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Effectiveness of syndecan-1 as an adjunct diagnostic marker in small bowel injury: a report of two cases

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ABSTRACT

Background Small bowel injuries are rare in trauma. Diagnosing these injuries is difficult owing to the lack of clear signs, and delays in diagnosis might increase complications and mortality. Trauma can damage the vascular endothelial glycocalyx, with syndecan-1 emerging as a marker of injury. Here, we describe two cases of small bowel injury due to traffic motor vehicle crash trauma.

Case presentation The patients, one in their 40s and one teenaged, were transported to our hospital after a traffic motor vehicle crash. Both patients were wearing seat belts at the time of the motor vehicle crash, and the car's airbags deployed properly. Their vital signs were stable at admission, and non-operative treatment was selected. However, their abdominal pain did not improve, and based on posthospitalization CT reconstructive imaging, intra-abdominal hemorrhage was suspected. Surgery was performed, revealing small intestinal injuries. In both patients, a high serum syndecan-1 level in the blood test at admission was a common characteristic.

Conclusion Increased serum syndecan-1 level was observed in blood tests during the initial treatment of small intestinal injuries in these patients, suggesting its potential utility in early diagnosis. However, further accumulation of cases and detailed studies are required to substantiate these results.

BACKGROUND

Intestinal injuries caused by blunt trauma are relatively rare, occurring in approximately 1% of patients.[1] Diagnosing small bowel injury is challenging, and delays in diagnosis can lead to increased complications and mortality rate.[2] The glycocalyx, present in the vascular endothelium, is reportedly damaged by insults such as sepsis and trauma.[3] Syndecan-1 has been used as a marker of this damage.[4] Here, we describe two cases in which the initial blood tests for isolated small bowel injuries showed elevated syndecan-1 level, suggesting that it might be effective for the early diagnosis of small bowel injuries.

CASE PRESENTATION

Case 1

A patient in their 40s was injured in a car crash and was transported to our hospital via emergency service. This patient was wearing a seat belt, and the car's airbags were deployed correctly at the time of the motor vehicle crash. On arrival, vital signs were as follows: respiratory rate, 20 breaths/min; SpO_2, 100% on 10 L O_2/min using a reservoir mask; heart rate, 85 beats/min; blood pressure, 128/66 mm Hg; body temperature, 36.0°C. Physical examination revealed a mildly distended abdomen with tenderness predominantly in the lower abdomen. No obvious seat belt signs were observed on the body. An extended focused assessment with sonography in trauma (E-FAST) revealed slight fluid accumulation in the pouch of Douglas.

Contrast-enhanced CT revealed small bowel wall thickening and slight fluid accumulation in the pouch of Douglas, which can be considered to be within the physiological range. No mesenteric stranding or bowel wall discontinuation was observed (figure 1A). Other traumatic findings were limited to a minor pulmonary contusion. Blood tests on arrival showed a C-reactive protein (CRP) level of 0.03 mg/dL and white blood cell count of 8100/μL. The serum syndecan-1 level was elevated at 75.7 ng/mL (healthy adults: approximately 20 ng/mL).[5]

Non-operative management was chosen initially, and the patient was admitted to the hospital. Although no significant changes in vital signs or abdominal pain were observed, a repeat CT scan performed 8 hours later revealed free air in the abdominal cavity (figure 1B), prompting an exploratory laparotomy. Partial small bowel resection was performed after a 10 mm perforation in the small bowel, approximately 150 cm from the ligament of Treitz, was discovered during surgery (figure 1C). Postoperatively, although partial wound dehiscence was observed, the patient's overall condition remained stable, and this patient was discharged on postoperative day 14.

Case 2

A teenage patient fell asleep while driving, resulting in a collision with a wall. This patient was admitted to our hospital via emergency transport. The patient had the seat belt on, and the car's airbags deployed at the time of the motor vehicle crash.

On arrival, vital signs were as follows: respiratory rate, 15 breaths/min; SpO_2, 98% on room air; heart rate, 80 beats/min; blood pressure, 140/66 mm Hg; body temperature, 36.4°C. Physical examination revealed a seat belt sign across the lower abdomen and severe tenderness from the periumbilical area to the right flank. E-FAST results were negative.

Contrast-enhanced CT revealed bowel wall thickening in the small bowel intestine and mild mesenteric stranding; however, no evidence of free air, free fluid or intravenous contrast extravasation in the mesentery was observed (figure 2A). No other obvious traumatic findings were observed.

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Figure 1 Contrast-enhanced CT of patient 1. (A) Contrast-enhanced CT revealed small bowel wall thickening. (B) Repeat CT performed 8 hours later revealed free air in the abdominal cavity. (C) Operative findings revealed a 10 mm perforation in the small bowel approximately 150 cm from the ligament of Treitz.

At admission, blood tests showed a CRP level of 0.02 mg/dL and white blood cell count of 13 680/μL indicating a mild increase in white blood cells; the serum syndecan-1 level was elevated at 164.7 ng/mL.

Similar to patient 1, initially, a non-operative management was chosen, and the patient was admitted to our hospital. Although the patient's vital signs were stable, abdominal pain did not improve. A repeat CT scan performed 6 hours later revealed free air and fluid in the abdominal cavity (figure 2B), promoting an exploratory laparotomy.

Surgical findings revealed hemorrhagic ascites in the abdominal cavity and a 5 mm perforation in the small bowel, approximately 90 cm from the ligament of Treitz. A segmental resection of the small intestine was performed (figure 2C). A hematoma was observed in the mesentery with slight oozing bleeding, which was successfully controlled. The postoperative course was uneventful, and the patient was discharged on postoperative day 10.

DISCUSSION

Peritoneal signs tend to develop slowly in small bowel injuries because the luminal contents have a neutral bacterial load. Furthermore, bowel perforation can be a delayed response to vascular injury, resulting in bowel ischemia and necrosis; as such, peritoneal signs may take many hours to develop.[1] Therefore, it is not uncommon for patients to present with only mild abdominal pain and stable vital signs during initial treatment. However, even a delay of 6–8 hours in diagnosis can lead to sepsis from abdominal contamination with intestinal contents after perforation, peritonitis, abscess formation, longer hospital stays, and higher rates of acute respiratory distress syndrome.[6] A multicenter cohort study of 198 patients with small bowel injuries after blunt trauma reported a significant correlation between mortality rates and increasing time interval to surgical intervention (2%, 9%, 17%, and 31% for time-to-surgery groups of <8 hours, 8–16 hours, 16–24, and >24 hours, respectively; p=0.009).[7] In patients where there are seat belt signs on the abdomen, intra-abdominal injuries are reported to occur in 20%–60% of patients[8] and small bowel injuries are reported to occur in 12%–15% of patients.[9]

Reportedly, an increase in the procalcitonin level within the first 2 days in patients with bowel injuries compared with that in patients with other abdominal organ (such as the spleen or mesentery) injuries or non-abdominal trauma.[10] However, this marker is difficult to use for early diagnosis and rapid surgical treatment. Currently, CT scans are an effective diagnostic tool for small-bowel injuries. However, only 45.2% of patients show the characteristic findings of extraluminal gas in the abdominal cavity on the initial CT scan.[11] Therefore, it is often challenging to diagnose small-bowel injuries on initial CT scans, particularly when determining whether surgical intervention is necessary.

Although the three most common CT signs of small bowel injury are hemoperitoneum, mesenteric stranding, and bowel wall thickening,[12] the sensitivity of CT scans for stable patients is reportedly 73%–96%, whereas the specificity is 48%–84%, indicating a high rate of missed diagnoses.[13] The low specificity of CT findings leads to a high number of false-positive cases, resulting in 30%–40% of non-therapeutic laparotomies.[14] A repeat CT scan is thought to be effective in confirming the presence of newly appearing extraluminal gas or an increase in free fluid in the abdominal cavity. A follow-up scan should be performed 6–8 hours after the initial examination.[1 15]

In the present cases, initial CT scans only showed thickening of the small bowel wall. However, repeat CT scans approximately 6–8 hours later revealed extraluminal gas,

Figure 2 Contrast-enhanced CT of patient 2. (A) Contrast-enhanced CT revealed bowel wall thickening in the small bowel intestine and mild mesenteric stranding. (B) Repeat CT performed 6 hours later revealed free air and free fluid in the abdominal cavity. (C) Operative findings revealed hemorrhagic ascites in the abdominal cavity and a 5 mm perforation in the small bowel approximately 90 cm from the ligament of Treitz.

allowing for surgical intervention. Early diagnosis is highly desirable, as it reduces pain and the time to therapeutic intervention, leading to fewer complications.[16]

The glycocalyx, composed of polysaccharides and glycoproteins, covers the surface of the endothelial cells within the vascular lumen. Syndecan-1, the core protein in the endothelial glycocalyx, is shed into the blood under various systemic inflammatory conditions.[17] Therefore, its utility as a biomarker has been reported in acute conditions that cause endothelial damage, such as sepsis and ischemia.[3 18] Additionally, in trauma cases, the serum syndecan-1 level significantly correlates with the predicted survival rate.[16] Among the six body regions defined in the Abbreviated Injury Scale used to calculate the Injury Severity Score, the 'abdominal' region is significantly associated with serum syndecan-1 level in patients with trauma.[19] In the field of gastrointestinal surgery, a significant increase of up to 1.5-fold in syndecan-1 level has been reported 24 hours postsurgery.[20]

In the present cases, initial CT revealed only bowel wall thickening; however, on arrival at the emergency room, the syndecan-1 level was elevated (75.7 ng/mL and 164.7 ng/mL). Elevated syndecan-1 level is thought to result from microvascular injury and necrosis, causing glycocalyx disruption and its subsequent release into the bloodstream. As mentioned above, determining syndecan-1 level at the time of first aid may facilitate the early diagnosis of small bowel injury.

CONCLUSIONS

Increased serum syndecan-1 level was observed in blood tests during the initial treatment of small bowel injury, suggesting its potential utility in the early diagnosis. However, further accumulation of cases and detailed investigations are warranted to substantiate these findings.

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