Delayed Presentation of Nail Gun-Associated Traumatic Pneumothorax with a Retained Foreign Body: A Case Report

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Patient: Male, 30-year-old
Final Diagnosis: Traumatic pneumothorax
Symptoms: Chest pain
Medication: —
Clinical Procedure: Video assisted thoracoscopy
Specialty: Cardiac Surgery

Objective: Rare disease
Background: Pneumatic nail guns were first introduced in the 1950's, which revolutionized the construction industry. Since that time, nail gun injuries have been reported predominantly in the extremities with rare cases of thoracic and head injuries. A nail gun can easily propel nails through human tissue with velocities varying based on propellant and object. There are limited case reports on the appropriate management of thoracic nail gun injuries.

Case Report: A 30-year-old man presented to the Emergency Department with right-sided chest pain seven and a half hours after getting struck in the right lateral thorax with a pneumatic nail gun. The patient was hemodynamically stable and without respiratory distress. A chest X-ray was taken and showed a right pneumothorax with a retained radio-opaque object at the right lung hilum. A CT angiogram subsequently showed the object abutting the right middle lobe branch of the pulmonary artery. Cardiothoracic surgery was called and the patient was taken urgently to the operating room for right thoracotomy, finding the nail deep in the right fissure at the hilum with the nail head in contact but not puncturing the right middle lobe branch of the pulmonary artery. The patient was extubated and recovered well postoperatively.

Conclusions: This case demonstrates the critical nature of nail gun injuries and can better inform the trauma protocols used to treat these injuries. Even in a delayed presentation, there should be a high suspicion of traumatic lung and cardiac injuries due to the velocities obtained with pneumatic nail guns.

Keywords: Acute Lung Injury • Advanced Trauma Life Support Care • Thoracic Surgery

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**Background**

Pneumatic nail gun injuries are very common among construction workers, with injuries to the arms and hands being most common [1]. There are few case reports available on pneumatic nail gun injuries to the thorax and head. Pneumatic nail guns can easily propel nails through sheets of wood, making travel through human bone and tissues very possible [1-3]. These circumstances necessitate a high index of suspicion for significant penetration and injury to patients presenting with nail gun injuries. Most published case reports of nail gun injuries to the thorax involve cardiac damage but few involve isolated significant lung injury. The aim of this case report is to detail our evaluation and management of a traumatic lung injury from pneumatic nail gun use.

**Case Report**

A 30-year-old man with no past medical or surgical history presented to the Emergency Department at our Level 2 Trauma Center, with pain in the right lateral chest upon deep inspiration. The patient reported that at noon that day he had been at work on a construction site and had a pneumatic nail gun deploy at his right chest. He says that he was on a ladder and his coworker handed him the nail gun when he accidentally grabbed the trigger and a nail was shot at his right chest. He denied any fall off the ladder and any associated trauma. He reported that he saw a scratch on his chest where he assumed the nail hit but the pain was minimal and he continued to work. Later that evening he had some worsening right chest pain with deep inspiration, which prompted him to go to urgent care. At urgent care, they noted decreased breath sounds on the right and right pneumothorax on chest X-ray and he was instructed to go to the emergency room. He presented to the Emergency Department at 7:30 PM that evening with continued right chest pain but no respiratory distress. During work-up in the Emergency Department, another chest X-ray was obtained, which showed a 25% right-sided pneumothorax with a retained foreign body near the right hilum (Figure 1). A trauma consult was called at that time. Upon examination by the Trauma Team, the patient was in no respiratory distress, was able to speak complete sentences without issue, and saturating 100% on room air. A small punctate lesion was seen on the right lateral chest between the fifth and sixth ribs at the anterior axillary line, without bleeding. An occlusive dressing had been placed over the area at Urgent Care. The chest X-ray was reviewed prior to placing a chest tube. At that time, the metallic foreign body was noted in close proximity to the right

**Figure 1.** Chest X-ray showing foreign metallic object near the right pulmonary hilum and right-sided pneumothorax.

**Figure 2.** Axial view from CT angiogram showing foreign metallic object with the tip abutting a branch of the right pulmonary artery and large right pneumothorax.

**Figure 3.** Coronal view from CT angiogram showing foreign metallic object abutting and surrounded by branches of the right pulmonary artery.
Prior to intervention, the patient was placed on supplemental oxygen and emergently taken for a CT angiogram of the chest. The CT angiogram showed a large right-sided pneumothorax with a metallic nail-like density 5 cm long in the right lung parenchyma abutting the pulmonary vasculature, without any evidence of active bleeding or hematoma (Figures 2, 3). At this time, Cardiothoracic Surgery was consulted and the patient was emergently taken to the operating room at 10:00 PM. A right thoracotomy with exploration of the right pleural cavity and removal of foreign body and placement of right chest tube was done. A 5-cm nail was found in the right pulmonary hilum abutting but not penetrating the right middle lobe pulmonary artery branch and the bronchus intermedius (Figures 4, 5). The patient was extubated without issue and taken to the Surgical Intensive Care Unit for respiratory monitoring at 1:20 AM. The patient recovered well postoperatively and was downgraded from SICU that day. The chest tube remained to water seal with no leak and was removed on the second post-operative day. The patient was deemed appropriate for discharge on post-operative day three. The patient was seen at the Cardiothoracic Surgery Clinic on post-operative day ten, with continued improvement and no issues since surgery.

**Discussion**

The presentation of delayed traumatic thoracic pneumatic nail gun injuries can vary greatly in symptoms and severity. Even in experienced trauma centers, these injuries can present important learning points in evaluation and management. Pneumatic nail guns can propel a nail at approximately 150 ft/second, and abdomen and thoracic injuries represent up to 60% of related fatalities [4]. These injuries should always elicit a high suspicion for serious injury and careful evaluation per the Advanced Trauma Life Support protocol and Western Trauma Association Guidelines on penetrating chest trauma [5-7]. Upon presentation of a patient with thoracic pneumatic nail gun injury, the differential diagnosis should include traumatic pneumothorax, tension pneumothorax, hemopneumothorax, retained foreign body, mediastinal injury, and vessel injury. In our patient, the secondary survey with chest X-ray findings of traumatic pneumothorax necessitated a right tube thoracostomy. However, ATLS and Western Trauma guidelines do not address protocols for pneumothorax with a retained foreign body. The retained nail appeared close to the hilum on chest X-ray but it could not be appropriately determined how close it was to major vessels. After some discussion, the Trauma Team decided further evaluation with CT angiogram was warranted in our hemodynamically stable patient without respiratory compromise before intervention was done. The team was present throughout the entire exam, with needle thoracostomy and tube thoracostomy tools at the ready in case of decompensation while in the CT. Upon image review, it was noted that the foreign body was abutting a branch of the pulmonary artery. Any attempt at tube thoracostomy might have unknowingly pushed the nail into the artery, causing uncontrolled hemorrhage. This highlights an important point in evaluation and management with the ATLS and Western Guidelines protocol for nail gun-associated thoracic trauma. Without personal careful review of the chest X-ray and high suspicion for retained foreign body on the differential, this common trauma-bay procedure could have had catastrophic consequences. To avoid these potential dire mistakes in management, even stable patients with pneumatic nail gun injuries should be evaluated with the utmost suspicion of serious injury. Even though ATLS and Western Guidelines recommend CT angiogram of the chest, mostly for trans-mediastinal injuries, this evaluation should be strongly
considered in the case of retained foreign objects near mediastinal vasculature prior to intervention.

Few other case reports exist with isolated lung injuries caused by pneumatic nail guns, owing to the rarity of these injuries [8]. In similar reports with lung or cardiac injuries, delayed presentation was not uncommon and operative intervention was also required [7-9]. In an unstable patient with nail gun-associated traumatic thorax injury, immediate operative intervention should be done. In a seemingly stable patient with nail gun-associated traumatic thorax injury, further workup with chest X-ray and CT should be done to fully evaluate the extent of injury [7-9]. Using these tools to completely evaluate the extent of the injury and make a diagnosis prior to intervention will better serve the patient and assure the correct exposure and operation is done. Caution should also be taken to prepare for acute decompensation of these patients while the evaluation continues.

Conclusions

With the widespread use of pneumatic nail guns, all trauma centers and emergency departments should be educated in and prepared to treat these injuries. Adherence to the ATLS and Western Trauma protocols and a high suspicion of serious cardiac/lung injury should be maintained for all patients presenting with thoracic nail gun injuries. Based on early primary survey findings, further evaluation with CT angiogram should be done prior to invasive procedures in stable patients with probable cardiac/lung injury due to a retained foreign body. We recommend continued research and updates of the ATLS and Trauma protocols to account for these necessary deviations in protocol. Trauma and Cardiothoracic Surgery should be consulted early to prepare for likely operative management. Appropriate training and protective equipment use should be required by all pneumatic nail gun users to avoid serious preventable injury.

Declaration of Figures’ Authenticity

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