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Case Report

# Robotic assisted splenectomy after failure of splenic angioembolization in blunt abdominal trauma

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ABSTRACT

Traumatic blunt splenic injury in the hemodynamically stable patient is initially managed with a nonoperative strategy that may include angioembolization. If patients continue to have ongoing signs of bleeding after angioembolization, definitive management is surgical splenectomy. We report the case of a patient with a grade IV blunt splenic injury who had ongoing bleeding after angioembolization and was taken for diagnostic robotic surgery. An isolated splenic injury was identified and the patient was treated with robotic splenectomy. On one month follow up the patient was noted to be doing well with minimal pain. To our knowledge, this is the first report of robotic splenectomy after failed non-operative manage in the setting of trauma. This case shows the potential value of robotic surgery to apply the benefits of minimally invasive surgery in hemodynamically stable patients who fail non-operative management after traumatic splenic injury.

## Introduction

Splenic injuries are one of the most common organ injuries identified after abdominal trauma [1]. In the modern era blunt splenic injuries are typically managed non-operatively by serial examination with or without angioembolization [2]. If patients fail these management strategies, then definitive treatment is surgical splenectomy. Traditionally, splenectomy for traumatic injury was performed via exploratory laparotomy. With the growing experience of surgeons in minimally invasive surgery, there has been an increase in the use of both diagnostic laparoscopy and laparoscopic splenectomy (LS) for trauma [1,3–5]. Despite the widespread adoption of robotic surgery in general surgery, the role of robotic-assisted surgery after abdominal trauma is only beginning to be explored [6–9]. Robotic surgery offers many advantages to laparoscopic surgery such as decreased conversion rates to open, increased dexterity, and decreased pain [10,11]. To our knowledge, no prior report exists of robotic assisted splenectomy after failure of non-operative management for splenic trauma. We report the case of a patient with ongoing bleeding after splenic embolization for grade IV blunt splenic injury managed by robotic assisted splenectomy with good outcome.

## Case report

A 60-year-old female with a history of hypertension, coronary artery disease, type two diabetes, and chronic kidney disease presented one day after a fall with left upper quadrant pain. On arrival she was noted to be tachycardic with a heart rate of 114. She

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was taken for computed tomography of the abdomen and pelvis which identified a grade four splenic injury with a subcapsular hematoma measuring 8.5 × 2.9 × 8.4 cm and contrast extravasation into the hematoma. Initial hemoglobin was 14.3, but dropped to 10.7 on recheck (AAST trauma). Despite remaining normotensive, the patient developed worsening tachycardia to 126 and was taken for angioembolization with interventional radiology. No extravasation was noted on angiogram and a proximal splenic artery coil angioembolization was performed. After embolization the patient's hemoglobin continued to downtrend from 8.9 post-embolization to 6.5 over the next 48 h. Given the concern for ongoing bleeding, she was taken for robotic assisted diagnostic surgery and possible splenectomy. The patient was placed supine and abdominal entry was performed with gasless optiview entry to the left of midline. Three additional 8 mm trocars were placed in a horizontal line across the abdomen. An assist port was placed between the third and the fourth 8 mm ports. An additional incision was made for the Nathanson liver retractor. The DaVinci Xi robot (DaVinci - Intuitive Surgical, Sunnyvale, CA) was docked. On diagnostic exploration we noted hemoperitoneum and rupture of the posterior capsule of the spleen with ongoing bleeding. No other abdominal injuries were identified. Given the significant damage to the spleen we proceeded with robotic assisted splenectomy. Dissection began with entry into the lesser sac and proceeded with mobilization of the stomach up to the left crus to expose the pancreas and splenic hilum. Additional bleeding was noted from the splenic hilum. The splenocolic ligament, gastrosplenic ligament, and lateral splenic attachments were transected to further expose the splenic hilum. The splenic hilar vessels were ligated using the vessel sealer and Hem-o-lok clips (Teleflex, Wayne, PA). The remaining diaphragmatic attachments were transected and the spleen was removed from the patient. A Jackson-Pratt drain was placed in the splenic hilum. The total case duration was 104 min with 57 min of console time. On post operative day one the patient was downgraded from the ICU and her diet was advanced. Her hemoglobin remained stable throughout hospitalization. The patient was otherwise ready for discharge on post-operative day two but remained admitted pending clearance from physical therapy. On postoperative day five her drain was removed and the patient was discharged. On one month follow up, the patient was noted to be doing well with minimal pain (Figs. 1-7).

## Discussion

Splenic trauma is increasingly managed by a non-operative strategy of serial examination with or without angioembolization. This initial strategy is supported for hemodynamically stable patients with any grade of blunt splenic injury by the World Society of Emergency Surgery (WSES) [2]. Angioembolization is strongly encouraged for all patients with contrast blush on imaging, and is recommended for grades IV and V injuries. If angioembolization is ineffective then patients are recommended to undergo laparotomy with splenectomy or splenic salvage procedure [2]. The WSES guidelines acknowledged case reports of LS in trauma, but do not recommend performing LS in the early trauma scenario for bleeding patients [2]. Despite this recommendation, 212 cases of LS after trauma were identified in the literature between 1990 and 2018 [1]. Reports have consistently found LS to have comparable safety to open splenectomy in hemodynamically stable trauma patients, with the most common indication for LS being failure of non-operative

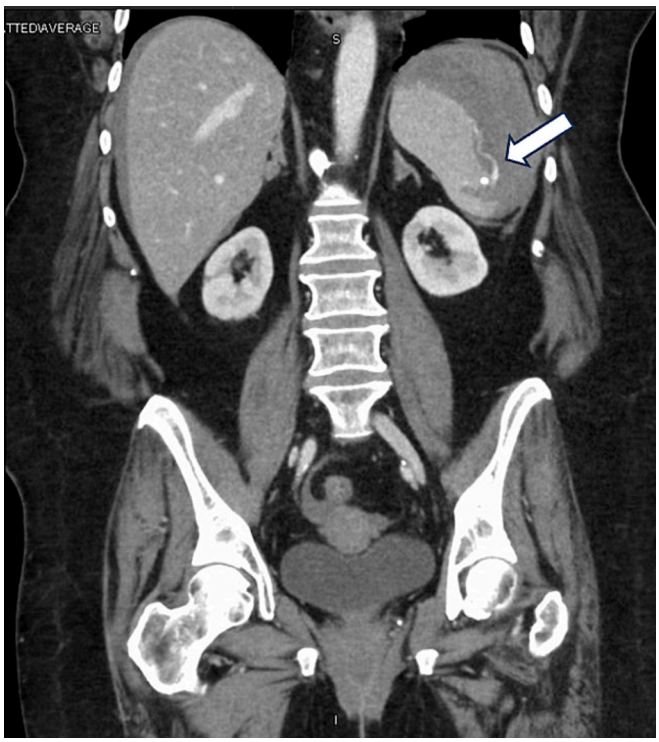


**Fig. 1.** Coronal image of splenic capsular hematoma and active extravasation of contrast into the hematoma as shown by the arrow.

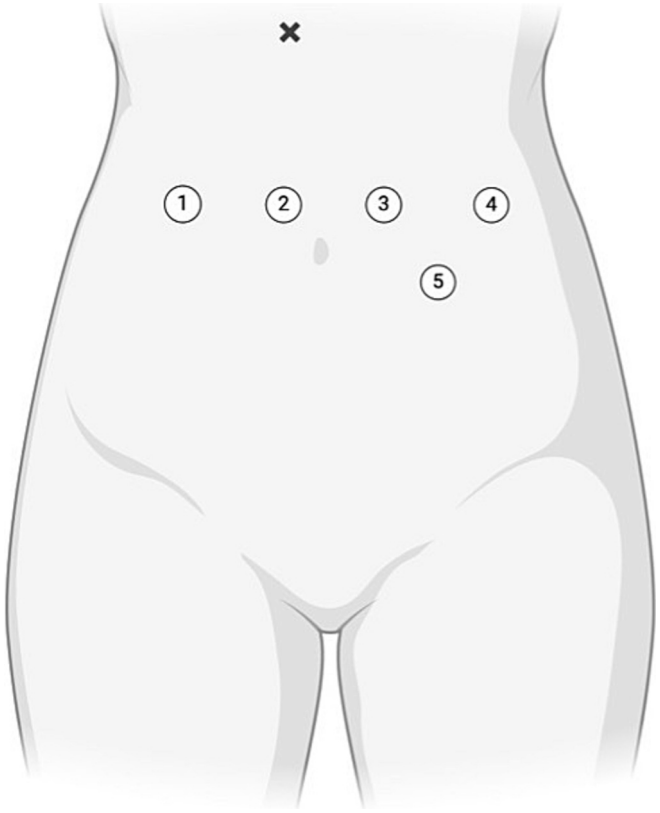


**Fig. 2.** Port placement. Port 1 is the force bipolar, port 2 is the camera, port 3 is the vessel sealer extended tip, port 4 is the robotic suction, and port 5 is an assist port. The X represents the incision for the Nathanson retractor [18].

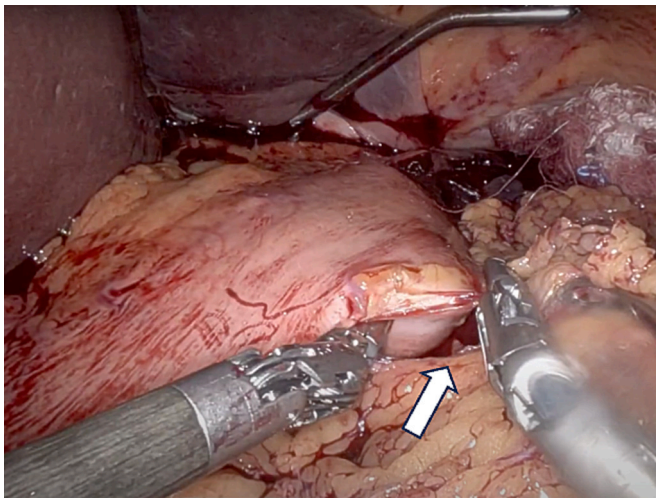

**Fig. 3.** Accessing the lesser sac. Free fluid and blood can be noted in the lesser sac.

management [1,3,5]. Potential benefits noted from laparoscopic splenectomy include shorter hospital length of stay, decreased pain, decreased wound infection, shorter bedrest, and decreased ileus but this has not been definitively shown across every study [1,3,5,12]. Operative duration has been noted to be longer in cases of laparoscopic splenectomy with a mean operative time of 106.6 min, which is similar to our total operative duration of 104 min for robotic splenectomy, though only 57 min of console time was needed [1].

Prior studies of minimally invasive surgery for abdominal trauma have exclusively reported on laparoscopy. Diagnostic laparoscopy in trauma has been shown to decrease the rates of negative laparotomies resulting in shorter hospital stays for patients without

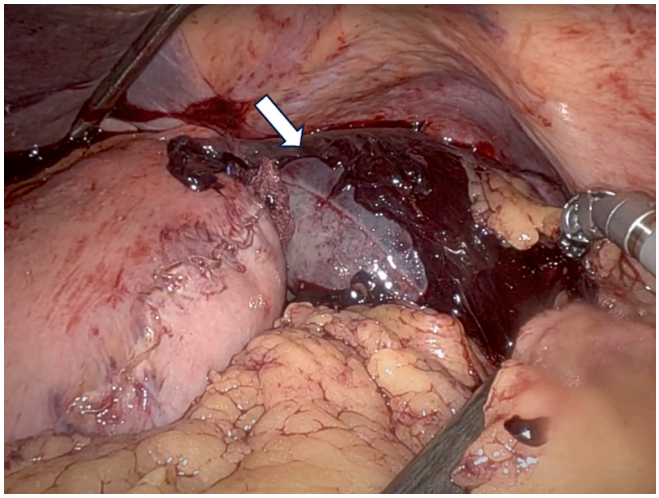

**Fig. 4.** Initial visualization of splenic injury with posterior capsule disruption and hematoma.

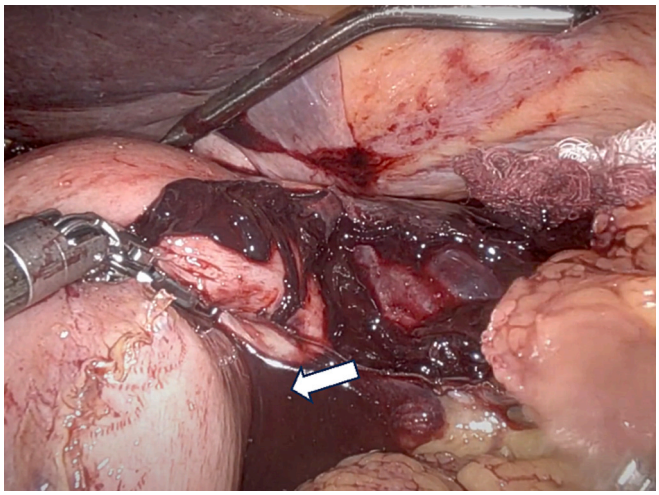

**Fig. 5.** Hemoperitoneum extending from the splenic hilum with ongoing bleeding despite prior embolization.

abdominal injuries [13]. However, in patients found to have organ injuries there likely continues to be high rates of conversion to open surgery for therapeutic surgery. Koganti et al. retrospectively reviewed their centers experience using diagnostic laparoscopy after trauma and found that 16/17 (94.1 %) patients found to have splenic injury had conversion to open surgery [4]. Of note, their study was performed on patients taken emergently for surgery on initial presentation, which may result in higher rates of conversion to open surgery. With the growing experience of surgeons in robotic surgery, our hope is that the robotic platform will allow for decreased conversion rates to open as compared to laparoscopic surgery. This potential benefit of robotic has been shown by decreased conversion rates in other abdominal surgeries [10].

Robotic splenectomies are known to be a safe alternative to laparoscopic splenectomy, and have been associated with decreased blood loss with a trend towards decreased conversion [14]. Typically, robotic splenectomy is performed with the patient in the right lateral decubitus position with reverse Trendelenburg to assist in exposure of the spleen [15]. Given the patient's scenario, we wanted to maintain the principles of trauma surgery and allow for easy conversion to exploratory laparotomy. The patient was therefore positioned supine instead of right lateral decubitus. We believe it is essential to patient safety to be prepared to adapt if a minimally invasive surgery is unable to successfully manage a traumatic injury, even if it makes the case slightly more challenging.

Despite the widespread adoption of robotics in general surgery, the role of robotic surgery after abdominal trauma remains to be determined. In a case series of robotic splenectomies by Giulianotti et al. the indication for two of the splenectomies, one total and one partial, was post-traumatic hematomas [16]. However, no further details are provided about the patient's course. Only limited other case reports exist of robotic surgery for abdominal trauma. Previous cases include the repair of an abdominal wall defect with omental herniation, a spleen preserving distal pancreatectomy, and diaphragmatic hernia repair [8,9,17]. Thus far it appears patient selection is important to maintaining good outcomes, as all patients were hemodynamically stable at the time of surgery and had completion

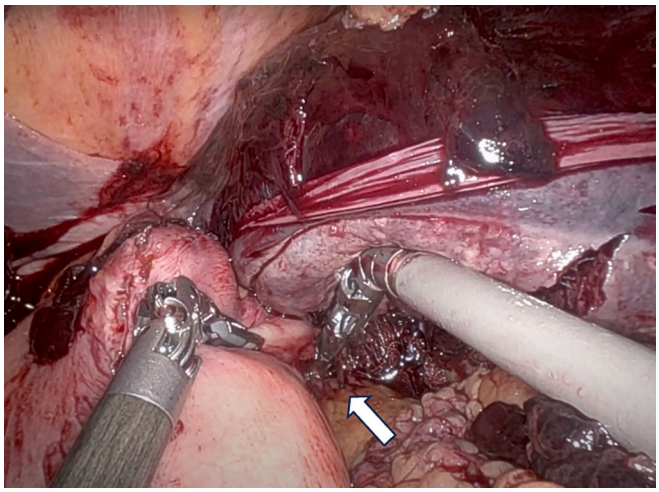

**Fig. 6.** Retraction of the spleen and release of the gastrosplenic attachments.

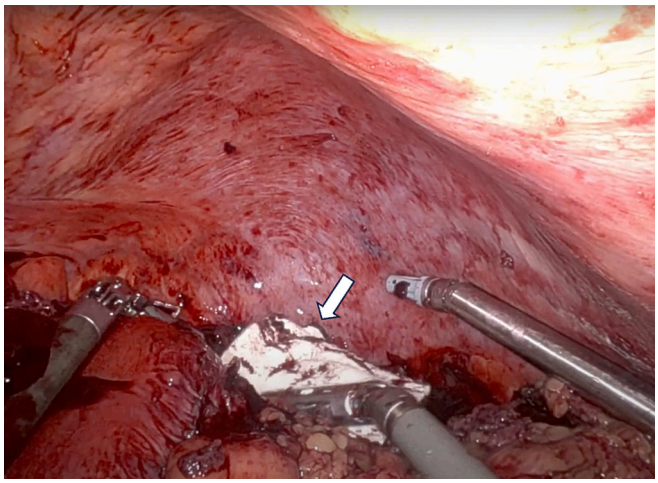

**Fig. 7.** Placement of Everest (J&J MedTech, Warsaw, IN) into splenic fossa after obtaining hemostasis.

computed tomography imaging. Only the case by Schatsko et al. was performed emergently on initial presentation, with the others being performed urgently but later in the index hospitalization [8]. These early results are promising, showing a potential benefit of therapeutic robotic surgery for trauma in hemodynamically stable patients that merits further research.

To our knowledge this is the first reported case of robotic splenectomy for ongoing bleeding after splenic embolization due to trauma. Our case shows the feasibility of the robotic surgery platform for splenectomy in the hemodynamically stable trauma patient who fail non-operative management. We were successfully able to rule out further intra-abdominal injuries, showing an additional diagnostic benefit of the robotic platform. For the appropriately trained surgeon, abdominal trauma should not be a contraindication to robotic surgery in the hemodynamically stable patient. Applying this technology has the potential to extend the benefits of minimally invasive surgery to patients who would have otherwise required open surgery.

## CRediT authorship contribution statement

**Zach Rollins:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Conceptualization. **Deki Tsering:** Writing – review & editing, Project administration. **Terral Goode:** Writing – review & editing, Supervision. **Anthony Mark:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Investigation, Conceptualization.

## Declaration of competing interest

The authors declare that they have no known competing financial interest of personal relationships that could have appeared to

influence the work reported in this paper.

## References


[1] P. Fransvea, G. Costa, A. Serao, et al., Laparoscopic splenectomy after trauma: who, when and how. A systematic review, J. Minim. Access Surg. 17 (2) (Apr-Jun 2021) 141–146, https://doi.org/10.4103/jmas.JMAS_149_19.

[2] F. Coccolini, G. Montori, F. Catena, et al., Splenic trauma: WSES classification and guidelines for adult and pediatric patients, World J. Emerg. Surg. 12 (Aug 18 2017) 40, https://doi.org/10.1186/s13017-017-0151-4.

[3] A. Birindelli, M. Martin, M. Khan, et al., Laparoscopic splenectomy as a definitive management option for high-grade traumatic splenic injury when non operative management is not feasible or failed: a 5-year experience from a level one trauma center with minimally invasive surgery expertise, Updat. Surg. 73 (4) (Aug 2021) 1515–1531, https://doi.org/10.1007/s13304-021-01045-z (Epub 2021 Apr 10).

[4] D. Koganti, B.J. Hazen, C.J. Dente, J. Nguyen, R.B. Gelbard, The role of diagnostic laparoscopy for trauma at a high-volume level one center, Surg. Endosc. 35 (6) (Jun 2021) 2667–2670, https://doi.org/10.1007/s00464-020-07687-1 (Epub 2020 Jun 4).

[5] L. Romeo, F. Bagolini, S. Ferro, et al., Laparoscopic surgery for splenic injuries in the era of non-operative management: current status and future perspectives, Surg. Today 51 (7) (Jul 2021) 1075–1084, https://doi.org/10.1007/s00595-020-02177-2 (Epub 2020 Nov 16).

[6] K.H. Sheetz, J. Claflin, J.B. Dimick, Trends in the adoption of robotic surgery for common surgical procedures, JAMA Netw. Open 3 (1) (Jan 3 2020) e1918911, https://doi.org/10.1001/jamanetworkopen.2019.18911.

[7] C. Griffin, W. Crute, W. White, Robotic-assisted laparoscopic repair of a penetrating extraperitoneal bladder injury, Urology 181 (2023) e205, https://doi.org/10.1016/j.urology.2023.08.009.

[8] A. Shchatsko, G. Swenson, A. Vasyluk, Robotic evaluation and repair of penetrating injury of the abdominal wall, Cureus 16 (7) (Jul 2 2024) e63685, https://doi.org/10.7759/cureus.63685.

[9] E. Kim, P. Collier, Siffring, et al., First robotic spleen preserving distal pancreatectomy for trauma, in: Poster presented at: SAGES 2017 Annual Meeting, March, 2017 (Houston, TX).

[10] P.C. Shah, A. de Groot, R. Cerfolio, et al., Impact of type of minimally invasive approach on open conversions across ten common procedures in different specialties, Surg. Endosc. 36 (8) (2022) 6067–6075, https://doi.org/10.1007/s00464-022-09073-5.

[11] K. Reddy, P. Gharde, H. Tayade, M. Patil, L.S. Reddy, D. Surya, Advancements in robotic surgery: a comprehensive overview of current utilizations and upcoming frontiers, Cureus 15 (12) (Dec 12 2023) e50415, https://doi.org/10.7759/cureus.50415.

[12] A.A. Shamim, S.N. Zafar, W. Nizam, et al., Laparoscopic splenectomy for trauma, JSLS 22 (4) (Oct-Dec 2018), https://doi.org/10.4293/JSLS.2018.00050 (e2018.00050).

[13] K. Hage, A. Nelson, M.H. Khurshid, et al., Diagnostic laparoscopy in trauma patients: do we need to open and see if we can see without opening? J. Surg. Res. 303 (2024) 14–21, https://doi.org/10.1016/j.jss.2024.08.014.

[14] P. Bhattacharya, L. Phelan, S. Fisher, S. Hajibandeh, S. Hajibandeh, Robotic vs. laparoscopic splenectomy in management of non-traumatic splenic pathologies: a systematic review and meta-analysis, Am. Surg. 88 (1) (2022) 38–47, https://doi.org/10.1177/0003134821995057.

[15] G. Gamme, D.W. Birch, S. Karmali, Minimally invasive splenectomy: an update and review, Can. J. Surg. 56 (4) (2013) 280–285, https://doi.org/10.1503/cjs.014312.

[16] P.C. Giulianotti, N.C. Buchs, P. Addeo, S. Ayloo, F.M. Bianco, Robot-assisted partial and total splenectomy, Int. J. Med. Robot. 7 (4) (2011) 482–488, https://doi.org/10.1002/rcs.409.

[17] A. Hargrave, C. Przeslawski, C.A. Solomon Schnurr, K. Jamil, Robotic repair of acute traumatic diaphragmatic injury from an abdominal approach: a case report, Cureus 16 (8) (Aug 31 2024) e68335, https://doi.org/10.7759/cureus.68335.

[18] Created in BioRender, Z. Rollins. BioRender.com/r01s373, 2024.