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Hepatic Trauma Management in Polytraumatised Patients

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Rezumat

Managementul traumatismului hepatic la pacientul politraumatizat

În literatura de specialitate din ultimul deceniu există tendința tot mai mult acceptată pentru managementul nonchirurgical ca tratament de elecție în traumatismele abdominale închise. Scopul acestui studiu este de a evidenția importanța managementului optim al leziunilor hepatice pornind de la conduita clinică, paraclinică şi terapeutică. Acest studiu este bazat pe analiza datelor examinării clinice şi paraclinice, precum şi pe evaluarea rezultatelor tratamentului, la 1671 pacienți cu traumatisme abdominale cu interesare multiplă de organe, tratați în Clinica de Chirurgie a Spitalului Clinic Județean de Urgență Oradea pe parcursul anilor 2008 – 2011. Gestionarea nonoperativă a traumatismelor hepatice este indicată la pacienții stabili hemodinamic în cazul CT abdominal indică leziuni hepatice nesângerânde şi absența altor leziuni semnificative intraabdominale. Această atitudine a fost aplicată la 52% din pacienți; 48% din cazuri au fost tratate chirurgical. Evoluția favorabilă fără complicații după intervenția chirurgicală a fost constatată la 72% din pacienți, restul de 28% pacienți au prezentat una sau mai multe complicații postoperatorii

Abrevieri: CT = Tomografie computerizată; ISS (Injury Severity Score) = Scorul de severitate a leziunii; AIS (Abbreviated Index Severity) = Abrevierea indexului de severitate; ATI = Anestezie terapie intensivă; AAST = Scala leziunilor hepatice a Asociației Americane pentru Chirurgia Traumatismelor; ARDS = Sindrom de detresă respiratorie a adultului; ECO FAST = Ecografie abdominală bazată pe traumatism; MSOF = Insuficiență multiplă de organe şi sisteme; TCC = Traumatism cranio-cerebral

Cuvinte cheie: traumatism, hepatic, management nonoperator

Abstract

The specialty literature of the last decade presents the non-operative management of the closed abdominal trauma as the treatment of choice. The purpose of this study is to highlight the importance of the optimal management of hepatic lesions considering the clinical, paraclinical and therapeutic approach. Our study is based on the analysis of the clinical and paraclinical data and also on the evaluation of the treatment results in 1671 patients with abdominal trauma affecting multiple organs who were treated at the Clinic of Surgery, County Hospital of Oradea from 2008 to 2011. The non-operative approach of the hepatic trauma, applied in 52% of the patients, was indicated in stable hemodynamic status, non-bleeding hepatic lesions on the abdominal CT, and the absence of other significant abdominal lesions. The remaining 48% were treated surgically. The postoperative evolution was free of complications in 72% of the patients while the rest of 28% presented one or more postoperative complications.

Abbreviations: CT = Computer Tomography; ISS= Injury Severity Score; AIS = Abbreviated Index of Severity; AAST = American Association for the Surgery of Trauma; ARDS = Adult Respiratory Distress Syndrome

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Key words: trauma, liver, nonoperative management

Introduction

Patients that suffer multiple lesions are generally known as victims of major trauma. In abdominal trauma, the liver is the most frequent injured organ (1,2) due to morphologic particularities and anatomic situation that expose it to the action of vulnerable agents (3). Initial evaluation of a critical patient with polytrauma is a difficult task and every minute can make the difference between life and death. A multidisciplinary approach is necessary in order to achieve an optimal management of major trauma patients and the same evaluation and treatment technique should be followed in closed abdominal trauma.

The specialty literature of the last decade presents the non-operative management as treatment of choice in the closed abdominal trauma, with success rates well over 80% (4,5,6, 7,8,9). This requires that the patient is hemodynamically stable and without other indications for surgical intervention. With this general tendency towards a non-operative and interventional radiology management, the most difficult cases only are candidates for surgery.

The purpose of this study is to highlight the importance of an optimal management of hepatic lesions, considering the clinical, paraclinical and therapeutic conduct.

Material and Method

This observational, prospective and cohort study is based on the analysis of clinical and paraclinical data, as well as on the treatment results of 1671 polytraumatised patients, with multiple organ injury and abdominal trauma treated in the Clinic of Surgery at the Clinical Emergency County Hospital of Oradea, and in collaboration with the Anesthetic and Intensive Care Department (ICU) from 2008 to 2011.

The inclusion and exclusion criteria are identified in *Table 1*.

Upon the basis of the above described criteria, we excluded the following patients categories: 1) demographic data did not fulfill the inclusion criteria (n = 380), 2) patients presenting with mild traumatic lesions defined as ISS < 9, AIS < 3 (n = 200) and 3) patients not admitted to ICU (n = 135). Therefore, a total of 956 patients remained for later analysis (*Table 2*).

From these 956 polytraumatised patients a lot of 200 patients with traumatic hepatic lesions were selected.

In order to stage the morphological severity of the intra-abdominal organs traumatic lesions we used the AAST scale (*Table 3*)

For the staging of the hepatic lesions severity, based on the CT scan, we used Mirvis's score (10) (*Table 4*)

Med Calc software was used for storing study files' information in a database and for the statistic analysis.

Table 1. *Inclusion and exclusion criteria*

Inclusion criteria	- patients with multiple organ lesions with politrauma - age between 18-80 y.o - patients admitted in the ICU - major trauma defined as AIS > 3, ISS > 17 - 2 or more criteria that define sepsis: (1) temperature > 38°C or < 36°C; (2) cardiac frequency > 90 bpm; (3) respiratory frequency > 20/min or $PaCO_2$ < 32 mmHg; (4) white blood cells > 12000/μL, < 4000/μL or 10% immature white blood cells. - hemodynamic instability; - vasopressor treatment
Exclusion criteria	- age lower than 18 or over 80 years - light trauma defined as AIS < 3, ISS < 9 - patients not admitted in the ICU

Table 2. *Demographic and clinical characteristics*

		n = 956
Sex M/F		745 (78%) / 211 (22%)
Average age (years)	43 ± 19	
Age categories (years)		
	18 - 23	191 (20%)
	24 - 65	688 (72%)
	66 - 80	77 (8%)
Etiologic factor		
Traffic accidents	328	
Falls from hight	226	
Direct hit	Physical agent	128
	Direct impact	82
White weapon wound		120
Crushing	64	
Other causes	8	
Etiopathogenetic factor		
Blunt abdominal trauma		814 (85%)
Open abdominal trauma		142 (15%)
Hemodynamic status		
Stable	570	
Unstable	386	

Categorical variables will be described through their absolute values and percentages in brackets. They will be studied using the following tests: chi-squared test with Yates' correction for continuity – for 2 x 2 frequency tables (categorical variables with 2 possible values between 2 study lots) with over 20 cases; simple chi-squared test – for other types of frequency tables (3 x 2, 3 x 3, etc.); Fisher test – for 2 x 2 tables with less than 20 patients.

Results

Laparoscopic approach diagnosed hepatic injuries in 56 (32%) cases and hemoperitoneum in 77 (44%) cases, without a clear specification regarding the source of the bleeding.

Hepatic trauma patients were distributed as the data shows in *Tables 5*, 6.

According to Mirvis score, the hepatic lesions were

Table 3. *Liver injury scale AAST*

Grade*		Lesion description
I	Hematom	Subcapsular, < 10% surface area.
	Laceration	Capsular tear, < 1 cm parenchymal depth.
II	Hematom	Subcapsular, 10% to 50% surface area; intraparenchymal < 10 cm in diameter.
	Laceration	Capsular tear 1-3 parenchymal depth, < 10 cm in length.
III	Hematom	Subcapsular, > 50% surface area of ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma > 10 cm or expanding
	Laceration	> 3 cm parenchymal depth.
IV	Hematom	intraparenchymal ruptured and active bleeding
	Laceration	Parenchymal disruption involving 25% to 75% hepatic lobe or 1-3 Couinaud's segments
V	Laceration	Parenchymal disruption involving > 75% of hepatic lobe or > 3 Couinaud's segments within a single lobe
	Vascular	Juxtahepatic venous injuries; ie, retrohepatic vena cava/central major hepatic veins
VI	Vascular	Hepatic avulsion

*Advance one grade for multiple injuries up to grade III

Table 4. *CT-based injury severity of blunt hepatic trauma proposed by Mirvis*

CT-based Grade	Criteria
1	Capsular avulsion, superficial laceration(s) less than 1 cm deep, subcapsular hematoma less than 1 cm in maximum thickness, periportal blood tracking only
2	Laceration(s) 1–3 cm deep, central-subcapsular hematoma(s) 1–3 cm in diameter
3	Laceration greater than 3 cm deep, central-subcapsular hematoma(s) greater than 3 cm in diameter
4	Massive central-subcapsular hematoma greater than 10 cm, lobar tissue destruction (maceration) or devascularization
5	Bilobar tissue destruction (maceration) or devascularization

Table 5. *Hepatic lesions distribution in blunt abdominal trauma*

Liniary lesions on the right lobe	35 (20%)
Liniary lesions on the right lobe	9 (5%)
Bilobar lesions	19 (11%)
Liniary lesions in frontal plane on the right lobe	7 (4%)
Star like lesions on the right lobe	56 (32%)
Star like lesions on the left lobe	21 (12%)
Bilobar star like lesions	7 (4%)
Hilum lesions	14 (8%)
Ruptures from the insertion point om the diaphragm and hepatic veins	7 (4%)

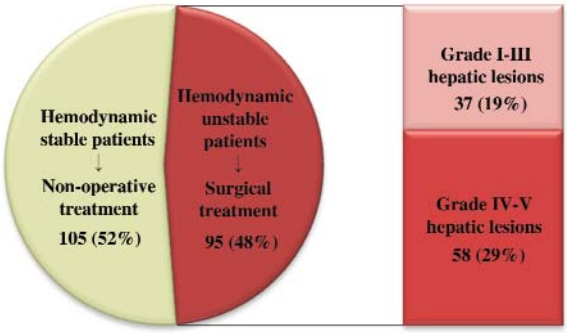

Figure 1. *Therapeutic management depending on the hemodynamic status in patients with hepatic trauma*

distributed as follows: grade II – 30 (17%), grade III – 40 (23%) and grade IV – 21 (12%).

Operative or non-operative management was applied according to *Fig. 1*.

The surgical management was decided by the gravity of the hepatic lesions. *Table 7* shows details regarding the surgical treatment of hepatic trauma.

A favorable evolution without complication was observed

Table 6. *Distribution of hepatic lesions patients depending on the hemodynamic status*

Severity of lesion AAST	Hemodynamic stable n = 105 (52%)	Hemodynamic unstable n = 95 (48%)	p†
Grade I	10 (9%)	4 (4%)	p = 0,2328*
Grade II	46 (44%)	14 (15%)	p < 0,0001*
Grade III	49 (47%)	19 (20%)	p < 0,0001*
Grade IV	0	34 (36%)	p < 0,0001*
Grade V	0	24 (25%)	p < 0,0001*

* chi-squared test; † p < 0,05 proves a statistic significant difference between studied lots

Table 7. *Surgical control of hepatic lesions*

Treatment	Grade of hepatic lesion				
	I	II	III	IV	V
Initial control of bleeding and contamination					
Temporary hemostasis with spontaneous bleeding stopping, electrocauterisation or local hemostatic agent	4	5	-	-	-
Pringle maneuver	-	-	19	22	11
Perihepatic packing	-	1	19	22	11
Intrahepatic tamponade	-	-	-	12	13
Definitive surgical procedures					
Hepatorrhaphy	-	8	17	8	-
Hepatectomy with selective vessel ligation	-	-	2	22	11
Surgical debridement or „non-anatomic" resection	-	-	-	2	7
Anatomic hepatic resection	-	-	-	2	6
Peritoneal drainage	2	7	12	18	7
Number of patients (n = 95)	4	14	19	34	24

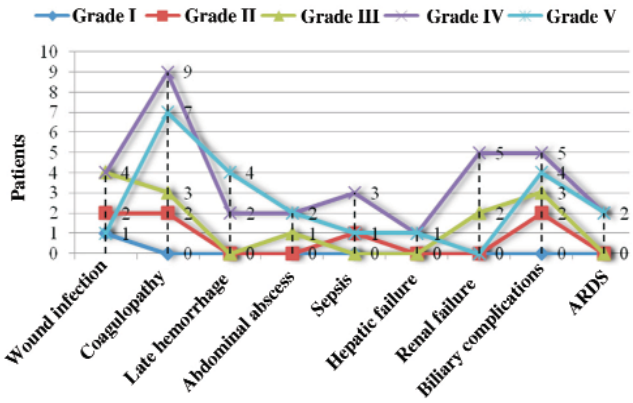

Figure 2. *Distribution of patients with postoperative complications depending on the grade of the hepatic lesion*

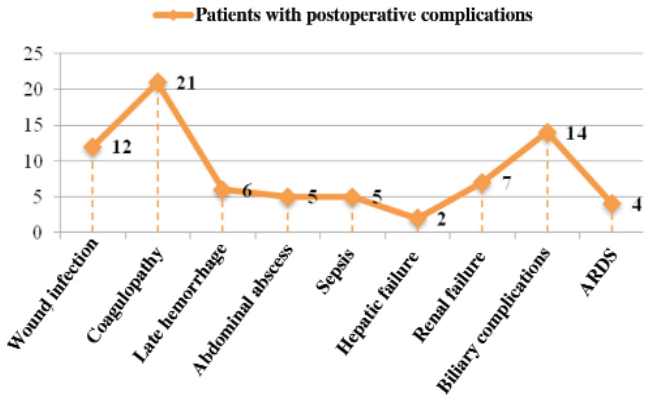

Figure 3. *Distribution of patients with postoperative complications*

in 68 (72%) patients, the rest of 27 (28%) presented one or more postoperative complications (*Fig. 2* and *3*).

Multiple organ failure appeared in 13 patients with grade III-V lesions, due to hepatic failure, renal failure and ARDS (*Table 8*).

In the reference lot 39 (41%) patients died due to hepatic lesions in 31 (79%) patients.

Discussion

In hemodynamic unstable patients the diagnostic procedures were laparocentesis and ECO FAST applied simultaneously with resuscitation procedures. Nicolau (11) in his study also underlined the importance of laparoscopy in selected cases of abdominal trauma in order to reduce unnecessary laparotomies. Laparoscopy was used for once the hemodynamic parameters' were stable. CT was used only in hemodynamically stable patients, tomographic data being decisive in the non-operative management.

The decision for non-operative approach was based on data provided by the CT, but these criteria must be correlated with hemodynamic parameters. There are some studies in the specialty literature in favor of the above selection criteria: in a study on 72 patients, Poletti (12) demonstrated the role in selecting the type of trauma management as well as the possible complications.

Therefore in the lot we studied the patients with grade I, II and III (AAST and Mirvis) lesions, with stable hemodynamic status, that responded well to the initial reanimation, without peritoneal signs, pneumoperitoneum and any intra or retro peritoneal CT scan lesions, that would require surgery, were treated nonoperatively. The patients were monitored on ICU for the first 24-48 hours. After leaving ICU, they were hemodynamically monitored every 4-6 hours as well as biologically (hepatic transaminases); they were ultrasound and CT imaging dynamically supervised. Following discharge, the patients were followed up at 6-12 months, clinically, radiologically (CT, scintigraphy) and biologically, and no

Table 8. *Mortality in operated patients with hepatic trauma*

Grade of hepatic lesion	Nr. of patients (n = 95)	Lesion's mechanism		Cause of death	Death due to liver lesion	Associated lesions	Hepatic resection
		Blunt (n = 70)	Open (n = 25)				
Low grade	37 (5)	28 (3)	9 (2)		No		
I	4	3	1				
II	14 (1)	12 (1)	2	Severe CCT (1)		E	
III	19 (4)	13 (2)	6 (2)	Severe CCT (1) Exsanguination (2) MSOF (1)		E I E and I	
High grade	58 (34)	42 (29)	16 (5)		Yes		
IV	34 (15)	27 (15)	7	Severe CCT (1) Exsanguination (10) MSOF (2) Sepsis (2)	Yes Yes 	E E and I E E and I	 Yes (1)
V	24 (19)	15 (14)	9 (5)	Exsanguination (18) Sepsis (1)	Yes Yes	E and I E and I	Yes (3)
TOTAL	95 (39)	70 (32)	25 (7)	8	31		

( ) = deceased, E = Extraabdominal lesions, I = Intraabdominal lesions, CCT = Craniocerebral trauma, MSOF = Multiple systems and organs failure

deviations from normal were recorded. The surgical treatment was applied to patients with hepatic lesions grade I-III, and hemodynamically unstable, as well as to patients with grade IV and V AAST hepatic trauma. The immediate purpose was to control the hemorrhage, followed by debridement or devitalized liver resection, the control of any biliary leakage and adequate drainage.

In a study on 661 patients with blunt abdominal trauma Malrhota applied the nonoperative treatment in 85% cases, based on CT examination and hemodynamic stability (5), opposed to our study lot in which this management was applied in 52% of the patients.

Demetriades (13) in a 152 patients whith open abdominal trauma mentions applying nonoperative treatment in 28%.

We consider the data to be concordant with our study because the lot we studied included both blunt and opened abdominal trauma.

Exploratory laparotomy was conducted through a generous median incision, that can be extended, if necessary, through an oblique incision in the seventh intercostal space or an under costal right incision, or if the lesions are limited to the supracolic compartment through a bilateral subcostal incision.

Temporary hemostasis was obtained by Pringle maneuver, which implies digital compression or portal triad clamping, thus blocking the vascular afflux from the hepatic artery and portal vein. Pringle maneuver is often used as an adjuvant in perihepatic packing for temporary hemostasis (14).

We used oxidative cellulose (Surgicel®) as a local hemostasis adjuvant. Hepatorrhaphy associated with perihepatic packing was used in grade II, III and IV AAST lesions, in 34% of the surgically treated patients. This requires profound suture of the hepatic parenchymal tissue, in order to obtain hemostasis by compressing bleeding vessels and dead space diminishing. Mazilu, in a study of 49 patients with had hepatic trauma, practiced hepatorrhaphy in the majority of the patients (39%), and in another 18% has associated hepatorrhapy with perilesional packing. The most severe complication mentioned by Mazilu was hepatic parenchyma necrosis (15).

Unfortunately, as reported also in the studies conducted by Pogetti (16) and Pachter (17), this technique was complicated by the hepatic tissue ischemia, progressing towards infarction and necrosis, becoming a site for infection. So, in a great measure, hepatorrhaphy was substituted with selective ligation of the vessels hepatectomy. Under Pringle maneuver control, using a curve hemostatic clamp at the laceration level, blood vessels are selectively ligated. For vascular hemostasis the electrocautery can also be used.

Malhotra (5) in his study conducted hepatic hemostasis in 75 % cases, while in our study lot this was applied in 65% of the operated cases; hepatic resection/debridement was applied in 9% cases, while Malhotra conducted it in 4%.

In transfixing hepatic lesions (through white weapon or firearm) an effective alternative to extended hepatectomy is hemostasis by intrahepatic tamponage, using an intrahepatic balloon, that can be a Penrose drain and a Foley catheter or a Sengstaken-Blakemore catheter (16).

In severe lesions graded IV and V AAST surgical debridement was practiced. This requires the elimination of all unviable tissue in order to minimize postoperative sepsis and secondary hemorrhage. Debridement is frequently associated with Pringle maneuver and hepatectomy.

In patients with lesions extending to half of the liver's surface anatomic hepatic resection was practiced. With all this, in trauma, the mortality associated with this procedure exceeds 50% in most cases. Peritoneal drainage was set up for safety. A closed aspirating drainage system was used, because of the lower infection risk. Drainage wasn't necessary for minor lacerations.

The most frequent postoperative complication was the coagulopathy, that was corrected by administrating vitamin

Table 9. *Mortality risk factors*

Factors	Mortality *	OR (95% CI)
High grade	34/58 (87%)	9,06 (3,08–26,63)+
Low grade	5/37 (13%)	0,11(0,037–0,32)+
Hepatic lesions + E and I associations	31/58 (79%)	4,16 (1,63–10,62)+
Blunt abdominal trauma	32/70 (82%)	2,16 (0,80–5,83)+
Open abdominal trauma	7/25 (18%)	0,46 (0,14–1,24)+
Hemodynamic instability (hypovolemic shock through hemorrhage)	39/95 (41%)	147,51(8,89-2445,28)+

* deaths/ total number of patients (mortality - %); + $p<0,05$ in univariable results analisys

K and fresh frozen plasma, followed by biliary complications and infection of the wound.

Biliary complications were recorded in 14 (15%) patients with grade II-IV hepatic trauma and consisted in bilious leakage through the safety drainage tubes after the primary operation, biliary fistulas, intrahepatic collections, circumscribed hepatic necrosis, biliary peritonitis.

Intrahepatic collections developed in 5 paients postoperative after hepatorrhaphy for grade III-IV liver lesions. These were clinically expressed by fever, shiver, jaundice, moderate pain in the upper right quadrant and high levels of hepatic cytolysis enzymes. An important role in the diagnosis' confirmation was played by abdominal ultrasound and CT scan. These were solved by relaparotomy, conservative treatment, open drainage and ultrasound guided punction.

Diffuse biliary peritonitis was recorded in 2 patients operated for grade III-IV traumatic hepatic lesions. The diagnosis was established late, 3-4 days after surgery, because of the antibiotic ant analgetic treatment, on behalf of the intestinal paresis and the inefficient curative measures for activating the intestinal peristalsis and bile elimination through drainage tubes in the pelvis. In one case the peritonitis' source was bilirrhage from the liver lesion in the gall bladder's lodge, being solved by hepatic wound resuturing, cleaning and drainage of the peritoneal cavity. In the second case the primary intervention was conducted for a grade IV lesion with extension towards the hilum. It the second intervention bilirrhage from the drainage's fixing spot in the common bile duct was found. Hepaticojejunostomy a là Roux on Vöelker drainage was practiced. In both cases postoperative evolution was serious but favorable.

Two cases of liver necrosis were observed after two operations for grade V hepatic lesions and were solved by surgical debridement.

Malhotra mentions in his study the development of intraabdominal abscesses in 12,5% of the operated cases, while in our study lot this complication appeared in 5% of the cases.

Biliary fistulas developed in two cases after removing the tampon used for intrahepatic packing in the primary operation for grade V lesions.

In this study we used closed system aspiring drainage, the risk of infection being lower. Drainage wasn't necessary for minor lacerations. 3 of 5 patients that had intraabdominal sepsis died, in spite of the aggressive drainage and antibiotic treatment.

Death causes were exanguination in 30 cases, craniocerebral severe trauma in 3 cases, sepsis in 3 cases and multiple organ failure in 3 cases. Six patients died in the operating room because of massive bleeding, 5 patients with liver lesions and 1 with massive hemothorax.

In high grade hepatic lesions, mortality rate was linked to the lesion itself (87%), which was more frequently observed after blunt abdominal trauma (29 vs. 5; $p < 0,0001$). In low grade lesions, mortality was the result of other associated lesions, and its rate didn't have statistical significant differences from the lesions' mechanism of injury point of view (3 vs. 2, $p = 1,0000$). (*Table* 9)

Conclusions

The nonoperative management of hepatic trauma is indicated in hemodynamically stable patients in whom CT scan shows non-bleeding hepatic lesions in the absence of other significant intra-abdominal lesions. This is the choice in over 80% of blunt hepatic trauma patients. Patients that are managed nonoperatively should be closely monitored for at least 48 hours. This management should be abandoned when the patient requires multiple transfusions, becomes hemodynamically unstable or presents peritoneal signs. The complications of the conservative management include late hemorrhage, biliary leakage, abdominal sepsis and omission of the intra-abdominal lesions. They are relatively rare and appear in high-grade hepatic lesions. Nowadays, the vast majority of these complications can be conservatively treated. Selective embolization angiography is the option for late bleeding. Percutaneous drainage can be performed in "biliomas" or hepatic abscesses. Clots in the biliary tree can be decompressed by ERCP, and the intra-parenchymal ductal hepatic lesions can be stented using the same procedure.

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