

Nonoperative management of blunt hepatic injury: An Eastern Association for the Surgery of Trauma practice management guideline

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BACKGROUND: During the last century, the management of blunt force trauma to the liver has changed from observation and expectant management in the early part of the 1900s to mainly operative intervention, to the current practice of selective operative and nonoperative management. These issues were first addressed by the Eastern Association for the Surgery of Trauma in the Practice Management Guidelines for Nonoperative Management of Blunt Injury to the Liver and Spleen published online in 2003. Since that time, a large volume of literature on these topics has been published requiring a reevaluation of the previous Eastern Association for the Surgery of Trauma guideline.

METHODS: The National Library of Medicine and the National Institutes of Health MEDLINE database were searched using PubMed (www.pubmed.gov). The search was designed to identify English-language citations published after 1996 (the last year included in the previous guideline) using the keywords *liver injury* and *blunt abdominal trauma*.

RESULTS: One hundred seventy-six articles were reviewed, of which 94 were used to create the current practice management guideline for the selective nonoperative management of blunt hepatic injury.

CONCLUSION: Most original hepatic guidelines remained valid and were incorporated into the greatly expanded current guidelines as appropriate. Nonoperative management of blunt hepatic injuries currently is the treatment modality of choice in hemodynamically stable patients, irrespective of the grade of injury or patient age. Nonoperative management of blunt hepatic injuries should only be considered in an environment that provides capabilities for monitoring, serial clinical evaluations, and an operating room available for urgent laparotomy. Patients presenting with hemodynamic instability and peritonitis still warrant emergent operative intervention. Intravenous contrast enhanced computed tomographic scan is the diagnostic modality of choice for evaluating blunt hepatic injuries. Repeated imaging should be guided by a patient's clinical status. Adjunctive therapies like angiography, percutaneous drainage, endoscopy/endoscopic retrograde cholangiopancreatography and laparoscopy remain important adjuncts to nonoperative management of hepatic injuries. Despite the explosion of literature on this topic, many questions regarding nonoperative management of blunt hepatic injuries remain without conclusive answers in the literature. (*J Trauma Acute Care Surg.* 2012;73: S288–S293. Copyright © 2012 by Lippincott Williams & Wilkins)

KEY WORDS: Guideline; liver; hepatic; blunt abdominal trauma; surgery.

STATEMENT OF THE PROBLEM

During the last century, the management of blunt force trauma to the liver has changed from observation and expectant

management in the early part of the 1900s to operative intervention, to the current practice of selective operative and nonoperative management. The current nonoperative paradigm in adults was stimulated by the success of nonoperative management of solid organ injuries in hemodynamically stable children. The advantages of nonoperative management include lower hospital cost, earlier discharge, avoiding nontherapeutic celiotomies (and their associated cost and morbidity), fewer intra-abdominal complications, and reduced transfusion rates. Selective nonoperative management of blunt hepatic injury is associated with an improvement in mortality when compared with operative therapy.^{1–3} A 2008 study by Tinkoff et al.⁴ showed that 86.3% of hepatic injuries are now managed without operative intervention. These issues were first addressed by the Eastern Association for the Surgery of Trauma (EAST) in the Practice Management Guidelines for Non-operative Management of Blunt Injury to the Liver and Spleen published online in 2003.⁵ Since that time, a large volume of literature on these topics has been published. As a result, the Practice Management Guidelines Committee of EAST set out to develop updated guidelines for the nonoperative management of hepatic

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and splenic injuries. The practice management guideline update was split into separate recommendations for the nonoperative management of blunt hepatic and splenic injuries in adult trauma patients rather than the amalgamated recommendations included in the 2003 practice management guideline.

Reports of nonoperative management in adults with injuries to the liver continue to support nonoperative management in hemodynamically stable adults, but questions still exist about efficacy, patient selection, and details of management.^{2,6-9} These questions include as follows:

- Are the 2003 recommendations still valid?
- Is nonoperative management appropriate for all hemodynamically stable adults regardless of the severity of solid-organ injury or presence of associated injuries?
- What role should angiography and other adjunctive therapies play in nonoperative management?
- Is the risk of missing a hollow viscous injury a deterrent to nonoperative management?
- What is the best way to diagnose injury to the liver?
- What roles do computed tomographic (CT) scan and/or ultrasound have in the hospital management of the patient being managed nonoperatively?
- Should patients be placed on a “bed rest” activity status, and if so, for what duration?
- Finally, what period and evaluation is needed before releasing patients back to full activity?

PROCESS

Identification of References

References were identified by research librarians at the University of Rochester—Miner Medical Library. The MEDLINE database in the National Library of Medicine and the National Institutes of Health was searched using Entrez PubMed (www.pubmed.gov). The search was designed to identify English-language citations published after 1996 (the last year of literature used for the existing guideline) using the keywords: *liver injury*; and *blunt abdominal trauma*. The articles were limited to humans, clinical trials, randomized controlled trials, practice guidelines, meta-analyses, and reviews. Two hundred twenty-three articles were identified. Case reports and small case series were excluded. The committee chair and members then reviewed the articles for relevance and excluded any reviews and tangential articles. One hundred seventy-six articles were reviewed, of which 94 were used to create the nonoperative management of blunt hepatic injuries recommendations. (Table, Supplemental Digital Content 1, <http://links.lww.com/TA/A184>).

Quality of References

The methodology developed by the Agency for Healthcare Policy and Research of the US Department of Health and Human Services was used to group the references into three classes.¹

Class I: Prospective randomized studies (no references).

Class II: Prospective, noncomparative studies and retrospective series with controls (12 references).

Class III: Retrospective analyses (case series, databases or registries, and case reviews) (82 references).

Based on the review and assessment of the selected references, three levels of recommendations are proposed.

Level 1

The recommendation is convincingly justifiable based on the available scientific information alone. This recommendation is usually based on Class I data; however, strong Class II evidence may form the basis for a Level 1 recommendation, especially if the issue does not lend itself to testing in a randomized format. Conversely, low-quality or contradictory Class I data may not be able to support a Level 1 recommendation.

Level 2

The recommendation is reasonably justifiable by available scientific evidence and strongly supported by expert opinion. This recommendation is usually supported by Class II data or a preponderance of Class III evidence.

Level 3

The recommendation is supported by available data, but adequate scientific evidence is lacking. This recommendation is generally supported by Class III data. This type of recommendation is useful for educational purposes and in guiding future clinical research.

RECOMMENDATIONS

Upon review of the updated literature, it was found that most of the recommendations from the 2003 guideline remain valid. The previous guidelines were incorporated into the greatly expanded current recommendations as appropriate. A multitude of unanswered questions remain in the literature for nonoperative management of blunt hepatic injuries.

Level 1

1. Patients who are hemodynamically unstable or who have diffuse peritonitis after blunt abdominal trauma should be taken urgently for laparotomy.

Level 2

1. A routine laparotomy is not indicated in the hemodynamically stable patient without peritonitis presenting with an isolated blunt hepatic injury.
2. In the hemodynamically stable blunt abdominal trauma patient without peritonitis, an abdominal CT scan with intravenous contrast should be performed to identify and assess the severity of injury to the liver.
3. Angiography with embolization may be considered as a first-line intervention for a patient who is a transient responder to resuscitation as an adjunct to potential operative intervention.
4. The severity of hepatic injury (as suggested by CT grade or degree of hemoperitoneum), neurologic status, age of more than 55 years, and/or the presence of associated injuries are not absolute contraindications to a trial of nonoperative management in a hemodynamically stable patient.

5. Angiography with embolization should be considered in a hemodynamically stable patient with evidence of active extravasation (a contrast blush) on abdominal CT scan.
6. Nonoperative management of hepatic injuries should only be considered in an environment that provides capabilities for monitoring, serial clinical evaluations, and an operating room available for urgent laparotomy.

Level 3

1. After hepatic injury, clinical factors such as a persistent systemic inflammatory response, increasing persistent abdominal pain, jaundice, or an otherwise unexplained drop in hemoglobin should prompt reevaluation by CT scan.
2. Interventional modalities including endoscopic retrograde cholangiopancreatography, angiography, laparoscopy, or percutaneous drainage may be required to manage complications (bile leak, biloma, bile peritonitis, hepatic abscess, bilious ascites, and hemobilia) that arise as a result of nonoperative management of blunt hepatic injury.
3. Pharmacologic prophylaxis to prevent venous thromboembolism can be used for patients with isolated blunt hepatic injuries without increasing the failure rate of nonoperative management, although the optimal timing of safe initiation has not been determined.

There was not enough literature available to make recommendations regarding the following:

1. Frequency of hemoglobin measurements
2. Frequency of abdominal examinations
3. Intensity and duration of monitoring
4. Time to reinitiating oral intake
5. Duration and intensity of restricted activity (both in hospital and after discharge)
6. Optimum length of stay for both the intensive care unit (ICU) and hospital
7. Timing of initiating chemical deep venous thrombosis (DVT) prophylaxis after hepatic injury

SCIENTIFIC FOUNDATION

Nonoperative management of blunt hepatic trauma is now the standard of care for hemodynamically stable patients with blunt hepatic trauma at most of the US trauma centers, with reported success rates ranging from 82% to 100%.^{8,10-14} Some have even voiced that operative management of hepatic trauma leads to increased hepatic hemorrhage and may lead to unnecessary interventions with an increased incidence of iatrogenic complications.^{2,3} Factors previously thought to completely preclude nonoperative management of hepatic injuries include hepatic injury grade, head injury, injury severity score, degree of hemoperitoneum, age greater than 55 years, number of transfusions, periportal tracking of blood or pooling of contrast/a blush on CT scan.^{15,16} More recent literature has challenged these findings and the severity of hepatic injury (as suggested by CT grade or degree of hemoperitoneum), neurologic status, presence of a "blush" on CT scan, age greater than 55 years,

and/or the presence of associated injuries are no longer considered absolute contraindications to a trial of nonoperative management in the hemodynamic stable patient.^{3,6,17-19}

There is no established consensus on how much blood loss or transfusion requirement mandates the decision to intervene, whether operatively or angiographically.^{3,16} A correlation between hepatic injury grade and failure of nonoperative management has not been consistently shown; therefore, the initial management of patients with blunt hepatic trauma should be mandated by their hemodynamic status rather than their grade of hepatic injury.^{7,20,21} Patients who are hemodynamically unstable with evidence of intra-abdominal hemorrhage (a positive FAST or DPL) should undergo operative management of their hepatic bleeding.^{22,23} Patients who have peritonitis should undergo immediate exploratory laparotomy.¹² Nonoperative management should only be performed in centers capable of diagnosis of hepatic trauma and associated injuries, rapid response to change in patient status if necessary, and delayed interventions if complications arise. Careful and repeated examinations and multidisciplinary consultation are needed to support this management strategy.¹² Any suspicion of hollow viscous injury or change in abdominal pain pattern indicates a need for operation. In addition, as increasing numbers of solid organ injuries are detected in a patient with blunt trauma, the incidence of hollow viscous injury increases.²⁴ The overall incidence of missed injury is quite low and should not influence decisions concerning eligibility for nonoperative management.^{25,26} Adopting a standardized protocol of nonoperative management for isolated liver trauma based on hemodynamics reduces resource use and hospital costs, without any detriment to care.²⁷

A CT scan of the abdomen with intravenous contrast administration is the optimal diagnostic modality for hemodynamically stable patients to aid in both the diagnosis and management of blunt hepatic trauma.²⁸ It is also useful in quantifying the amount of hemoperitoneum and identifying other intraperitoneal or retroperitoneal injuries or the presence of pneumoperitoneum.²⁹⁻³¹ CT scan also offers the advantage of potentially identifying ongoing active bleeding.^{32,33} The finding of a "blush" or pooling of intravenous contrast material within the liver parenchyma on CT scan can be indicative of active hemorrhage.^{32,33} Hemodynamically stable patients with free intraperitoneal extravasation should be considered for immediate angiography if readily available.³⁴ Close observation alone with planned angiographic embolization for signs of ongoing bleeding, such as a drop in hematocrit or need for transfusion, is also an option in appropriate facilities.^{33,35} Fang et al.²⁸ showed that intraperitoneal contrast extravasation and hemoperitoneum in six compartments on CT scan indicates massive or active hemorrhage and should be regarded as high risk for the need of operation or angiography in hemodynamically stable patients after blunt hepatic injury. Multi-channel detector CT scanners have improved sensitivity, and more rapid imaging allows for the visualization of major vascular structures in different phases following contrast enhancement. In addition, reconstruction can be performed in multiple planes without significant loss of image quality.³⁶ However, while serious abnormalities on CT scan often predict the need for intervention for blunt liver injuries, clinical

findings including shock or peritoneal signs may outweigh findings on CT scan and may lead to operative intervention or the need for angioembolization.³⁷ Although routine follow-up CT scans are not necessary, clinical factors such as persistent systemic inflammatory response syndrome, abdominal pain, jaundice, or an unexplained drop in hemoglobin level should prompt reevaluation by CT scan.^{19,30,38} Grossly elevated transaminases after traumatic injury should prompt further evaluation of the liver with CT scan if possible.^{39,40}

The role of angioembolization in the management of blunt hepatic injury remains controversial. Poletti et al.⁴¹ showed that CT injury grade (AAST Grade III or higher), evidence of arterial injury (a contrast “blush”), and evidence of hepatic venous injury are useful indicators of high-risk patients who would benefit from hepatic angiography to limit persistent or delayed bleeding or other delayed complications.⁴² In a study by Hagiwara et al.,³⁴ all stable patients with Grade III or higher liver injuries had an angiogram where nearly half of the Grade III injuries and nearly all of the Grade IV injuries had active bleeding on angiography regardless of the presence of CT scan blush. The reported efficacy of angioembolization for the control of bleeding after blunt hepatic injury is as high as 83%, with some patients requiring a repeated angiogram.²⁰ Misselbeck et al.⁴³ showed that angiography is useful in management of those with patients with a “blush” on CT scan and that these patients are 20 times more likely to require embolization than those without. While angioembolization can be very effective, it remains associated with significant morbidity owing to renal impairment related to the injection of iodinated contrast agents; to arterial dissection or accidents at the arterial puncture site; to localized hepatic necrosis, abscess, and necrosis of the biliary tract; and to cholecystitis, which occurred in up to 58% of patients in some studies.^{43,44}

There is no consensus in the literature regarding predicting the failure of nonoperative management of hepatic injuries. Patients with hepatic injuries who require ongoing fluid resuscitation to maintain hemodynamic stability have multiple solid-organ injuries, a higher Injury Severity Score (ISS), large hemoperitoneum, or contrast extravasation on CT scan are more likely to fail nonoperative management and will likely require additional treatment, either angioembolization and/or laparotomy.^{14,23,45} Malhotra et al. showed that patients with concomitant liver and spleen injuries have higher ISS, mortality, length of stay, and transfusion requirement and are more likely to fail nonoperative management of their injuries than those with single solid-organ injuries.^{46,47} However, other studies have not found that multiple solid-organ injuries to be a great detriment to successful nonoperative management of blunt hepatic injury.⁴⁸

Hemodynamic instability is responsible for 75% of all failures of nonoperative management.⁷ While the incidence of delayed hemorrhage is low at 2.8% to 3.5% in an appropriately chosen population, it still remains the most common complication and cause of death in nonoperative management.² Angiography with embolization should be considered as a first-line intervention for a patient who is a transient responder to resuscitation before potential operative intervention (if embolization is unsuccessful).⁴⁹ For those patients who are hemodynamically unstable despite continuous re-

suscitation, laparotomy followed by embolization if needed is likely a safer approach.³ The amount of blood transfused and infectious complications were significantly reduced for patients with angioembolization as first-line therapy compared with those who underwent laparotomy followed by embolization.⁴⁴

Many patients who undergo nonoperative management of hepatic trauma have complications including bile leaks, hemobilia, bile peritonitis, bilious ascites, hemoperitoneum, abdominal compartment syndrome, missed injuries, hepatic necrosis, hepatic abscess, and delayed hemorrhage.^{3,8,25} The complication rate increases with the grade of injury as illustrated in several studies of patients where those with Grade III had a complication rate of 1%, Grade IV at 21%, and Grade V at 63%.^{35,46,47} Minimally invasive endoscopic techniques and interventional radiology therapies are available and more likely to be required for patients being managed conservatively with higher-grade injuries.^{47,50} Typically, biliary complications present in a more delayed fashion for patients with high-grade injuries.⁴⁷ Biliary duct disruptions with associated bilomas, bile peritonitis, biliary leaks, and biliary sepsis occur in approximately 3.2% of all hepatic trauma patients and contribute significantly to the morbidity associated with hepatic injuries.³ Biliary leaks are more common in higher-grade injuries, and most patients will develop clinical symptoms such as a systemic inflammatory response, sepsis, an elevation in serum bilirubin levels, or worsening abdominal pain. Hepatobiliary iminodiacetic acid scans have been shown to be nearly 100% sensitive and specific for diagnosing bile duct leaks after liver injury.⁵¹ Although most peripheral biliary leaks will seal without treatment, continued high-output biliary drainage may warrant adjunctive endoscopic retrograde cholangiopancreatography and stenting.³⁹ Continued observation of biliary leaks is necessary because multiple and recurrent late complications occur, which can be dealt with operatively (laparoscopic or open) or through less invasive means such as endoscopic retrograde cholangiopancreatography with stenting or percutaneous drainage.^{20,46} Laparoscopic washout of biliary peritonitis is gaining traction as an adjunctive therapy to the nonoperative management of liver injuries. It is thought that this washout helps to resolve the systemic inflammatory process that is a result of the bile peritonitis.^{52–54} Intrahepatic abscesses occur in up to 4% of nonoperatively managed hepatic trauma, and mortality is approximately 10%.³¹ The treatment may be either surgical drainage (open or laparoscopic) or percutaneous drainage.⁵⁰

Nonoperative management of hepatic injuries should only be considered for patients who are hemodynamically stable and have an absence of peritoneal signs and in an environment that has the capability for monitoring, serial clinical evaluations, and facilities for urgent laparotomy. Nonoperative management of blunt hepatic injury consists of a period of in-hospital/ICU observation/monitoring, serial abdominal examinations, serial hematocrit measurements, and a period of immobility (bed rest/postdischarge restricted activity). What remains unclear in the literature is the duration and frequency required of all of these interventions.¹ St Peter et al.⁵⁵ showed that an abbreviated trauma protocol with overnight bed rest for Grades I and II injuries and two nights for higher-grades

could be safely used for patients with blunt hepatic injuries. In adults, timing of an in-hospital mobilization did not seem to contribute to delayed hemorrhage in a retrospective study by London et al.;⁵⁶ however, this has not been confirmed in a prospective fashion. Median healing time for hepatic subcapsular hematomas was found to be different from hepatic lacerations in a single study by Tiberio et al.⁵⁷ The median healing time for a Grade I hematoma was found to be 6 days, while it was 16 days for Grade II and 108 days for Grade III hematoma. For lacerations, the median healing time was found to be 29 days for Grade II, 34 days for Grade III, and 78 days for Grade IV. These patients are being discharged earlier now than previous periods without negative consequences.⁷ There is no true consensus about what constitutes an appropriate in-hospital and posthospital management of a patient with blunt hepatic injury once they have been selected for non-operative management. Frequency of serial hematocrits, abdominal examinations, and monitoring; when a diet should be started; how long should patients be kept at bed rest; the optimum length of stay in both the ICU and hospital; and how long should activities be limited are all questions to which there are no clear-cut answers in the literature.

Chemical DVT prophylaxis can be used for patients with isolated blunt hepatic injuries without increasing the failure rate of nonoperative management. Eberle et al.⁵⁸ showed that chemical DVT prophylaxis may not increase the failure rate of nonoperative management. In their study, early (<3 days) use of low-molecular weight heparin did not seem to increase failure rates or blood transfusion requirements for patients with hepatic injuries. Although the use of chemical DVT prophylaxis has been shown not to negatively impact nonoperative management of hepatic injuries, there is no literature consensus about safe initiation time.

SUMMARY

There has been a plethora of literature regarding nonoperative management of blunt hepatic injuries published since the 2003 EAST practice management guideline was written. Non-operative management of blunt hepatic injuries is now the treatment modality of choice in hemodynamically stable patients, irrespective of the grade of injury. Its use is associated with a low overall morbidity and mortality when applied to an appropriate patient population. Nonoperative management of blunt hepatic injuries should only be considered in an environment that provides capabilities for monitoring, serial clinical evaluations, and an operating room available for urgent laparotomy. Patients presenting with hemodynamic instability and peritonitis still warrant emergent operative intervention. Intravenous contrast-enhanced CT scan is the diagnostic modality of choice for evaluating blunt hepatic injuries. Repeated imaging should be guided by a patient's clinical status. Adjunctive therapies such as angiography, percutaneous drainage, endoscopy/ERCP and laparoscopy remain important adjuncts to nonoperative management of hepatic injuries. Despite the explosion of literature on this topic, many questions regarding nonoperative management of blunt hepatic injuries remain without conclusive answers in the literature.

DISCLOSURE

The authors declare no conflicts of interest.

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