Gastrointestinal Anastomosis (GIA) Stapler as a safe and efficacious damage control tool for High-Grade Liver Injury in Hemodynamically Unstable Patient- A Case Report

Sabah uddin Saqib (✉ drsabahsaqib@hotmail.com)
Aga Khan University Hospital

Wafa Iftekhar
Aga Khan University Hospital

Hasnain Zafar
Aga Khan University Hospital

Case report

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Abstract

Background:

Liver injury occurs in approximately 5% of all trauma admissions. The large size of the liver and its location makes it more susceptible to injuries. Nowadays, the majority of isolated liver injuries are successfully managed with non-operative methods, however, operative management is still the mainstay of treatment for hemodynamically unstable patients. There are many traditional ways of controlling hemorrhage from the liver and here we report a case in which a GIA 75 stapler was successfully used to manage Grade IV liver injury in a hemodynamically unstable patient.

Case presentation:

45 years old policeman presented in the emergency, within 20 minutes after sustaining a gunshot injury to his abdomen. At presentation, he was hemodynamically unstable with a heart rate of 100 beats/min and blood pressures of 70/35 mm Hg. On examination, he had a single entry wound in the epigastrium with no exit wound and had generalized peritonitis. He was paraplegic and had a sensory level. He was rushed to the operating room (OR) for exploratory laparotomy which revealed a shattered left lobe of the liver. Gastrointestinal anastomosis 75 stapler device was used for non-anatomical left segmentectomy (segments I and II). Active bleeding from tributaries of left hepatic vein and small branches opening into retrohepatic inferior vena cava (IVC) was identified and the vessels were suture ligated. Perihepatic packing was done and the patient shifted to the surgical intensive care unit (SICU). His improved hemodynamically and was re-explored within 24 hours. No active bleeding was seen after the packs were removed and the abdomen was closed. The next day he was moved out of SICU and the rehabilitation program was initiated for his spine injury. He was discharged on the 10th day of admission.

Discussion:

Grade IV liver injuries are often very complex and challenging to manage in a hemodynamically unstable patient. The role of GIA staplers for hepatic resection is quite common and safe in elective settings but their similar use in the context of trauma is less described. The concept of damage control surgery rests on quick control of life-threatening bleeding and a GIA stapler can be effectively used for rapid non-anatomical resection of the liver in trauma. This can prevent the depletion of physiological reserves and the life-threatening death triad.

Conclusion:

GIA stapler device is an effective, safe, and rapidly deployable tool for managing high grade liver injury in a hemodynamically unstable patient. It controls bleeding without any concomitant chances of bile leak and also resection of the shattered liver gives good access for inspecting the rest of the bleeding sites.
The liver injury occurs in approximately 5% of all trauma admissions(1). Large surface area and more anterior location beneath the subcostal margin make the liver a more susceptible organ to sustain both blunt or penetrating injuries. The management of liver trauma continues to evolve with improved techniques of diagnosis and management, both operatively and nonoperatively. However, high-grade liver injuries which include major parenchymal disruption, retrohepatic venous injuries, and those involving the portal triad continue to remain a challenge and despite technological advances, associated with high mortality(2). Therefore, despite our progress in liver injury management, many avenues for improvement remain to be explored.

Operative management for managing Grade IV hepatic injuries and non-responders associated with active hemorrhage and hemodynamic instability includes multiple surgical techniques ranging from initial packing, manual compression, Pringle’s maneuver, direct suturing, balloon inflation, use of energy devices to ligation of vessels and hepatic resection. (3). We report a case of a patient who sustained a high-grade hepatic injury and underwent damage control surgery, where the GIA stapler device was used to perform non-anatomical liver resection and control active bleeding. This uncommon method of managing liver injuries was found to be safe, effective, and more importantly time-saving for the patient.

Case Presentation:

A 45 years old policeman, otherwise healthy, was brought to the trauma bay in the ER after sustaining a single gunshot injury to his abdomen from a high-velocity weapon. The incident occurred while pursuing a terrorist in Karachi, early morning at around 6.30 Am. He was shifted to the Emergency room of a tertiary care hospital within 20 minutes after sustaining the injury.

On arrival, advanced trauma life support system protocols were initiated and immediate resuscitation was started. During the examination, he was agitated with a heart rate of 100 beats/min, BP of 70/35 mm Hg, and respiratory rate of 30 breaths per minute. Abdominal examination showed a single entry wound on his mid-epigastrium, 3 cm below the xiphoid process, and no exit wound identified. There was generalized tenderness with distension and absent gut sounds. He had numbness in his lower legs and unable to move his bilateral lower limbs. A lax anal tone was also found on the digital rectal examination and the findings were suggestive of spinal injury as well. Fluid resuscitation was initiated but he did not respond hence massive transfusion protocol (MTP) was activated and an immediate decision was taken to move him to the operating room (OR) for exploratory laparotomy.

In OR, an exploratory laparotomy was performed by a midline incision starting from the xiphoid process to 4 cm below the umbilicus. All 4 quadrants were packed and the source of bleeding was identified to be the hepatic parenchyma. The incision was extended to the right subcostal area for better exposure and mobilization of the liver. Meanwhile, uncrossed match blood was transfused with a ratio of 3:3:3, packed RBCs, FFPSs, and platelets. After stabilizing the mean arterial pressure (MAP) at 55, packs were carefully removed. On exploration, segment II and III of the liver were completely fractured, and active pooling of blood was noted underneath the liver. Peri-hepatic packing failed to control the bleed so a gastrointestinal
anastomosis (GIA 75) stapler used for non-anatomical segmental resection of the liver. Three GIA 75 cartridges were used for this purpose and resection of the shattered liver provided exposure to the bleeding vessels.

Tributaries of the left hepatic vein and some branches to IVC were actively bleeding which were suture ligated with vicryl 2/0. Adequate hemostasis was controlled and other viscera were inspected. No other visceral injury was identified. Intraoperative arterial blood gas showed a pH of 7.29 and the patient had hypothermia of 35 degrees centigrade so the decision for damage control surgery was made. His abdomen was temporarily packed and closed with a vacuum dressing. He was shifted to ICU for the correction of physiological disturbances where he responded very well and improved. The next day he was taken back to OR for the definitive procedure and fascial closure. As shown in figure (1.a and 1.b) there was no active bleeding, no pooled blood, and no evidence of bile leakage from cut ends of the liver. The abdomen was irrigated and 13 Fr Jackson Pratt drain was placed in the subhepatic location.

The patient was extubated the next day and stepped down to a high dependency unit and later in the general ward. To investigate his spinal injury, a CT scan spine without contrast was done which showed a burst fracture of the vertebral body of D12 with complete cord transection and bullet in the subcutaneous location at the tip of the spinous process of D12. (Fig. 2.a and b)

Rehabilitation and physiotherapy were started for the spinal injury. The patient was discharged on the 10th day of admission and later followed in the clinic where his bullet was removed under local anesthesia. He was tolerating diet and had normal bowel movements. His skin staplers were removed and he was advised to continue physiotherapy. He has been followed up and has developed no long term complications.

Discussion:

The use of Stapling devices in surgical procedures is very common nowadays, it is not only safe and effective but reduces overall operative time. In hepatobiliary surgery, the operative technique plays a significant role in overall morbidity and mortality. Various types of staplers are in use for hepatobiliary procedures(4). Their role is well established for transection of hepatic vessels but the use of staplers for resecting liver parenchyma has only been gradually introduced and still debatable. The potential complications from the use of staplers in hepatic resection are blood loss due to incomplete sealing of vessels or tearing of a major vein while placing the device. However, recent publications have reported the use of staplers as safe and efficient as it decreases the amount of blood loss, total operative time dramatically, the overall cost of the procedure, and also eliminates the need to do a Pringle maneuver or other vascular control (5). It has also been found to reduce the incidence of bile leak or biloma.

The use of staplers to divide hepatic vessels during hepatectomy is viewed as an accomplishment that has helped in reducing major blood loss while performing elective resection. Furthermore, segmentectomies and wedge resections performed with stapler also showed promising results (6). Schemmer et al (7) in their series of 416 patients of elective liver resection reported that the use of endo
GIA stapler as a safe and effective technique for liver resection with a mortality rate of around 4% and biliary fistula complication rate around 7%. Although they were all elective oncological cases, the median value of blood loss was around 700 ml.

During a trauma laparotomy, the surgeons' main aim is to control the hemorrhage. The procedure is highly dependent upon the skills of the surgeon and the equipment available. The total time taken to achieve hemostasis plays a critical role in the management of all types of major hemorrhage as delays can bring about and propagate the lethal triad of trauma. Outcomes of hepatic injuries greatly depend upon the grade of liver injury and fatal outcomes have been observed with Grade IV and above liver injuries. Massive hemorrhage from liver injury results in significant mortality ranges from 10–15%\(^8\).

The surgical technique for performing stapled resection of liver parenchyma is simple and easy to learn. In non-anatomical and non-oncological resection of the liver, especially in the setting of trauma, the injured and devascularized portions of the liver parenchyma are removed peripheral to the fracture line, leaving just one surface, requiring suture or ligation of bleeding vessel. The liver tissue can be fractured stepwise with a clamp if the parenchyma is too thick to accommodate the GIA stapler\(^7\). Liver parenchyma is then subsequently divided with GIA staplers as shown in Figs. 3a and 3b.

The goal of the operative management of liver trauma is to achieve adequate hemostasis, minimize contamination and bile leak and initiate damage control resuscitation as soon as possible. The use of stapler devices for hepatic resection can be feasible and rapidly achieve the desired outcome. Our patient did not develop any short or long term complications after the procedure and recovered uneventfully.

**Conclusion**

GIA stapler device is an effective, feasible, and safe instrument in providing rapid control of hemorrhage in cases of high grade liver injuries in a hemodynamically unstable patient. Controlled clinical trials should be done to investigate the safety and efficacy of this operative technique in trauma surgery. Additionally, the increase in the operative procedure cost with the use of staplers needs to be compared with the cost reduction due to the decrease in the total operative time.

**Declarations**

**Consent for publication**

Informed written consent was obtained from the patient for reporting the case and the accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

**Conflict of interest statement:** None

**Availability of data and material:** All data will be available on request, keeping the anonymity of patients.

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Authors' contributions:
The concept of reporting the case, seeking consent, and drafting the main manuscript was done by Dr. Sabah Saqib.

Dr. Wafa Iftekhar contributed to collecting and writing patient information.

Dr. Hasnain Zafar, the primary attending surgeon, proofread the article and provided the final approval.

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References

1. Taghavi S, Askari R. Liver Trauma. StatPearls. Treasure Island (FL)2020.
2. Coccolini F, Montori G, Catena F, Di Saverio S, Biiffl W, Moore EE, et al. Liver trauma: WSES position paper. World J Emerg Surg. 2015;10:39.
3. Kozar RA, Feliciano DV, Moore EE, Moore FA, Cocanour CS, West MA, et al. Western Trauma Association/critical decisions in trauma: operative management of adult blunt hepatic trauma. J Trauma. 2011;71(1):1–5.
4. Fong Y, Blumgart LH. Useful stapling techniques in liver surgery. J Am Coll Surg. 1997;185(1):93–100.
5. Delis SG, Bakoyiannis A, Karakaxas D, Athanassiou K, Tassopoulos N, Manesis E, et al. Hepatic parenchyma resection using stapling devices: peri-operative and long-term outcome. HPB (Oxford). 2009;11(1):38–44.
6. Wrightson WR, Edwards MJ, McMasters KM. The role of the ultrasonically activated shears and vascular cutting stapler in hepatic resection. Am Surg. 2000;66(11):1037–40.
7. Schemmer P, Friess H, Hinz U, Mehrabi A, Kraus TW, Z’Graggen K, et al. Stapler hepatectomy is a safe dissection technique: analysis of 300 patients. World J Surg. 2006;30(3):419–30.
8. Badger SA, Barclay R, Campbell P, Mole DJ, Diamond T. Management of liver trauma. World J Surg. 2009;33(12):2522–37.

Figures
Figure 1

Figure 1 (a) shows the resection end of the liver with an intact stapled line, Figure 1 (b) shows dry entire surgical field without evidence of bleeding.

Figure 2

Figure 2.a shows CT spine with a burst fracture of D12 vertebra with complete cord transection, Figure 2.b shows a sagittal section of CT spine with the bullet at the tip of the spinous process of D12 vertebra.
Figure 3

Figure 3.a shows the resection of liver parenchyma with help of a GIA stapler. Figure 3.b shows the resected part of the liver.

Supplementary Files

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