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"NAVIGATING COMPLEXITIES IN TRAUMATIC TENSION PNEUMOTHORAX MANAGEMENT: INSIGHTS FROM A CHALLENGING CASE"

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ABSTRACT

Background: Tension pneumothorax can be life-threatening if not managed effectively. ATLS guidelines advocate needle decompression followed by posterior ICD placement In traumatic tension pneumothorax. This case report attempts to present an ATLS-managed situation that failed to result in the intended outcome. Our objective is to alert clinicians about potential treatment failures and to emphasize the relevance of treatment modifications in traumatic tension pneumothorax cases. **Case Presentation:** A 56-year-old man involved in a vehicle accident presented to our emergency department in a periarrest condition. He had severe respiratory distress, tachypnea, and an oxygen saturation of 60%. He had surgical emphysema, crepitations, and a chest wall contusion. The trocar approach was used to introduce bilateral posterior ICDs, which were then followed by rapid sequence intubation (RSI). The patient went into cardiac arrest despite initial resuscitation efforts, and subsequent computed tomography (CT) revealed bilateral pneumothorax. The patient's condition deteriorated, and he eventually died despite repeated attempts at ICD insertion. **Conclusion:** This case report demonstrates that posterior ICD insertion may not successfully drain traumatic hemopneumothorax. Anterior ICD insertion with blunt dissection technique should be considered in trauma scenarios if initial ICDs fail to stabilize the patient.

KEYWORDS :

INTRODUCTION

Tension pneumothorax (TPT) is a serious medical condition characterised by the accumulation of air in the pleural space under positive pressure, resulting in mediastinal structural displacement and substantially decreased cardiac function (1,2). Swift intervention is imperative to prevent severe consequences and ensure patient survival. Despite its relatively low incidence, TPT requires immediate recognition and appropriate management to avert potentially fatal outcomes (3).

The standard protocol to TPT management, as defined in the Advanced Trauma Life Support (ATLS) guidelines, consists of first needle decompression followed by chest tube thoracostomy if indicated (4). However, there have been cases where the clinical course of TPT management was inconsistent with the aforementioned standards, revealing instances where expected therapeutic effects were not met despite protocol adherence (5-9). This case report focuses on a particular scenario in which a tube thoracostomy was performed to manage TPT but failed to resolve the condition as expected.

We aim to accomplish two major objectives by presenting this case. Firstly, we seek to illuminate the intricate nuances and challenges associated with the management of TPT, particularly in the context of traumatic injuries. Secondly, we emphasise on the necessity of adopting a flexible and adaptable approach to treatment options when encountered with cases that deviate from the usual clinical trajectory. While established recommendations provide a vital framework, individual patient responses might vary significantly, necessitating a customised approach to maximise clinical outcomes and reduce the mortality rate associated with this critical condition.

Case Presentation

A 56-year-old previously healthy gentleman was brought to our tertiary care emergency department following a traumatic road traffic accident. Upon arrival, he was in a state of periarrest, exhibiting profound respiratory distress, tachypnea with a respiratory rate of 40 breaths per minute, and a concerning oxygen saturation of only 60%. He was initially managed with bilevel positive airway pressure (BPAP) in the prehospital setting to alleviate his respiratory distress.

On initial assessment, the patient's blood pressure was not recordable, and he displayed restlessness and combativeness, suggestive of profound air hunger. Physical examination revealed visible signs of trauma, including surgical emphysema extending to the neck region, bony crepitations, and contusions over the chest wall. Furthermore, he demonstrated clinical features consistent with severe chest trauma, and signs of hemorrhage or active external bleeding sources were ruled out.

Given the patient's critical condition, BPAP was promptly discontinued in favor of alternative measures to address the suspected hemopneumothorax and compromised circulation. The use of BPAP in the presence of suspected hemopneumothorax was re-evaluated, as it could potentially exacerbate hemodynamic instability. In addition, the presence of a pneumothorax was confirmed via E-Focused Assessment with Sonography for Trauma (FAST) examination, further validating the need for immediate intervention.

Since the patient's condition was deteriorating, rapid sequence intubation (RSI) was performed to secure the airway. Bilateral intercostal drains (ICDs) were inserted urgently as part of the initial resuscitation efforts. However, the procedure had complications as the patient experienced a sudden cardiac arrest during tube thoracostomy. Resuscitation was initiated per Advanced Cardiac Life Support (ACLS) protocol, and the patient was successfully revived after 15 minutes of cardiopulmonary resuscitation (CPR).

The bilateral ICDs drained approximately 250ml of blood from each side, and their appropriate placement was confirmed by visualizing satisfactory column movement. Due to the extent of his injuries and ongoing hemodynamic instability, a left femoral vein catheterization was performed to establish vascular access for crystalloid infusion and blood transfusion. Despite the patient's initial response to resuscitation, his condition remained precarious, prompting further evaluation.

A computed tomography (CT) polytrauma series was conducted to assess for additional injuries, including major vascular and mediastinal injuries, given the mechanism of injury (run over accident). The CT imaging revealed normal findings for the brain, spine, and abdomen. However, the CT chest unveiled bilateral haemopneumothorax and pneumomediastinum, despite the presence of properly positioned bilateral intercostal drains (Figure No. 1).

Interestingly, the CT imaging also highlighted that the bilateral ICDs were posteriorly placed, which raised concerns about their ability to effectively drain the pneumothorax. This finding led to a re-evaluation of the initial approach to ICD insertion. The patient was subsequently transferred to the trauma intensive care unit (ICU) for close monitoring, and consultation with cardiothoracic vascular surgery (CVTS) was sought to explore potential surgical interventions if required.

While in the ICU, the patient experienced yet another cardiac arrest, requiring prompt resuscitation efforts once more. An additional ICD was inserted anteriorly from the ICU, aiming to provide more effective drainage. Unfortunately, despite the comprehensive and relentless resuscitative measures, the patient's hemodynamic instability persisted, ultimately resulting in his untimely demise.

DISCUSSION

This case study highlights the management challenges posed by bilateral tension pneumothorax resulting from a road traffic accident, which were addressed through bilateral trocar-directed intercostal

drain (ICD) insertion. However, the failure of the ICDs to effectively drain the pneumothorax potentially stemmed from their posterior placement. Tension pneumothorax (TPT), though uncommon, follows a severe and potentially fatal course if untreated (1,4).

This condition arises when trapped air accumulates within the pleural space under positive pressure, displacing mediastinal structures and compromising cardiopulmonary function (11-14). In cases of highly suspected TPT, immediate interventions like emergent needle decompression or chest tube thoracotomy are imperative (15).

A critical consideration lies in the avoidance of positive pressure ventilation initially, as it has the potential to exacerbate the size of the tension pneumothorax and precipitate circulatory shock. Implementation of positive pressure ventilation should ideally follow chest tube placement. (8,15,16). In this case, the patient received non-invasive ventilation during transfer, a practice that might have contributed to the subsequent hypotensive episode.

Unlike the classic approach of needle decompression, direct tube thoracostomy was chosen in this case. This decision aligns with multiple reports citing the inefficacy of needle decompression, with successful outcomes primarily achieved through tube thoracostomy (11,13-17). The choice to forgo needle decompression was likely influenced by the apparent hemopneumothorax, which necessitated immediate drainage.

Site Selection And Technique

An important anatomical reference for ICD insertion is the "Triangle of safety," endorsed by the British Thoracic Society (BTS) (18). This guideline suggests the fifth intercostal space at the mid-axillary line as an appropriate insertion site for an ICD, given that in over 90% of adult individuals, chest wall thickness at this location is below 3.5cm (19). However, in this case, bilateral thoracostomy tubes were inserted in the fifth intercostal space, which eventually raised concerns about the posterior placement of the ICDs. The decision to use a trocar technique for ICD insertion was motivated by the need to address the concurrent hemopneumothorax and suspected vessel injuries, allowing for prompt drainage of extravasating blood. Notably, the trocar technique has been associated with a heightened risk of complications such as tube malposition, in contrast to the more prudent blunt dissection technique (20).

Clinical Implications

This case report highlights the necessity of acknowledging that tension pneumothorax is a dynamic condition that may not consistently align with established protocols. Clinicians must remain vigilant and open to adapting their management strategies to the evolving clinical state of the patient. The critical decision of where and how to insert ICDs demands thoughtful deliberation, especially in the context of traumatic scenarios. Anterior ICD insertion with a blunt dissection technique may offer more reliable outcomes and should be considered if initial attempts fail to stabilize the patient.

Limitations And Future Directions

It is crucial to recognize the limitations inherent to this case report, including its retrospective nature and potential biases. Furthermore, the generalizability of its findings to all trauma scenarios is limited. Further research, including prospective studies, is warranted to validate the proposed modifications to ICD insertion techniques and site selection in the context of traumatic tension pneumothorax.

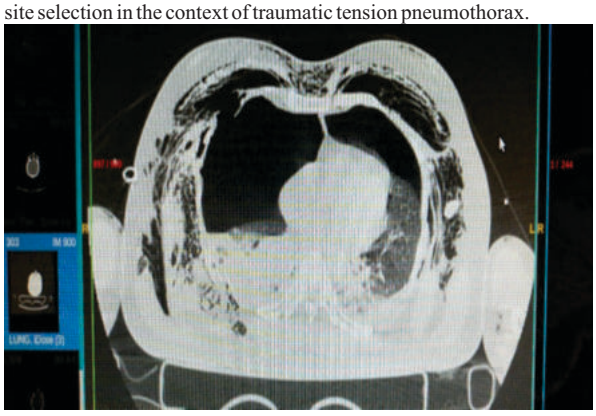

Figure No. 1 CT Chest with ICD in situ

CONCLUSION

The presented case underscores the paramount importance of personalized and adaptable management strategies for tension pneumothorax, particularly in trauma-related settings. Although ATLS guidelines offer a solid foundation, this case serves as a potent reminder of the need for flexibility when confronting cases that deviate from the expected clinical course. Anterior ICD insertion with a blunt dissection technique may hold the potential for improved outcomes in traumatic hemopneumothorax cases. This report serves as a clarion call to the indispensable roles of clinical acumen, adaptability, and patient-centered care in successfully managing the formidable challenge of tension pneumothorax.

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