

Staged Multimodal Analgesia in Complex Blunt Thoracoabdominal Trauma at a Resource-Limited Hilly Hospital: A CARE-Compliant Case Report

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Abstract

Background: Complex blunt thoracoabdominal trauma is challenging in resource-limited settings, particularly when severe chest pain, respiratory compromise, hemorrhagic shock, and occult intra-abdominal injuries coexist. We report a 59-year-old male who presented following a road traffic accident with hemorrhagic shock, severe hypoxemia, massive left hemothorax, multiple bilateral rib fractures, and a VAS pain score of 10/10. Initial management included tube thoracostomy, massive transfusion with four units of whole blood, vasopressor support, and resuscitation. Subsequent imaging demonstrated traumatic left diaphragmatic rupture, pulmonary contusion, pneumothorax, hemothorax, and bowel herniation. A staged analgesic strategy comprising a transdermal fentanyl patch, bilateral ultrasound-guided erector spinae plane block, and perioperative thoracic epidural analgesia progressively reduced pain from VAS 10/10 to 1/10. Definitive surgery revealed diaphragmatic rupture and Grade IV splenic injury requiring splenectomy and primary diaphragmatic repair. The patient was extubated on the operating table and subsequently underwent early pulmonary rehabilitation without major postoperative pulmonary complications. He was discharged on hospital day 15. This case highlights the feasibility and potential clinical value of individualized, staged multimodal analgesia integrated with resuscitation and definitive surgical management of complex thoracoabdominal trauma in a resource-limited hilly hospital.

Keywords: blunt thoracoabdominal trauma; multimodal analgesia; erector spinae plane block; thoracic epidural analgesia; traumatic diaphragmatic rupture; rib fractures; hemorrhagic shock.

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INTRODUCTION

Blunt thoracic trauma is an important cause of morbidity and mortality following high-energy road traffic accidents and is frequently associated with multiple rib fractures, pulmonary contusion, hemothorax, pneumothorax, and concomitant abdominal injuries. These injuries can substantially impair respiratory mechanics, particularly when severe chest-wall pain prevents adequate inspiration, coughing, and clearance of respiratory secretions. Inadequately controlled pain may consequently contribute to hypoventilation, atelectasis, hypoxemia, pneumonia, and prolonged respiratory support. Therefore, early and effective analgesia is an essential component of comprehensive management of patients with significant thoracic trauma.^[1,2]

Multimodal analgesia combining systemic medications with regional anesthetic techniques has increasingly been advocated for traumatic rib fractures. Among regional techniques, the ultrasound-guided erector spinae plane (ESP) block has emerged as a useful option because of its relatively superficial anatomical approach, technical simplicity, and favorable safety profile.^[3,4] It can provide effective thoracic analgesia and facilitate deeper breathing and pulmonary rehabilitation. Contemporary evidence also emphasizes tailoring analgesic techniques to the patient's injury pattern, physiological status, coagulation profile, and

anticipated surgical requirements.^[5] Such an individualized strategy may reduce reliance on systemic opioids while improving pain control, respiratory mechanics, mobilization, and overall perioperative recovery.^[6]

Management becomes considerably more challenging when severe chest trauma coexists with hemorrhagic shock, pulmonary injury, and occult thoracoabdominal pathology, particularly in resource-limited or geographically isolated healthcare facilities. Hemodynamic instability may initially restrict the use of certain regional techniques, while limited access to advanced imaging and specialist services can delay definitive diagnosis and intervention. In these circumstances, a staged approach that progressively escalates analgesia according to physiological stabilization may provide a practical strategy for optimizing respiratory and perioperative status.^[7]

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We report a case of complex blunt thoracoabdominal trauma involving multiple bilateral rib fractures, hemothorax, pulmonary contusion, traumatic diaphragmatic rupture, and severe splenic injury, managed successfully in a remote hilly hospital. A staged multimodal analgesic approach progressing from transdermal fentanyl to bilateral ESP block and subsequently thoracic epidural analgesia provided progressive pain relief, facilitated respiratory optimization and pulmonary rehabilitation, and supported definitive surgical management.

CASE DESCRIPTION

A 59-year-old male was brought to a mid-zonal military hospital in a remote hilly region following a road traffic accident in which the vehicle toppled and he was crushed beneath other occupants. At presentation, the patient was in hemorrhagic shock with severe respiratory distress and intense chest pain. His heart rate was 110 beats/min, blood pressure was initially 90/50 mmHg and subsequently decreased to 70/50 mmHg, peripheral oxygen saturation (SpO₂) was 80–85% on room air, and the visual analogue scale (VAS) pain score was 10/10.

Bedside extended focused assessment with sonography in trauma (E-FAST) revealed a massive left hemothorax. An immediate left-sided tube thoracostomy was performed, followed by resuscitation according to Advanced Trauma Life Support principles. Estimated blood loss was approximately 2 L, necessitating activation of the massive transfusion protocol. Four units of whole blood were transfused. Persistent hypotension required noradrenaline infusion, initially administered at 12 mL/h using a single-strength solution and gradually tapered after restoration of hemodynamic stability.

Because the hospital was located in a geographically isolated hilly region with limited access to advanced diagnostic facilities, non-contrast computed tomography (NCCT) of the chest and abdomen could be performed only on day 3 after adequate stabilization. Imaging demonstrated a left traumatic diaphragmatic rupture with herniation of bowel into the thoracic cavity, left lower-lobe pulmonary contusion with adjacent atelectasis, mild left pneumothorax, mild right hemothorax, multiple bilateral rib fractures, and left chest-wall subcutaneous emphysema.

Staged Multimodal Analgesia: Severe pain from multiple bilateral rib fractures significantly impaired deep breathing and effective ventilation. Considering the initial hemodynamic instability and complex thoracic injuries, analgesia was introduced in a staged manner. On the day of admission, a 25 µg/h transdermal fentanyl patch was applied, reducing the VAS pain score from 10/10 to 4/10.

On day 2, after improvement in hemodynamic status, an ultrasound-guided bilateral erector spinae plane block was performed using 15 mL of 0.25% bupivacaine on each side. The intervention further reduced the VAS score to 2/10 and was accompanied by improved respiratory effort and ability to participate in pulmonary care.

Following continued resuscitation and respiratory optimization, definitive surgery was planned on day 5.

Before induction of general anesthesia, a thoracic epidural catheter was inserted at the T6–T7 interspace. Epidural analgesia was initiated with morphine 3 mg combined with 0.125% bupivacaine. Postoperatively, 0.125% bupivacaine was administered through the epidural catheter every 8 hours.

Operative Management: Balanced general anesthesia was administered with invasive hemodynamic monitoring and lung-protective ventilation. Diagnostic laparoscopy demonstrated traumatic rupture of the left hemidiaphragm with herniation of abdominal contents into the thoracic cavity. Further exploration revealed a Grade IV splenic rupture, with the injured spleen herniating through the diaphragmatic defect into the left hemithorax. Consequently, the procedure was converted to open laparotomy.

Splenorrhaphy was initially attempted; however, persistent hemorrhage prevented satisfactory hemostasis, and splenectomy was performed. The herniated abdominal contents were reduced, followed by primary repair of the diaphragmatic defect. The total duration of surgery was approximately 4.5 hours.



Figure 1. Preoperative chest radiograph demonstrating left-sided thoracic abnormalities following blunt thoracoabdominal trauma, with an intercostal chest drain in situ.

Postoperative Course and Outcome: At completion of surgery, the patient fulfilled the criteria for extubation and was successfully extubated on the operating table. He was subsequently transferred to the intensive care unit (ICU) with supplemental oxygen at 4 L/min. His oxygen requirement progressively decreased to 1 L/min by postoperative day 1. Thoracic epidural analgesia provided excellent postoperative pain control, with a VAS score of 1/10. Effective analgesia facilitated deep breathing, coughing, and pulmonary rehabilitation. Incentive spirometry, chest physiotherapy, and early ambulation were initiated on postoperative day 2. Clinical recovery was satisfactory, and both the intercostal chest drain and abdominal drain were removed on postoperative day 4. The patient remained under intensive monitoring in the ICU for 11 days. No major postoperative pulmonary complication was observed. He was discharged from the hospital on the 15th

hospital day with satisfactory respiratory recovery and stable clinical status.

The clinical course demonstrated successful sequential escalation of analgesia from transdermal fentanyl to bilateral erector spinae plane block and finally thoracic epidural analgesia, integrated with damage-control resuscitation, respiratory optimization, and definitive surgical management in a resource-limited hilly hospital.

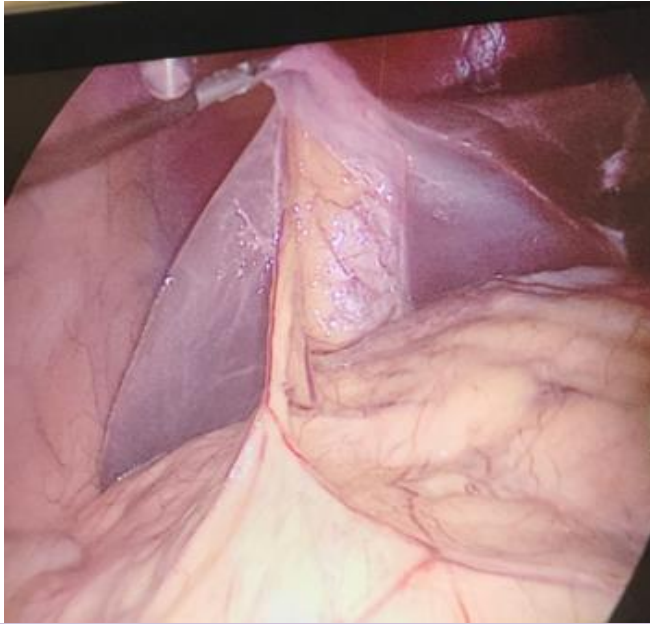


Figure 2: Intraoperative laparoscopic view demonstrating traumatic rupture of the left hemidiaphragm with herniation of abdominal contents into the thoracic cavity.



Figure 3: Resected spleen demonstrating extensive traumatic laceration consistent with a Grade IV splenic injury.

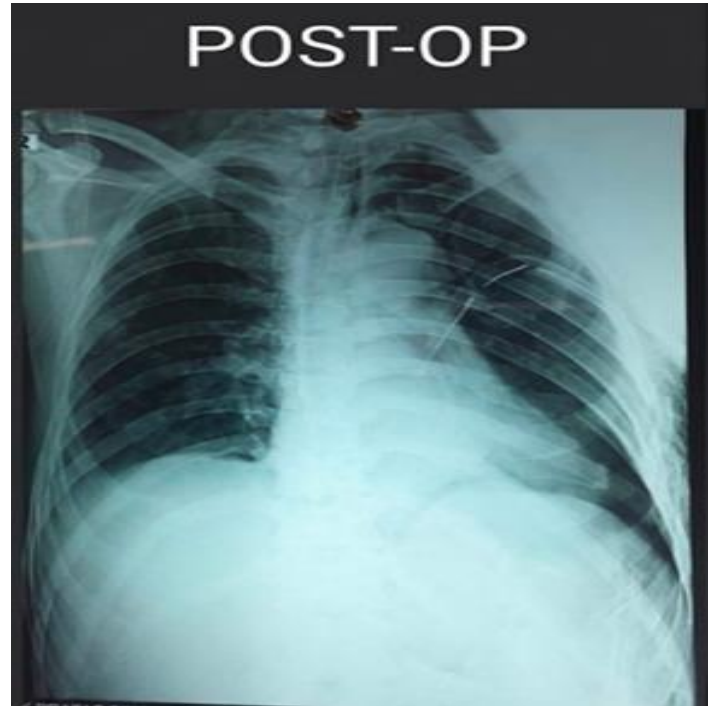


Figure 4: Postoperative chest radiograph demonstrating improved left lung expansion following diaphragmatic repair and surgical management.

DISCUSSION

Complex blunt thoracoabdominal trauma poses substantial perioperative challenges because pain, pulmonary injury, hemorrhage, and associated intra-abdominal injuries frequently coexist. In patients with multiple rib fractures, inadequate analgesia restricts inspiration and coughing, leading to secretion retention, atelectasis, hypoxemia, and potentially pneumonia. Contemporary management therefore emphasizes effective analgesia together with pulmonary rehabilitation and early mobilization. Feray et al. highlighted the importance of multimodal and regional analgesic techniques in chest trauma to reduce pain and facilitate respiratory recovery.^[8]

In the present case, analgesia was deliberately escalated according to the patient's physiological condition. Initial transdermal fentanyl reduced severe pain while resuscitation was ongoing. Once hemodynamic stability improved, bilateral ultrasound-guided erector spinae plane (ESP) blocks further reduced the VAS score to 2/10 and improved respiratory effort. Singh et al. demonstrated that ESP block can provide effective analgesia in patients with multiple rib fractures and may represent a useful alternative to thoracic epidural analgesia.^[9] The potential value of sequential regional techniques is also illustrated by Coblenz et al., who reported the use of thoracic epidural analgesia when stronger analgesia was required following ESP blockade.^[10]

Thoracic epidural analgesia was selected before definitive surgery after adequate resuscitation. It provided excellent postoperative analgesia, with a VAS score of 1/10, permitting early incentive spirometry, chest physiotherapy, and ambulation. These measures are particularly important in severe thoracic trauma, where pulmonary contusion, hemothorax,

pneumothorax, and multiple rib fractures can collectively compromise ventilation. Lodhia et al. similarly emphasized coordinated analgesic, respiratory, and surgical management in patients with significant thoracic trauma.^[11]

The traumatic diaphragmatic rupture in this patient further complicated diagnosis and treatment. Such injuries may accompany high-energy blunt trauma and can be overlooked during initial resuscitation, particularly when other life-threatening injuries predominate.^[12] Weber et al. demonstrated that traumatic diaphragmatic rupture is commonly associated with substantial concomitant injuries and requires a high index of clinical suspicion.^[13] In the present resource-limited setting, definitive CT evaluation was delayed until physiological stabilization, subsequently demonstrating diaphragmatic rupture with intrathoracic herniation.

Hemorrhagic shock constituted another major perioperative concern. Early tube thoracostomy, massive transfusion, whole-blood replacement, vasopressor support, and subsequent definitive hemorrhage control were essential components of management. Contemporary evidence supports whole-blood-based resuscitation as an effective strategy for severely bleeding trauma patients.^[14] Moreover, earlier administration of whole blood has been associated with improved survival among patients with severe traumatic hemorrhage.^[15]

This case demonstrates the practical value of a staged multimodal analgesic strategy, progressing from systemic opioid therapy to ESP blockade and subsequently thoracic epidural analgesia according to improving physiological stability and evolving perioperative requirements. Such an individualized approach may be particularly valuable in resource-constrained environments where definitive imaging, specialist services, and transfer facilities are not immediately available.

CONCLUSION

Staged multimodal analgesia can facilitate respiratory optimization and perioperative management of complex blunt thoracoabdominal trauma. Sequential use of transdermal fentanyl, bilateral ESP block, and thoracic epidural analgesia provided effective pain control and enabled pulmonary rehabilitation and early extubation in this patient. The case also highlights the importance of physiological stabilization, timely hemorrhage control, and adaptable trauma management in resource-limited settings.

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Conflicts of interest

There are no conflicts of interest.

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