

Non-operative Management of Liver Trauma

Review Article

A. Marinis, S. Rizos

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Abstract

Aim-Background: Non-operative management (NOM) of liver trauma is well-established and accepted in current clinical practice. Initially considered as appropriate for lower grades of injury, NOM is now widely preferred for moderate and severe liver injuries too.

Methods: This review is based on a search of the English literature in Pubmed, using terms such as “liver trauma” and “non-operative”. Reconsideration of currently used indications and selection criteria for the non-operative management of liver trauma, as well as therapeutic strategies, complications and patient outcome, are discussed.

Results: Appropriate selection of patients according to the following criteria is essential for the successful outcome of NOM: haemodynamic stability (on arrival or after initial resuscitation), the absence of associated injuries to intra- or retro-peritoneal organs necessitating operative intervention, and the availability of a multidisciplinary team including an experienced radiologist, an experienced liver (preferably) surgeon and intensive care facilities. The volume of haemoperitoneum and the grade of injury are not considered factors that preclude NOM. Of paramount importance is the monitoring of signs of peritonitis, related to a possible unrecognised hollow viscus injury, which is appropriately managed operatively. Computed tomography is also important for early diagnosis of ongoing bleeding, in order to intervene either angiographically (embolization) or operatively (haemostasis). Mortality during NOM varies between 0.4% (liver-related) up to 13% (associated injuries).

Conclusions: In conclusion, the main selection criterion of patients with liver trauma for NOM is haemodynamic stability, independent of the grade of injury and the volume of haemoperitoneum. Accurate

interpretation of liver CT scanning is of paramount importance, in order to exclude or diagnose any associated injuries requiring operative intervention or active bleeding that can be treated with angiography and selective embolization. The prospect of haemodynamic instability not improving with resuscitation, the increased need for liver-related blood transfusions (> 4 pRBCs), and failure of conservative treatment to deal with complications, necessitate prompt operative intervention to avoid the consequences of delayed management.

Key words:

Liver trauma, Non-operative

Introduction

In 1908, J H. Pringle provided the first description of operative management of liver trauma [1]. Unfortunately, all eight patients died postoperatively; thereafter, Pringle recommended the non-operative management (NOM) of these injuries. However, his recommendation was not deemed acceptable for more than half a century, and it was only in 1972 that a new paper for this subject was published [2]. NOM was only established in clinical practice the last two decades [3 – 12] due to several factors, such as (a) the recognition that 50-80% of liver injuries stop bleeding spontaneously, resulting in as many as 67% negative exploratory laparotomies, (b) the remarkable progress made in liver imaging with computed tomography (CT) scanning [6, 12 – 15] and (c) the successful NOM of liver trauma in children. Although NOM was initially introduced mainly for minor liver injuries (grades I and II), it has progressively been applied successfully in moderate or even severe injuries (grades III - IV) [16 – 22]. Non-operative management is recommended not only for blunt liver trauma but for stab injuries and, recently, for gunshot wounds as well, provided there are no other concomitant injuries that require operative treatment and patients are haemodynamically stable [23 – 49]. The traditional fear of sepsis rates rising due to infection of bile or blood collections has proved to be inaccurate [29].

A. Marinis (Corresponding author), S. Rizos

- First Department of Surgery, Tzaneion General Hospital, 1 Afentouli & Zanni, 18536, Piraeus, Greece

✉ e-mail: drmarinis@gmail.com

Indications - Selection criteria for NOM

The selection criteria of patients suitable for NOM of liver trauma are constantly re-evaluated and include increasingly higher grades of injury. Thus, indications for applying NOM in liver trauma include: (a) patients haemodynamically stable on arrival or stabilized after minimal resuscitation, (b) absence of associated intra- and/or retro-peritoneal injuries necessitating operative management and (c) availability of a multidisciplinary specialised team, including an experienced radiologist for accurate interpretation of liver CT and possible angiographic intervention, an experienced (liver trauma preferably) surgeon and, finally, intensive care unit (ICU) facilities [10,15,16,20-22,42,50]. Despite disagreements related to the liver injury grade ($> III$) and the volume of haemoperitoneum (> 500 ml) as factors determining the decision for operative intervention, it is currently established that the main criterion for the application of NOM is haemodynamic stability of the patient, regardless of the grade of injury and the quantity of intraperitoneal blood [8,10,20-22,43,46].

Non-operative management

- *Monitoring.* Patient monitoring includes recording of vital signs, urine output and level of consciousness, estimation of significant changes of the haematocrit and haemoglobin, and the assessment of the total number of transfusions needed for the liver injury. Minor or moderate injuries (grades I - III), constituting 80% of liver trauma, do not require monitoring in an ICU setting.

- *Computed tomography.* CT is necessary for evaluating the grade of liver injury, its relation to major liver vascular structures and the presence of active bleeding (intra-parenchymal or intra-peritoneal), and for the exclusion of associated injuries of other intra- and retro-peritoneal organs. It can safely guide NOM in 80 - 90% of cases, while prompt diagnosis of ongoing bleeding and other complications can lead to early intervention (angiography, embolism or laparotomy), with a great impact on patient prognosis and outcome. CT is not usually recommended as a follow-up imaging modality for grades I-III liver injuries, but only for severe liver trauma (grades IV and V) and is further individualised in selected patients: for example, in the presence of large intra-parenchymal haematomas or associated vascular injuries, angiography is recommended in order to exclude the possibility of active bleeding [51, 52].

- *Angiography - Embolization.* Angiography is necessary in patients with a suspicion of active bleeding on CT and in patients continuing to bleed after

placement or removal of liver packing. Several liver injuries can be diagnosed, such as major vascular injuries, pseudoaneurysms, major abnormalities of the hepatic arteries, devascularisation of liver segments, communications of traumatized vessels with the biliary tree or biliary injuries with the hepatic veins and abnormalities of portal vein blood flow [53]. The application of embolization in bleeding or irregular vessels, pseudoaneurysms and communications with the biliary tree or the hepatic veins, has considerably reduced the mortality rate from 65% (without embolization) to 30% (with embolization) of severe liver trauma [54].

- *Endoscopic retrograde cholangiopancreatography (ERCP).* Due to the coexistence of serious biliary injury in 5% of liver trauma, ERCP can precisely localize the damage and treat it with the placement of a stent or nasobiliary drain [52].

- *Prevention of venous thromboembolism (VTE).* Prophylaxis for VTE in patients with liver trauma is not recommended when the risk of bleeding is significant. Instead of using antithrombotic agents, the use of mechanical preventive measures, such as graded compression stockings, intermittent compression devices and pneumatic compression is recommended (level A) [55].

Failure of NOM

Possibility of failure is greater in severe injuries (grade IV and V) and is seldom related to liver trauma (0-3.5%); operative intervention is usually carried out for the management of associated injuries, such as delayed spleen or kidney bleeding, rather than for liver-related complications [10,17,29]. Other factors that determine the failure of NOM in liver trauma are age, haematocrit, the development of haemodynamic instability, the presence of active bleeding in CT and the progressively increased need for liver-related transfusions (> 4 pRBCs).

Complications of NOM

- *Delayed bleeding from the liver.* As already mentioned, delayed bleeding usually concerns associated organ injuries (kidney, spleen) and only rarely the liver itself, leading uneventfully to a delayed laparotomy. It is a more frequent complication of NOM of liver injury. Usual errors for not promptly diagnosing delayed bleeding from the liver include the negative correlation of ongoing bleeding with the liver injury, continuing management with more transfusions (> 4 U pRBCs), the erroneous interpretation of CT for the existence of active bleeding and the overestimation of blood losses attributed to associated injuries.

- *Unrecognized hollow viscus injury.* The incidence varies from 0.7 - 26.5% and treatment involves direct operative intervention [56]. Therefore, it is of vital importance that any traumatic hollow viscus perforation initially (clinically and radiologically) be excluded and the patient closely monitored for signs of peritonitis during NOM.

- *Biliary injuries.* Constituting the second most frequent complication, these include: (a) biliary fistula, (b) biliary peritonitis, (c) biloma, (d) haemobilia (communication of a bleeding vessel with the biliary tree), manifested as jaundice, right upper quadrant colic and upper gastrointestinal bleeding, (e) communication of the biliary tree with the hepatic veins (cholaemia) and (f) delayed biliary stricture. Management includes ERCP and stent placement or nasobiliary drainage.

- *Hepatic abscess.* Their incidence is not increased with NOM. Percutaneous drainage with CT guidance is successful in 78-100% of cases.

- *Thrombosis of the inferior vena cava (IVC).* The development of a multilobular fluid collection in the location of a pre-existing liver injury which subsequently compressed the IVC, finally leading to the formation of an intraluminal clot, has been reported in the literature [57].

Patient outcome

Prognosis and outcome of patients with liver trauma managed non-operatively depend on the selection of patients according to the established criteria aforementioned, the development of strict protocols of CT liver imaging and the grade of injury. Misdiagnosed injuries during imaging workup can be as frequent as 12%, while the development of strict protocols reduces them to 0.2%. Mortality during NOM of liver injuries varies between 0.4% (liver-related) up to 13% (associated injuries).

Conclusions

In conclusion, the main selection criterion of patients with liver trauma for NOM is haemodynamic stability, independent of the grade of injury and the volume of haemoperitoneum. Accurate interpretation of liver CT scanning is of paramount importance, in order to exclude or diagnose any associated injuries requiring operative intervention, or active bleeding that can be treated with angiography and selective embolization. The presence of haemodynamic instability not improving with resuscitation, the increased need for liver-related blood transfusions (> 4 pRBCs), and the failure of conservative treatment of complications, necessitate prompt operative intervention, in order to avoid the consequences of

delayed management.

Conflict of interest

The authors declare that they have no conflict of interest.

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Μη Χειρουργική Αντιμετώπιση του Ηπατικού Τραύματος

Άρθρο Ανασκόπησης

A. Μαρίνης, Σ. Ρίζος

Περίληψη

Εισαγωγή-Σκοπός: Η μη χειρουργική θεραπεία (ΜΧΘ) του τραύματος του ήπατος είναι πλέον ευρέως αποδεκτή και καθιερωμένη στην κλινική πράξη. Αν και αρχικά εφαρμόστηκε κυρίως στις μικρής βαρύτητας ηπατικές κακώσεις, σταδιακά επεκτάθηκε και στις μέτριας και μεγάλης βαρύτητας κακώσεις.

Μέθοδος: Η ανασκόπηση της σύγχρονης Αγγλικής βιβλιογραφίας έγινε με την αναζήτηση στο Pubmed όρων όπως “liver trauma” και “non-operative”. Συζητούνται οι σύγχρονες ενδείξεις και τα κριτήρια επιλογής των ασθενών που μπορούν να αντιμετωπιστούν μη χειρουργικά, καθώς και η θεραπευτική στρατηγική, οι επιπλοκές καθώς και η έκβαση των ασθενών.

Αποτελέσματα: Η σωστή επιλογή των ασθενών με βάση τα ακόλουθα κριτήρια είναι σημαντική στην επιτυχή έκβαση της ΜΧΘ: η αιμοδυναμική σταθερότητα, η απουσία συνοδών ενδο- ή οπισθοπεριτοναϊκών κακώσεων που χρήζουν χειρουργικής αντιμετώπισης και η διαθεσιμότητα σε 24ωρη βάση μιας πολυδύναμης ομάδας, που περιλαμβάνει εξειδικευμένο ακτινολόγο, έμπειρο χειρουργό (ήπατος κατά προτίμηση) και περιβάλλον εντατικής παρακολούθησης. Ο όγκος του αιμοπεριτοναίου και ο βαθμός της κάκωσης δεν αποτελούν πλέον παράγοντες που αποκλείουν την εφαρμογή της ΜΧΘ. Μέγιστης σημασίας είναι η παρακολούθηση του ασθενή για σημεία περιτονίτιδας, που σχετίζονται με αδιάγνωστη διάτρηση κοίλου σπλάγχνου, η οποία αντιμετωπίζεται χειρουργικά. Η αξονική τομογραφία είναι σημαντική για την έγκαιρη διάγνωση συνεχιζόμενης αιμορραγίας, ώστε να αντιμετωπισθεί αγγειογραφικά (εμβολισμός) ή χειρουργικά (αιμόσταση). Η θνητότητα κατά τη διάρκεια της ΜΧΘ διακυμαίνεται από 0.4% (σχετιζόμενη με την ηπατική κάκωση) έως 13% (σχετιζόμενη με τις συνοδές κακώσεις).

Συμπεράσματα: Συμπερασματικά, το βασικό κριτήριο επιλογής του ασθενή με τραύμα ήπατος που μπορεί να αντιμετωπισθεί μη χειρουργικά είναι η αιμοδυναμική αστάθεια, ανεξάρτητα από το βαθμό της κάκωσης και τη ποσότητα του αιμοπεριτοναίου. Η ακριβής ερμηνεία της αξονικής τομογραφίας έχει μεγάλη σημασία, προκειμένου να αποκλεισθούν ή να διαγνωσθούν άλλες συνοδές κακώσεις που πιθανά θα χρειασθούν χειρουργική αντιμετώπιση ή ενεργό αιμορραγία που μπορεί αντιμετωπισθεί αγγειογραφικά με εμβολισμό. Η εμφάνιση αιμοδυναμικής αστάθειας που δεν ανταποκρίνεται στην ανάνηψη, οι αυξανόμενες ανάγκες σε μεταγγίσεις για την κάκωση του ήπατος (> 4 pRBCs) και η αποτυχία συντηρητικής αντιμετώπισης επιπλοκών, απαιτούν την άμεση χειρουργική παρέμβαση προκειμένου να αποφευχθούν οι συνέπειες της όποιας καθυστέρησης.

Λέξεις κλειδιά

Ηπατικό τραύμα, Μη χειρουργική αντιμετώπιση