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ORIGINAL ARTICLE

Can we refine the management of blunt liver trauma?

L. Barbier[a,d,*], M. Calmels[a], M. Lagadec[b], T. Gauss[c], P.-S. Abback[c], F. Cauchy[a], M. Ronot[b], O. Soubrane[a], C. Paugam-Burtz[c]

[a] *HPB Surgery, hôpital Beaujon, université Paris 7 Diderot, DHU Unity, France*
[b] *Radiology, hôpital Beaujon, université Paris 7 Diderot, DHU Unity, France*
[c] *Department of Anesthesiology and Critical Care, hôpital Beaujon, université Paris 7 Diderot, DHU Unity, France*
[d] *Department of Digestive Surgery, hôpital Trousseau, université Rabelais, Tours, FHU SUPORT, France*

KEYWORDS
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Non-operative management;
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Biliary fistula;
Therapeutic embolization

Summary
Aim: To describe the management of blunt liver injury and to study the potential relation between delayed complications, type of trauma mechanisms and liver lesions.
Patients and methods: This is a retrospective single center study including 116 consecutive patients admitted with blunt liver injury between 2007 and 2015.
Results: Initial CT-scan identified an active bleeding in 33 (28%) patients. AAST (American Association for the Surgery of Trauma) grade was 1 to 3 in 82 (71%) patients and equal to 5 in 15 (13%) patients. Eighty (69%) patients had NOM, with a success rate of 96%. Other abdominal organ lesions were associated to invasive initial management. A follow-up CT-scan was useful to detect hepatic and extra-hepatic complications (46 complications in 80 patients), even without clinical or biological abnormalities. Subsequent hepatic complications such as bleeding, pseudo aneurysms, biloma and biliary peritonitis developed in 15 patients and were associated with the severity of blunt liver injury according to AAST classification (3.7 ± 1.0 *vs.* 3.0 ± 1.1, $P = 0.010$). Total biliary complications occurred in 13 patients and were significantly more frequently observed in patients with injury of central segments 1, 4 and 9 (69% *vs.* 36%, $P = 0.033$).
Conclusions: Non-operative management is possible in most blunt liver injury with a success rate of 96%. A systematic CT-scan should be advocated during follow-up, especially when AAST grade is equal or superior to 3. Biliary complications should be suspected when lesions involve segments 1, 4 and 9.

Introduction

Non-operative management (NOM) is the reference treatment of blunt liver injuries (BLI) in hemodynamically stabilized patients [1—3]. NOM can be proposed in 65% to 85% of patients with BLI according to liver injury grading and associated lesions [2—4]. Computed Tomography-scan

* Corresponding author at: Department of HPB Surgery, hôpital Beaujon, 100, avenue du Général-Leclerc, 92110 Clichy-la-Garenne, France.
E-mail address: louisebarbier@hotmail.fr (L. Barbier).

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(CT-scan) is the corner stone in the assessment of BLI and the diagnostic modality of choice [5]. CT-scan allows the grading of the liver injury as established by the American Association for the Surgery of Trauma (AAST) [6] and the identification of associated lesions.

Failure of NOM is defined by the need for a delayed operation [3] and represents 5% [2] to 11% [7] of patients without early surgery. Systolic blood pressure on admission of 100 mmHg or less and the presence of other abdominal organ injury have been identified as independent factors of failure of NOM in AAST grades 4 and 5 BLI [3]. There is also no consensus on the monitoring of patients with NOM, specifically regarding the systematic imaging re-assessment.

Biomechanical and modelization studies of livers subjected to injury have focused on the mechanisms of the lesions and the relationship with both liver anatomy and its attachment system [8–10]. However, there is no radio-anatomical study focusing on the relationship between the type of mechanism, the type of liver injury and the potential vascular and biliary complications.

The aims of this study were to describe the initial management of BLI and to study the potential relation between delayed complications, type of trauma mechanisms and liver lesions.

Patients and methods

Type of study

This retrospective study was conducted in the Beaujon Hospital a designated Trauma Center in the Paris region (France). Data from all consecutive patients with BLI who were admitted at the Trauma Center between 2007 and 2015 were collected from computerized clinical files. The trauma system and trauma management in the Paris region has been previously described [11].

Management of patients with trauma

Trauma patients were admitted in the resuscitation area after pre-alert from a physician-lead enhanced care team. The trauma leader, a senior intensivist, coordinated the trauma team including other specialists such as general surgeon, orthopedic surgeon, and radiologist. If the patient could be hemodynamically stabilized, a body CT-scan was performed. If not, the patient went directly to the dedicated operating room after minimum assessment included Chest X-Ray, pelvis X-Ray and FAST ultrasound. When there was no active hemorrhage or significant associated lesions, the NOM was the treatment of choice for BLI. In case of identified isolated active hemorrhage, interventional radiology with selective intra-arterial embolization was proposed, using either temporary agent such as Gel foam cubes or a permanent one such as micro coil depending on the type of vascular lesion and the selectivity of the catheterization. Indications for emergency laparotomy were uncontrolled hemorrhage or associated lesions such as perforation of hollow organs. Surgery was based on damage control laparotomy [12] with peri hepatic packing in case of massive venous hemorrhage involving hepatic veins, splenectomy, hollow organs sutures or stoma in case of perforation... Failure of NOM of BLI was defined as delayed surgery (but not interventional radiology) or death related to BLI during in-hospital stay [3].

CT-scan

The initial CT-scan was performed in hemodynamically stabilized patients and with the presence of the trauma leader and surgeons. Radiologists perform a body CT-scan according to trauma protocol with intravenous contrast enhancement and different time points: arterial phase or mixed arterio-portal phase and delayed phase. Liver lesions were described according to the recommendations using the AAST liver injury scale [6,13]. However, this scale has limitations and additional imaging findings were searched for: extension of the injury to the hepatic vessels, active bleeding, hemoperitoneum or hemoretroperitoneum, presence of a pseudo aneurysm, anatomic localization of the injury, and imaging findings of non-liver injuries (thorax, spleen, pancreas, bowel). The locations of the liver injuries that were specifically studied were: central segments (1, 4 and 9) that include the main biliary convergence, right and main portal scissures, frequently involved in case of acceleration or deceleration trauma, that respectively include the posterior and right biliary ducts on their path, and the right liver. CT-scan during the follow-up was performed according to the attending practitioner and depending on the initial lesions.

Definitions

Hemodynamic instability was defined [14] by mean arterial pressure less than 65 mm Hg and/or systolic pressure less than 90 mmHg, and the need for crystalloids and/or red blood cells transfusions. Hypothermia was defined by body temperature less than 35 °C, and acidosis by pH less than 7.36 [15]. Coagulopathy was defined by the association of low platelets count (less than 100 000/mm^3), low fibrinogen (less than 1 g/L), prothrombin time above 3 s, and increase in soluble fibrin or fibrinogen degradation products [16].

Statistical analysis

Qualitative variables were described as absolute numbers and percentages. Two groups of qualitative variables were compared using the Chi-2 test, with Yates' correction as appropriate and the Fischer's exact test according to the number of data and the distribution of the variable. Quantitative variables were described as mean and standard deviation of the mean. Two groups of quantitative variables were compared using the unpaired *t*-test or the Mann–Whitney test, according to the number of data.

Statistical analysis was performed using Microsoft® Excel® for Mac 2011 v 14.7.1 and Prism 7 for Mac OS X v 7.0b, GraphPad Software, Inc.

Ethics

Data for this study were extracted from a regional prospective trauma registry. The registry approval was obtained from the Institutional Review Board (Comité de Protection des Personnes, Paris VI) from the Advisory Committee for Information Processing in Health Research (CCTIRS, 11.305bis) and from the National Commission on Informatics and Liberties (CNIL, 911461). The structure of the database integrates algorithms for consistency and coherence. A central administrator assures the data monitoring. Missing data were collected anonymously from medical records.

The present study being an observational, non-interventional, retrospective study, neither informed consent nor approval of the ethics committee was required to

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