TREATMENT OF BLUNT LIVER INJURIES IN CHILDREN

Zoran Marjanović, Ruzica Milicević, Marijana Krstić, Stevan Jovcić and Ana Kostić

Liver is the largest parenchymatous organ, well vascularized, weighing approximately 1.8-3.0% of the whole body weight. Among all abdominal traumas liver injuries account for 25%. For more serious liver injuries the mortality is around 40% in children below 10 years of age. For lesions of the juxtahepatic veins (three major hepatic veins or the retrohepatic portion of v. *cava)* or for complex, combined intraabdominal injuries, the mortality is even up to 70%.

This work analyzed the period 1988-2000 during which there were 19 children admitted and treated for blunt liver injuries at the Clinic of Pediatric Surgery and Orthopedics in Nis; I, II and **III** scale injuries prevailed (17 cases; 89.4%). These injuries were surgically treated for the most part (17 cases; 89.4%). In 7 children (36.8%) there were combined injuries. The lethality was 26.3%-5 cases, with three major complications: two intrahepatic hematomas and one biliary fistula associated with biliary peritonitis and biloma formation. *Acta Medica Medianae 2003; 42 (2): 23-26.*

Key words: *liver, trauma, intrahepatic hematoma*

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Introduction

Liver is the largest parenchymatous organ, well vascularized, and the largest digestive gland weighing 1.8-3.0% of the whole body weight. It occupies the right subphrenical and the smaller part of the left subphrenical space (Fig. 1).

Surgical interventions on the liver started with Langebuch (1887), who was the first to perform partial resection of the left hepatic lobe, then through Wendel (1910) who performed the first anatomic resection of the right hepatic lobe. Modern hepatic surgery had its start during the 1960s owing to the work of Hjorstroj and above all to Couinaud (1954), chich enabled practitioners to get an insight into the functional segmental liver anatomy (1). With three hepatic fissures (corresponding to the projection of the hepatic veins), out of which one is the main fissure - *fissura principalis* (Cantly's line corresponding to the medial hepatic vein), the liver is divided into two functional lobes, four sectors, ie. eight segments (Fig. 2).

It is well known that trauma is the leading cause of death in children above 1 year of age, with traffic traumas as the cause of one third of all death cases (2). Etiologically, 40% of all abdominal injuries in children are the consequence of traffic accidents, while 30% of them are the consequence of the fall from heights. The rest of the injuries are the result of playing, running, riding a bicycle and so on.

Among all abdominal traumas, hepatic injuries account for 25%. They are more common in children than in adults. With ultrasonography (US), and especially computerized tomography (CT), it has been established that hepatic injuries are almost as frequent as splenic injuries but much more fatal abdominal traumas. Approximately one half of the children with serious liver traumas die before they reach the hospital (3).

Over 80% of all liver injuries involve the right lobe. Hepatic convex surface is injured twice as often as other parts of the liver.

Hepatic traumas may be divided (2,4) into four anatomic cathegories (Fig. 3):

- Type A - injuries to the convex surface and the dome (these injuries are not readily observable on abdominal surgery);
- Type B - injuries to the anterior surface and anterior edge of the right or left lobe;
- Type C - injuries to the inferior or concave surface of the right lobe, often associated with to the extrahepatic bile ducts;
- Type D - injuries to the right lobe posterior surface - "counter-coup" type.

Type A injuries are predominant and responsible for most cases of traumatic hemobilia (5).

According to the lesion depth and based on the CT findings (6) liver injuries may be divided into six cathegories - scales. Scale I, II and III injuries include subcapsular hematoma in up to 50% of the liver surface, intraparenchymatous hematoma sized up to 5 cm and laceration deep up to 3 cm and up to 10 cm long. These injuries are conservatively treated. Scale IV and V injuries are serious liver traumas (so called "complex

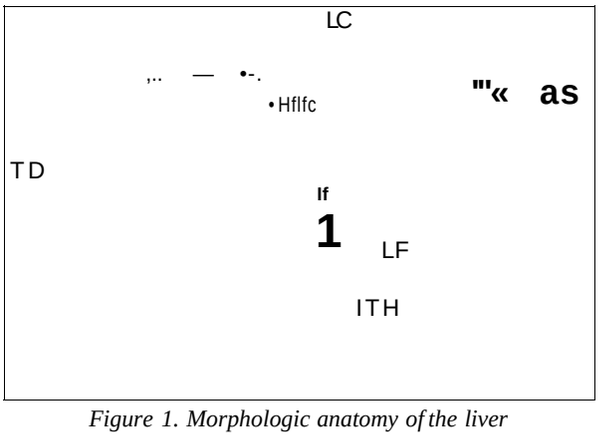


Figure 1. Morphologic anatomy of the liver

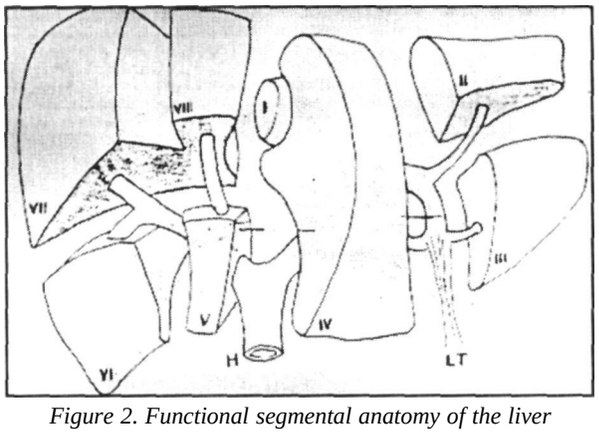


Figure 2. Functional segmental anatomy of the liver

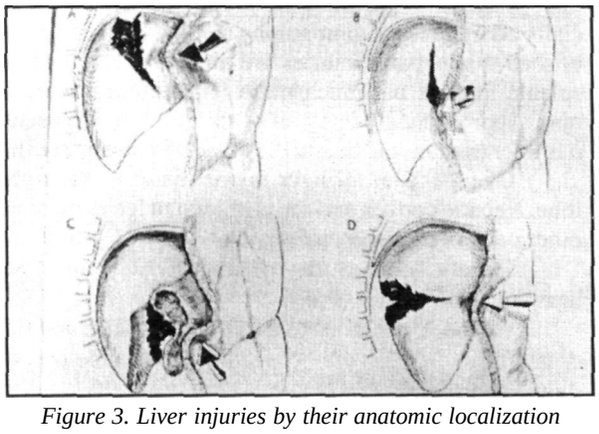


Figure 3. Liver injuries by their anatomic localization

traumas"); they involve 25-75% destruction of one hepatic lobe, rupture of the central hematoma or the lesion of juxtahepatic veins (MHVIs - major hepatic vascular injuries). Their treatment is exclusively surgical (7). Scale VI injury is in fact hepatic avulsion - such injuries may be regarded as lethal.

Liver injury diagnosis is made based on the anamnesis, clinical presentation, ultrasonography, CT finding, NMR findings, scintigraphy, abdominocentesis, selective hepatic angiography (used mostly in resolving hepatic trauma complications). Liver ruptures are practically an insolvable problem in abdominal trauma management. There is a significant improvement in the treatment of penetrant liver injuries (mortality up to 15%) while for blunt injuries no significant improvement was observed (mortality around 40%) for any type of liver injury in children aged up to 10 years. For lesions involving juxtahepatic veins (three major hepatic veins or the retrohepatic part of v. *cava)* or for complex, combined intraabdominal injuries mortality rises up to 70% (2).

Regarding the treatment of hepatic injuries, the principle of maximal possible conservation (preservation) applies. Whenever possible, major hepatic resections should be avoided since they are associated with a high proportion of mortality (8). The tamponade procedure in deep hepatic injury treatment is controversial.

Treatment involves:

1. Elimination of hemorrhage and removal of blood collections from the abdomen;
2. Removal of divitalized and necrotic tissue from the hepatic lesion area (non-anatomic resection debridement);
3. Covering of the injured hepatic surface (with vascularized omentum, fibrin-glue, falciform ligament);
4. Exact exploration of adjacent organs;
5. Contact multiple drainage of lesion area.

In order to carry out all these maneuvers, adequate liver mobilization is required - this is the "conditio sine qua non". In large hepatic ruptures PRINGLE maneuver is usually applied (application of clamps to the hepatoduodenal ligament).

Hepatic injury complications include: postoperative hemorrhage - as the most common cause of death (9), intrahepatic hematoma, abscessus, biliary fistula, biliary peritonitis, biloma, traumatic hemobilia, hypoglycemia, sepsis, hemorrhagic diathesis and so on (10).

Aim of **the** work

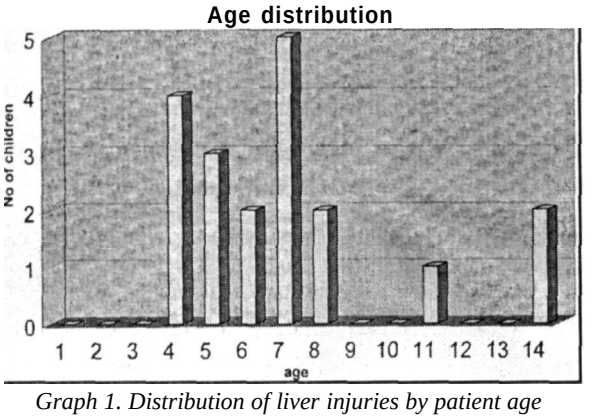
This work aims to present this very important and serious problem awaiting to be resolved within the field of pediatric abdominal injuries. It should also point out the modern tendencies of treatment of blunt liver injuries, expressing at the same time certain therapeutic dilemmas regarding scale III and IV injuries in hemodynamically stable children, with the final goal of reducing the frequency of postoperative complications.

Results

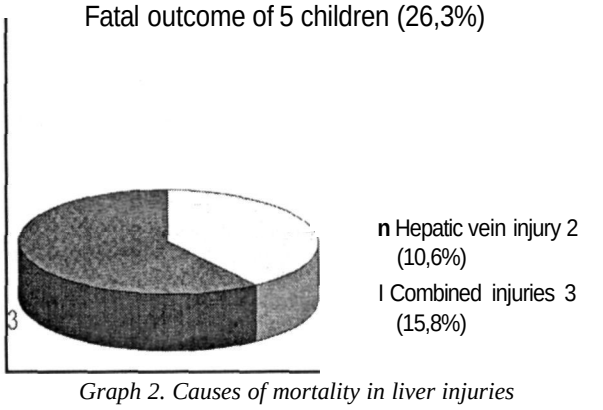
In the period 1988-2000 (twelve years) there were 19 children admitted and treated at the Clinic of Pediatric Surgery and Orthopedics in Niš for blunt liver injury. There were 10 boys (52.6%) and 9 girls (47.4%). Regarding their age (Graph. 1), most of the cases (14; 73.7%) were pre-school children (4-7 years of age).

Right lobe injuries were predominant related to left lobe (18:1; 94.7%:5.3%). In most of the cases (16 children; 84.2%), liver injuries were the consequence of traffic accidents. According to the degree of rupture of the liver parenchyma, there were 17 injuries (89.4%) of I, II and III scale and 2 injuries (10.6%) of IV and V degree. Isolated liver injury was observed in 12 cases

(63.2%). There were 7 combined, complex injuries (36.8%), with in total 13 separate injuries: spleen rupture (5), rupture of the anterior wall of the stomach (2), fracture of the femur (2), rupture of the kidney (1), skull fracture (1), rupture of the extrahepatic biliary ducts (1) and rupture of the diaphragm (1). Out of the abovementioned 7 children, 6 (31.5%) had two combined injuries accompanying the liver injury (spleen and femur - 2, spleen and stomach - 1, spleen and kidney - 1 , spleen and diaphragm - 1 , and skull and shinbone fracutre - 1). Three of the children (15.8%) had rib fractures on the right side, while in 2 cases (10.6%) abdominocentesis for diagnostic purposes was performed.



Graph 1. Distribution of liver injuries by patient age



Graph 2. Causes of mortality in liver injuries

Most of the children with blunt liver injuries were surgically treated-17 cases (89.4%), while only 2 cases (10.6%) with isolated liver injury of I, II and III scale were treated conservatively - without surgery.

Fatal outcome was observed in 5 cases (26.3%) (Graph. 2). According to the cause, fatal outcome was in 2 children (10.6%) a direct consequence of the juxtahepatic veins lesion, while 3 children (15.8%) died of combined, complex injuries.

The complications were observed in 3 children (15.8%). In two of these cases (10.6%) intrahepatic hematoma developed. In one child (5,3%), in spite of the drainage, biliary fistula appeared after the IV scale liver injury. In the further disease course a subhepatic incapsulated bile collection (biloma) evolved.

Discussion and conclusion

This paper focuses especially on the two intrahepatic hematomas after blunt liver injury. Both of them developed in male patients, resulting from the III and IV scale rupture of the right liver lobes; they were surgically managed by deep surgical sutures of the rupture site. On the 5th postoperative day, the pain in the upper right side of the abdomen occured in both cases, accompanied by high temperature (septic type). Diagnosis of hematoma was made with ultrasound and CT examinations. One of the cases of hematoma was treated with percutaneous drainage under US guidance, while the other case was managed with re-laparotomy and ligature of *a. hepatica dextra.*

Modern therapeutic concept regarding blunt liver injuries is conservative (non-surgical) and based on the experience that in the time of laparotomy at least 45% of the patients required only drainage. Liver injury treatment is not surgical and in various series it ranges from 40% to 90% (3, 4, 11, 12).

• It is indisputable that I and II scale liver injuries should be conservatively treated.

• The dilemma exists, however, whether III and IV scale injuries in hemodynamically stable pediatric patients should be managed conservatively or surgically. If these children are nevertheless surgically treated, should we suture deep liver ruptures and accept the risk of in such cases relatively common intrahepatic hematoma (abscessus) or traumatic hemobilia;

• Or should we make atypic resection of the lacerated liver tissue (non-anatomic resection debridement), with control of the injured liver surface with transfixational ligatures of the biliovascular structures.

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LEČENJE TUPIH POVREDA JETRE U DECE

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Jetra je najveći parenhimski organ, odlično vaskularizovan, čija težina iznosi 1,8-3,0% telesne težine. U okviru abdominalne traume povrede jetre učestvuju sa 25%. Za teže oblike jetrenih povreda mortalitet je oko 40% u dece do 10 godina. Kod lezija jukstahepatičnih vena (tri velike hepatične vene ili retrohepatični deo v. *cave)* ili prisustva udruženih intraabdominalnih povreda smrtnost iznosi i do 70%.

U radu je analiziran period od 1988-2000 god., za koje vreme je na Klinici za dečju hirurgiju i ortopediju u Nišu, hospitalizovano i lečeno 19 dece sa tupom povredom jetre. Dominirale su povrede I, II i **III** stepena i to 17 dece (89,4%). Povrede su lečene uglavnom operativno 17 dece (89,4%). Kod 7 dece (36,8%) postojale su udružene povrede. Letalitet je bio 26,3% - petoro dece, uz tri velike komplikacije: dva intrahepatics hematoma i jednu bilijarnu fistulu praćenu bilijarnim peritonitom i formiranjem biloma. *Acta Medica Medianae 2003; 42 (2):* ***23-26.***

Ključne reči: *jetra, trauma, intrahepatični hematom*