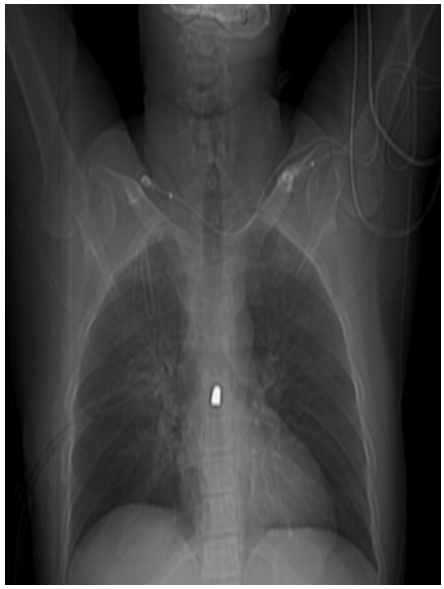
# A Novel Endoscopic Approach in the Management of a Penetrating Esophageal Gunshot Wound

*Ruchi Amin, MD,[*] Kenji Leonard, MD,[†] Nicole Garcia, MD,[†] and Carlos Anciano, MD[*]*

## CLINICAL SUMMARY

A 38-year-old man was brought to our Level I Trauma Center after sustaining multiple gunshot wounds (GSW) to the right upper extremity, back, flank, and thigh. Computed tomography (CT) scan showed evidence of free fluid and air concerning for intra-abdominal injury, and a distal intraluminal esophageal bullet fragment (Fig. 1). We performed exploratory laparotomy, 3 small bowel resections, ileocecectomy, and creation of distal feeding access after intraoperative identification of multiple intestinal enterotomies. A 2 cm longitudinal injury in the posterior proximal thoracic esophagus was seen on esophagogastroduodenoscopy (EGD), without evidence of significant blast effect (Fig. 2). Endoscopic removal of the projectile, primary endoclip closure (Instinct clip; Cook Medical, Limerick, Ireland) of the mural injury, and coverage of the repair with a 100 × 23 mm fully covered esophageal stent (ALIMAXX-E; Alveolus, Charlotte, NC) was performed (Fig. 2).

Although paraplegic from the thoracic spine injury, the patient progressed well from his intra-abdominal and esophageal repairs. Esophagram on postoperative day (POD) 7 was negative for leak. His stent was removed on POD21, after which he was started on a clear liquid diet by mouth in addition to enteral feeds eventually progressing to a mechanical soft diet. Follow-up endoscopy at 6 and 10 weeks showed complete resolution of the mucosal injury, and evidence of peristaltic activity with only 2 endoclips remaining at the site. The patient did not have any clinical evidence of symptoms that would be suggestive of occult infection either at the time of discharge and during clinic follow-up. He has undergone CT scans at 2-month intervals, and magnetic resonance imaging of spine at 6 months (currently) as follow-up. No infectious complications have arisen. There is active bone healing in T2-T3, and expected post-traumatic myelomalacia.



Intraluminal esophageal foreign body after a transthoracic gunshot wound.

**Central Message**

We present a novel minimally invasive approach to managing a penetrating esophageal injury from a transthoracic gunshot wound using endoclip application and esophageal stent placement.

## DISCUSSION

Esophageal perforation (EP) is a rare but highly morbid condition that requires prompt diagnosis and intervention.[1] There has been growing interest in the use of minimally invasive techniques for EP management to avoid the morbidity associated with traditional open surgery.[2] Literature on the use of these advanced techniques in the management of penetrating traumatic injuries in particular is sparse.[3,4] We present a unique

*Division of Thoracic Surgery, East Carolina University, Greenville, North Carolina
†Division of Trauma and Acute Care Surgery, East Carolina University, Greenville, North Carolina

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Address reprint requests to Ruchi Amin, MD, Division of Thoracic Surgery, East Carolina University, 2100 Stantonsburg Road, Greenville, NC 27834. E-mail: aminr@ecu.edu



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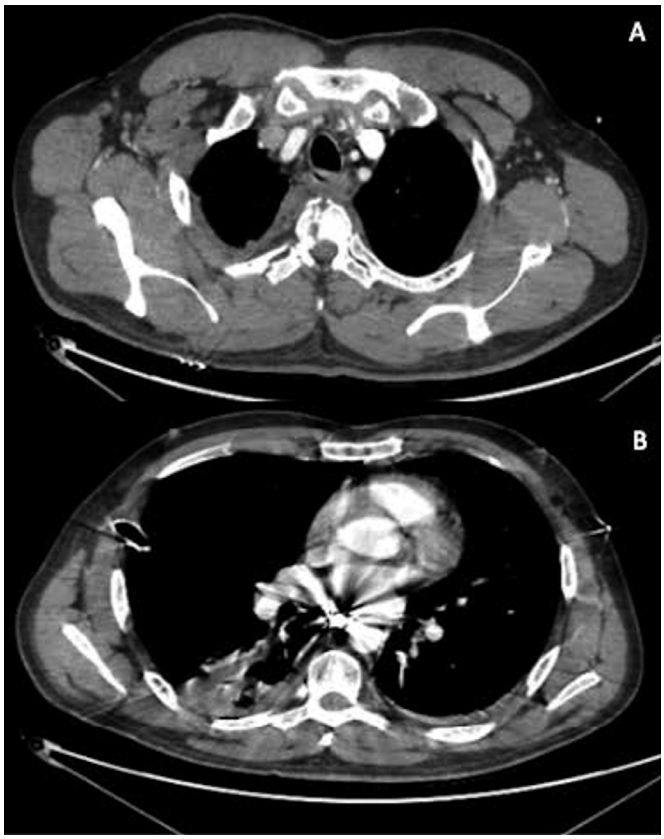



**Figure 1.** Computed tomography scan of a patient who sustained multiple gunshot wounds includes a transthoracic wound with a comminuted right posterior fourth rib fracture, T3 vertebral body fracture (A), and bullet fragment at the level of T8 (B), descending intraluminally within the esophagus.

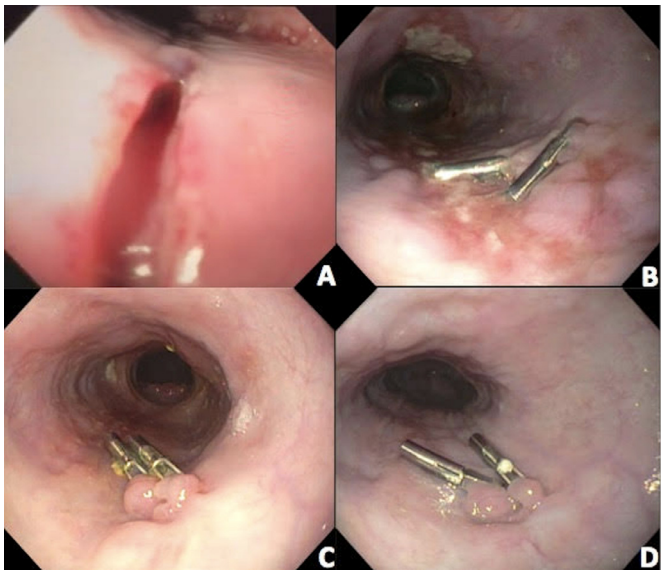



**Figure 2.** (A) Esophageal injury after a transthoracic gunshot wound at the time of initial endoscopy. Endoscopic closure of the area of injury during the initial intervention (B), at 6 weeks (C), and then again at 10 weeks (D).

and challenging case of esophageal GSW management using endoscopic primary closure with clips and stent placement.

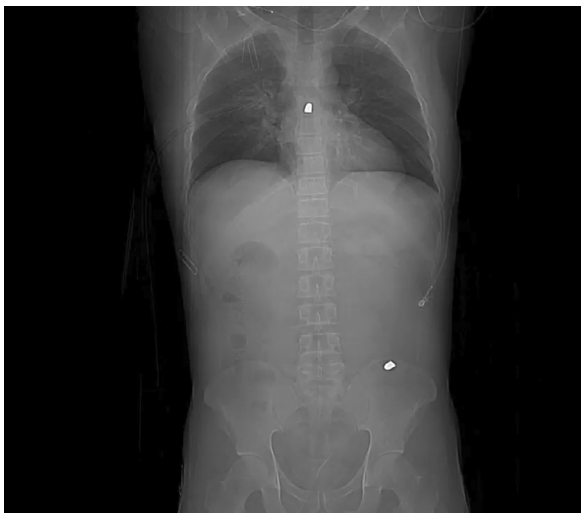
Diagnosis of EP can be made using a combination of CT, esophagram, and EGD. Our patient had an intraluminal bullet that was clearly visualized on CT, with findings of fat stranding and extraluminal air concerning for EP. Due to the need for emergent abdominal exploration, we elected to proceed directly to the operating room for an EGD to better evaluate the injury. The patient had a posterior mediastinal GSW with an extrapleural trajectory through the T3 vertebral body, ultimately entering the back wall of the esophagus at that level. There was ecchymosis on the front wall of the esophagus, but no evidence of mucosal injury. The impact and energy transfer of the GSW on the esophageal wall was likely ameliorated by the transvertebral trajectory. The traditional approach for management for this level of injury would require single-lung ventilation and a high posterior right thoracotomy. Following endoscopic bullet removal with graspers, EGD demonstrated a linear appearance of the mucosal injury, limited length of the injury and viable edges. Based upon short time interval from injury to intervention, extrapleural trajectory, and little significant esophageal wall defect, we elected to proceed with endoscopic management of the EP attaining primary closure with multiple endoclips. The endoscopic procedure of the portion took under 15 minutes and was performed while rest of the team worked the laparotomy portion of the case, thus not increasing overall intervention/operative time. Emphasis was made to minimize unnecessary sustained insufflation, in conjunction with a $CO_2$-enabled system, in an effort to limit the insufflation pressure gradient and risk of spinal contamination, meningitis, or pneumocephalus. We recognized that blast injury may develop over the subsequent days, and hence the stent was added and sized to cover well above and below the area in anticipation. While this method of closure has not been described before in this setting, esophageal stenting and endoscopic clipping are well accepted methods of endoscopic intervention. Our thoracic and foregut surgery practice has extensive experience with peroral mucosal resections, dissections, myotomies, endoluminal vac therapy, transluminal mediastinal and pleural intervention, endoscopic drain management as well as stent use. As a result, our emergent trauma and thoracic surgery consents include the use of endoscopic therapies, as do our elective cases. As presented, the patient underwent rigorous follow-up to monitor for failure, complications, and early need for escalation in management. Given the relative limited extent of injury with no appreciable gross pleural contamination, it was felt that the patient would benefit from minimally invasive approach in his chest, in the setting of significant intra-abdominal operative intervention. There are risks with the endoscopic procedure such as stent migration and fistula development; however, the risks of further injury, complication of his spine condition, contamination of pleural cavities, leaks, breakdown, and bipolar diversion requirement associated with a formal primary repair can be consequential as well.

Additional postoperative considerations in the management of EP include prevention of ongoing contamination and nutritional support. We did not perform drainage of the mediastinum as there was no pneumothorax or hemothorax; therefore, the patient was maintained on broad-spectrum antibiotics with gram negative and antifungal coverage for 2 weeks with close attention for the development of mediastinitis and empyema. In anticipation of the development of an interval blast injury, a right thoracostomy tube may be of clinical importance to better characterize the quality, quantity, and chemistry of the pleural drainage. Additionally, the esophageal injury was located right above an open fracture of the T3 vertebrae; therefore, close attention to symptoms suggestive of osteomyelitis was of utmost importance in preventing additional morbidity. Furthermore, the patient also had evidence of severe esophagitis, a mild peptic stricture, and sliding hiatal hernia on his intraoperative endoscopy. In the setting of recent stent placement, we elected to keep the patient on twice daily proton pump inhibitor, carafate, and upright precautions to minimize reflux over the repair. The patient remained on enteral feeds via jejunostomy for nutritional supplementation. The delay in initiating an oral liquid diet was secondary to recovery from his underlying intra-abdominal injuries.

This is a unique case of a penetrating esophageal injury from a transthoracic gunshot wound with a retained esophageal bullet. While the standard of care remains open surgery in these patients, we have shown that a minimally invasive approach for EP repair using endoscopic clip application, and esophageal stent placement, is feasible with appropriate patient selection by clinicians with expertise in endoscopic management of esophageal disease.

## SUPPLEMENTARY MATERIAL

The following is the supplementary data to this article:



**Video 1.** A 38-year-old man sustained multiple GSW to the right upper extremity, back, flank, and thigh. CT scan showed a clear injury through the posterior mediastinum at the level of T3 with a trajectory through the vertebral body correlating with the posterior midscapular wound. There was no evidence of pneumothorax or hemothorax. The projectile was seen in the distal esophagus and appeared to be intraluminal in position. At the time of laparotomy for his intra-abdominal injuries, bronchoscopy and upper endoscopy were performed. Upper endoscopy showed a full thickness injury along the posterior wall of the esophagus, with no bruising anteriorly. Blast injury was ameliorated by the transvertebral trajectory of the projectile, which was located further down in the esophagus. This was removed endoscopically. Primary closure of the viable edges was performed with approximation of the tissue using endoclips. A 23 × 100 mm fully covered self-expanding stent was placed in anticipation of blast injury progression. Postoperative imaging shows coverage of the injured area. Barium swallow on POD7 showed no leak. The stent was removed on POD21. Follow-up endoscopic evaluation showed progressive healing of the injury. Peristaltic activity in the injured area was witnessed by week 10. The patient is currently tolerating a regular diet.

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