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Journal of Clinical Surgery and Research
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Case Report

Hemorrhagic Shock Caused by Mesenteric Injury - Ski Pediatric Blunt Abdominal Trauma case report

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Received Date: 06 January 2022 | **Accepted Date:** 31 January 2022 | **Published Date:** 24 February 2022

Citation: A Firdus, K Karavdić, L K Zametica, D Anić, N K Spahović, et al. (2022). Hemorrhagic Shock Caused by Mesenteric Injury - Ski Pediatric Blunt Abdominal Trauma case report. *Journal of Clinical Surgery and Research*. 3(3); DOI:10.31579/2768-2757/040

Abstract:

Trauma is the leading cause of pediatric mortality and abdominal injury is a significant contributor to morbidity. Abdominal trauma in the population of injured children, is the third leading cause of death in this population, after head and thoracic injuries. It is the most common cause of death owing to unrecognized injury. They most often occur in traffic accidents, games and sports. The clinical presentation depends on the severity of the injury, the injured organ and the associated injuries. Mesenteric injury from blunt abdominal trauma is uncommon and can be difficult to diagnose. It is known that seatbelt trauma from motor vehicle accidents is the most common mechanism of mesenteric injury and that the mesentery of the small bowel is injured more frequently than that of the colon. We present an unusual case, a seven-year-old boy who was injured while skiing. The patient was in a state of hemorrhagic shock and underwent emergency surgery after an urgent diagnosis. During the operation, the leading trauma and the reason for the hemorrhagic shock were found to be a mesenteric injury, and bleeding from the branches of the superior mesenteric artery. Early transport, monitoring and diagnostics significantly contribute to reducing morbidity and mortality. The standard in surgery is non-operative treatment of injured parenchymal organs. A multidisciplinary approach that includes doctors of various specialties (pediatric surgeons, pediatricians, neurosurgeons, anesthesiologists and radiologists) who contribute to the diagnosis and treatment of injured children through diagnostic and therapeutic procedures has a key role. At the end, the decision regarding surgical treatment is responsibility of pediatric surgeon.

Key Words: mesenteric injury; skiing; blunt abdominal trauma

Introduction:

Intraabdominal injuries occur as a result of blunt abdominal trauma or penetrating trauma and it is the most common cause (85%), while penetrating trauma is present in a minority of cases (15%). Abdominal trauma is the third leading cause of death in children older than 1 year [1]. Approximately 50-75% of blunt abdominal trauma is caused by motor vehicle collisions. Other causes include sports injuries, falls and child abuse. Sports injuries most frequently cause isolated organ injuries [2].

There are two main mechanisms: a direct stroke in the abdominal area and high-energy mechanisms that produce multisystem trauma. The latter is associated with higher mortality. Solid organ injury refers to the liver, spleen, or kidneys [3]. The most commonly injured organs are the spleen, liver, and kidney; because the spleen is the most common cause of intra-abdominal bleeding. Although blunt kidney injuries are much less common than spleen or liver lesions, children are more susceptible to kidney injuries compared to adults due to anatomical aspects. Bowel and mesenteric injuries are the third most common type of injury from blunt trauma to abdominal organs [4]. Three basic mechanisms may cause bowe and mesenteric injuries of blunt trauma: Direct force may crush the gastrointestinal tract; rapid deceleration may produce shearing force between fixed and mobile portions of the tract; and a sudden increase in intraluminal pressure may result in bursting injuries [5].

Despite the frequency with which abdominal trauma occurs in children, there is still controversy over the optimal evaluation strategy to identify intra-abdominal injury.Assessment by the American Association for the Surgery of Trauma Surgery (AAST) is most commonly used to classify spleen, liver, and kidney injuries. Management of SOI has evolved since 1970 when a group of pediatric surgeons in Toronto advocated for non-

operative management of spleen injuries. This new trend was accompanied by advances in diagnostic imaging techniques which allowed more accurate evaluation of the lesion and avoidance of treatment delays. However, the management of blunt trauma in children has been a reason for debate in recent years. Currently, hemodynamic status is considered the most relevant factor in the process decision making [6].

Injuries of the abdominal organs can be in the form of cracks, perforations and ruptures of the abdominal organs such as the spleen, liver, mesentery, kidneys, diaphragm, stomach, duodenum, pancreas, intestines. They can be in form of injuries to blood vessels or rupture of the mesentery which leads to intraabdominal bleeding. Also, perforation can occur which leads to the peritonitis [7].

Children have an increased risk for intraabdominal injuries compared to adults for several reasons. They weigh less and receive force that is subsequently dissipated over a smaller area . Their organs are less protected due to having less fat and weaker muscles. Their ribs offer less protection due to their increased pliability [8].

Aim of the paper:

Aim of this case report is to show a case of 7-year-old who suffered heavy blunt trauma while skiing due to collision with another person. We discuss and consider the challenge of blunt trauma management in pediatric patients, as well as current guidelines.

Case report:

The case report is about a 7 years old boy, he was brought by ambulance accompanied by his father, who gave heteroanamnestic data regarding the child. Injury was caused during skiing by a direct collision from another person. On that occasion, he suffered head, abdomen and left lower leg injuries.Heteroanamnesis has indicated that after a collision with another skier, boy lost consciousness and had nausea. Blood pressure was 70/40 mmHg at the moment of arrival to hospital. At the time of examination he was conscious, communicative, oriented, did not reconstruct events, vomited twice, had nausea. The skin was pale. Abdomen was at chest level, tense, painful during palpation. Based on diagnostics (CT of the head, spine, pelvis with hips, thorax, abdomen, X-ray of lungs and left lower leg) as well as the laboratory findings (HTC 0.24, HGB 98) . CT showed a grade III spleen injury with a torn spleen greater than 3 cm and a hematoma with an irregular hypodense surface with obscure edges. The kidney had an irregular defect of the renal parenchyma deeper than 1 cm. The renal collecting system was not affected. This was considered grade III kidney damage. Free intraabdominal blood has been seen.(Figure 1.2.3.).

Figure 1: *The obtained CT scans show that the liver is inhomogeneous parenchyma with visible laceration that is monitored from segment IVa with the incision to the right lobe and propagated to the cholecyst lodge and in that part is presented as a hematoma and followed to the segment V where some free fluid is also observed.*

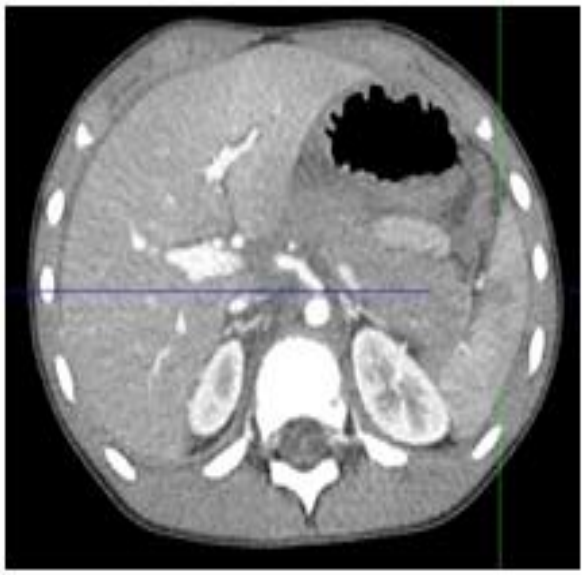

Figure 2: *Transection of the spleen in the lower pole and hematoma in the central part of a towards the lower pole. The hilus of the spleen appears intact*

Figure 3: *Edema of the jejunum in the left hemiabdomen. Discrete inhomogeneity of the lateral arm of the left adrenal gland and pancreas tail edema most likely by type of contusion The CT finding on other organs of the abdomen was unremarkable except of free bulky fluid consist with haemorrhage in abdomen and pelvis.*

On the left lower leg punctiform wound was visible. Deformity that was present was treated by an orthopedist (immobilization). (Figures 4.5.6.)

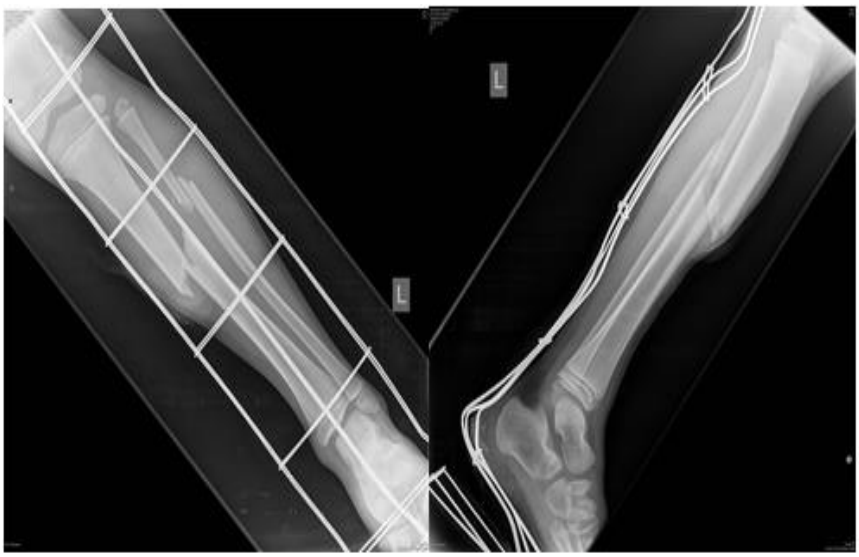

Figure 4&5: *Tibial fracture with dislocation.*

Figure 6: *Control X-ray after conservative immobilization treatment.*

After admittance and after regular preoperative preparation (laboratory findings, radiological diagnostics – head, thorax, abdominal CT and consultation of various specialists), the same day after admission) the condition of hemorrhagic shock was verified and under general anesthesia, urgent surgical procedure was performed. The surgery was done as a vital indication due to clinical signs of hemorrhagic shock.

A medium laparotomy was chosen as the surgical approach and in abdominal cavity greater amount of fresh blood subhepatic right, paracolic on both sides, perihepatic, perisplenic and interintestinal was seen. The blood was evacuated and detailed exploration was done which pointed to subcapsular lesion of the spleen on the convexity in the middle part which did not bleed, hematoma of the lower part of spleen with incomplete demarcation to other tissue, traumatic liver lesion on the incision that is shallow, about 2 cm long, of slight depth, did not bleed or had a biliary leak; the second lesion is next to the fundus of the gallbladder just below the free edge of the liver, it is about 4 cm long and 1 cm deep, did not bleed actively or had biliary leak; the gallbladder was contused with a hematoma of the medial wall without elements of compression of the duct (Figure 7);

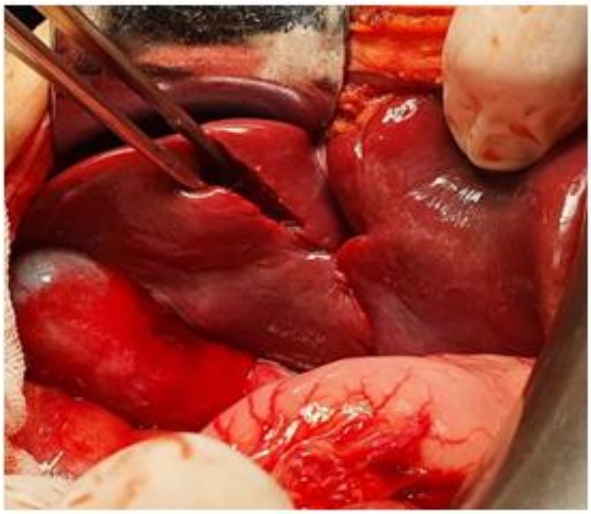

Figure 7: *The lesion is next to the fundus of the gallbladder just below the free edge of the liver, it is about 4 cm long and 1 cm deep, did not bleed actively or had biliary leak; the gallbladder was contused with a hematoma of the medial wal without elements of compression of the duct.*

Traumatic lesion of the mesentery about 55 cm from Treitz with rupture of a bleeding blood vessel leading to a larger hematoma retroperitoneally on the left; the injury is taken care of by suture; lesion of the mesentery at about 70 cm with lesion of vascular branches with active bleeding (Figure 8);

Figure 8: *Traumatic lesion of the mesentery about 55 cm from Treitz with rupture of a bleeding blood vessel leading to a larger hematoma retroperitoneally on the left; the injury is taken care of by suture*

Traumatic rupture of the mesocolon in its half with a Riolan's arch lesion and consequent bleeding (Figure 9). The same is taken care of by blood vessel ligatures.

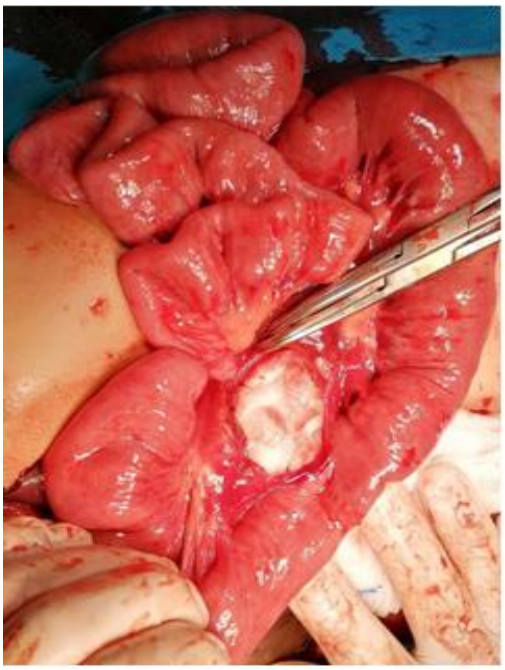

Figure 9: *Lesion of the mesentery at about 70 cm without lesion of vascular structures; traumatic rupture of the mesocolon in its half with a Riolan's arch lesion and consequent bleeding. The same is taken care of by blood vessel ligatures*

The exploration did not find other lesions or changes in the organs of the abdominal cavity.Lavage and hemostasis control are performed, and surgicell is placed on liver and spleen lesions. Ruptures of the mesentery and mesocolon are sutured and serous sutures are placed in two places. Throughout the operative work, the trophicity of the segment of the transverse colon and jejunum was monitored, which remained normal until the end and with preserved peristalsis. In conditions of induced hypertension, there was no active bleeding. Drains were placed: subhepatic right, subdiaphragmatic left and contact drain in Douglas space. The number of swabs were controled and operative wound was closed. The patient was transferred postoperatively to the Intensive Care Unit to continue monitoring and resuscitation treatment.

After surgical treatment abdomen was below level of thorax, postoperative wound was normal. Medial lap as well as the openings of three drains were covered with bandage material. Plaster was placed on the left thigh. On the right leg clinical finding was normal.The child wakes up regularly after general anesthesia. After that, the child is transferred to Pediatric Intensive Care Unit for the continuation of further treatment where he spends 10 days when the child was transferred back to Pediatric Surgery Clinic with recommendations.Antibiotic therapy was continued - Meropenem, Vankomycin for 11 days. Due to laboratory results (CRP 20, Le 10, SE 40) and due to small left basal pleural effusion and minor basal change corresponding to pulmonary infiltration on the left side of the lungs antibiotic therapy was modified - amoxicillin clavulanate 3x500 mg intravenously, with Fluconazole 1x200mg orally, according to the recommendation of the pulmonologist. In the therapy there were also analgetics, antipyretics and anticoagulants therapy enoxaparin sodium 1x4000mg subcutaneously due to high values of D-dimer and postoperative state.Since the child is still febrile on the 14th postoperative day, inflammatory markers were checked (CRP 9) and blood culture was done which was negative (sterile). On the 17th postoperative day a control X-ray of the lungs was performed and it was showing discrete basal changes, ultrasound of the abdomen corresponded to the postoperative condition, and the antimicrobial therapy was modified again due to recommendations of infectious disease specialist to oral Flucloxacillin 400mg 2x1 and Fluconazole tabletes 1x200mg.The child on the discharge properly tolerates oral intake, does not vomit, have a normal stool, was in good general condition, afebrile last 3 days, eupnoic, euhydric, with normal urinary function, and good local finding, wound was calm and dry.The child was discharged for further home treatment in good general condition and a satisfactory local finding with a recommendation of rest and further controls.

Discussion

Blunt abdominal trauma is the most common cause of abdominal injuries in children. Blunt abdominal injuries are characterized by the transfer of high impact energy or acceleration and cause spraying of the capsule, laceration of the tissue of parenchymal organs, rupture of hollow organs filled with fluid or content.A special feature of abdominal injuries are lesions of the organs of the retroperitoneal space, and that is the space which, in addition to large blood vessels, also includes parts of the intraperitoneal organs. The pathophysiology, etiology, and clinical findings in children with internal abdominal injuries has some established characteristics. The first is that, generally, due to the anatomy, injuries in children tend to cause more organ damage and be more severe for the following reasons: 1) a small external force can cause severe injuries because the supportive tissues around the ribs, abdominal muscles, and organs are weak; 2) the relative capacities of solid organs such as the liver, pancreas, and spleen are large; and 3) the solid organs are not protected by the ribs because the diaphragm is almost horizontal [9-11] Other characteristics include the following: 1) since a small force is focused on a particular point, organ damage is often more severe than expected; and 2) compression between the abdominal wall and vertebral body by an external force often results in more severe organ damage. According to previous reports, in children who experienced non-accidental injuries, the frequencies of organ damage caused by blunt abdominal trauma were 64.1% in the liver, 19.2% in the kidney, 12.0% in the stomach and intestines, 9.0% in the spleen, and 7.3% in the pancreas [12, 13].

These injuries are often part of polytrauma, and special emphasis should be placed on the possibility of overlooking abdominal injuries with internal bleeding if a polytraumatized child is dominated by craniocerebral injury with loss of consciousness or apparently open

fracture, which may distract physicians from discrete initial symptoms of internal injury.

In addition to the anamnesis, clinical findings and follow-up, as well as the laboratory findings, the most valuable diagnostic data on the location, type and extent of injury and possible free fluid in the peritoneal cavity can be obtained by echosonographic examination of the abdomen.If we do not have a clear diagnosis, we can expand the diagnosis with peritoneal lavage, and in ideal clinical conditions with laparoscopy and CT imaging. Although the patient was hypotensive, with signs of initial hemorrhagic shock, after Focused Assessment with Sonography in Trauma (FAST), together with anesthesiologists, who started resuscitation, we assessed that the patient is still hemodynamically stable and that CT was possible. FAST in unstable patients, is not useful for the diagnosis of lesions of intestinal and mesenteric injury because of its low sensitivity [14]. For hemodynamically stable trauma patients CT plays an importan role. Radiological signs associated with intestinal and mesenteric injuries are well defined [15]. Signs of intestinal wall injury include:discontinuity of the intestinal wall, thickening of the bowel walland increased or decreased enhancement of the intestinal walldefect after i.v. contrast injection. Images suggestive of mesentericinjury include: i.v. contrast extravasation (blush) or abrupt dis-continuation along a vascular branch, infiltration of mesenteric fatand hematoma.

Ruptures of the liver and spleen belong to the most common and most serious consequences of blunt abdominal injury. The exposure of these organs is higher than in adults due to their relatively larger volume and poorerweaker protection by a thin muscular wall. Symptoms relate to palpatory tension of the abdominal wall due to peritoneal stimulation and symptoms of bleeding. In splenic injuries, the pathognomonic clinical symptom of irradiation of pain in the left shoulder should be borne in mind. The patient should also be monitored if symptoms decrease and the red blood cell count stabilizes as subcapsular hematoma may rupture and subsequent bleeding may occur 24 to 48 hours after injury. Injuries to the urogenital system - the kidney is an organ that is functionally part of the urinary system but anatomically belongs to the retroperitoneal part of the abdomen and can be injured by blunt force injuries to the abdomen, and especially by a fall or blow to the back or groin.

The boy which we operated on had a lot of blood in the abdominal cavity, subcapsular lesion of the spleen on the convexity in the middle part which did not bleed, hematoma of the lower part of the spleen with incomplete demarcation to other tissue, two liver injuries (2 and 4cm) no bleed actively or had biliary leak; the gallbladder was contused with a hematoma of the medial wal without elements of compression traumatic lesion of the mesentery about 55 cm from Treitz with rupture of a bleeding blood vessel leading to a larger hematoma retroperitoneally on the left, lesion of the mesentery at about 70 cm with lesion of vascular branches with active bleeding; traumatic rupture of the mesocolon in its half with a Riolan's arch lesion and consequent bleeding. Ruptures of the mesentery and mesocolon are sutured and serous sutures are placed in two places.

Mesenteric and hollow organ injury represent 16% of all blunt abdominal traumas and occur as a result of high energy trauma involving motor vehicle accidents in 70–90% of cases [16]. Our case report was caused by a blow from another skier, which high energy obviously corresponded to the force and present in traffic accidents. Intestinal injuries and their mesenteries (mesocolon and mesentery) are con-sidered as a single clinico-anatomic entity. Small intestinal injuries constitute more than half of all blunt intestinal injuries, with equal involvement of the jejunum and ileum. The second most frequentlocation of injury is the colon: some studies show that left colonis more commonly injured than the transverse or right colon [17]. Our patient had an injured mesocolon transversum and branches of the arcus Riolani that give the arteries colica media and sinistra. Duodenal lesions are less common, representing 10% of the total and are often associated with pancreatic trauma. There are several types of intestinal and mesenteric injuries. The mesenteric injuries range from bruising, to hematoma, to frank bleeding through thetorn peritoneal envelope. Mesenteric disinsertion may occur with avulsion of the proximal or distal mesenteric root, which may cause intestinal perforation along the mesenteric surface of the bowel and localized devascularization of an intestinal segment resultingin ischemia and secondary perforation. Our patient did not have problematic intestinal vitality, although bleeding from the branches of the mesenteric vessels led to hemorrhagic shock [18].

The mechanism of mesenteric injury in blunt abdominal trauma involves compression and deceleration forces which result in a spectrum of injuries that range from contusions, to tearing of the bowel wall, to shearing of the mesentery, to loss of vascular supply or bleeding. Our patient was injured when another skier, an adult, crashed into a boy at high speed.Three basic mechanisms may cause bowel and mesenteric injuries of blunt trauma: Direct force may crush the gastrointestinal tract; rapid deceleration may produce shearing force between fixed and mobile portions of the tract; and a sudden increase in intraluminal pressure may result in bursting injuries [19].

The term solid organ injury refers to the liver, spleen, and kidney. Currently, non-operative management is the golden standard of care in favorable circumstances.A multidisciplinary approach that includes doctors of various specialties (pediatric surgeons, pediatricians, neurosurgeons, anesthesiologists and radiologists) who contribute to the diagnosis and treatment of injured children through diagnostic and therapeutic procedures has a key role. At the end, the decision regarding surgical treatment is responsibility of pediatric surgeon.

Conclusions

Due to the anatomy, injuries in children tend to cause more organ damage and be more severe.

In a polytrauma pediatric patient, with abdominal symptoms, clinical exa-ination and imaging studies (preferable a ct scan) are necessary.

Mesenteric injuries are difficult to diagnose and their undiagnosed complications are as a result of haemorrhage with high mortality rates

If the patient is hemodynamically unstable, polytraumatized, with signs of extensive mesenteric injuries, surgical treatment is indicated.

Intestinal or mesenteric pediatric injury should be suspected in all high energy blunt abdomia trauma.

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DOI: 10.31579/2768-2757/040