Healing of Blunt Liver Injury After Non-Operative Management: Role of Ultrasonography Follow-Up

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Abstract
Background: Non-operative management of patients with blunt liver trauma has become the standard of care. Usually after initial computed tomography (CT) evaluation and a short-term intra-hospital instrumental and clinical monitoring, no other imaging assessment is routinely requested. A restriction of physical activities for a few (unfixed number of) months is the most common recommendation. A few studies investigated the re-establishment of normal hepatic parenchymal architecture, but there is no evidence of the correct length of time for a certain resumption to normal life. To understand the progression of traumatic liver damage and the time course of healing, and to indicate the correct spontaneous recovery time, a long-term sonographic follow-up was done.

Methods: Forty-four patients with blunt non-operatively managed hepatic injury were selected by a retrospective review of a prospectively collected database. At admission, in accordance with the American Association for the Surgery of Trauma (AAST), all lesions were evaluated by CT and graded by the Organ Injury Scale (OIS). The progression of liver repair was followed by ultrasonographic (US) controls on days 3, 5, 10, 15, 30, and 60, and monthly up to a complete clinical recovery and sonographic disappearance of lesions.

Results: One OIS grade I, 20 grade II, 13 grade III, eight grade IV, and two grade V hepatic injuries were included in the study. Forty patients were monitored until liver normalization by 218 US examinations. The median time for liver repair in OIS grades II, III, IV, and V was 30, 63, 62, and 118 days, respectively, and 75% of the patients recovered in 60, 80, and 98 days in the II, III, and IV classes, respectively.

Conclusion: In our experience, a long time variability for spontaneous liver repair after blunt trauma and non-operative treatment was found, but a parenchymal US normalization was evidenced in a median time shorter than that usually reported in the literature.

Key Words
Blunt liver injury · Non-operative management · Sonographic long-term follow-up

Introduction
Over the last several decades, non-operative management (NOM) of blunt hepatic injuries has been demonstrated, in selective patients, to be both safe and highly successful. Many studies have confirmed that 80–90% of all blunt liver injuries may be managed
without laparotomy. The presence of a liver injury is usually made via abdominal computed tomography (CT) scanning. Following diagnosis and clinical judgment, observation with serial hematocrits and physical examinations is the norm [1–5].

From the 1990s onwards in the emergency rooms of trauma centers, before a CT evaluation, surgeons or emergency physicians have routinely been performing focused assessment sonography for trauma (FAST) in the recognition of the presence of intra-abdominal free fluid [6, 7]. Regardless of the initial ultrasonography (US) result, repeated sonographic examination could be performed in patients who were initially managed non-operatively, to monitor quantitative changes in fluid collection or detect new findings not initially detected. In Europe and Japan, US has been used to care for injured trauma patients for many years, not only to detect the intraperitoneal fluid collection, but also to identify lesions of intra-abdominal organs [8–10]. In expert hands, sensitivity for the detection of abdominal solid organ injury ranges from 63 to 99% [11–14].

The selection of further appropriate imaging studies, after initial and indispensable CT evaluation, may be institution- or physician-specific, as expert interpretation is, perhaps, the most important factor in deciding which imaging study to employ. The appropriate approach should be determined by local resources, expertise, clinical conditions, and, furthermore, by instrumental location [15].

Since 1980 in the Department of Emergency Surgery of the University of Milan, Ospedale Maggiore Policlinico, in the first few days of hospitalization, in addition to CT, some US examinations have been performed in order to estimate the free abdominal fluid and evaluate the morphologic characteristics of traumatic abdominal injuries and, as this paper shall show, to make a long-term follow-up.

In other experiences, if a great interest has been focused on acute imaging, little attention was paid to the instrumental follow-up. Some authors have used CT follow-up imaging to demonstrate healing of the liver injury as a trigger to allow patients to return to full activity. However, recently, other investigators have questioned the utility of routine imaging in blunt liver injury. These authors indicate that a routine CT follow-up scanning rarely changes the patient’s management [4, 16–18].

Limits of physical activities have been recommended by several authorities in an attempt to prevent complications. No clear consensus exists as a time frame for these restrictions. Richardson shares this opinion in a recent discussion at the American College of Surgeons’ 90th Annual Clinical Congress, New Orleans, LA, October 2004; he pointed out that there are numerous unresolved questions about liver and spleen NOM, in particular “in the role of follow-up scans.” He reported that, in his unit, generally, they are used to obtaining such scans, but there is no specified protocol to recommend. All patients should avoid strenuous activity for several months, but this “recommendation is intuitive rather than data-driven” [19].

In this scenario, many young people should not resume normal life prior to 5 or 6 months. This common recommendation is given in order to mitigate against re-injury, which might, arguably, have a higher failure rate with NOM [20].

There is little evidence that defines the time required for liver repair; as a matter of fact, the knowledge of the healing time of blunt hepatic injuries is based on presumptive time of scar development ascertained in a few young patients or animal models [21, 22].

In 1983, Karp et al. studied 15 children between 2 and 13 years of age with hepatic injuries. They demonstrated that liver injuries heal with a predictable pattern. Healing occurred as early as 2 months in simple lacerations and as late as 6 months in more complex injuries [21].

In 1990, Dulchavsky et al. investigated liver healing in both canine and porcine models and demonstrated that liver healing by secondary intention is both rapid and complete [22].

Some studies used US in order to identify the healing time of traumatic liver injuries, but only a few adopted a periodic program of follow-up [4, 15, 16, 22, 23]. Moreover, referring to them, a low percentage of patients have been followed until a complete morphologic liver recovery.

The purpose of this study is to identify the establishment of normal parenchymal architecture by US and, consequently, to indicate the correct spontaneous recovering time of liver traumatic lesions after NOM.

**Methods**

A retrospective review of a prospectively collected database was conducted between 1988 and December 2000 on patients with non-operative-managed blunt liver injuries treated at the Ospedale Maggiore Policlinico, one of five level I trauma centers in Milan, Italy. All patients underwent initial care according to the Advanced Trauma Life Support® guidelines.

During the study period, 126 patients were admitted to the trauma service for blunt liver injuries.