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A Small Bowel Perforation in a Goalkeeper: A Case Report and Return-to-Play Progression

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Sport-related intra-abdominal injuries are rare and may be associated with significant morbidity if missed. We present the case of a 21-year-old male collegiate goalkeeper who sustained a small bowel perforation after colliding with a teammate in practice. The athlete underwent laparoscopic primary repair of his small bowel perforation, a relatively uncommon type of surgical intervention for this injury given that similar patients are typically treated via laparotomy. Due to the rarity of small intestine injuries in athletes, information regarding the success of surgical interventions and return-to-play (RTP) standards are lacking, as is information on outcomes and return to sport after a laparoscopic repair. In this case report, we discuss the unique challenge of constructing an RTP protocol for this high-level athlete and propose a protocol for RTP after intra-abdominal injury treated laparoscopically.

Key Words: intestinal perforation, intra-abdominal injury, laparoscopy, athlete

Key Points

- A patient's clinical status as well as the surgeon's preference will usually guide whether surgical intervention can be performed laparoscopically or needs to be performed via laparotomy. Ccurrently, most sport-related small bowel injuries are addressed via laparotomy.
- Although timelines can be helpful in a return-to-play protocol, advancement to the next step in a protocol should be largely based on goals and objective criteria. These goals and objective criteria should be tailored to the type of surgical intervention performed and personalized to the needs of the athlete's role or position.

Serious sport-related intra-abdominal injuries are rare but can be life threatening. Researchers[1] have shown that only 10% of abdominal injuries in the general population result from a sport-related incident. Furthermore, injuries to the bowel are even rarer, occurring in just 1% to 5% of blunt abdominal trauma.[2] The most common mechanism of injury for intra-abdominal trauma is blunt force, which can occur from contact with another player, surface, or playing apparatus.[1,3] Most reported cases of sport-related intra-abdominal injury have occurred in collision and contact sports such as soccer and American football.[4]

The diagnosis can be challenging, as it may take several hours for patients to develop signs and symptoms. Serial abdominal examinations should be performed and a computerized tomography scan obtained if there is concern for an intra-abdominal injury. Most commonly, blunt trauma injures the liver, spleen, or kidneys rather than the small intestine.[1]

Delayed diagnosis of an intra-abdominal injury can lead to significant morbidity and even mortality.[2] Our athlete presented with key initial findings that led to his immediate transfer for further evaluation and ultimately the diagnosis and treatment of a small bowel perforation via laparoscopic repair.

Due to the rarity of injuries to the small intestine, information regarding the success of surgical interventions and return-to-play (RTP) standards are lacking in the athletic literature. In addition, the few sport-related small bowel injuries reported were most often treated via laparotomy.[5,6] We discuss the unique challenge of constructing an RTP protocol for this high-level athlete and propose a general protocol for RTP after intra-abdominal injury treated laparoscopically.

CASE PRESENTATION

Patient

A 21-year-old male collegiate goalkeeper collided with a teammate during soccer practice. During the on-field evaluation, the patient complained of the immediate onset of severe abdominal pain, difficulty moving, and nausea. He was diffusely tender to palpation in the right and left mid to lower quadrants with guarding present.

He was removed from the field and transferred to the nearby sports medicine clinic to be examined by the team physician. His blood pressure was 124/72, heart rate was 80 beats/minute, and oxygen saturation level was 96%. He was alert and in mild distress. Cardiac and pulmonary auscultation were normal. He exhibited diffuse abdominal tenderness to palpation.

Figure. Abdominal computerized tomography scan demonstrated extraluminal free air and multiple thickened loops of small bowel and mesenteric edema.

As part of the initial evaluation, an abdominal radiograph was obtained and showed no free air. Urinalysis was negative for blood. The athlete was unable to tolerate oral rehydration, so he was transferred to the emergency department for further evaluation. At that facility, a rapid focused bedside ultrasound assessment was negative for acute internal bleeding.

Laboratory tests revealed a normal hemoglobin level but a mild leukocytosis. A computerized tomography scan of the abdomen was obtained, which showed pneumoperitoneum suggestive of hollow viscus injury, with the possible site of injury in either the transverse colon or proximal small bowel (Figure).

Intervention

The athlete was taken immediately to the operating room for a diagnostic laparoscopy. An isolated 1.5-cm perforation of the proximal jejunum was visualized, approximately 45 cm distal to the ligament of Treitz. The surgeon determined that the defect could be addressed via a laparoscopic approach given the size and low level of contamination. The defect was repaired primarily, and he was discharged home on postoperative day 2.

The surgeon's judgement, the overall clinical stability of the athlete, the availability of treatment modalities, and personal procedural preferences usually guide whether surgical intervention can be performed laparoscopically or requires laparotomy. Isolated, low-grade injuries can often be repaired, whereas more complex injuries may require bowel resection. Our athlete underwent the least invasive type of surgical intervention for this injury, namely, laparoscopic primary repair. He had 4 small incisions: 3 were 5 mm each and 1 was 12 mm. Among similar case reports,[5,6] athletes with such injuries typically underwent laparotomy and required larger incisions, longer hospital stays, and more recovery time before return to activity. Our athlete was able to start his return to sport relatively quickly and returned to competition in less than 8 weeks.

Returning this athlete safely to sport was a challenge for the medical staff, as no established guidelines were available. Even protocols for returning high-level athletes after common abdominal surgeries, such as appendectomy, appeared to be lacking. Researchers[7] who published a study of anterior cruciate ligament (ACL) return-to-sport protocols suggested using goal-oriented progressions based on objective and functional testing. For this athlete, we developed a 4-phase RTP protocol (Table). Of note, the timeline in this protocol was based on our surgeon's recommendations and our patient's achievements. Time should not be the sole variable when deciding how to progress an athlete through an RTP protocol because timelines for the achievement of goals can vary significantly. Instead of time, we recommend using goals or criteria (or both) when deciding whether an athlete is ready to advance to the next stage of an RTP protocol. When developing these goals and criteria, the medical team should consider objective measures such as weight gain, measureable physical activities, and specific benchmarks for patient-reported outcomes.

Phase I of the RTP protocol focused on returning the athlete to normal, pain-free activities of daily living (ADLs). Rest and limited mobility were crucial during the first postoperative days. During this initial phase, the patient's incision site and the actual internal organ injury were monitored for signs of infection and obstruction. Such signs might include a sudden increase in pain, change in or lack of bowel movements, and fever. For an intra-abdominal injury, the greater the size of the wound and the greater the contamination of the cavity, the greater risk the patient has for infection and delayed healing.[9] In contrast, small laparoscopic incisions tend to favor faster progress, as was the case with our athlete. Under the guidance of the surgeon, the athlete was able to start slowly adding more movement after the first few days of rest. The increase in movement was gradual and based on the athlete's pain and energy tolerance. Once ADLs returned to normal, the athlete was cleared to begin a more dedicated RTP protocol.

The purpose of phase II was to reintroduce the athlete to exercise while monitoring for red-flag symptoms, including signs of hernia formation. During this phase, plyometric exercises were avoided, as they could hypothetically cause shearing around the internal incision site. However, few researchers have studied the effects of plyometric exercises on an athlete after laparoscopic surgery. Recommendations for load progression were closely monitored and guided by the surgeon. Light aerobic activity, basic core exercises, and simple body-weight exercises were advanced as tolerated when the athlete demonstrated the appropriate movement and strength to do so. Toward the end of the phase, the athlete was introduced to beginner levels of sport-specific drills in a controlled setting.

At the end of phase II, the internal injury was deemed to be no longer at risk for infection or delayed healing. The patient had been cleared by his surgeon to continue progressing activity. Phases III and IV used themes drawn from the final 2 phases of an ACL RTP protocol.[7] These themes were a balanced progression of training load, movement complexity, and changes in the external environment.[7,10,11] Phase III focused on continued strength improvement, progression from jogging to sprinting, change of direction and acceleration and deceleration, and advancement through sport-specific activity. Phase IV concentrated on the introduction to controlled and limited practice, progression of sport-specific drills, and assurance that the athlete was able to perform all skills required by a

Table. Four-Phase Return-to-Play Protocol

Phase	Theme	Goals	Criteria to Progress
I (2 wk)	Normalize ADLs	• Sutures removed, wound healing, scar tissue mobilized • Pain-free ADLs (eg, rest, walking, stairs, standing or sitting for long periods of time) • Normalized eating habits • Normalized bowel movements • Gained ability to increase weight	• Ability to consume solid food and consume meals with enough calories to support athletic activity • Pain-free, normal bowel movements • Pain-free, normal walking for at least 30 min • Ability to start gaining weight • PRO tools in which the patient reports 90% with ADLs
II (2 wk)	Introduction to fitness	• Movement assessment performed • Progressed to 20 min jogging on land without difficulty • Progressed through basic core and bodyweight exercises • Introduced sport-specific drills in a controlled setting • Continued weight gain	• Continues pain-free, normal ADLs (normal eating habits and bowel movements, day-to-day activities) • Weight gains of 1–2 kg (0.5–1 kg per week) • Ability to run pain free 1600 m on land in time that is within normal limits for sport • Demonstrates ability to perform full body-weight exercises without pain or major compensations (squat, lunge, push-up) • PRO tools in which the patient reports 100% with ADLs and 25% with sport-related activity
III (2 wk)	Progression of fitness and advance sport specific drills	• Tolerated level 2–3 core exercises • Progressed fitness • Demonstrated ability to complete all skills required in controlled, closed setting • Continued weight gain • Increased confidence in sport activity	• Continues pain-free, normal ADLs (normal eating habits and bowel movements, day-to-day activities) • Weight gain of 1–2 kg (0.5–1 kg/wk) • Sprint test within 95% of normal value for sport • PRO tools in which patient reports 100% with ADLs and 75% with sport-related activity • SANE score $\geq$ 85% • Ability to perform sport-specific skills in controlled setting, without pain, compensation at 90% self-reported effort
IV (1–2 wk)	Progression into practices and full return to play	• Tolerated contact drills • Limited practice and monitoring training loads to ensure progression • Improved confidence with sport • Coaches recognized normal style of play • Demonstrated ability to perform skills required in open setting • Gained weight to within 95% of baseline	• Continues pain-free, normal ADLs (normal eating habits and bowel movements, day-to-day activities) • Body weight within 95% of baseline • PRO outcome in which patient reports 100% with ADLs and 85% with sport-related activity • SANE score $\geq$ 95% • Ability to perform sport-specific skills in open setting, without pain, compensation at 100% self-reported effort • Movement assessment screening within 95% of baseline

Abbreviations: ADLs, activities of daily living; PRO, patient-reported outcome; SANE, Single Assessment Numerical Evaluation.[8]

player at his position. Exercise selection in these stages was tailored to our athlete's specific needs as a goalkeeper. Intensity and duration were progressed using a session rating of perceived exertion, a valid means of tracking training load.[12] Clinicians are encouraged to complete a needs assessment for each athlete, which will vary based on sport and position, to create a personalized exercise plan and progression.

Throughout the RTP phases, the medical staff closely monitored several variables, including weight, abdominal signs and symptoms, patient-reported outcomes, and functional movement. These various forms of subjective and objective testing provided the medical staff with information to help manage the needs of the patient. Of note, patient-reported outcomes have been shown to be a successful means of tracking a patient's progress.[7] However, most patient-reported outcomes surveys were developed for individuals participating in activity limited to ADLs.[13]

Comparative Outcome

The patient was able to return to live game play at 50 days after the injury. He was able to finish the season without any secondary concerns or injuries. In similar case reports, athletes did not return to their sport in the same season in which the injury occurred. It is important to note that a college soccer goalkeeper performs significantly different types of activity than a field position player does.[14] Understanding the physical requirements of an athlete is an important factor to consider in the RTP process. Incorporating a structured increase in load will improve patient outcomes and decrease the risk for a secondary injury.[11]

DISCUSSION

Sport-related intra-abdominal injuries are overall rare, and most commonly, the liver, spleen, or kidneys rather than the small intestine are injured by blunt abdominal ~~trauma~~[7], Because few cases of small bowel perforation in

athletes have been reported, data are lacking as to how to manage recovery and return to sport. Even less information exists about how to return an athlete after laparoscopic surgery rather than a laparotomy for such an injury. We constructed a unique protocol for our athlete by drawing from themes of ACL RTP protocols. The protocol was successful in returning our athlete to an elite level of sport at less than 8 weeks after the injury. We propose that this protocol may be generalized for athletes returning to sport after laparoscopic treatment of intra-abdominal injuries.

Although protocols are helpful, RTP decisions are most successful when an integrated team-based approach is followed.[15] For our process, we included input from the athlete, athletic trainer, registered dietitian, sports psychologist, coach, team physician, and the surgeon who performed the procedure. For unique cases, creating a case management team with a diverse skill set will ensure all the needs of the athletes are met and considered during their return to sport.

Clinical Bottom Line

Researchers[1] have shown that 10% of abdominal injuries in the general population result from a sport-related incident. Furthermore, injuries to the bowel are even rarer, occurring in 1% to 5% of blunt abdominal trauma.[2] Most sport-related small bowel injuries are addressed via laparotomy.[3,5,6] In this case report, we presented an uncommon intervention, laparoscopy, and developed a protocol that achieved a successful outcome for a high-level athlete. We believe that the choice of laparoscopic repair rather than laparotomy significantly shortened the athlete's RTP process. Drawing from other RTP protocols, we created a new framework of goals and progression that can be followed to help monitor and safely return athletes to play after laparoscopically treated abdominal injury. Due to the few similar cases in the literature, clinicians need to continue to track and reflect on protocols used to safely return athletes to play after intra-abdominal injuries. Reflection is needed to review outcomes and determine if the approach was successful. Lastly, patient-reported outcome tools for intra-abdominal injuries do not have sport-specific adaptations. Future investigators need to determine how to improve the ability to track progress in an athletic population after such an injury.

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