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# Hepatic trauma: contemporary management

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There is probably no area in trauma care that is more contentious and controversial than the contemporary management of liver trauma. The issues/controversies include several questions. Has the incidence of liver injuries increased? Are there more blunt injuries relative to penetrating injuries? Is the enthusiasm for nonoperative management of severe liver injuries warranted? Are the complications following nonoperative management unacceptable? What are reasonable strategies for operative management of the more severe liver injuries?

To understand these controversies and contemporary management of liver trauma, we must look first at historical perspective. For reasons that will become obvious, historical perspective is divided into four areas: pre-World War II, World War II–1965, 1965–1981 and post-1981. This is followed by a discussion of contemporary management.

## Historical perspective

### *Pre-World War II*

The first successful treatment of a liver injury is attributed to Hildanus in the early seventeenth century [1]. He treated a young man who had been stabbed and suffered a severe hemorrhage. A large piece of liver presented to the wound and was removed; the patient recovered [1]. Otis's painstaking review of Civil War injuries documented 37 individuals who recovered after gunshot wounds of the liver [2]. Twenty-three of these cases were complicated by injury of other viscera in the abdomen. Despite these successes during the Civil War, surgeons were reluctant to operate on patients with liver injuries over the next 50 years. Bruns treated a gunshot wound of the liver by resection of the lacerated portion in 1870 [3]. In 1902, Beck summed up various treatment methodologies for liver injuries [3].

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These included removing the liver tissue by cautery alone, cutting away the pathologically changed tissue following the cut with the thermo-cautery, curetting and tamponading afterwards, cauterization and ligature of some vessels that continued bleeding after cauterization, and ligature en masse. In 1904, Tilton reported on 189 injuries of the liver [4]. He emphasized that wounds to the liver are very frequently associated with injuries of other organs. One of his most important observations was "there are many mild cases of laceration of the liver to go onto recovery without complications and with very few symptoms. The number of these cases is, I think, larger than is generally supposed." His review of the literature at that time showed that rupture of the liver was associated with a 78.1% mortality if the wound was caused by blunt forces, 39% if caused by gunshot wounds, and 37.5% if caused by stab wounds. In addition, he reviewed all of the New York hospitals with large accident services over a 10-year period and found there were 25 liver injuries: 12 were caused by blunt injuries, 9 by gunshot wounds, and 4 by stab wounds. Overall mortality was 44%. Twenty out of the 25 patients were operated on, with a mortality of 40%. In his paper, he discussed current therapy and acknowledged that some surgeons recommended non-operative management. Tilton stated, "This seems a wrong principle to work on. Many cases might recover without interference but others will prove fatal from oversight, an intestinal perforation or foreign body or from insufficient drainage of the wound in the liver." He also made the point that the surgeon "has no choice" but to operate on those patients with aggressive symptoms of internal hemorrhage. His recommended method of stopping hemorrhage was to use sutures or gauze packing. He stated "the thermal cautery is of very little value in arresting hemorrhage from the liver."

Hemorrhage was the most vexing issue facing surgeons during the early 1900s. Pringle did an elegant study in animals showing that control of bleeding by compressing the portal vessel stopped the hemorrhage from deep liver wounds [5]. He then amputated the lobe that was injured and passed sutures through the stump. He removed the portal vessel pressure and most of the animals survived. He subsequently operated on two patients using the same technique. Both of these patients succumbed; one from hemorrhage and the other from an associated injury to the kidney.

A 1936 study from Detroit Receiving Hospital in Detroit, Michigan covered a 7-year period [6]. There were 60 patients and the overall mortality was 61.6%. There did not appear to be any significant difference in mortality whether the patient had an operation or not: it was 53.6% if an operation was performed and 60% when there was no operation. Most of these injuries (68%) were gunshot wounds. A similar study was reported in 1939 by Lamb covering 22 years at the Boston City Hospital in Boston, Massachusetts [7]. Again, there were 60 cases. Twenty-six patients died before an operation could be performed. Of the 34 patients who were operated on, 15 died and 19 recovered; a mortality rate of 44%. To control

hemorrhage from the liver, the surgeons used the Pringle maneuver, cautery, packing with various materials such as gauze or muscle, omentum, and ligature carried on a blunt, noncutting, supple needle. Lamb stated "the simplest method that will check hemorrhage is the best. Gentle packing with gauze is the quickest and easiest but not always the wisest procedure." He also stated that all loose fragments of tissue deprived of blood supply must be removed.

Liver injuries in the first 40 years of the twentieth century were characterized by high mortality, and resection of liver tissue was rarely done. World War II changed this approach.

### *World War II–1965*

A major paradigm shift occurred in World War II in the management of liver injuries in the European Theater. In their book *Trauma to the Liver*, Madding and Kennedy stated that "before the war, house surgeons advocated expectant or conservative treatment, or no treatment at all for the majority of wounds of the liver" [8]. In 1942 and 1943, the Second Auxiliary Surgical Group managed liver injuries the same way. The authors noted that "as time passed, serious complications were noted frequently following this method of treatment. Disastrous hemorrhage followed the removal of gauze packs. Abscesses occurred within the liver or within the perihepatic spaces, and hepatic necrosis was observed in areas that had been packed. Peritonitis, hepatitis, fistulas and numerous other complications followed this form of treatment." By draining most liver injuries and abandoning the use of gauze packs, the mortality rate dropped from 30% to 17% in the next two years. The authors concluded that superficial liver wounds that were not bleeding could be drained only. Larger wounds that were bleeding at the time of exploration required suturing as well as drainage. For a small group of patients (fewer than 10%) who had severe bursting, crushing, or high-velocity bullet wounds, it was necessary to do resectional debridement and possibly lobectomy. They also advocated formal lobectomy for retrohepatic caval injuries or major hepatic vein injuries. They further stated that "use of packing either with gauze or absorbable hemostatic agents should be avoided, except for temporary purposes." In a 16-month period during the latter part of World War II, they cared for 829 wounds of the liver in 3154 patients with abdominal and thorco-abdominal wounds. Overall mortality was 27%, a significant improvement from the prewar data. It is noteworthy that the interval from wounding to hospitalization was 6.9 hours in 1944 and 6.1 hours in 1945. It is possible that this may have preselected some of the patients with severe injuries in shock and they died before hospitalization.

Following World War II, reports from large municipal hospitals showed an increase in the number of patients presenting with liver injuries, but there was a corresponding decrease in operative mortality. In one interesting

study from the Ben Taub Hospital in Houston, Texas over a 36-year period, the mortality for all liver injuries fell from 20.6% in 1939 to 9.2% in the last four years of their study, 1971 to 1974 [9]. There are two other representative studies in this time period that show a reduction in mortality of operative liver injuries compared with World War II. The first study from the Medical College of Virginia in Richmond, Virginia examined the records of 42 patients admitted over a 2-year period, January 1, 1966 to December 31, 1967 [10]. There were 42 patients: 19% had blunt injuries, 18% had stab wounds, and the remaining 63% sustained gunshot wounds. Six patients had major hepatic resections for their injuries, with five survivors. In contrast, 2 of the 36 patients who had less aggressive approaches died. The second study included the time period January 1953 to January 1963 at Southwestern Medical School in Dallas, Texas [11]. Two hundred fifty-nine injuries are reported: 31 patients sustained blunt injuries, 111 had gunshot wounds, and 117 had stab wounds. Of the patients with blunt injuries, 64.5% presented in shock. The treatment in these patients included 8.9% who had no suture but were drained; 71.1% had suture and drains. Gauze packs were used in only 1 patient and resection was performed in 9.6% of the patients. Overall mortality in this series was 11.2%; 20% for those 25 patients who had resections. In contrast, Mikesky et al reported a combined series of 300 consecutive patients in whom the mortality from blunt trauma to the liver was 67%, similar to prewar values [12]. The year 1965 became a pivotal year from a historical perspective because this was the year that diagnostic peritoneal lavage (DPL) was introduced. This diagnostic test seemingly increased the incidence of liver injuries; however, it really represented that relatively benign liver injuries were now being diagnosed. This created problems.

### *1965–1981*

In 1965, Root et al introduced diagnostic peritoneal lavage, and one of their recommendations was that it be used in diagnosing intraperitoneal bleeding following blunt trauma [13]. Before 1965, it is estimated conservatively in multiple clinical series, intraperitoneal blood was not diagnosed in up to 50% of all patients with blunt abdominal injury [14–16]. Many of these patients had associated head injury. DPL turned out to be very sensitive at picking up peritoneal blood and initially all of these patients were operated on. It soon became clear that diagnostic peritoneal lavage was too sensitive and resulted in nontherapeutic celiotomies in up to 30% of patients [17]. This led to the development of quantitative peritoneal lavage, which also turned out to be imperfect compared with computed tomography (CT) [18].

Diagnostic peritoneal lavage also contributed to two other possible misconceptions: a perceived increase in liver injuries, and a change in the ratio of blunt injuries to penetrating injuries. In 1981, an article was

published in this journal stating that 60% of liver injuries were caused by gunshot wounds, 20% by stab wounds, and 20% by blunt trauma [19]. This is almost completely opposite to what is currently being reported. Richardson's paper shows nicely what has happened over a recent 25-year period [20]. DPL diagnosed a number of liver injuries never previously diagnosed, which has contributed to a perceived increase in liver injures. Two other contributing factors to this perceived increase, however, are the increase in the population and the concentration of severe injuries in trauma centers. The increasing number of trauma centers and the components of a trauma system, such as prehospital care, may have caused an increase in liver-related mortality because more severe injuries were arriving alive in emergency rooms.

*1981–present*

The year 1981 marked the introduction of computed tomography for diagnosing visceral injuries following blunt trauma [21]. Shortly after introduction of CT, the concept of nonoperative management of liver injuries was also reintroduced, albeit in a small percentage of cases [22]. Through increased use of CT, it was appreciated that many liver injuries, particularly Grade I and II, did not require operative management (Table 1). CT was also extremely valuable in picking up associated injuries that might require operation, and also in diagnosing retroperitoneal injuries that might require surgical intervention. Diagnostic peritoneal lavage is incapable of this differentiation. In essence, nonoperative management of liver injuries and CT are inextricably linked. It is also important to recognize that CT is not only qualitative and allows the surgeon to make a decision whether the patient needs an operation or not, but it also picks up other injuries that are missed by diagnostic peritoneal lavage [18]. An equally important contribution of CT to our understanding of liver injuries is the diagnosis of late complications [23–32]. Unfortunately, some of the reports are difficult to interpret because they report total mortality and morbidity percentages and not a subset of liver-related mortality and morbidity.

## Contemporary management

An anatomic grading of liver injuries was introduced in 1989 by Moore and modified in 1995 [33,34]. We now know that almost all Grade I and II injuries were not diagnosed before diagnostic peritoneal lavage. Since 1981, the great majority of blunt liver injuries are diagnosed by CT and most of the Grade I and II injuries can be managed nonoperatively, provided the patient has no other source of bleeding or hollow viscous injury and also assuming physiologic stability. It is the Grade III, IV, and V injuries that are problematic and controversial in the current surgical literature [35–47].

Table 1
Liver injury scale (1994 revision)

| Grade[a] | | Description |
|---|---|---|
| I. | Hematoma | Subcapsular, <10% surface area |
| | Laceration | Capsular tear, <1 cm parenchymal depth |
| II. | Hematoma | Subcapsular, 10–50% surface area; intraparenchymal, <10 cm in diameter |
| | Laceration | 1–3 cm parenchymal depth, <10 cm in length |
| III. | Hematoma | Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma<br>Intraparenchymal hematoma >10 cm or expanding |
| | Laceration | >3 cm parenchymal depth |
| IV. | Laceration | Parenchymal disruption involving 25–75% of hepatic lobe or 1–3 Couinaud's segments within a single lobe |
| V. | Laceration | Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe |
| | Vascular | Juxtahepatic venous injuries; ie, retrohepatic vena cava/central major hepatic veins |
| VI. | Vascular | Hepatic avulsion |

[a] Advance one grade for multiple injuries, up to Grade III.

Some authors have gone back to pre-World War II liver surgery and use only packs and liver sutures to control bleeding. This has led to significantly morbidity [23–32]. In contrast, Strong et al have shown that, using all modalities of the surgical armamentarium, including lobectomy, an overall mortality in 37 patients was 8.1% and mortality was 11.1% in those patients undergoing hemihepatecotmy. The liver-related morbidity was 19% [48,49] This mirrors my own experience [50].

Although some severe liver injuries (Grade III, IV, and V) can be managed nonoperatively, there is a disturbing trend in the literature for too many to be managed either nonoperatively or without debridement or resection. This has led to increasing morbidity. These complications include bilomas, biliary fistulae, early or late hemorrhage, false aneurysm, arteriovenous fistulae, hemobilia, liver abscess, and liver necrosis. Strong et al argue that many of these complications could be avoided if resection of necrotic tissue or lobectomy were used appropriately [49]. They also argue that perihepatic packing should be used only on a temporary basis, with few exceptions. They further argue that authors reporting few or no resections for severe liver injuries reflects lack of experience in gaining rapid control of liver bleeding and lack of ability to carry out an anatomic section. This may be true, as the American Board of Surgery only requires experience with four liver cases to sit for the American Board of Surgery examinations.

I will now discuss strategies facing the surgeon who is presented with a patient who has a penetrating injury to the liver (for a more advanced discussion, see [50]). These patients are divided grossly into three categories: those that are hemodynamically stable, those that are initially stable and then deteriorate, and those who present in shock.

We will look at the patients who are stable first. Surgeons at the University of Southern California in Los Angeles, California have stated that 28% of patients with penetrating injuries to the right upper quadrant can be managed nonoperatively [51]. Most of these injuries involve the liver, and are due to low-velocity gunshot wounds and stab wounds. The caveat is that the patient cannot have a hollow viscous injury including the gall bladder, duodenum, or colon. I am somewhat skeptical of this concept, but if practiced, I believe CT can aid the surgeon in making this diagnosis and the decision for the need of operation. Patients who go on to develop peritoneal signs or have CT evidence of hollow viscous injury should undergo exploratory celiotomy.

In those patients who are hemodynamically unstable or who deteriorate, I try to limit the time in the emergency room to 15 minutes or less. The surgeon's primary goal is to stop hemorrhage. Upon opening the abdomen, I generally pack all four quadrants and then let the anesthesiologist catch up on fluids and warm the room if it has not already been warmed. It may be necessary to gain more venous access routes or to activate the massive transfusion protocol. Almost all venous hemorrhage in the liver can be controlled temporarily with packs. I remove the packs in the two lower quadrants of the abdomen and rapidly control any fecal contamination. I then remove the packs from the left upper quadrant; if the spleen is also injured, I remove it. Next, I remove the packs in the right upper quadrant. If the injury is due to a high-velocity wound or a shotgun blast, this often reveals extensive laceration of liver tissue and active bleeding. If it is primarily venous, I pack and compress it for a minimum of 15 minutes. If this controls the hemorrhage, omentum can be placed over the wound, or loose liver sutures can be applied if the lacerations are oozing. Hemostatic agents such as fibrin glue, surgicell, and gel foam soaked in thrombin are adjunctive measures. If hemorrhage continues, I then clamp the porta hepatis with a soft clamp or Rummel tourniquet. If this controls the bleeding, the injury is either to a branch of the portal vein or, in some instances, the hepatic artery. I then consider opening the liver wound and try to control the bleeding vessel with 3-0 or 4-0 silk ligatures. Another adjunctive measure is to dissect out the lobar artery and vein; however, only one of these can be ligated. If the injury is high in the dome of the liver or involves that portion of the liver, the right lobe must be mobilized. This requires the assistant to retract the lateral surface of the right lobe toward the midline; the surgeon takes down the coronary and triangular ligaments. Gentle compression to the liver will often staunch some of the bleeding. In some instances, I have been able to control the hole in the hepatic vein or suprahepatic cava with my index finger while the right lobe is being mobilized. It has been my experience that high-velocity missile injuries and shotgun blasts often require lobectomy. Alternative strategies dealing with Grade IV and V injuries from high-velocity wounds and shotgun blasts include placing a Statinsky clamp across the suprahepatic vena cava and the

supra renal vena cava, and the Rummel tourniquet around the porta hepatis (Heaney technique). The Heaney technique is used routinely by liver transplant surgeons but is limited in the patient who has been in shock, because venous return to the heart has already been impaired. Despite this limitation, I prefer this technique to the atrial-caval shunt or veno-veno bypass. I must also emphasize the importance of the anesthesiologist, who must restore volume as the surgeon gains control of the bleeding. It is during vascular isolation that debridement, resection, or lobectomy can be performed with minimal blood loss. The clamps are then removed and attention turned to parenchymal bleeding. In general, control of parenchymal bleeding is done with a combination of suture ligatures, electrocautery, and the Argon beam coagulator. With shotgun blasts, it is imperative to remove all foreign bodies, particularly the plastic wadding or clothing that may be blown into the liver by the blast. Another adjunctive measure that I have found occasionally useful with major bleeding from the confluence of the hepatic veins and vena cava is to do a sternotomy to control the inferior vena cava within the pericardium. The other two clamps are placed as above.

If resectional debridement or lobectomy is performed, I place one or more 10 mm Jackson-Pratt drains near the raw liver surface for possible bile leak. I also schedule a second-look operation if I have to use packs or am concerned about ongoing bleeding or liver viability. During the first operation or second operation, I also put in a feeding jejunostomy if I predict a prolonged postoperative course.

The only instance where I use clamping of the aorta as an adjunct is when I suspect an additional injury to the abdominal aorta from a penetrating injury. Clamping the aorta to control liver bleeding does not work and only contributes to acidosis and reperfusion injury. If, during the conduct of the operation, the patient becomes coagulopathic, hypothermic, or acidotic, I try to control the arterial bleeding and then pack the liver for ongoing venous hemorrhage. This constitutes a first operation for damage control. In subsequent operations, bleeding from venous vessels is controlled and any obvious bile leaks are suture ligated. I recommend that reoperation should take place as soon as the patient's coagulopathy, hypothermia, and acidosis are reversed. I prefer not to leave packs in for extended periods and use them as a temporizing measure only. Another consideration after the triad of coagulopathy, hypothermia, and acidosis has been corrected is arteriography/embolization before returning the patient to the operating room.

The patients who sustain blunt trauma require somewhat different strategic approaches. In the emergency room when the patient arrives, they also have the same three types of presentation as discussed above. Patients who arrive stable may deteriorate during the initial resuscitation, which usually means they were in compensated shock when they arrived and deteriorated when they started to bleed again after initiating resuscitation.

As noted above, the stable patient should not remain in the emergency room more than 30 minutes, and the unstable patient should be limited to 15 minutes. The control of hemorrhage is the primary objective.

Most Grade I and II injuries that arrive hemodynamically stable should have radiographs of all bony injuries and go to CT scan. If the patient has associated head and chest injuries, this should be included in the initial CT. If the CT scan shows Grade I or II injury with no associated injuries within the peritoneal cavity or retroperitoneum and they are maintaining hemodynamic stability, the patient can be admitted to a ward bed and associated injuries prioritized. In some instances, such as comorbidity factors of age, cirrhosis, or bleeding tendencies, the patient may need monitoring in an intensive care unit. If CT scan shows a Grade III, IV, or V injury and the patient is hemodynamically stable, and if there is minimal blood loss within the peritoneal cavity and no associated injuries, the patient should be monitored in the intensive care unit. Patients are at risk for early or late hemorrhage if the capsule should break. This hemorrhage is usually due to a clot becoming unlodged, or occurs as the intrahepatic hematoma liquefies and becomes hyperosmolar, bringing more fluid into the cavity and causing rupture. All of these patients managed nonoperatively will require CT scans 4 to 7 days following injury. This will diagnosis bilomas and hepatic necrosis and may show arterial aneurysms or fistulas.

Patients who arrive hemodynamically stable but deteriorate, or those patients who arrive initially unstable, usually have severe liver injuries (Grade III, IV, or V). Other possibilities include Grade I or II liver injuries with bleeding due to other visceral injuries, such as to the spleen or tears in the mesentery. Patients with femur fractures or chest injuries may also manifest shock. When possible, it is optimal to get a CT scan even in these patients, provided it does not compromise the patient's life. As shown in World War I by Cannon, maintaining a blood pressure above 80 mm Hg is optimal [52]. On the other hand, it is not optimal to have the patient become hypertensive, as this will just aggravate visceral hemorrhage. In addition, the patient should have warming devices almost immediately in anticipation of reperfusion injury leading to coagulopathy, hypothermia, and acidosis. If the patient can safely have an abdominal CT with intravenous contrast, this allows the surgeon to assess the injuries and formulate a number of decisions. If the patient has a vascular blush on CT, it may be prudent to consider angiogram and embolization before surgery. If the patient has a Grade III, IV, or V injury of the liver and extensive intraperitoneal blood, however, exploratory celiotomy is indicated as soon as possible. If a blood pressure of 80 mm Hg cannot be achieved in the emergency room, the patient should be taken directly to the operating room.

In the operating room, the approach to the injured liver is similar to the approach to a patient with penetrating injuries. The abdomen is packed, massive transfusion protocol is initiated, and the room is warmed. The packs in the two lower quadrants are removed and then those in the left

upper quadrant. If the spleen is injured, it should be removed immediately. The packs in the right upper quadrant are then removed, and an assessment of the damage and extent of bleeding is done. The most typical injury that I deal with is a patient who has the so-called ''bear claw'' injury (Fig. 1). This occurs when the ribs are compressed into the liver and there are typically curvilinear lacerations across the dome and anterior surface of the right lobe. If the patient has been involved in a T-bone crash as a passenger (United States), the right lobe is very susceptible to compression by the lateral ribs. Sometimes this is limited to venous and parenchymal bleeding. Compression for an extended period of 15 to 20 minutes can occasionally achieve homeostasis. Gentle compression of the right lobe by the assistant can allow the surgeon to search the depths of the wound and place 3-0 or 4-0 silk ligatures on obvious bleeding vessels. The application of hemostatic agents such as fibrin glue, surgicell, or gel foam soaked in thrombin may also have adjunctive roles at this time. If the bleeding continues despite these efforts, the surgeon then must consider more extensive procedures. This requires mobilizing the right lobe and occasionally the left lobe. Vascular isolation of the liver is done by the methods described in penetrating injuries (Figs. 2, 3). If the patient develops the triad of coagulopathy, acidosis, and hypothermia at any time, it is more prudent to temporarily pack and take the patient to the intensive care unit to repair the three components of the triad. In my experience this usually takes 3 to 6 hours. The patient should then be returned to the operating room, at which time it may be necessary to do resectional debridement, partial hepatectomy, or a formal lobectomy. (See the articles by Roh and Belghiti in this issue). As in penetrating trauma, do not hesitate to schedule a patient for a second look operation if there is a need for reassessment of liver viability or peritoneal toilet.

Complications following liver trauma have been mentioned above. The primary goal of the surgeon is to reduce not only fatality, but also

Fig. 1. A typical ''bear claw'' injury from a frontal compression of the anterior chest. Note the assistant surgeon compressing the liver to stop the bleeding.

Fig. 2. This 14-year old male was accidentally shot by his brother at close range while hunting. The entrance wound was at the inferior border of the right nipple. He was transported to the nearest emergency room, where he was giving 8 units of blood and transported by helicopter to the Level I trauma center 50 miles away. The highest blood pressure was 80 mm Hg. He was taken immediately to the operating room where a right lobectomy was performed. The wadding from the shotgun shell was found in the middle of the right lobe.

unwarranted complications that may come with some of the nonoperative approaches to liver injury. Strong has established a contemporary gold standard of 11% fatality following lobectomy and 19% hepatic-associated complications. If the surgeon is uncomfortable or lacks experience in liver surgery, it may be more prudent to involve hepato-biliary surgeons or transplant surgeons from the same hospital, or refer the patient to a center that has such surgeons.

## Summary

In the introduction, I posed several questions that were issues/controversies. The answers will probably be interpreted as equally controversial. I do not believe there is strong evidence that the incidence


Fig. 3. This 18-year old male fell asleep and crashed his car. He had a seatbelt mark from his left clavicle to the right iliac wing. CT shows a vascular blush, probably from the left portal vein or possibly the left hepatic artery. There is approximately 1500–2000 cc of blood in the peritoneal cavity confirmed at operation. A left lobectomy was done.

of liver injuries has increased. Diagnostic modalities have contributed to this seeming increase, as well as population increases and the concentration of severe liver injuries in trauma centers, now present in 35 states. I believe there are more blunt injuries now, relative to penetrating injuries. The peak of penetrating injuries occurred in the 1970s and 1980s and lasted almost 2 decades. I believe some authors are overly enthusiastic for nonoperative management. I am particularly critical of authors who do not include all components of the surgical armamentarium into their treatment of severe liver injuries. I also believe that the complications following nonoperative management are currently unacceptable, as documented in the references. I have shared with you the strategies for operative management, but there are equally good or better strategies in the surgical literature.

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