malignant neoplasm involving the peritoneum at least two days before the clinical onset of peritoneal adhesions;[11] inability to obtain appropriate clinical management for peritoneal adhesions[12].

Pathophysiological causes of bowel obstruction are represented by peritoneal adhesions, bowel perforation, mesenteric defect, intramural hemorrhage, and localized ischemia[13].

As the result of the lack of an effective prevention method, the adhesion formation have traditionally received little attention in the literature, even though they are frequent after open general and gynecologic procedures. In the largest autopsy series of abdominal adhesions, which included 752 subjects, over 44% presented peritoneal adhesions, among which 67% with prior

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[11] Weibel M-A, Majno G. Peritoneal adhesions and their relation to abdominal surgery. A postmortem study. *Am J Surg*. 1973;126:345-353

[12] Federal Register of Legislative Instruments F2016L00006; Statement of Principles concerning Peritoneal Adhesions (Balance of Probabilities) (No. 4 of 2016) Veterans' Entitlements Act 1986

[13] Kaban G., Somani R., Carter J. Delayed presentation of small bowel injury after blunt abdominal trauma: a case report, J. Trauma 56 (2004) 1144e1145

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surgery, and 33% with no surgery, after multiple laparotomies, the incidence of adhesions being even higher than 90%[14].

Intestinal obstruction or chronic pain, as complications of the peritoneal adhesion syndrome after trauma is rare, with only few reported cases[15]. Symptoms of peritoneal adhesions can occur years after a trauma event. Such scenarios have been observed in patients with intestinal stenosis where localized ischemia after blunt abdominal trauma determined a fibrotic healing of the peritoneum[16]. Intraabdominal bleeding was, also, considered an important factor for intestinal obstruction after blunt abdominal trauma[17].

One of the issues regarding peritoneal adhesions after surgical intervention or abdominal trauma, that remains unsolved, is represented by the length of time needed to form a fibrous band capable of increasing the morbidity. The postoperative adhesions are, usually, expected to appear after 2 or 3 weeks, the formation of adhesions after trauma not being clearly estimated, since there is no enough research on this matter. One possible reason for the unclear data regarding peritoneal adhesions after blunt abdominal trauma is represented by the fact that underdiagnosed traumatic events account for a major portion of unexplained adhesional obstructions, highlighting the importance of a proper assesment of the personal medical history of the patients. Enhanced CT is known to have high sensitivity in diagnosing hemorrhaging, perforations, and organ damage. However, missed injuries do occur, as findings can be nonspecific and subtle[18].

Hefny et al. described adhesive intestinal obstruction in a patient with no former abdominal surgery seven weeks after blunt abdominal trauma[19].

There is no enough data regarding the prevalence of adhesions after blunt abdominal trauma, even though peritoneal adhesion syndrome is still a problem for all physicians who perform abdominal or pelvic operations. Unfortunately, much of the research conducted in each discipline occurs independently and is not well disseminated.

The present study, a case-series research that included 10 patients with history of abdominal trauma and no surgical intervention, demonstrated that 7 out of the total population presented high grade adhesions, according to Mazuji and Zhülke scores, a high rate, taking into account the limited time interval of research and follow-up, determining the authors of the article to continue the research in this field.

Although the present study is limited by its nature, having only 10 patients included in the research, with a high probability of not including cases with missed diagnosis of blunt abdominal trauma, it has the potential of raising awareness and triggering future studies with the purpose of

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[14] Ellis H, Moran BJ, Thompson JN, et al. Adhesion-related hospital readmissions after abdominal and pelvic surgery: a retrospective cohort study. Lancet. 1999;353:1476-1480; Parker MC, Ellis H, Moran BJ, et al. Postoperative adhesions: Ten-year follow-up of 12,584 patients undergoing lower abdominal surgery. Dis Colon Rectum. 2001;44:822-830

[15] Gray J., Garstin I., Intestinal obstruction following blunt abdominal trauma, Ulst. Med. J. 71 (2002) 139e141

[16] Gray J., Garstin I., Intestinal obstruction following blunt abdominal trauma, Ulst. Med. J. 71 (2002) 139e141

[17] Lampert E.G., Goodfellow J.G., WachowskiI T.J., Traumatic subserosal hemorrhage causing small bowel obstruction, Ann. Surg. 140 (5) (1954) 768e770

[18] Maciver A.H., MacCall M., Shapiro A.M.J., Intraabdominal adhesions: cellular mechanisms and strategies for prevention, Int. J Trauma 9 (2011) 589e594; Hefny A.F., Lunsjo K., Joshi S., Abu-Zidan F.M., Adhesive intestinal obstruction following blunt abdominal trauma, Saudi Med. J. 26 (2005) 1464e1467

[19] A.F. Hefny, K. Lunsjo, S. Joshi, F.M. Abu-Zidan, Adhesive intestinal obstruction following blunt abdominal trauma, Saudi Med. J. 26 (2005) 1464e1467

determining the prevalence of peritoneal adhesions after abdominal trauma and of developing adequate guidelines and follow-up programs for trauma patients.

CONCLUSIONS

- A high prevalence of peritoneal adhesions after blunt abdominal trauma resulted from the analysis of the data of the present study.
- The incidence and prevalence of peritoneal adhesions after surgical procedures has been studied, in contrast with the references related to peritoneal adhesions following penetrating or blunt abdominal trauma that are scarce.
- Taking into account the increasing adaptability to non-operative management in abdominal trauma, a high index of suspicion of intestinal obstruction secondary to peritoneal adhesion syndrome is needed in patients with history of blunt abdominal trauma.
- Awareness of a patient's surgical history and appropriate monitoring for early and late complications is important, a specific approach being highly recommended for those with history of abdominal trauma.
- Posttraumatic peritoneal adhesion syndrome is an entity, frequently underdiagnosed, thus, patients complaining of chronic abdominal pain, with no prior abdominal surgery and with a suspicion of partial small bowel obstruction, should be specifically questioned about previous blunt trauma.
- Complications of peritoneal adhesions can occur years after a trauma event, raising awareness and triggering future studies regarding the developing of adequate guidelines and follow-up programs for trauma patients.
- There is a lack of clinically oriented guidelines for the diagnosis, treatment and options for reduction of adhesions, the severe consequences of intra-abdominal adhesions for patients, physicians, and healthcare systems standing in stark contrast to the low level of awareness and knowledge, a phenomena caused by the lack of standardization.

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