

# Prediction of Sensitivity of Supine Chest Radiograph for Detecting Pneumothorax in the Trauma Bay

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## ABSTRACT

**Introduction:** Pneumothorax is a common complication encountered in the trauma bay in patients presenting with blunt trauma or post RTA. Imaging plays an important role in detecting pneumothorax in the trauma setting. A supine chest radiograph despite its limitations is usually the first investigation that is performed. Computed Tomography of the chest has been considered to be the gold standard in ruling out pneumothorax.

**Aims & Objectives:** The aim of this study is to predict the sensitivity for detection of pneumothorax on supine chest radiograph on patients in the trauma bay, and compare its sensitivity based on the CT Scan Chest Findings.

**Materials & Methods:** 100 patients who presented to the Trauma bay were retrospectively evaluated for the presence of pneumothorax on portable supine chest x-ray followed by Computed Tomography of Chest, and the results of both were compared.

**Results:** Out of the 100 patients that were evaluated, 18 patients showed presence of pneumothorax on Computed Tomography of the Chest. Out of these 18 patients, only 8 were detected with pneumothorax on the supine chest radiograph. The sensitivity of supine chest radiograph was found to be 44.44% for this respective study.

**Discussion:** The sensitivity of detection of pneumothorax on supine chest radiograph in our study was found to be 44.44%. The supine chest radiograph failed to detect more than half the cases of pneumothorax in the study. The findings of pneumothorax on the supine chest radiograph tend to be subtle and are often hard to detect compared to the CT Scan of the chest. The low sensitivity of the supine chest radiograph alone in the detection of pneumothorax warrants a follow up with CT Scan of the chest which can provide much more additional information.

**Conclusion:** In the setting of trauma, the sensitivity of detection of pneumothorax on supine chest radiograph remains low. The findings from this study show that a CT Scan is significantly more likely to yield additional information than a supine chest radiograph alone. The supine chest radiograph should be followed up by a CT Scan for better detection and management of pneumothorax. CT Scan of the chest remains the Gold Standard investigation for detection of pneumothorax in the trauma bay.

**Keywords:** Pneumothorax, Supine Chest Radiograph, X-ray, CT Scan, Trauma Bay

## INTRODUCTION

Pneumothorax is defined as an abnormal collection or leak of air in the pleural space and classified as either spontaneous (primary or secondary) or traumatic. It is important to recognise pneumothorax early, as it can be a life-

threatening condition and may require immediate intervention.

Primary spontaneous pneumothorax usually occurs in the absence of underlying lung disease, classically seen in tall men, aged 20 to 40 years, who are smokers. Secondary pneumothorax occurs commonly due to lung pathology, including chronic

obstructive pulmonary disease, cystic fibrosis, tuberculosis, asthma, interstitial lung disease, menstruation, and *Pneumocystis jirovecii* pneumonia.

Traumatic pneumothoraces occur with blunt or penetrating trauma, commonly including iatrogenic subclavian line placement or thoracentesis or following pleural or lung biopsy. Tension pneumothorax is a medical emergency and occurs in the setting of penetrating trauma, lung infection, and cardiopulmonary resuscitation or positive end expiratory pressure. Following spontaneous pneumothorax, 30% of patients experience a recurrence after either observation or tube thoracotomy treatment.<sup>[1]</sup> Blunt thoracic injuries are the third most common injury in polytrauma patients following head and extremities injuries.<sup>[2]</sup>

Role of imaging is key when one is suspecting pneumothorax. Portable chest radiography is most commonly the initial imaging method used at the emergency workup of the concerned patient. Due to clinical concerns and cervical spine immobilization, initial imaging in seriously injured patients typically consists of a supine anteroposterior (AP) chest radiograph (CXR).<sup>[3]</sup> However, the superiority of Computed Tomography has been documented in the literature. Computed Tomography has the ability to detect significant disease in patients with normal chest radiographs. In 20% cases computed tomography can reveal more extensive injuries with the abnormal initial radiographs, necessitating a change in the management protocol.<sup>[4]</sup>

The gold standard for detecting pneumothorax remains Computed Tomography of the Chest.

### **Aims and Objectives**

This study aims to check the sensitivity of supine chest radiographs for detection of pneumothorax in the trauma bay, Computed Tomography of the Chest being the gold standard. It focuses mainly on the post traumatic pneumothoraces in

trauma patients for whom supine chest radiograph was followed up by computed tomography of the Chest.

## **METHODS AND MATERIALS**

### **Method-**

This was a retrospective study conducted from 2020 to September 2020. This study was carried out on 100 trauma patients in the trauma bay in the tertiary care hospital in Panvel, Navi Mumbai. All patients who were subjected to supine chest radiograph followed by Computed Tomography of the Chest have been included. Patients with clinical suspicion of pneumothorax and with no clinical suspicion of pneumothorax, both have been included in this study.

**Study Type** - Retrospective study

**Study Period** – June 2020 to September 2020

**Sample Size** – 100

**Study Population** – All trauma patients presenting in the trauma bay for whom supine chest radiographs were followed up by computed tomography of the Chest/Abdomen.

### **Inclusion Criteria –**

- 1) Patients in whom the supine chest radiograph was followed up by computed tomography of the Chest.
- 2) Patients presenting with blunt/penetrating trauma to the chest/abdomen
- 3) Post RTA

### **Exclusion Criteria-**

- 1) Patients in whom the supine chest radiograph was not followed up by computed tomography of the Chest.
- 2) Patients presenting with pneumothorax due to non-traumatic causes.

### **Materials-**

- 1) Supine Chest Radiographs were performed on Siemens (600 mA) machine using 60Kvp and 40mAs.
- 2) Computed Tomography of the Chest were performed on Toshiba 16 Slice MDCT machine.

### Supine Chest Radiograph Findings of Pneumothorax

The findings of pneumothorax on a supine chest radiograph can be very subtle compared to the standard PA projection. Intrapleural air may accumulate in several different positions when a patient is in supine position. Mainly two areas are of primary concern-

- 1) **Lung Base** – In the supine position the highest part of the pleural space is at the lung base under the inferior surface of the lung.
  - a) Hyperlucent upper quadrant of the abdomen on the affected side.
  - b) Deep Sulcus Sign i.e. intrapleural air which has collected in the lateral costophrenic space which is the most lateral and inferior aspect of the pleural space.
  - c) Sharply defined dome of the diaphragm on the side of the pneumothorax.
- 2) **Medial** – In the supine position the pleural air may collect anteromedially against the heart.
  - a) A deep and well-defined anterior cardiophrenic sulcus. (can be the earliest sign of a small pneumothorax)
  - b) A sharply defined Cardiac border.

- c) A sharply defined pericardial fat pad.
- d) A sharply defined margin of the anterior junction line.

### RESULTS

During the study, 100 patients in the trauma bay who were subjected to both a supine chest radiograph and a CT scan of the Chest during in the trauma bay during the 3 month period were included in the study and the findings were assessed.

All the 100 patients underwent a portable supine chest x-ray followed by computed tomography of the chest. It was found that out of the 100 patients 18 were found to have findings of pneumothorax on CT Scan of the Chest.

Out of these 18 patients who showed findings of pneumothorax on CT Scan, only 8 out of 18 (44.44%) were detected to show findings of pneumothorax on the portable supine chest radiograph.

Keeping the CT scan of the Chest as the gold standard of investigation for detecting pneumothorax the sensitivity of the supine chest radiograph in the trauma setting was found to be 44.44% in our study.

A table depicting the findings of the study has been shown below.

Total number of patients assessed	Total number of patients showing pneumothorax on CT Scan	Total number of patients showing pneumothorax on supine Chest Radiograph	Sensitivity of Supine Chest Radiograph, CT Scan being the Gold Standard
100	18	8	44.44%

### CASES

#### CASE 1

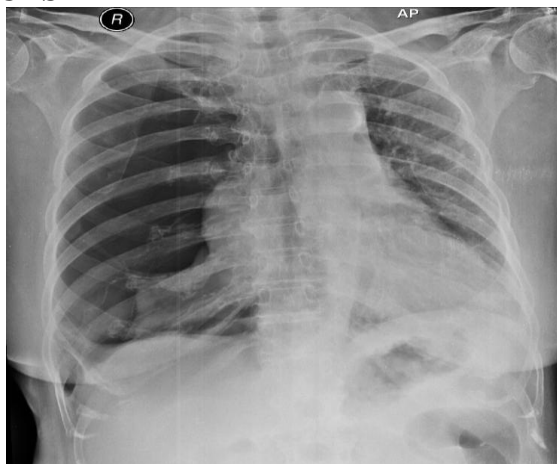


Figure 1a. Supine chest radiograph of the patient shows right sided pneumothorax with collapsed underlying lung and cardio-mediastinal shift to the left.

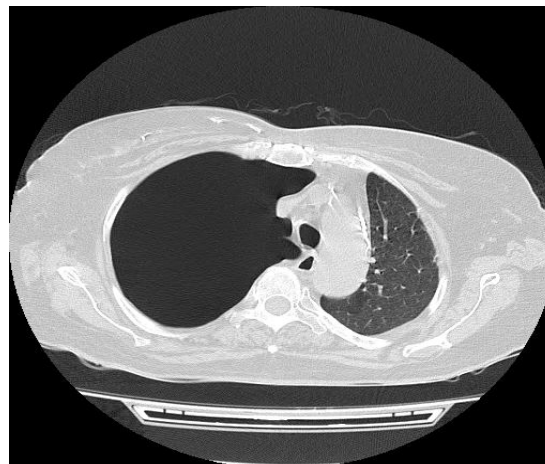


Figure 1b. The corresponding CT Scan of the same patient confirms the findings of pneumothorax with cardio-mediastinal shift to the left.

## CASE 2



Figure 2a. Supine chest radiograph in the patient shows consolidation in the right lower zone, right paracardiac region. No pneumothorax was detected on this study.

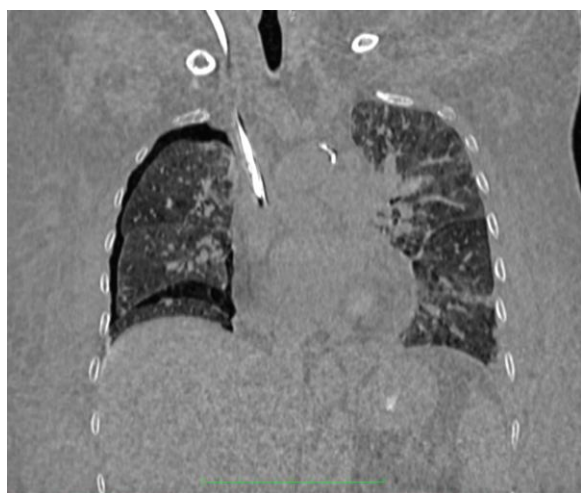


Figure 2b. The corresponding CT Scan of the same patient shows the presence of a small pneumothorax on its coronal reformatted image.

## DISCUSSION

The main diagnosis of pneumothorax on a supine chest radiograph is with the visibility of the pleural line, the lung field beyond which is devoid of any lung markings. The other signs like the sharpened cardiac silhouette and others are often very subtle findings on the radiograph and may not be used for diagnosis.

The conventional chest x-ray despite this remains the most widely used initial investigation. In our study, it was clearly found that CT Chest scanning was significantly more effective than a supine chest radiograph in detection of pneumothoraces and provided a wider range of information.

In our study, supine chest radiographs failed to detect over half of the pneumothoraces which were further detected on CT Scan. With the increasing trend of CT Evaluation of trauma patients, several cases in which pneumothorax were not suspected are also being detected. These pneumothoraces have been defined as 'Occult'.

Out of the 100 patients included in the study, 18 were found to have findings of pneumothorax which were positive on CT Scan, out of which only 8 showed positive findings on supine chest radiograph.

Cases in which a supine chest radiograph is not followed up by a CT scan of the chest, several times a pneumothorax maybe entirely missed and can prove to be fatal.

## CONCLUSION

The results of this study highlighted that a CT scan is significantly more likely to yield additional information than a supine chest radiograph alone, the sensitivity of which was found to be 44.44%. Though the supine chest radiograph remains the most widespread and commonly used initial first investigation in the setting of trauma, CT scan of the chest was much more effective in the detection of pneumothorax and remains the gold standard in the detection of pneumothorax in the trauma bay.

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How to cite this article: Mani S, Khandediya O, Kapoor P. Prediction of sensitivity of supine chest radiograph for detecting pneumothorax in the trauma bay. Int J Health Sci Res. 2020; 10(11):177-181.

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