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**Isolated jejunal perforation – hidden danger in blunt
abdominal trauma**

Изолована перфорација јејунума – скривена опасност у тупој
абдоминалној трауми

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Isolated jejunal perforation – hidden danger in blunt abdominal trauma

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SUMMARY

Introduction Isolated jejunal perforation (IJP) without any associated injuries is rare in blunt abdominal trauma (BAT). It most commonly occurs in decelerating trauma. Diagnosis of traumatic intestinal perforation may be difficult in the first hours after injury so unrecognized “missing” intestinal injuries incidences are as high as 24%. Unrecognized traumatic bowel perforation without adequate treatment leads to the intestinal leakage into the peritoneal cavity, making progress in secondary peritonitis and potentially lethal complications.

Case outline We presented the case of 43 years old woman injured in road traffic accident. She was admitted to emergency surgery after diagnostic procedures according to the protocol for trauma. Initial examination, and body computed tomography (CT) revealed orthopedic injuries. Daily monitoring and follow-up examinations were done, she did not complain of any discomfort nor pain in the abdomen and there were no signs of abdominal injury. Two days after trauma, follow-up abdominal CT revealed highly suspected jejunum perforation, still with no signs of pneumoperitoneum. Laparotomy was performed and diagnosis of IJP was confirmed. Bowel perforation was surgically closed in two layers, followed by drainage of septic collections, abdominal saline lavage and primary abdominal closure. The patient was discharged on the seventh postoperative day without complications.

Conclusion In the case of BAT due to severe traumatic force in patient with nonspecific clinical signs of abdominal trauma on initial clinical and radiological examination, follow-up in a short period is necessary, to detect hidden jejunal perforation. Surgery is a life-saving for those patients and treatment of these injuries usually require simple operative procedures.

Keywords: isolated jejunal perforation; blunt abdominal trauma; computed tomography; surgery

САЖЕТАК

Увод Изолована перфорација јејунума без других придружених повреда је ретка у случају тупе абдоминалне трауме. Најчешће се дешава у случају децелерације. Дијагностика трауматске интестиналне перфорације може бити веома тешка у првим сатима након повреде те је инциденца непрепознатих повреда црева 24%. Непрепозната трауматска перфорација црева без оптималног третмана доводи до цурења цревног садржаја у перитонеалну дупљу што доводи до секундарног перитонитиса и потенцијално леталног исхода.

Приказ болесника Приказујемо случај жене старе 43 године која је повређена у саобраћајној несрећи. Она је примљена на одељење ургентне хирургије након спроведених дијагностичких процедура по протоколу за трауму. Иницијални преглед и компјутеризована томографија (КТ) су показали ортопедске повреде. Учињени су свакодневни мониторинг и контролни прегледи који нису показали знаке абдоминалне повреде а болесница се није жалила на нелагодност или бол у абдомену. Два дана након повреде учињен је контролни КТ преглед абдомена који је показао високо суспектну перфорацију јејунума, и даље без знакова пнеумоперитонеума. Учињена је лапаротомија и потврђена је дијагноза изоловане перфорације јејунума. Перфорација црева је хируршки збринута у два слоја уз дренажу инфицираних колекција, абдоминалну лаважу и трбух је потом затворен по слојевима. Пацијент је отпуштен из болнице седмог постоперативног дана без компликација.

Закључак У случају тупе абдоминалне трауме услед јаке трауматске силе код пацијента са неспецифичним знацима абдоминалне трауме на иницијалним клиничким и радиолошким прегледима неопходна је рана контрола ради детекције евентуалне перфорације јејунума. Хирургија је од виталног значаја за ове пацијенте а третман обично подразумева једноставне хируршке технике.

Кључне речи: изолована перфорација јејунума; тупа абдоминална траума; компјутеризована томографија; хирургија

INTRODUCTION

Isolated jejunal perforation (IJP) in blunt abdominal trauma (BAT) is severe but extremely rare injury [1]. Although small intestine trauma is the third most common organ injury in BAT, those injuries have a low incidence of 1–5%, with bowel perforation in only 0.3% patients [1–4]. However, what is important to point out is that missing intestinal injuries have incidences as high as 24% [1–4].

In most cases, jejunal perforation is associated with injuries of solid or other hollow abdominal organs. Jejunal injury usually occurs in BAT during deceleration. This mechanism of injury in the traffic accidents is created due to a strong decelerating force between human body and seatbelt. Furthermore, the intestinal loops can be suddenly pressed between the anterior abdominal wall and the spinal column, which leads to increased pressure in the bowel lumen and perforation [3–6]. Significant blunt small bowel and mesenteric injuries (SBBMI) requires surgical treatment are: bowel transection, bowel perforation, segment devascularization, active mesenteric hemorrhage, mesenteric injury with hematoma and intestinal ischemia [4–8]. Traumatic SBBMI without adequate treatment leads to the intestinal leakage into the peritoneal cavity, making progress in secondary peritonitis and potentially lethal complication.

Unfortunately, timely detection of IJP in polytrauma patient if there is not a clinical suspicion is difficult because symptoms are initially sparse and abdominal pathology does not dominate in clinical presentation during first hours after trauma. Therefore, daily clinical monitoring and use of diagnostic modalities (plain abdominal radiography X-ray, ultrasound (US), laparoscopy) are important, but the role of computed tomography (CT) in insolate jejunal injury detection is significant for early diagnosis, treatment and outcome in these patients [5–8].

We report a case of 43 years old women with IJP and non-specific clinical presentation, 7mm isolate jejunal perforation was discovered at the follow-up CT two days after trauma, she underwent surgery and recovered successfully.

CASE REPORT

A 43 years old female was admitted to Emergency Surgery after sustaining road traffic accident. She was the driver, wearing seatbelt and she had front impact without airbag deployed. Patient had no previous medical or surgical history. The clinical examination revealed spontaneous breathing and hemodynamic stability, with discrete seat belt sign on abdominal wall and multiple abrasions on the left legs. Abdominal palpation showed a mild localized tenderness. Hemoglobin (Hb) level was 12.5 g/dL and white blood cell (WBC) count was 33.000/uL. Plain radiography of abdomen was normal, without pneumoperitoneum. FAST (Focused Assessment Sonography in Trauma) showed no signs of free fluid or organ injury. On CT exam there was no significant thorax, abdominal or pelvic findings. Orthopedic clinical examination and radiographic examination showed left femur fracture, right tibia and patella fracture. There was no head and chest injuries. Patient was hospitalized due to severe bone fracture, and non-operative management was initially applied including intensive monitoring, rehydration, symptomatic treatment and antibiotic therapy.

On the first day of hospitalization clinical examinations revealed persistence of very mild abdominal tenderness and there was no muscular defense or peritoneal reaction. Follow-up US has showed oedema of jejunal loops in left hemiabdomen, with hyperechoic reaction of mesenterium, and small amount of fluid between loops (Figure 1). Patient was hemodynamically stable and she did not complain of abdominal pain or discomfort.

On the second day of hospitalization patient began to complain on pain during abdominal examination, with positive signs of local peritoneal irritation in left abdominal quadrant.

Routine daily blood analyzes discovered a leukocytosis (18.000/uL). Plain X-ray showed a few air-fluid levels, no signs of pneumoperitoneum. We indicated a follow-up CT and it showed segmental thickening of jejunal wall in left hemiabdomen with small striped hipodense lesion in at antimesenterial border with small amount of fluid, mesenterial “fat-stranding” and thickening of adjacent parietal peritoneum but without pneumoperitoneum. (Figure 2, 3 and 4) Surgery was indicated and exploratory laparotomy confirmed an IJP. We found a single jejunal perforation of size 7 mm at antimesenteric border, about 20 cm away from the ligament of Treitz (Figure 5). Jejunal trauma was classified according to the American Association of Surgery of Trauma (AAST) as grade II injury [9]. The perforation was hidden under the omentum that covered it. Peritonitis was enclosed in the upper left quadrant of the abdomen. There were no other abdominal organs injuries. After minimal excision of bowel edges around perforation into the healthy tissue, the jejunum was closed in two layers, followed by detailed abdominal lavage and standard abdominal closure. Parenteral nutrition and antibiotics were introduced immediately in the early postoperative course. On the third postoperative day, patient started with food and fluid intake. The abdominal ultrasound performed after surgery revealed no presence of fluid or collections. Patient was discharged from Emergency Surgery department after seven days, without complications. She continued with orthopedic treatment and rehabilitation.

All procedures performed involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Written consent to publish all shown material was obtained from the patient.

DISCUSSION

BAT occurs during road traffic accidents in 75% cases and it is often accompanied by serious organs injury and intra-abdominal bleeding. Small bowel injury following BAT is very rare with incidence about 1% [9, 10]. Even more rare is significant small bowel trauma with only 0.3% cases with small bowel perforation [3–6]. Abdominal injury known as “seatbelt syndrome” with linear ecchymosis on abdominal wall as a result of car accident was described by Garrett and Braunstein in 1962. Simpler form of injury the “seatbelt sing” is expanded to the larger “seatbelt complex” which implies the existence of abdominal organs injures, thorax and spine trauma, major vascular structures trauma, ribs and sternum fractures [9, 11].

Mechanisms of small bowel perforation in BAT are clarified and basically it occurs due to the deceleration forces, bowel compression and blowout trauma due to a sudden intraluminal pressure increase in fluid-filled or air-filled bowel loops [7–10]. Diagnostic delays and unrecognized small bowel lesions in first 24 hours, have a high incidence of 24%, despite routine use of CT [1, 2, 3]. Timely diagnosis of isolated jejunal injury can be difficult because of nonspecific clinical findings, absence of peritoneal irritation during abdominal palpation and non-radiological signs of injury immediately after trauma. We presented a case of a patient with significant small bowel injury although it was just one IJP, without sign of perforation during 24 hours after car accident. Patient had a “seatbelt sing” on abdominal wall as the only marker of abdominal trauma.

The diagnosis of SBBMI is based on mechanism of injury, a precise follow-up clinical examination, laboratory results, radiologic methods (abdominal X-ray, US, CT), Diagnostic Peritoneal Lavage (DPL) and laparoscopy [3–8]. Initial clinical examination can be nonspecific during first hours after the BAT. Radiological methods play an important role in the diagnosis of jejunal perforation in the absence of specific clinical symptoms. Lawson et al. suggest that era “trauma scan” leads to reduction missing body injuries, but the bowel injuries are still the

most commonly missed and the key to success in treatment is clinical doubt about intestinal trauma in severe trauma patients [12]. Matsushima and colleagues analyzed 7,875 blunt trauma patients, they found blunt hollow viscus and mesenteric injury (BHVMI) in 67 (0.8%) patients who were divided in two groups: non-ischemic-BHVMI (perforation, laceration, and hematoma without devascularization) and ischemic-BHVMI (devascularization confirmed at laparotomy) [13]. Authors found that even using an advanced imaging technique, the diagnosis of I-BHVMI can be delayed, with significant negative impact on patient outcome [12].

Based on clinical observations and significant findings several scores have been presented to evaluate the extent of small intestine and mesenteric injury: American Association of Surgery of Trauma (AAST) and Injury Scoring Scales, Mesenteric Injury Score (MIS), Z-Score, Bowel Injury Prediction Score (BIPS) [3–6]. BIPS introduced by McNutt et al is able to predict risk of bowel injury if two or three parameters are positive on admission: high grade mesenteric injury on CT scan (presence of a mesenteric contusion or hematoma with associated bowel wall thickening and inter-loop fluid collection, or an active vascular/oral contrast extravasation, bowel transection or pneumoperitoneum), increased WBC (> 17,000) and abdominal tenderness [5]. The degrees of small bowel injury classified according to the AAST are: Grade I hematoma or laceration without perforation; Grade II characterized by a laceration of less than 50% of the circumference; Grade III laceration of more than 50% of the circumference without transection; Grade IV transection of the small bowel; Grade V transection of the small bowel with loss of segmental tissue or vascular injury with segmental devascularization [7, 12].

In our patient IJP was presented as 7mm size of single jejunum perforation with secondary peritonitis, jejunal trauma classified as AAST grade II injury. Clinical history plays a particularly important role in determining the appropriate imaging examination for evaluating a possible perforated viscus [13].

In IJP abdominal plain X-ray rarely can show free air in peritoneal cavity – pneumoperitoneum, as a significant sign of hollow viscus perforation [8]. More often radiography can show indirect signs of trauma such as the presence of air-fluid levels due to parietic intestinal loop [8]. Non-invasive and simple method for abdominal examination is the ultrasound. It is sensitive in the detection of the small intestine wall edema as well as free fluid in the surrounding peritoneal space and may sometimes detect free intraperitoneal air [14]. These almost non-specific findings on US should be properly interpreted in trauma because they can lead to the diagnosis if there is a clinical suspicion. CT is the most reliable method for detection of small bowel perforation (sensitivity 92%, specificity 94%) [7, 15, 16, 17]. Recent systematic reviews increasingly support performing CT scans of the abdomen and pelvis without the need for positive oral contrast in most clinical situations [18]. Small bowel perforation on CT is evident in the presence of direct signs such as bowel wall discontinuity, extraluminal air or presence of extraluminal contrast, or indirect CT signs: bowel wall thickening, abnormal bowel wall enhancement, presence of abdominal abscess formations [7, 15, 16, 17] or mesenteric fat stranding and a moderate to large volume of unexplained intraperitoneal fluid in the absence of solid organ injury [19]. CT signs that correlated with mesenteric laceration are abdominal wall injury, mesenteric contusion, free fluid in peritoneal cavity, segmental bowel hypoenhancement, and bowel hyperenhancement adjacent to a hypoenhancing segment [20]. CT scan also indicates the location of bowel perforation. In our patient abdominal US, plain X-ray and CT scan were performed and did not show perforation of the jejunum immediately after accident. However, a follow-up CT scan showed that there was a thickening of the proximal jejunal wall that could indicate injury (Figure 4).

There is still no consensus in the literature regarding the effects of delayed surgical treatment of traumatic small intestine perforation, but it is generally accepted that morbidity and mortality is significantly lower in the case of early diagnosis and emergency surgical

treatment [21, 22]. SBBMI without adequate treatment can be associated with severe complications and catastrophic outcome, because of the potential of these injuries to complicate to secondary peritonitis, sepsis and Multiple Organ Dysfunction Syndrome (MODS). Fakhry et al. shows on 198 patients that diagnostic delays have influence on outcome in patients with blunt small bowel injury: mortality increased from 2% for patients with delays treatment of <8 hours to 30.8% for patients treated after 24 hours [23, 24].

Faria et al introduced the term “killing time”. They found that all postoperative deaths in patients with both blunt and penetrating bowel injuries occurred in those who were operated after the first 24 hours [25].

Mingoli and colleagues found that leukocytosis and delayed treatment (>6 hours) are independent predictors of postoperative morbidity [26].

Therefore, in trauma patient surgeons require a high index of clinical suspicion and early recognition which followed by adequate treatment is of crucial importance.

Detection of isolated jejunal trauma as the only injury in BAT is a challenge because these injuries can be clinically silent and radiological hidden during the first hours and even days after trauma. Missing small bowel perforation with secondary peritonitis without treatment can be followed by deadly complication.

We must always suspect on small intestine perforation in case of BAT. In that light intensive clinical monitoring and radiology follow-up are imperative. Surgery is a life-saving for those patients and treatment of these injuries usually require simple operative procedures.

Conflict of interest: None declared.

REFERENCES

1. Goyal S, Goyal S, Garg MK. Single jejunal blowout perforation following blunt abdominal trauma: Diagnostic dilemma. *J Mahatma Gandhi Inst Med Sci* 2013;18:144-6. DOI: [10.4103/0971-9903.117798](https://doi.org/10.4103/0971-9903.117798)
2. Nonterah EA, Atindama S, Achumbowina E, Kaburise MB, Saanwie E, Ewura A, Al-Hassan M. Isolated Jejunal Perforation and Mesentery Injury following a Kick on the Abdomen of a College Student: A Case Report from a District Hospital in Northern Ghana. *Case Reports in Critical Care*. 2020 Mar 26;2020.<https://doi.org/10.1155/2020/3063472>
3. Evlimer S, Okumuser I, Delibas D. Delayed small bowel perforation with finding of severe ischemia following blunt abdominal trauma. *Pol J Radiol*, 2017;82:271-274. doi: [10.12659/PJR.900382](https://doi.org/10.12659/PJR.900382)
4. Jahromi A, Johnson L, Youssef AM. Delayed small bowel perforation following blunt abdominal trauma: a case report and review of literature. *Asian J Surg*, 2016;39(2):109-112. DOI: [10.1016/j.asjsur.2013.01.006](https://doi.org/10.1016/j.asjsur.2013.01.006)
5. Zingg T, Agri F, Bourgeat M, Yersin B, Romain B, Schmidt S, Keller N, Demartines N. Avoiding delayed diagnosis of significant blunt bowel and mesenteric injuries: Can a scoring tool make the difference? A 7-year retrospective cohort study. *Injury*. 2018. Jan;49(1):33-41. doi: [10.1016/j.injury.2017.09.004](https://doi.org/10.1016/j.injury.2017.09.004).
6. Fakhry SM, Watts DD, Luchette FA. Current diagnostic approaches lack sensitivity in the diagnosis of perforated blunt small bowel injury: Analysis from 275,557 trauma admissions from the EAST Multi-Institutional HVI Trial. *J Trauma*. 2003;54:295-306. □ DOI: [10.1097/01.TA.0000046256.80836.AA](https://doi.org/10.1097/01.TA.0000046256.80836.AA).
7. McNutt MK, Chapinnvulla N, Beckman NM, Camp AE, Pommereing MJ, Laney RW et al. Early surgical intervention for blunt bowel injury: the Bowel Injury Prediction Score (BIPS). *J Trauma Acute Care Surg* 2015;78, 1:105–11. DOI: [10.1097/TA.0000000000000471](https://doi.org/10.1097/TA.0000000000000471).
8. Bekker W, Hernandez MC, Zielinski MD, Kong VY, Laing GL, Bruce JL et al. Defining an intra-operative blunt mesenteric injury grading system and its use as a tool for surgical-decision making. *Injury, Int. J. Care Injured*. 2019;50: 27–32. doi: [10.1016/j.injury.2018.08.014](https://doi.org/10.1016/j.injury.2018.08.014).
9. Maharaul HH, Tungla P, Shah K. Post traumatic jejunal perforation: A series of 3 cases and literature review. *International Journal of Surgery*. 2019;3(2):11-3. <https://doi.org/10.33545/surgery.2019.v3.i2a.04>
10. Biswas S, Adileh M, Almogy G, Bala M. Abdominal injury patterns in patients with seatbelt signs requiring laparotomy. *J Emerg Trauma Shock*. 2014;7:295–300. DOI: [10.4103/0974-2700.142764](https://doi.org/10.4103/0974-2700.142764).
11. Singh AP, Gupta AK, Pardeshi R, Barolia DK. Blunt trauma abdomen-induced jejunal perforation with appendicitis. *Medical Journal of Dr. DY Patil Vidyapeeth*. 2018 Jul 1;11(4):371.
12. Sugi MD, Menias CO, Lubner MG, Bhalla S, Mellnik VM, Kwon MH et al. CT findings of acute small-bowel entities. *Gastro Imaging* 2018; 38:1352–1369. DOI: [10.1148/rg.2018170148](https://doi.org/10.1148/rg.2018170148).
13. Bekker W, Kong VY, Laing GL, Bruce JL, Manchev V, Clarke DL. The spectrum and outcome of blunt trauma related enteric hollow visceral injury. *Ann R Coll Surg Eng*. 2018;100(4):290-294. doi: [10.1308/rcsann.2018.0013](https://doi.org/10.1308/rcsann.2018.0013).
14. Lawson CM, Daley BJ, Ormsby CB, Enderson B. Missed injuries in the era of the trauma scan. *J Trauma* 2011; 70: 452-456. DOI: [10.1097/TA.0b013e3182028d71](https://doi.org/10.1097/TA.0b013e3182028d71).
15. Matsushima K, Mangel PS, Schaefer EW, Frankel HL. Blunt hollow viscus and mesenteric injury: still underrecognized. *World J Surg*. 2013;37(4):759-65. doi: [10.1007/s00268-012-1896-2](https://doi.org/10.1007/s00268-012-1896-2)
16. Detanac DS, Mujdragić M, Detanac DA, Bihorac D, Mulić M. Small bowel perforation following blunt abdominal trauma caused by an accidental hammer blow: A case report. *Medicinski preglod*. 2020;73(3-4):108-11.
17. Reisig KV, Miles CM. Jejunal perforation from blunt abdominal trauma by an end zone pylon in a division I football player. *Sports health*. 2018 Nov;10(6):565-6. doi: [10.1177/1941738118796130](https://doi.org/10.1177/1941738118796130).
18. Kielar AZ, Patlas MN, Katz DS. Oral contrast for CT in patients with acute non-traumatic abdominal and pelvic pain: what should be its current role? *Emerg Radiol* 2016;23(5):477–481. DOI: [10.1007/s10140-016-1403-4](https://doi.org/10.1007/s10140-016-1403-4).
19. Pouli S, Kozana A, Papakitsou I, Daskalogiannaki M, Raissaki M. Gastrointestinal perforation: clinical and MDCT clues for identification of etiology. *Insight into imaging* 2020; 11(13). DOI: [0.1186/s13244-019-0823-6](https://doi.org/10.1186/s13244-019-0823-6).
20. Boscak A, Bodanapally U, Elshourbagy T, Shanmuganathan K. Segmental Bowel Hypoenhancement on CT Predicts Ischemic Mesenteric Laceration After Blunt Trauma. *AJR* 2021; 28:1-7. DOI: [10.2214/AJR.20.23108](https://doi.org/10.2214/AJR.20.23108).
21. Kopel J, Linda L, Warraich I, Sorensen G, Brower GL. Traumatic jejunal perforation associated with COVID19 infection. *Proc (Bayl Univ Med Cent)*. 2021 Jan 28;34(3):364-366. doi: [10.1080/08998280.2020.1866476](https://doi.org/10.1080/08998280.2020.1866476).
22. Manerikar KA, Verma P, Ghatage A, Garg S, Dholakia M. Delayed Presentation of Isolated Jejunal Perforation Following Accidental Trauma. *J Clin Diagn Res*. 2017 Mar;11(3):PD09PD10. doi: [10.7860/JCDR/2017/25254.9556](https://doi.org/10.7860/JCDR/2017/25254.9556). Epub 2017 Mar 1. PMID: 28511447; PMCID: PMC5427373.

23. Fakhry SM, Brownstein M, Watts DD, Baker CC, Oller D. Relatively short diagnostic delays (<8 hours) produce morbidity and mortality in blunt small bowel injury: an analysis of time to operative intervention in 198 patients from a multicenter experience. *J Trauma*. 2000;48(3):408–414. DOI: [10.1097/00005373-200003000-00007](https://doi.org/10.1097/00005373-200003000-00007).
24. Fakhry SM, Allawi A, Ferguson PL, Micheti CP, Newcomb AB, Liu C, Brownsein MR, EAST small bowel perforation (SBP) multi-center study group. Blunt small bowel perforation (SBP): An eastern association for the surgery of trauma multicenter update 15 years later. *J Trauma Acute Care Surg*. 2019; 86(4):642-650. DOI: [10.1097/TA.0000000000002176](https://doi.org/10.1097/TA.0000000000002176).
25. Faria GR, Almeida AB, Moreira H, Barbosa E, Correia-da-Silva P, Costa-Maia J. Prognostic factors for traumatic bowel injuries: killing time. *World J Surg*. 2012;36(4):807–812. DOI: [10.1007/s00268-012-1458-7](https://doi.org/10.1007/s00268-012-1458-7).
26. Mingoli A, La Torre M, [Brachini G](#), [Costa G](#), [Balducci G](#), [Frezza B](#), [Sgarzini G](#), [Cirillo B](#). Hollow viscus injuries: predictors of outcome and role of diagnostic delay. *Ther Clin Risk Manag*. 2017;13:1069-1076. doi: [10.2147/TCRM.S136125](https://doi.org/10.2147/TCRM.S136125).

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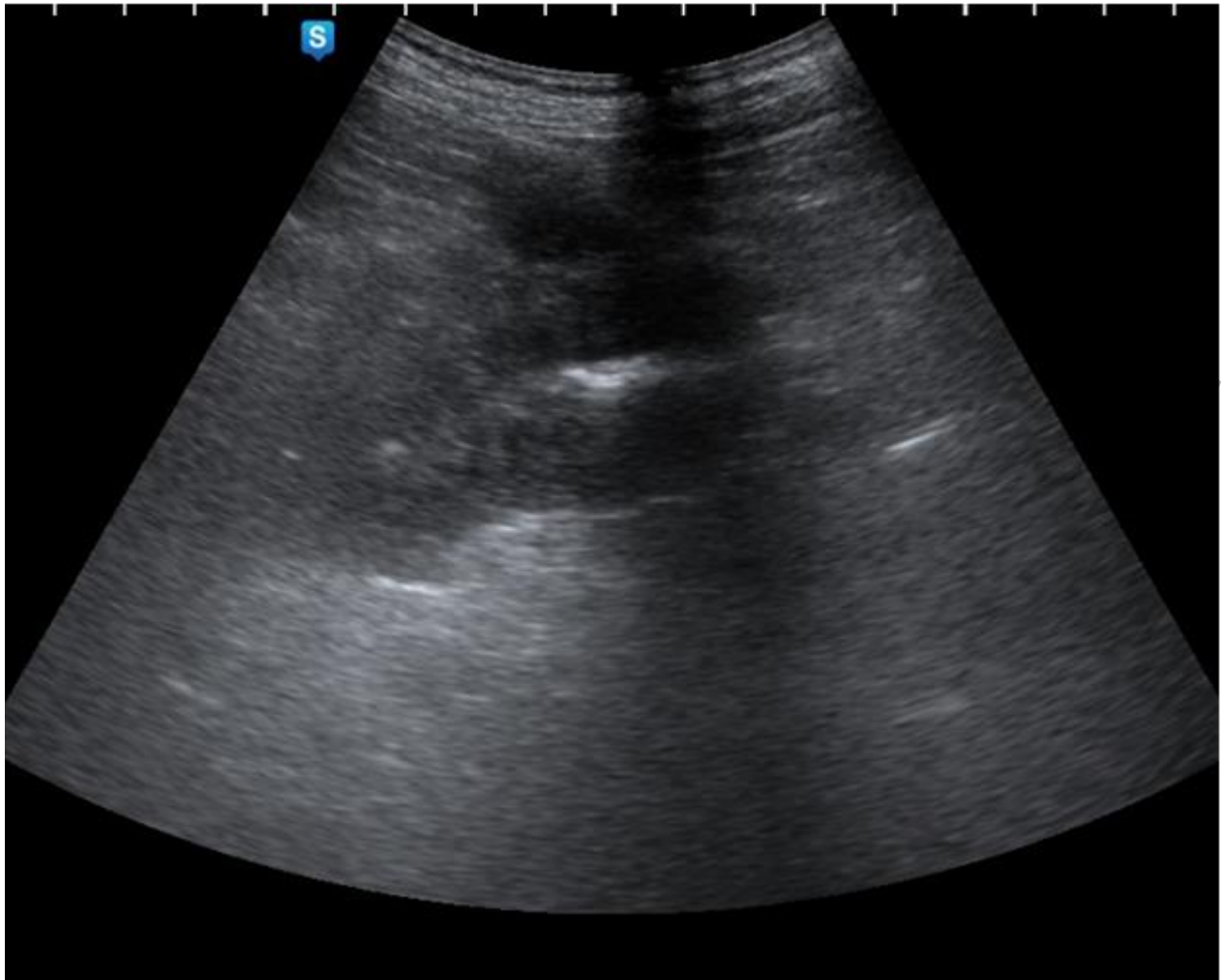


Figure 1. Transabdominal ultrasound – axial scan in left hypochondrium: thickened and hypoechoic jejunal wall with small amount of fluid in peritoneal cavity

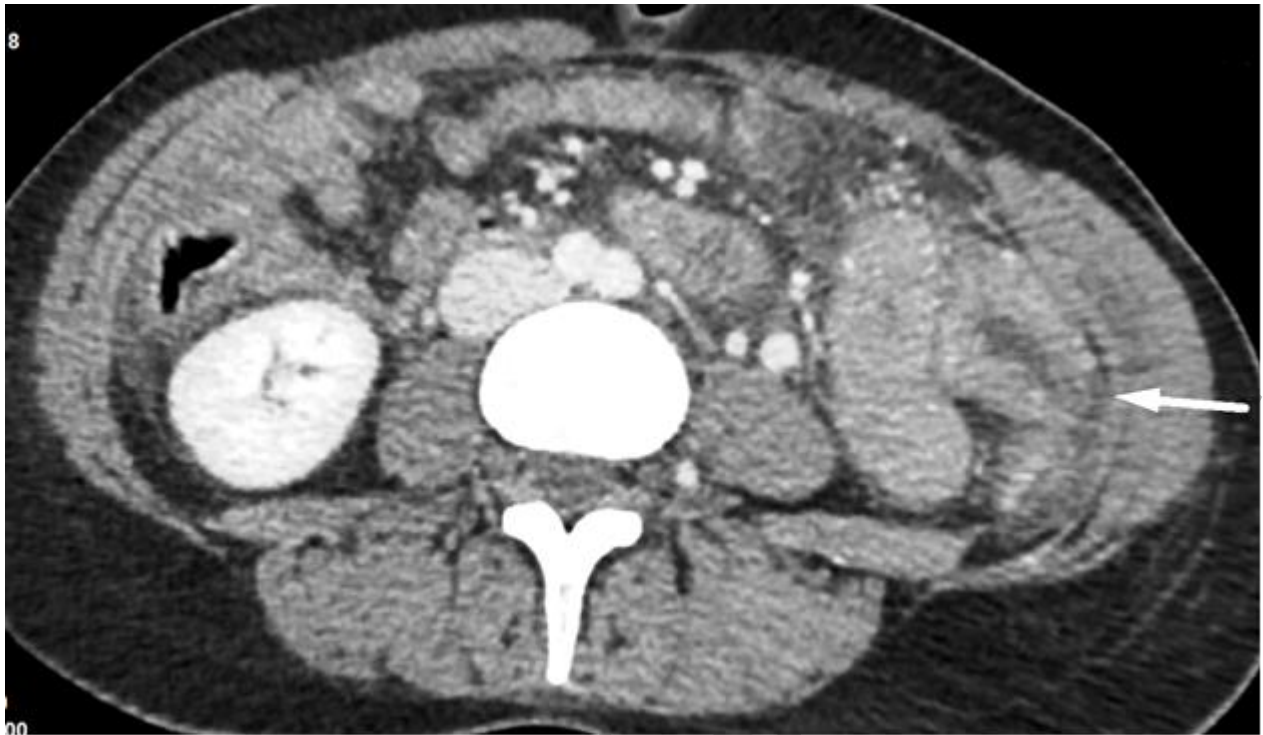


Figure 2. Contrast abdominal computed tomography – axial scan: thickened and hyperdense jejunal wall with small striped hypodense lesion at antimesenteric border (arrow) with small amount of fluid, mesenterial “fat-stranding” and thickening of adjacent parietal peritoneum – jejunal perforation



Figure 3. Contrast enhanced abdominal computed tomography – multiplanar coronal reconstruction: thickened and hyperdense jejunal wall with small striped hypodense lesion (arrow) at antimesenteric border which represent wall discontinuity – jejunal perforation



Figure 4. Contrast enhanced abdominal computed tomography – coronal reconstruction: thickened and predominantly hyperdense jejunal wall (white star) due to traumatic injury



Figure 5. Intraoperative finding: Single isolated jejunal perforation was found 20 centimeters away from the ligament of Treitz, perforation size was seven millimeters at antimesenteric border, with gaping mucosa; the isolated jejunal perforation was covered with omentum, with peritonitis enclosed in the upper left quadrant of the abdomen