

[Primary Care]

Return to Play After Liver and Spleen Trauma

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Context: Sport-related spleen and liver injuries pose a challenge for the physician. Although rare, these injuries can have serious and even life-threatening outcomes if not accurately diagnosed and managed in a timely fashion. Currently, there are no evidence-based guidelines on duration and intensity of restricted activity and return to play after spleen and liver injury. In addition, there is controversy on follow-up imaging after injury.

Evidence Acquisition: PubMed was searched using the terms *splenic* or *spleen* and *trauma* and *hepatic* or *liver* and *trauma* from 1980 to 2013. The citations from sentinel papers were also reviewed.

Study Design: Clinical review.

Level of Evidence: Level 3.

Results: Ultrasound is ideal in the unstable athlete. Nonoperative management of blunt splenic and hepatic injuries is recommended for hemodynamically stable patients regardless of injury grade, patient age, or presence of associated injuries. Follow-up imaging is not routinely recommended unless clinically indicated. Athletes may engage in light activity for the first 3 months after injury and then gradual return to unrestricted activity as tolerated. High-level athletes may choose splenectomy or serial imaging for faster return to play.

Conclusion: Intravenous contrast-enhanced computed tomography is the diagnostic imaging modality of choice in stable athletes with blunt abdominal trauma.

Strength-of-Recommendation Taxonomy: C.

Keywords: guideline; return to play; spleen and liver injury

Abdominal injuries are rare in sports. However, unrecognized, they can be serious and even life threatening. Up to 10% of all abdominal injuries result from sport-related trauma.^{5,55} The spleen and liver are the 2 most commonly injured organs in blunt abdominal trauma, with splenic injuries leading the way.^{10,15,51} Injuries to the abdomen can occur in almost any sport but are more common in contact or collision sports. Injury to the spleen and the liver have occurred from tackling in football,^{34,39,51} checking in hockey,⁴⁶ landing on a ball in rugby,³⁸ a blow to the abdomen from a boogie board⁶ or lacrosse ball,¹⁸ and even in downhill skiing and snowboarding.⁴ Delayed splenic rupture 3 weeks after being crosschecked during an amateur hockey game has occurred.¹⁴ Therefore, return-to-play decisions after injury remain controversial.

SIDELINE EVALUATION

Signs and symptoms of spleen and liver injuries can be very subtle, making it challenging for physicians to differentiate benign from life-threatening injuries. It is therefore crucial to have a high index of suspicion in any athlete complaining of abdominal pain or discomfort, particularly in those who have sustained trauma. Athletes may complain of pain radiating to the left or the right shoulder due to free intraperitoneal blood irritating the diaphragm (Kehr sign).³⁵ Ecchymosis in the periumbilical region (Cullen sign)⁴¹ and the lateral abdominal wall (Gray Turner sign)⁴¹ are suggestive of hemoperitoneum, which may cause diffuse abdominal pain, rebound tenderness, and guarding.^{35,41} Bowel sounds may be lost; however, these are often late findings. Cardiovascular signs may be an earlier

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manifestation of hemorrhage from an injured intra-abdominal organ. Tachycardia must be distinguished from the physiological elevation associated with activity. Pulse volume can weaken and become “thready.”⁹ Diminished blood pressure signifies hypovolemia but is also unfortunately a late sign after significant blood loss has occurred. Body movement, for example, walking or running, may precipitate pain,⁹ and the lower ribs should be assessed for fracture. However, physical exam can be very unreliable as signs of injury may be delayed, making frequent serial assessments imperative.^{35,41} Of athletes with significant abdominal trauma, 50% have a negative initial exam, so reexamination can be crucial. Moreover, 20% of patients with an acute hemoperitoneum have an initial benign abdominal exam.²⁵

The spleen is the most frequently injured organ and leading cause of death in sport-related abdominal trauma.⁴¹ Injury is typically caused by a direct blow to the left upper quadrant of the abdomen or left lower chest wall but has also occurred in open slope falls in snowsports.¹⁶ Injury to the spleen is classically described as left upper quadrant pain and tenderness to palpation. There may be tenderness over the ribs overlying the spleen. The athlete may also complain of pain radiating to the left or the right shoulder.⁴¹ Although not as common as splenic injuries, sport-related hepatic trauma can also have adverse outcomes. Liver injuries are caused by direct blows and deceleration mechanisms⁴¹ and usually occur after a blow to the right upper quadrant of the abdomen or the right lower chest. The ribs overlying the liver may also be tender.⁹

Review of symptoms and past medical history are also important in revealing predisposing factors for spleen and liver injuries.¹⁹ Infectious mononucleosis, malaria, hematologic disorders, and pregnancy can cause splenic enlargement and capsule thinning, making it more fragile.³⁵

Abdominal wall injury often produces transient localized pain and dyspnea that get better when the underlying muscle spasm resolves. Injury to the underlying organs leads to persistent or worsening symptoms.⁴¹ If a physician suspects intra-abdominal injury, prompt transport to a nearby trauma center should be arranged. Definitive treatment should not be delayed by performing time-consuming measures in the field.^{9,41} Further description of sideline management of abdominal trauma may be obtained from the First Aid in Rugby online course,²³ provided by the International Rugby Board, or equivalent field-side training manuals.

DIAGNOSTIC IMAGING

Computed tomography (CT) remains the gold standard in evaluating blunt abdominal trauma in hemodynamically stable patients^{3,19,40,45} and is the imaging modality of choice for diagnosing spleen and liver injuries (Figure 1).⁴¹ It has replaced ultrasonography in stable patients because it is more sensitive, provides accurate anatomic details, and allows for injury grading. Intravenous contrast-enhanced CT gives the most detailed information about organ injury (Figure 2)⁵⁴ and is



Figure 1. Computed tomography scan revealing a grade IV splenic laceration and moderate hemoperitoneum in a 14-year-old male kneeled in the left upper quadrant of the abdomen during soccer.

considered the optimal standard to diagnose splenic and hepatic injuries.^{12,56}

The most widely used grading system for blunt splenic injury is the American Association for the Surgery of Trauma organ injury scale. Splenic injuries are graded on CT from I to V based on hematoma or laceration location, percentage of spleen involved, and hilar vasculature involvement (Figure 3).²⁹ The recently developed Baltimore CT grading system for splenic injury integrates vascular injury into the score and supports clinical decision making, especially the need for angiography and embolization or surgery.³¹ Liver injuries are graded from I to VI on CT,^{29,33} with severity ranging from minor capsular tear without parenchymal injury to extensive disruption of both lobes (Figures 4-7).⁴¹

Ultrasonography has a role in the diagnosis of abdominal trauma. It is operator dependent and less sensitive than CT, but it is an ideal choice in the hemodynamically unstable patient.^{2,20} Studies have shown a sensitivity of approximately 85% and a specificity of 99% in detecting intra-abdominal injuries.²⁰ Although ultrasound can visualize free intraperitoneal fluid, it is poor at grading the injury and identifying the injured organ.⁵⁴ Conditions identified on ultrasound in stable patients will eventually require CT to identify the injury and to guide management.⁵⁴

MANAGEMENT

The current management practice for blunt spleen and liver injuries is selective operative and nonoperative treatment.^{22,47,48}

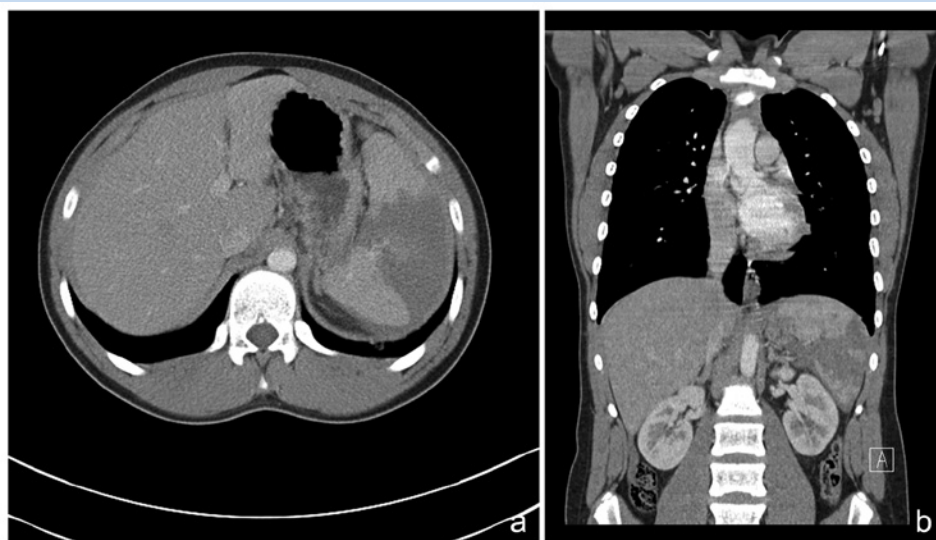


Figure 2. Computed tomography scan identifying a grade V splenic laceration with 50% hypoattenuation in a 14-year-old male who was kicked in the left flank during football. (a) Axial view and (b) coronal view.



Figure 3. Computed tomography scan demonstrating large hemoperitoneum (small arrow) and a grade IV-V splenic laceration with devascularization of the anterior aspect of the spleen (large arrow) in a 17-year-old male who sustained a left upper quadrant abdominal injury during ice hockey.

The 2012 Eastern Association for the Surgery of Trauma (EAST) guidelines for the management of blunt splenic injury suggest nonoperative management (NOM) for the hemodynamically stable patient regardless of injury grade, patient age, or

presence of associated injuries.⁴⁸ The overall morbidity and mortality are very low. NOM should be considered in a setting where close monitoring and an operating room for urgent laparotomy are available. NOM may fail in patients aged 40 years or older, with splenic injury grade III or higher, and with an injury severity score of 25 or higher.³⁰ Angiography with embolization continues to be an adjunctive therapy in NOM, along with repeat imaging based on changes in clinical status.⁴⁸ Hemodynamically unstable patients or those with diffuse peritonitis should undergo immediate exploratory laparotomy.⁴⁸ The 2012 EAST guidelines for the management of blunt hepatic injury are identical to those for blunt splenic injuries with adjunct interventions and include angiography, endoscopic retrograde cholangio pancreatography, endoscopy, and laparoscopy.⁴⁷ Blunt trauma patients with concomitant splenic and hepatic injuries have a higher failure rate with NOM, requiring close monitoring.²⁷

RETURN-TO-PLAY GUIDELINES

There is a lack of consensus on recommendations for resuming full activity after blunt splenic and hepatic injuries.^{13,15,17,21,37,51} Controversy stems from an inability to accurately predict delayed complications and the time needed for full recovery.

Splenic Injury

Recommendations for resuming unrestricted activity after splenic injury vary from 3 weeks to greater than 6 months for severe injury.^{13,15,17,21,37,51} Clinical judgment is often the key determinant for EAST members making return-to-activity decisions.¹³ For mild splenic injuries, most restricted all activity

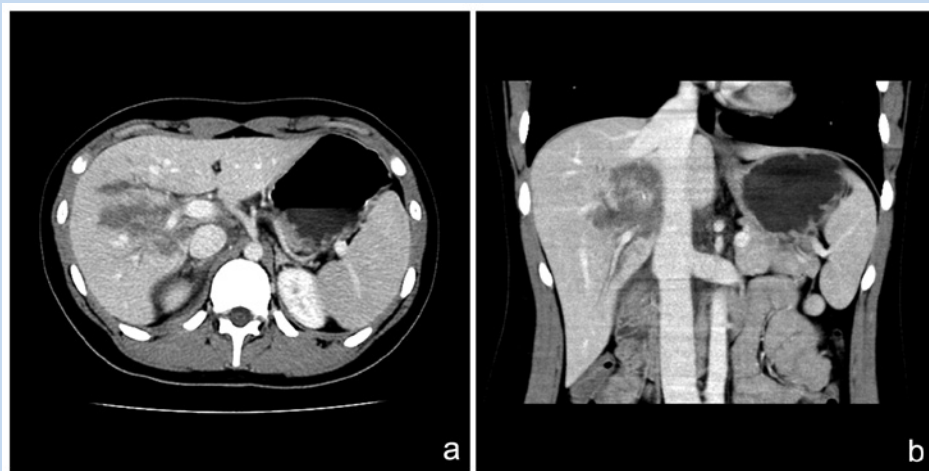


Figure 4. Computed tomography scan revealing a large area of decreased attenuation in the liver, consistent with a grade V laceration in a 13-year-old female who fell while skiing. (a) Axial view and (b) coronal view.



Figure 5. Computed tomography scan showing a grade IV liver laceration in a 15-year-old male who was run over by multiple dirt bikes in a race.



Figure 6. Computed tomography scan identifying a grade III-IV splenic laceration and a grade I liver laceration in a 14-year-old male who struck his abdomen against his BMX bike handle bars.

for 2 weeks, allowing full activity by 6 weeks.¹³ Restrictions were stricter for severe injuries (grade III-V).¹³

Two professional hockey players with grade III splenic injury were managed conservatively with serial CTs until radiographic and clinical findings suggested complete healing.⁴⁶ They returned to full-contact hockey within 2 months without any complications.⁴⁶ Athletes who choose splenectomy often return to activity much sooner.⁵¹ Athletes with splenic injury have returned to unrestricted activity 3 weeks after splenectomy.^{37,51}

Radiographic healing time is directly proportional to splenic injury grade.²⁶ In the study by Lynch et al,²⁶ CT-documented injury was identified by ultrasound for all patients, and patients returned to full activity with no long-term complications after ultrasound demonstrated healing (Table 1).

Computed tomographic healing of splenic injury has occurred in 84% of patients at 2.5 months, regardless of initial severity.⁴³

Delayed splenic rupture is the primary argument for follow-up imaging.¹⁹ Radiographic healing may lag physiologic healing.⁵¹

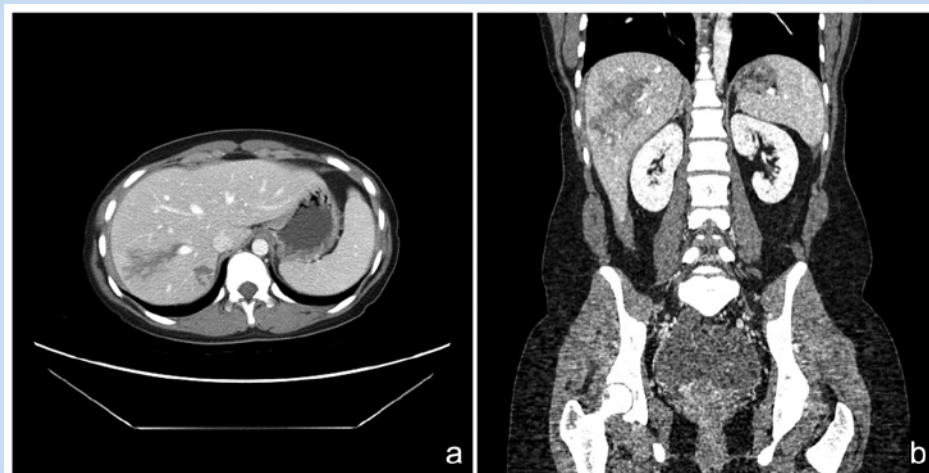


Figure 7. Computed tomography scan identifying a grade III hepatic laceration in a 17-year-old female complaining of right upper quadrant pain after being tackled in rugby. (a) Axial view and (b) coronal view.

Table 1. Mean time to ultrasound healing (weeks) by grade of splenic injury²⁶

Grade of Injury	Mean Time to Ultrasound Healing (Weeks)
I	3.1
II	8.2
III	12.1
IV	20.7

Therefore, routine follow-up abdominal CTs for blunt splenic injury are not necessary to allow patients to resume their normal activities after an appropriate time of restricted activity.^{1,42,44,52} Most recommend a 3-month period of activity restriction,^{1,35} with the first 3 weeks after discharge comprising light activity at home.¹⁷

Management and return-to-play decisions should be individualized. Athletes should be asymptomatic and back to baseline fitness before returning to unrestricted activity. Repeat imaging should be considered for unresolved or worsening symptoms. Referring to average healing times documented on CT can be a helpful guide to length of activity restriction. Serial CTs may be considered for high-level athletes on a case-by-case basis. However, the radiation exposure from multiple CTs should be considered.⁴⁶ Ultrasound may be a less potentially harmful option when considering repeat imaging, especially if a CT-documented injury was identified on ultrasound. Elective splenectomy for high-level athletes to return to play sooner should not be the norm, as it is not without its consequences

Table 2. Healing time by grade and type of liver injury⁵³

Grade of Liver Injury	Type of Liver Injury	Healing Time (Days)
I	Hematoma	6
II	Hematoma	16
II	Laceration	29
III	Laceration	34
III	Hematoma	108
IV	Laceration	78

such as an increased risk of sepsis, particularly from encapsulated organisms such as pneumococcus.³⁵ Postsplenectomy vaccination with pneumococcal and meningococcal vaccines is recommended.⁸

Liver Injury

The literature on activity restriction and return to play after liver injury is scarce. Healing of a simple liver laceration and subcapsular hematoma occurs in 2 to 4 months, whereas complex injuries require up to 6 months.²⁴ The healing time for hepatic lacerations is different from subcapsular hematomas (Table 2).⁵³

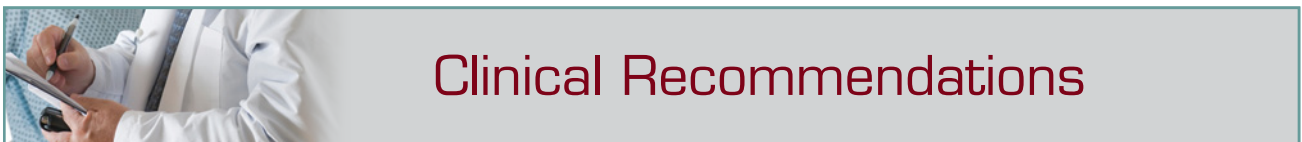
Some recommend return to unrestricted activity only after a normal CT, usually 3 to 6 months after injury.^{7,49} Although CT documentation of resolution was once standard of care, follow-up CT is no longer recommended unless clinically indicated.^{1,28,32,44,50}

Basic principles should be used to guide return-to-play decisions. In addition to return to baseline, the athlete should not compete until anatomic and functional healing occurs. Normalization of liver enzymes may be indicators of functional healing.^{34,41} Anatomic healing times documented by CT may also help guide return-to-play decisions. Just as with splenic injury, serial CTs with conservative management for high-level athletes can be considered with the knowledge of an increased risk of radiation.

CONCLUSION

Although abdominal injuries are uncommon in sports, frequent assessments are necessary to determine an athlete's status, especially the need for immediate intervention and transport to

the hospital.⁴¹ Intravenous contrast-enhanced CT is the diagnostic imaging modality of choice in stable athletes presenting with blunt abdominal trauma.^{3,19,40,41,45} Ultrasound is ideal in the unstable athlete.^{2,20} NOM for hemodynamically stable patients continues to be the norm.^{47,48} There is no consensus on the duration and intensity of restricted activity after spleen and liver injury.^{13,15,17,21,37,51} Athletes may engage in light activity for the first 3 months after injury and then gradually return to unrestricted activity as tolerated.^{13,17,41} Follow-up imaging is not routinely recommended unless clinically indicated.^{1,28,32,44,50} High-level athletes may choose splenectomy or serial imaging to return to play faster; however, the risks and benefits of these measures need to be considered.^{46,51}



Clinical Recommendations

SORT: Strength of Recommendation Taxonomy

A: consistent, good-quality patient-oriented evidence

B: inconsistent or limited-quality patient-oriented evidence

C: consensus, disease-oriented evidence, usual practice, expert opinion, or case series

Clinical Recommendation	SORT Evidence Rating
Athletes should only engage in light activity for the first 3 months after traumatic liver or spleen injury and then gradually return to unrestricted activity as tolerated. ^{1,13,17,24,36}	C
Average healing times documented on CT and ultrasound can be a helpful guide to length of activity restriction. ^{11,26,43,53}	C
Follow-up imaging is not recommended unless clinically indicated. ^{1,28,32,42,44,50,52}	C

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