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Delayed laparoscopy facilitates the management of biliary peritonitis in patients with complex liver injuries

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Abstract

Background: Nonoperative management is now regarded as the best alternative for the treatment of patients with complex blunt liver injuries. However, some patients still require surgical treatment for complications that were formerly managed with laparotomy and a combination of image-guided studies.

Methods: We reviewed the medical records of 15 patients who had complex blunt liver injuries that were managed nonoperatively and in which biliary peritonitis developed.

Results: Delayed laparoscopy was performed 2–9 days after admission in patients with extensive liver injuries. All 15 patients had developed local signs of peritonitis or a systemic inflammatory response. Laparoscopy was indicated to drain a large retained hemoperitoneum (eight patients), bile peritonitis (four patients), or an infected perihepatic collection (three patients). Laparoscopy was successful in all patients, and there was no need for further interventions.

Conclusion: The data indicate that as more patients with complex liver injuries are treated nonoperatively and the criteria for nonoperative management continue to expand, more patients will need some type of interventional procedure to treat complications that historically were managed by laparotomy. At this point, laparoscopy is an excellent alternative that should become part of the armamentarium of the trauma surgeons who treat these patients.

Key words: Laparoscopy — Liver injuries — Liver trauma — Peritonitis

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Over the last decade, there has been a dramatic change in the treatment of complex blunt liver injuries. Historically, patients with blunt liver injuries were managed by a sequence of measures, including (a) diagnosis of the injury by diagnostic peritoneal lavage; (b) exploratory laparotomy; (c) attempted surgical repair of injured vascular, parenchymal, or biliary structures; and (d) drainage of the perihepatic spaces to control biliary leaks or potential sepsis [2]. Currently, these patients are managed by different series of procedures that include (a) expeditious diagnosis of the liver injury by ultrasound (US) or computed tomography (CT); (b) careful monitoring, usually in an intensive care setting; (c) diagnosis and treatment of potential complications by lesser invasive procedures; and (d) follow-up of the healing process by US or CT. This overall change in management has been shown to be effective in almost all patients with grade I to III injuries and is increasingly common in patients with grade IV and V injuries [1, 5, 7, 19].

Even though this nonoperative treatment has been successful in obviating the need for surgery for most patients, ~75% of patients with grade IV and V injuries develop complications that require some type of interventional treatment [4]. Among these complications, hyperpyrexia and a systemic inflammatory response is observed in three-fourths of patients. Historically, it was believed that this was the result of pulmonary complications (i.e., pulmonary contusion, pneumonia, or atelectasis). The current hypothesis is that a cascade of events begin with ischemia of the injured liver, reabsorption of devitalized hepatic parenchyma into the venous system, and a subsequent febrile response most likely secondary to the release into the systemic circulation of activated chemical mediators by the presence of bile and blood in the peritoneal cavity [13, 21].

We report our experience with laparoscopy as an alternative to celiotomy to drain a large and retained fluid ab-

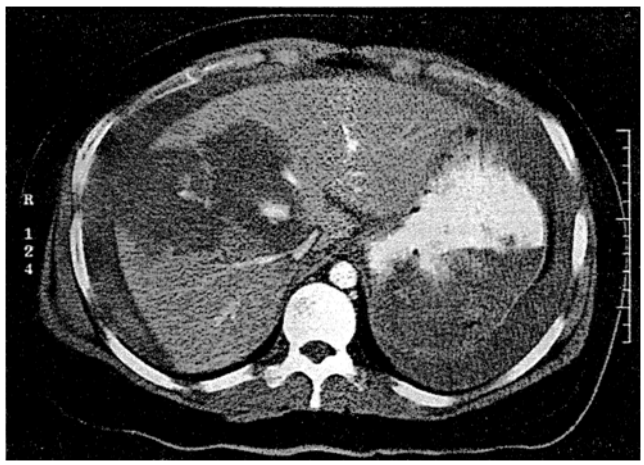

Fig. 1. Abdominal CT scan showing extensive liver laceration, active hemorrhage, and a large hemoperitoneum (grade IV). Bleeding was controlled with selective arteriography and embolization. Two days later, the patient developed increasing abdominal pain, fever, and tachycardia that resolved after laparoscopic drainage of a large retained abdominal fluid collection.

dominal collection in selected patients with extensive blunt liver injuries who were initially managed nonoperatively. Herein we describe our technique and review our results to date to determine the feasibility and efficacy of this approach in these patients.

Patients and methods

Patients

Between July 1995 and December 1999, 188 patients with blunt liver injuries were managed nonoperatively at the trauma service of the University of Louisville Hospital, a level I trauma center. Fifteen of these patients (8%) underwent delayed laparoscopy 2–9 days after the injury (average, 4 days) to perform a lavage of the peritoneal cavity and to drain a large retained fluid collection consistent with biliary peritonitis.

Demographic information, incidence of bacterial contamination of the peritoneal fluid, success rate of the laparoscopic drainage, short-term results, and hospital mortality were evaluated." short term results " as meant?

The inclusion criteria for laparoscopy were as follows:

1. Patients with blunt liver injuries associated with a large hemoperitoneum identified by CT scan who were initially managed nonoperatively (Fig. 1);
2. Peritoneal and systemic signs suggestive of a systemic inflammatory response;
3. Hemodynamic stability and no evidence of active liver hemorrhage; and
4. No clinical or CT findings that indicated an urgent exploratory laparotomy.

For the purposes of this review, the liver injuries were classified according to the guidelines put forth by the American Association for the Surgery of Trauma [14].

Laparoscopic technique

All procedures are performed in the operating room with the patient under general anesthesia. The technique includes routine cardiac and respiratory monitoring. Short-acting intravenous anesthetics were used to enhance the effect of inhalational anesthetics and facilitate extubation, if indicated at the end of the procedure.

The patient is placed in the supine position on the operating table with the table tilted 5° to the right side. A moderate Trendelenburg position is used to facilitate accumulation of fluid in the right upper quadrant. Standard laparoscopic instruments are employed, including a 10- and a 5-mm port, one in a periumbilical location for the camera, and a working port placed parallel to the umbilicus in the mid-axillary line. In general, there is no need for further port placement. The video monitors are placed as for standard biliary surgery.

Additional instruments include a Stryker suction/irrigator (Stryker Endoscopy, Santa Clara, CA, USA) for irrigation and suctioning of the peritoneal cavity. At the beginning of the procedure, before irrigation is begun, peritoneal fluid is routinely collected for microbiological analysis. The peritoneal cavity is irrigated in the right upper quadrant with 2–3 L of 0.9% saline solution for peritoneal lavage. At the end of the procedure, one perihepatic drain with bulb suction is placed for an average of 2 days, or longer if there are specific indications. No efforts are made to determine the extent of the liver injury. As a matter of fact, the liver injury is left undisturbed throughout the procedure to avoid any potential hemorrhage from the site of the liver injury. At the end of the procedure, the peritoneal cavity is inspected to assess whether there are any associated injuries to the intraabdominal structures.

Table 1. Indications for laparoscopic drainage of peritoneal fluid collection

Indication	No. of patients (%)
Large retained fluid collection	8 (54)
Increasing right upper quadrant pain	4 (27)
Suspected perihepatic infected collection	3 (19)

Results

Patient population

During the review period, 15 patients with blunt liver injuries that had been initially managed nonoperatively underwent delayed laparoscopy for drainage of a retained abdominal fluid collection. The mean age was 33.2 years (range, 18–58). There were 10 men (67%) and five women (33%). The liver injuries were classified as grade III in eight patients and grade IV in seven patients.

Indications for laparoscopy and findings

Laparoscopy was indicated for drainage of a large retained abdominal fluid collection in eight patients, increasing abdominal pain in four patients, and a suspected infected perihepatic fluid collection in three patients (Table 1). However, all 15 patients had systemic inflammatory signs, manifested by fever, tachycardia, mild hypotension, and leukocytosis. All 15 patients responded dramatically to the peritoneal lavage and resolved their systemic response within 24 h of the procedure (Table 2).

The average amount of fluid drained from the peritoneal cavity was 1250 ml, (range, 850–1800). The aspect of the fluid varied from pure blood to bilious, but most patients had a mixture of blood and bile that resembled crankcase oil. In only two patients (13%), bacterial growth was documented from the peritoneal fluid (*Enterobacter aerogenes* and *Klebsiella pneumoniae*).

Clinical outcome

There were no documented complications related to the procedure itself. Fourteen patients (93%) recovered unevent-

Table 2. Clinical and metabolic changes after drainage of retained hemoperitoneum[a]

Clinical findings	Preoperative[b]	Postoperative[b]
MAP	83	89
Heart rate (beats/minute)	138	88
Temperature	102.3°F	99.8°F
Serum bilirubin (total)	4.8 mg/dl	2.1 mg/dl
Abdominal pain, ileus	++++	+

MAP, mean arterial pressure
[a] Changes were documented 24 h after the initial intervention.
[b] Mean values

fully; however, one patient required additional CT-guided drainage of a perihepatic collection on two separate occasions. Most drains were removed within 48 h and all of them by the 3rd postoperative day.

There were no hospital deaths in this group of patients.

Discussion

Over the last 2 decades, major advances have been made in the nonoperative treatment of blunt liver injuries. These changes were fostered by the success initially described in the pediatric population [9, 15, 18]. Currently, most liver injuries classed as grades I–III and >60% of injuries classed as grades IV and V, according to the American Association for the Surgery of Trauma [14], are managed nonoperatively [1, 2, 10, 11, 16]. This evolving approach manages these patients based on their hemodynamic stability rather than the extent of the liver injury [2, 3, 6].

The success of this nonoperative treatment has been associated with an increase in the number of associated complications, some of them rather uncommon for patients who were formerly managed surgically [2, 8, 12, 20]. Probably the most frustrating complication in these patients is persistent hyperpyrexia associated with signs of a systemic inflammatory response without an identifiable infectious source. This condition is observed in nearly two-thirds of patients with grade IV and V liver injuries that are managed nonoperatively [17]. Currently, the most-favored hypothesis is that of a systemic release into the systemic circulation of chemical mediators from the injured and ischemic liver and from the mixture of blood and bile from the peritoneal cavity. In fact, ongoing work in our laboratory has documented a significant increase of interleukin-1 (Il-1) and monocyte chemotactic protein-1 (MCP-1) in the peritoneal fluid of these patients on a consistent basis.

Laparoscopy has been extremely helpful and effective in dealing with this problem. Our experience has shown that these patients improve dramatically in the ensuing hours after the procedure, despite the fact that in >90% of patients there has been no bacterial growth from the drained peritoneal fluid collection. What is usually found at the time of the laparoscopy is a bile-stained peritoneum with a dark fluid collection ("crankcase oil"). Also, there is always significant inflammation of the membranes of the peritoneum, with a serosal inflammatory reaction. As our experience has grown, we are now doing these laparoscopic lavages much sooner (2–4 days after the injury). At the time of the laparoscopic drainage, active hemorrhage from the liver parenchyma has not been demonstrated in any of the patients. Furthermore, the liver injuries consistently show an advanced degree of healing, with extensive fibrin deposits along the injuries.

Even though other factors may explain these local findings in our patients, our current clinical and experimental data suggest that this is a phenomenon that is initially triggered by a local inflammatory process secondary to the local action of bile and blood. We strongly believe that laparoscopy is a far better alternative and a more definitive option to drain these retained collections than multiple attempts at percutaneous drainage or celiotomy.

Clearly, the patients need to be assessed carefully to select those that will benefit from the procedure. We have found that patients with extensive liver injuries (grades IV and V) associated with a large hemoperitoneum (Fig. 1) and that develop a systemic inflammatory response are the ones who benefit most from this procedure.

In summary, laparoscopy offers an alternative that is safe and effective in patients who are in need of a delayed surgical intervention with minimal associated morbidity and a dramatic benefit. As the indications for nonoperative treatment of patients with complex blunt liver injuries continue to expand, more patients will need some type of interventional treatment to treat complications that in the past were managed exclusively by celiotomy or image-guided drainage. The use of laparoscopy in these patients with severe blunt liver injuries will, in the end, optimize the overall management, adding minimal or no morbidity to this group of patients with critical liver injuries.

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References

1. Cachecho R, Clas D, Gersin K, Grindlinger GA (1998) Evolution in the management of the complex liver injury at a level I trauma center. J Trauma 45: 79–82
2. Carrillo EH, Platz A, Miller FB, Richardson JD, Polk HC (1998) Non-operative management of blunt hepatic trauma. Br J Surg 85: 461–468
3. Carrillo EH, Richardson JD (1999) Delayed surgery and interventional procedures in complex liver injuries [Editorial]. J Trauma 46: 678–679
4. Carrillo EH, Spain DA, Wohltmann CD, Schmieg RE, Boaz PW, Miller FB, Richardson JD (1999) Interventional techniques are useful adjuncts in the nonoperative management of hepatic injuries. J Trauma 46: 619–622
5. Croce MA, Fabian TC, Menke PG, Waddle-Smith L, Minard G, Kudsk KA, Patton JH Jr, Schurr MJ, Pritcharol FE (1995) Nonoperative management of blunt hepatic trauma is the treatment of choice for hemodynamically stable patients: results of a prospective trial. Ann Surg 221: 744–753
6. Feliciano DV (1992) Continuing evolution in the approach to severe liver trauma. Ann Surg 216: 521–523
7. Feliciano DV, Pachter HL (1989) Hepatic trauma revisited. Curr Probl Surg 28: 458–524
8. Gable DR, Allen JW, Harrel DJ, Carrillo EH (1997) Endoscopic treatment of postraumatic "bilhemia": case report. J Trauma 43: 534–536
9. Giacomantonio M, Filler RM, Rich RH (1984) Blunt hepatic trauma in children: experience with blunt hepatic trauma in children. J Pediatr Surg 19: 519–522
10. Goan YG, Huang MS, Lin JM (1998) Nonoperative management for extensive hepatic and splenic injuries with significant hemoperitoneum in adults. J Trauma 45: 360–365

11. Goff CD, Gilbert CM (1995) Nonoperative management of blunt hepatic trauma. Am Surg 61: 66–68
12. Harrell DJ, Vitale GC, Larson GM (1998) Selective role for endoscopic retrograde cholangiopancreatography in abdominal trauma. Surg Endosc 12: 400–404
13. Jaeshke J (1996) Chemokines, neutrophils, and inflammatory liver injury. Shock 6: 403–404
14. Moore EE, Cogbill TH, Jurkovich GJ, Shackford SR, Malangoni MA, Champion HR (1995) Organ injury scaling: spleen and liver (1994) revision. J Trauma 38: 323–324
15. Oldham KT, Guice KS, Rykham F (1986) Blunt liver injury in children: evolution of therapy and current perspective. Surgery 100: 542–549
16. Pachter HL, Hofstetter SR (1995) The current status of non-operative management of adult blunt hepatic injuries. Am J Surg 169: 442–454
17. Pachter HL, Liang HC, Hofstetter SR (1996) Liver and biliary tract trauma. In: Feliciano DV Moore EE Mattox KL (eds) Trauma. Appleton & Lange, Stamford, CT, pp 487–523 3rd ed.
18. Richie JP, Fonkalsrud EW (1972) Subcapsular hematoma of the liver: nonoperative management. Arch Surg 104: 781–784
19. Sherman HF, Savage BA, Jones LM, Barette RR, Latenser BA, Varcelotti JR, McAuley CE, Jones RT, Myers AH (1994) Nonoperative management of blunt hepatic injuries: safe at any grade? J Trauma 37: 616–621
20. Steiner Z, Brown RA, Jamiesson DH, Milar AJW, Cywes S (1994) Management of hemobilia and persistent biliary fistula after blunt liver trauma. J Pediatr Surg 29: 1575–1577
21. Ward PA, Lentsch AB (1999) The acute inflammatory response and its regulation. Arch Surg 134: 666–669