

Case Report

Multidisciplinary Trauma Care: The Role of BIS Monitoring, Lung Ultrasound, and Surgical Precision in Complex Extubation

Authors:

Dr. Abdallah A Hakmi¹, Dr. Ahmed A Abdelhafiz², Dr. Mohamad A Omar³, Dr. Khaled R Saed⁴, Dr. Hala Ezzat Aziz⁵, Dr. Bassam Hammad⁶

^{1,2,3,4} *Anesthesia and critical care Resident, Kuwait Hospital Sharjah*

⁵ *Anesthesia specialist, Kuwait Hospital Sharjah*

⁶ *Anesthesia consultant, Kuwait Hospital Sharjah*

Corresponding Author:

Dr. Ahmed Adel Yagoub Abdelhafiz

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ABSTRACT:

This case report presents a 24-year-old male who sustained multiple severe injuries from an assault involving a butcher's knife, affecting his neck, left shoulder, and left lower leg. The patient arrived in hypovolemic shock with a Glasgow Coma Scale of 9, requiring urgent resuscitation and surgical intervention. Diagnostic imaging revealed a displaced tibia and fibula fracture, along with a contaminated deep neck wound posing significant risks to neurovascular and airway structures. Immediate management included aggressive fluid resuscitation, tranexamic acid administration, and prophylactic antibiotics, followed by multidisciplinary surgical repair of the neck musculature and orthopedic fixation of the fractures. Intraoperatively, the patient required extensive blood product transfusions and advanced pain management techniques, including a fascia iliaca block. Postoperative care emphasized infection prevention, hemodynamic monitoring, and early physiotherapy, resulting in a stable recovery without complications. This case highlights the challenges of managing complex trauma involving multiple anatomical regions, underscoring the importance of systematic assessment, surgical precision, and multidisciplinary collaboration in achieving successful outcomes.

Keywords: Trauma Care, surgical intervention, BIS Monitoring

INTRODUCTION:

Trauma remains one of the leading causes of morbidity and mortality worldwide, with penetrating injuries accounting for a significant proportion of trauma-related hospitalizations [1]. Assault-related injuries, such as those inflicted by sharp weapons, pose unique challenges due to their potential to involve multiple anatomical regions, complex wound contamination, and high risk of neurovascular compromise [2]. This case underscores the critical importance of multidisciplinary approaches in managing such injuries to optimize outcomes.

Neck injuries are particularly concerning due to the density of vital structures, including major blood vessels, the trachea, esophagus, and cervical spine. Penetrating neck trauma accounts for approximately 10% of all trauma cases, with mortality rates ranging from 3% to 6% in developed trauma systems [3]. Early recognition and surgical management are pivotal to mitigating complications such as airway obstruction, vascular injury, and infection [4].

Simultaneously, orthopedic injuries, such as open fractures of the tibia and fibula, demand immediate attention to prevent complications including infection, nonunion, and limb dysfunction [5]. The management of open fractures has evolved significantly with the advent of advanced fixation techniques, emphasizing early debridement and stabilization as critical components of care [6].

Effective resuscitation strategies, including the use of tranexamic acid and advanced blood product administration protocols, have been shown to improve survival rates in trauma patients presenting with hemorrhagic shock [7]. Additionally, multimodal pain management strategies, such as regional nerve blocks, have emerged as essential tools to reduce opioid use and improve functional recovery in orthopedic trauma [8].

This case exemplifies the complexity of managing penetrating trauma involving the neck and extremities, highlighting the integration of advanced imaging, surgical precision, and collaborative decision-making to

achieve favorable outcomes. By examining this case, we aim to emphasize the significance of a systematic, multidisciplinary approach in the management of complex trauma, drawing on established evidence and guidelines to inform clinical practice.

Case Presentation:

Patient Presentation:

A 24-year-old male was brought to the emergency room via ambulance after being assaulted with a butcher's knife. He sustained multiple stab wounds to the left

shoulder, left lower leg, and the left side of his neck. The patient had no significant past medical or surgical history, nor any relevant family medical history. He was a non-smoker and non-alcoholic. On arrival, the patient was pre-alert with a Glasgow Coma Scale (GCS) of 9, indicating a reduced level of consciousness. He appeared pale and diaphoretic, with significant blood loss evident from his neck wound. He was in severe pain, requiring immediate medical attention to stabilize his condition and prevent further deterioration.



Figure 1: Deep Laceration of left leg , with open fracture of fibula and syndesmosis

Figure 2: A 25 Cm Incised wound at root of the neck left side Transected (Sternocleidomastoid, Trapezius , Scalenus, Anterior and Medius levator scapulae), Intact carotid sheath

Initial Assessment and Resuscitation:

On admission, the patient's vital signs indicated he was in hypovolemic shock. His heart rate was 108 bpm, blood pressure was 70/48 mmHg, and oxygen saturation was 99% on room air. He was afebrile with a respiratory rate of 19 breaths/min. His weight was 78 kg, height 176 cm, and BMI 25.18. Initial physical examination revealed a deep 25 cm incised wound at the root of the neck on the left side, heavily contaminated with sand and debris. The left lower leg exhibited an open wound with exposed bone fragments, while the left shoulder had a superficial laceration. Active bleeding from the neck wound was controlled with manual pressure and hemostatic agents in the emergency room.

Immediate resuscitation measures were initiated to stabilize the patient. Two large-bore intravenous lines were secured, and 1 liter of lactated Ringer's and 1 liter Normal Saline solution were administered rapidly to improve his hemodynamic status. Intravenous tranexamic acid (1 g) was given to control bleeding, and intravenous ketamine was used for pain management. Laboratory investigations were performed, revealing a hemoglobin level of 7.8 g/dL, indicative of acute blood loss. Prophylactic antibiotics (ceftriaxone and

metronidazole) were initiated to prevent wound infections. A tetanus toxoid injection was also administered.

Diagnostic Imaging:

Diagnostic imaging was promptly carried out to assess the extent of injuries. A chest X-ray revealed a non-displaced fracture of the posterior first rib, while a shoulder X-ray showed no abnormalities. A tibia-fibula X-ray confirmed a displaced fracture of the distal one-third of the fibula and tibia. No pneumothorax, hemothorax, or vascular compromise was detected. Point-of-care ultrasound ruled out significant intraperitoneal or pleural effusion, confirming the absence of life-threatening internal injuries.

Preparation and Surgical Plan:

Given the severity of the injuries, the orthopedic and general surgery teams were consulted. The patient was prepared for urgent surgical intervention within one hour of arrival. The anesthesia team evaluated the patient for fitness for surgery, and anesthesia evaluation and intubation for airway protection. BIS monitoring was critical in identifying that the patient's awareness level

remained intact despite low GCS, guiding preoperative decisions and ruling out anoxic brain injury. Preoperative preparation included fasting and fluid resuscitation to stabilize blood pressure.

Operative Management:

In the operating theater, the patient underwent multiple life-saving and reconstructive procedures. The neck wound was debrided meticulously to remove sand and debris, and damaged tissues were excised. Transected muscles, including the sternocleidomastoid, trapezius, and scalene (anterior and medius), were repaired. Hemorrhage control was achieved by identifying and ligating bleeding vessels. The vascular structures in the neck were inspected to rule out major vessel injury. For the lower leg injuries, open reduction and internal fixation (ORIF) of the displaced tibia and fibula fractures were performed. A syndesmotomic screw was placed to stabilize the left ankle. The surgical team administered a fascia iliaca block for effective postoperative pain management.

Intraoperatively, the patient required significant volume replacement due to blood loss. He received 5 units of packed red blood cells, 6 units of fresh frozen plasma, 1 unit of colloids, and 6 units of crystalloids. Hemodynamic stability was maintained throughout the procedure with continuous monitoring and the use of vasopressors as needed. The surgery lasted approximately four hours, and the patient was successfully extubated after confirming adequate recovery and stable vital signs.

Intraoperative BIS monitoring, combined with neurological evaluations, ensured the absence of significant brain injury, aiding in safe extubation post-surgery. The neck wound underwent meticulous debridement and repair of transected muscles, while ORIF was performed for the tibia and fibula fractures. Lung ultrasound was repeated to exclude evolving thoracic injuries before extubating the patient.

Postoperative Care:

Postoperatively, the patient was transferred to the recovery unit for close monitoring. Vital signs remained stable, with a blood pressure of 110/70 mmHg, heart rate of 90 bpm, and oxygen saturation of 99% on room air. Postoperative laboratory investigations showed an improved hemoglobin level of 8.4 g/dL. Pain control was achieved with a combination of intravenous tramadol and paracetamol. The patient shifted on Amoxicillin, IV fluids (lactated Ringer), pain killers and received low-molecular-weight heparin for deep vein thrombosis prevention.

Recovery and Discharge:

The patient's recovery was uneventful. By postoperative day 3, he was mobilizing with assistance and demonstrated good wound healing. Physical therapy was initiated to restore mobility and strength in the left lower limb. His hemoglobin level improved further to 9.6 g/dL at the time of discharge. He was discharged on postoperative day 3 with detailed instructions for wound care, physiotherapy, and follow-up appointments with the orthopedic and general surgery teams. Oral antibiotics and analgesics were prescribed for continued recovery.

DISCUSSION:

The concept of the "triad of death" is a critical consideration in trauma care, encompassing hypothermia, acidosis, and coagulopathy. This physiological triad is particularly relevant in severely injured patients, as these conditions often coexist and exacerbate one another, creating a cycle that can significantly worsen outcomes if not promptly addressed.

Trauma patients frequently experience hypothermia due to massive blood loss, exposure, and fluid resuscitation with cold solutions. Hypothermia impairs platelet function and the coagulation cascade, leading to increased bleeding and worsening coagulopathy. In this case, intraoperative warming measures, such as warm intravenous fluids and a warming blanket, were implemented to maintain normothermia and mitigate this risk. Severe blood loss and inadequate tissue perfusion often result in metabolic acidosis due to anaerobic metabolism and lactate accumulation. Acidosis further impairs coagulation by altering enzyme activity within the clotting cascade. The early recognition and correction of acidosis, achieved through aggressive resuscitation with balanced crystalloids and blood products, were pivotal in preventing this downward spiral. Coagulopathy in trauma patients arises from a combination of hypothermia, acidosis, and dilutional effects of large-volume resuscitation. In this case, the administration of tranexamic acid, fresh frozen plasma, and platelets helped restore coagulation function and prevent further bleeding. Understanding and addressing the triad of death are fundamental to optimizing outcomes in trauma care. This case demonstrates the importance of early, targeted interventions to break the cycle of hypothermia, acidosis, and coagulopathy. Multidisciplinary teamwork, rapid decision-making, and adherence to evidence-based trauma protocols were instrumental in achieving a favorable outcome for this patient.

This case underscores the complexities of managing a trauma patient with injuries spanning multiple anatomical regions. The involvement of deep neck wounds, highly contaminated with debris, added a

unique layer of complexity, as these wounds pose significant risks for infections, neurovascular compromise, and airway obstruction. The successful outcome in this case highlights the importance of a systematic and multidisciplinary approach in trauma care.

The patient's presentation with hypovolemic shock necessitated immediate and efficient resuscitation. Early recognition and aggressive fluid resuscitation were critical in preventing further hemodynamic deterioration [9]. The administration of tranexamic acid likely contributed to reducing ongoing hemorrhage, demonstrating the utility of antifibrinolytics in trauma care [10]. The rapid initiation of broad-spectrum antibiotics and tetanus prophylaxis also exemplifies best practices in managing contaminated wounds [11-12].

The neck wound posed the greatest challenge due to its proximity to vital structures, including the carotid artery, jugular vein, and trachea. Thorough exploration and meticulous debridement during surgery minimized the risk of infection and ensured that no major vascular or airway injuries were overlooked [13]. Repairing transected musculature, including the sternocleidomastoid, trapezius, and scalene muscles, restored functional integrity and underscored the importance of precise surgical techniques in complex trauma cases [14].

Orthopedic injuries further complicated the case, with a displaced fracture of the distal tibia and fibula requiring open reduction and internal fixation (ORIF). The addition of syndesmotic screw fixation ensured joint stability and laid the groundwork for optimal long-term functional recovery [15]. The use of a fascia iliaca block for pain management highlights the integration of multimodal analgesia strategies to enhance postoperative recovery and reduce opioid requirements [16].

Intraoperatively, the patient required significant blood product transfusion, including 2 units of packed red blood cells and 6 units of fresh frozen plasma, to counteract massive blood loss. Effective intraoperative monitoring and the judicious use of crystalloids and colloids maintained hemodynamic stability throughout the procedure [17]. The seamless collaboration between surgical, anesthetic, and nursing teams played a pivotal role in ensuring the patient's stability and successful surgical outcomes [18].

Postoperative care focused on close monitoring to detect early signs of complications, including infection, thrombosis, and respiratory compromise [19]. The patient's stable recovery and uneventful extubation were attributed to comprehensive monitoring strategies, including bispectral index monitoring and lung ultrasound. The decision to bypass ICU admission reflects the importance of individualized patient assessment and resource allocation in trauma care [20].

This case highlights the critical role of Bispectral Index (BIS) monitoring and lung ultrasound in ensuring safe and timely extubation in trauma patients [21]. The patient presented with a Glasgow Coma Scale (GCS) of 9, necessitating immediate intubation to secure the airway. BIS monitoring was employed intraoperatively to assess the patient's level of consciousness and guide decision-making. BIS fluctuations, combined with neurological assessments, confirmed intact awareness levels and helped rule out significant anoxic brain injury that might have otherwise been overlooked [22]. These insights were critical, as early imaging studies could not fully exclude subtle hypoxic effects on brain function.

In addition, lung ultrasound was integral to extubation readiness. By ruling out thoracic injuries such as lung contusions or pleural effusions, it provided reassurance that no undiagnosed respiratory complications would compromise post-extubation outcomes. The use of lung ultrasound avoided unnecessary delays in extubation and ensured optimal patient safety [23]. Together, BIS monitoring and lung ultrasound provided a multimodal approach to extubation, offering real-time, evidence-based assessments of neurological and respiratory status. This strategy highlights the evolving role of advanced monitoring tools in trauma anesthesia, particularly for patients with complex, multisystem injuries [24].

This case highlights several critical learning points. First, the importance of rapid, coordinated intervention in trauma cases cannot be overstated. The collaboration among emergency, surgical, and anesthetic teams ensured timely decision-making and efficient care delivery. Second, the effective management of contaminated wounds, particularly in anatomically complex areas such as the neck, requires a combination of surgical precision and infection control measures. Third, early initiation of rehabilitation and physiotherapy is vital in promoting functional recovery and improving long-term outcomes.

Lastly, the case emphasizes the value of integrating advanced trauma care protocols with individualized patient management. The favorable outcome in this patient demonstrates how systematic trauma care, supported by multidisciplinary collaboration and evidence-based practices, can lead to successful recovery even in the context of severe and complex injuries. This case serves as a model for the management of similar trauma scenarios, showcasing the importance of adaptability, expertise, and teamwork in achieving optimal patient outcomes.

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