CASE SERIES

Post-earthquake delayed bowel perforations in multi-trauma patients: Insights from the 2023 Türkiye earthquakes

Hilmi Anil Dincer, Mehmet Ruchan Karaca, Nezih Akkapulu

Hacettepe University Faculty of Medicine, Department of General Surgery, Ankara-*Türkiye*

ABSTRACT

Intestinal perforation may occur, albeit rarely, following blunt abdominal trauma. However, there is insufficient data in the literature regarding late-onset intestinal ischemia and perforation observed during hospitalization in patients rescued from under the rubble after earthquakes. The intestinal perforations that occurred in this patient group were defined as "stress-related intestinal ischemia." After the two earthquakes measuring 7.8 and 7.5 on the Moment Magnitude Scale that occurred in Türkiye on February 6, 2023, a total of 1261 patients were treated at our hospital. Among these patients, delayed intestinal perforation developed in three cases (0.23%) during their hospitalization for various reasons. Two of the patients had a history of hemodialysis due to acute kidney injury, while one patient had undergone continuous renal replacement therapy. No mesenteric injury was detected in any patient, and the median time between the earthquake and the development of intestinal perforation was 30 days. Two patients underwent small bowel resection and anastomosis, while the other patient underwent subtotal colectomy with end colostomy. The median length of stay in the general surgery ward following abdominal surgery was 12 days, and the median total hospital stay for treatment was 67 days. All patients were successfully discharged after completion of their postoperative treatment. In conclusion, delayed intestinal perforations may occur in multi-trauma patients after earthquakes, especially in those with risk factors such as hemodialysis, major surgeries, and prolonged hospitalizations. Stress-induced intestinal necrosis should be considered in the differential diagnosis of acute abdominal conditions that may develop during extended hospital stays.

Keywords: Crush syndrome; earthquake; hemodialysis; intestinal perforation; non-occlusive mesenteric ischemia; multi-trauma.

INTRODUCTION

On February 6, 2023, two major earthquakes measuring 7.8 and 7.5 on the Moment Magnitude Scale (Mw) struck Türkiye at 04:17 and 13:24 local time (TLT), respectively. The epicenters were located in Nurdağı (Gaziantep) and Ekinözü (Kahramanmaraş), Türkiye.[1] Among patients trapped under rubble, multiple trauma, crush syndrome, and infectious complications—particularly soft tissue infections—are commonly observed. However, the reported incidence of abdominal injuries is approximately 3.8%.[2,3] Delayed intestinal perforations may occur during hospitalization, even in the absence of a history of abdominal trauma. To the best of our knowledge, only one case series in the English literature has reported three such patients, attributing the pathophysiology to stress-induced intestinal necrosis.[4] In this study, we present and discuss three cases of patients who were admitted to the hospital for reasons unrelated to abdominal trauma following the February 6, 2023 earthquakes, and who subsequently developed intestinal perforation during hospitalization.

CASE REPORT

Case 1

A previously healthy 22-year-old female patient was rescued after being trapped under rubble for eight hours. She was

Cite this article as: Dincer HA, Karaca MR, Akkapulu N. Post-earthquake delayed bowel perforations in multi-trauma patients: Insights from the 2023 Türkiye earthquakes. Ulus Travma Acil Cerrahi Derg 2025;31:809-812.

Address for correspondence: Hilmi Anil Dincer

Hacettepe University Faculty of Medicine, Department of General Surgery, Ankara,Türkiye

E-mail: hilmianil.dincer@hacettepe.edu.tr

Ulus Travma Acil Cerrahi Derg 2025;31(8):809-812 DOI: 10.14744/tjtes.2025.03633

Submitted: 22.06.2025 Revised: 22.06.2025 Accepted: 30.06.2025 Published: 05.08.2025

OPEN ACCESS This is an open access article under the CC BY-NC license (http://creativecommons.org/licenses/by-nc/4.0/).

intubated and initially managed at another healthcare facility. During this time, she underwent two sessions of hemodialysis due to acute kidney injury (AKI), and bilateral lower extremity fasciotomies were performed for crush syndrome. On the third day following the earthquake, she was transferred to our hospital in an extubated state. Initial imaging studies in the Internal Medicine Intensive Care Unit (ICU) revealed no intra-abdominal pathology. During non-operative follow-up, she developed paralytic ileus and was subsequently monitored for fever of unknown origin. On post-earthquake day 30, the patient developed rectal bleeding. Colonoscopy revealed widespread ischemic changes in the sigmoid colon, prompting surgical intervention. Intraoperatively, ischemic areas and perforations were found in the rectum, sigmoid colon, and descending colon (Fig. 1). A left-sided subtotal colectomy was performed, and an end colostomy was created at the level of the transverse colon. Histopathological examination showed ulceration, active chronic inflammation, and widespread congestive-ischemic changes. No postoperative surgical complications occurred. The patient was monitored in the general surgery ward until postoperative day 16. Due to ongoing orthopedic surgical needs related to crush syndrome and lower extremity injuries, she remained hospitalized for a total of 111 days and was eventually discharged in good health. Her colostomy was closed in the ninth postoperative month.

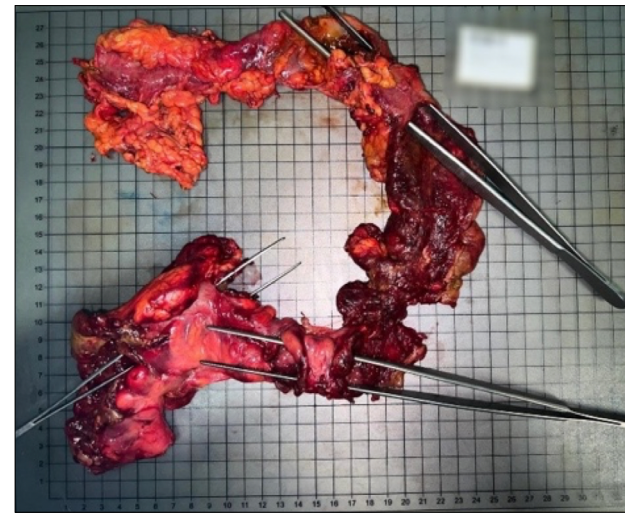


Figure 1. Surgical specimen from Case 1. From distal to proximal, the sequence includes the rectum, sigmoid colon, descending colon, and distal transverse colon.

Case 2

A previously healthy 29-year-old female patient was rescued after being trapped under rubble for 10 hours and was monitored at another healthcare facility for two days. During that period, she underwent one session of hemodialysis due to acute kidney injury. On the second day following the earthquake, she was admitted to the Internal Medicine ICU of our hospital. Initial assessment revealed no intra-abdominal pathology. Fasciotomy was performed on the left lower extremity due to compartment syndrome, and continuous renal replacement therapy was administered for eight hours. On post-earthquake day 9, she was referred to the General Surgery department with a preliminary diagnosis of paralytic ileus. After five days of observation, she developed abdominal pain, and computed tomography (CT) revealed findings suggestive of a contained perforation in the distal ileal loops. Emergency surgery was performed on day 14. Two perforations were identified, located 110 cm and 130 cm distal to the ligament of Treitz. A 30 cm segment of small intestine was resected, and an ileoileal anastomosis was performed. Histopathological examination revealed ulceration, active chronic inflammation, inflammatory granulation tissue, and ischemic changes. The patient was followed in the general surgery ward for 12 days. She remained hospitalized for an additional 30 days due to repeated orthopedic surgical interventions and was ultimately discharged in good health after a total of 42 days of hospitalization.

Case 3

A previously healthy 62-year-old male patient was rescued approximately one hour after being trapped under rubble. He was admitted to the Neurosurgical ICU of our institution on post-earthquake day 4 with a diagnosis of subarachnoid hemorrhage and vertebral fracture. Initial imaging studies revealed no intra-abdominal pathology. On post-earthquake day 26, posterior spinal instrumentation was performed by the neurosurgery team. On hospital day 45 (post-earthquake day 49),

Table 1. Patient characteristics

Age	Gender	HD	CRRT	Duration Under Rubble (hours)	Time to Surgery After Earthquake (days)	Perforation Site	Additional Surgeries
22	Female	+	-	8	30	Rectum, sigmoid colon, and descending colon	Fasciotomy, VAC revisions
29	Female	+	+	10	14	Ileum	Fasciotomy, VAC revisions
62	Male	-	-	1	45	Ileum	Posterior spinal instrumentation

HD: Hemodialysis; CRRT: Continuous renal replacement therapy; VAC: Vacuum-assisted closure.

he was referred to the General Surgery department due to two days of periumbilical abdominal pain. Computed tomography revealed findings suggestive of a contained perforation near the ileocecal valve, and the patient underwent emergency surgery. Intraoperatively, a perforation was identified in the distal small intestine. Resection followed by primary anastomosis was performed. Histopathological examination revealed ulceration, granulation tissue, and active chronic inflammation. The patient was monitored in the surgical ward for nine days and was ultimately discharged in good health after a total hospital stay of 67 days, following appropriate treatment and follow-up.

The patient characteristics for all cases are summarized in Table 1. Written informed consent was obtained from all patients included in this case report. Ethical approval was not required for this case series, in accordance with institutional and international guidelines.

DISCUSSION

Patients trapped under rubble following earthquakes often sustain multiple traumatic injuries. Among these, lower extremity injuries are the most common (36.2%), followed by upper extremity injuries (19.9%), while abdominal organ injuries are reported in approximately 3.8% of cases.[2] Although intestinal injuries following non-earthquake-related blunt abdominal trauma are rare, the most widely accepted mechanism is ischemia resulting from entrapment of mesenteric structures between two objects. Another mechanism involves partial or complete injury to the gastrointestinal mesentery due to shearing forces caused by rapid deceleration. A third mechanism is blast-like injury, which may occur due to increased pressure within the intestinal lumen during impact.[5] Several case reports in the literature have documented small bowel and colonic perforations resulting from blunt abdominal trauma.[6,7] According to the Hollow Viscus Injury Research Group, the incidence of small intestinal perforation following blunt trauma is approximately 0.3%.[8] In a study investigating colonic perforations associated with blunt trauma, the incidence was reported to be 1.1%.[9]

There is limited data on delayed intestinal perforations in multi-trauma patients without penetrating abdominal injuries following earthquakes. To date, only one study in the English literature has reported three such cases. In the study by Gong et al., these perforations were characterized as "stress-induced intestinal necrosis." The incidence of intestinal necrosis was 0.09%, with perforations developing at a median of 21 days post-earthquake. Of the three patients, two were discharged, while one died during follow-up.[4] In our hospital, 1,261 patients with earthquake-related injuries were admitted. Among them, delayed intestinal perforation occurred in three cases (0.23%). The median time from the earthquake to the onset of perforation was 30 days. In contrast to the previous study, all patients in our series survived and were discharged.

The incidence of acute mesenteric ischemia (AMI) in patients presenting to the emergency department with acute abdominal pain is reported to be 0.09%–0.2% in the general population, while among hemodialysis patients, it ranges from 0.3% to 1.9%.[10] Two of our patients had a history of hemodialysis due to AKI. One of the recognized etiologies of AMI is non-occlusive mesenteric ischemia (NOMI), which is characterized by mesenteric ischemia in the absence of obstructive pathology within the mesenteric vessels. Patients who develop NOMI are typically elderly, have undergone major cardiac or abdominal surgery, are septic, in shock, taking medications that induce mesenteric vasoconstriction, have low cardiac output, or suffer from underlying cardiac conditions that impair mesenteric perfusion. Non-occlusive mesenteric ischemia accounts for 20%–30% of AMI cases and carries a mortality rate of approximately 50%.[11] According to Gong et al., delayed intestinal necrosis may be attributed to prolonged mesenteric hypoperfusion triggered by severe stress related to trauma and its complications.[4] Reduced mesenteric blood flow leads to decreased oxygen delivery to intestinal cells, resulting in cellular injury and death. During the reperfusion phase, oxidative stress and neutrophil activation contribute to additional tissue damage, a process known as reperfusion injury.[12] No confirmed vascular pathology was identified in the patients included in this study. It is presumed that the mechanisms underlying the perforations may involve the aforementioned factors.

In conclusion, non-occlusive mesenteric ischemia and trauma-related intestinal perforations should be considered in the differential diagnosis of acute abdominal conditions in multi-trauma patients with a history of hemodialysis and prior surgery during prolonged hospitalizations following earthquakes.

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: H.A.D., N.A.; Design: H.A.D., M.R.K.; Supervision: N.A.; Resource: H.A.D., M.R.K., N.A.; Materials: M.R.K.; Data collection and/or processing: M.R.K.; Analysis and/or interpretation: H.A.D., M.R.K.; Literature review: H.A.D., M.R.K.; Writing: H.A.D., M.R.K.; Critical review: H.A.D., N.A.

Conflict of Interest: None declared.

Financial Disclosure: The author declared that this study has received no financial support.

Use of AI for Writing Assistance: Artificial intelligence (AI) was partially used in the translation of the manuscript.

REFERENCES

1. Dilsiz A, Günay S, Mosalam KM, Miranda E, Arteta C, Sezen H, et al. StEER-EERI: 2023 Mw 7.8 Kahramanmaras, Türkiye earthquake sequence joint preliminary virtual reconnaissance report (PVRR). Zurich: ETH Zurich; 2023.
2. Igarashi Y, Matsumoto N, Kubo T, Yamaguchi M, Nakae R, Onda H, et al. Prevalence and characteristics of earthquake-related head injuries:

A systematic review. Disaster Med Public Health Prep 2022;16:1253-8. [CrossRef]
3. Chen TW, Yang ZG, Dong ZH, Chu ZG, Tang SS, Deng W. Earthquake-related crush injury versus non-earthquake injury in abdominal trauma patients on emergency multidetector computed tomography: A comparative study. J Korean Med Sci 2011;26:438-43. [CrossRef]
4. Gong JQ, Zhang GH, Tian FZ, Wang YH, Zhang L, Cao YK, et al. Stress-induced intestinal necrosis resulting from severe trauma of an earthquake. World J Gastroenterol 2012;18:2127-31. [CrossRef]
5. Hughes TM, Elton C. The pathophysiology and management of bowel and mesenteric injuries due to blunt trauma. Injury 2002;33:295-302. [CrossRef]
6. Ertugrul G, Coskun M, Sevinc M, Ertugrul F, Toydemir T. Delayed presentation of a sigmoid colon injury following blunt abdominal trauma: A case report. J Med Case Rep 2012;6:247. [CrossRef]
7. Hamidian Jahromi A, Johnson L, Youssef AM. Delayed small bowel perforation following blunt abdominal trauma: A case report and review of the literature. Asian J Surg 2016;39:109-12. [CrossRef]
8. Watts DD, Fakhry SM; EAST Multi-Institutional Hollow Viscus Injury Research Group. Incidence of hollow viscus injury in blunt trauma: An analysis from 275,557 trauma admissions from the East multi-institutional trial. J Trauma 2003;54:289-94. Erratum in: J Trauma 2003;54:749. [CrossRef]
9. Ricciardi R, Paterson CA, Islam S, Sweeney WB, Baker SP, Counihan TC. Independent predictors of morbidity and mortality in blunt colon trauma. Am Surg. 2004;70:75-9. [CrossRef]
10. Shirazian S, Radhakrishnan J. Gastrointestinal disorders and renal failure: Exploring the connection. Nat Rev Nephrol 2010;6:480-92. [CrossRef]
11. Trompeter M, Brazda T, Remy CT, Vestring T, Reimer P. Non-occlusive mesenteric ischemia: Etiology, diagnosis, and interventional therapy. Eur Radiol 2002;12:1179-87. [CrossRef]
12. Gonzalez LM, Moeser AJ, Blikslager AT. Animal models of ischemia-reperfusion-induced intestinal injury: Progress and promise for translational research. Am J Physiol Gastrointest Liver Physiol 2015;308:G63-75. [CrossRef]

OLGU SERİSİ - *ÖZ*

Deprem sonrası multitravma hastalarında gecikmiş barsak perforasyonları: 2023 türkiye depremlerinden bulgular

Künt karın travmalarından sonra bağırsak perforasyonu nadir de olsa görülebilmektedir. Depremlerde göçük altından çıkarılan hastalarda görülebilen geç dönem bağırsak iskemisi ve perforasyonu ile ilgili ise literatürde yeterli veri bulunmamaktadır. Bu hasta grubunda meydana gelen bağırsak perforasyonları "stres ilişkili intestinal iskemi" olarak tanımlanmıştır. 06 Şubat 2023 tarihinde Türkiye'de meydana gelen 7.8 ve 7.5 Moment Magnitude büyüklüğünde iki depremin ardından hastanemizde 1261 hasta tedavi edilmiştir. Bu hastalardan üç tanesinde (%0.23) çeşitli sebeplerle tedavi edildikleri dönemde geç dönem bağırsak perforasyonu gelişmiştir. Hastaların ikisinde akut böbrek yetmezliği nedeniyle hemodiyaliz, bir tanesinde ise devamlı renal replasman tedavisi öyküsü bulunmaktaydı. Hiçbir hastada mezenterik yaralanma mevcut olmayıp, deprem ile bağırsak perforasyonu arasında geçen median süre 30 gündü. Hastalardan ikisine ince bağırsak rezeksiyonu ve anastomoz, diğer hastaya ise subtotal kolektomi ve uç kolostomi açılması ameliyatları yapıldı. Abdominal cerrahi sonrası hastaların median genel cerrahi kliniğinde yatış süresi 12 gün, toplam tedavileri için median hastanede kalış süresi ise 67 gündü. Hastaların tamamı ameliyat sonrası tedavi tamamlanarak şifa ile taburcu edildi. Sonuç olarak, deprem sonrası multitravma hastalarında, hemodiyaliz, büyük cerrahiler ve uzun hastane yatışları gibi risk faktörleri bulunan hastalarda gecikmiş intestinal perforasyonlar gelişebilmektedir. Uzamış hastane yatışları sürecinde gelişebilecek akut batın strese bağlı intestinal nekroz ayırıcı tanıda göz önünde bulundurulmalıdır.

Anahtar sözcükler: Crush sendromu; deprem; hemodiyaliz; intestinal perforasyon; intestinal iskemi; multitravma.

Ulus Travma Acil Cerrahi Derg 2025;31(8):809-812 DOI: 10.14744/tjtes.2025.03633