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Case study: tension pneumothorax

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Abstract

Tension pneumothorax is associated with mediastinal shifts, and Tension pneumothorax is a fatal health condition that requires urgent clinical management such as early identification, and early treatment. The incidence of tension pneumothorax is 1-13%.

Aims of this Case Study

- To identify the tension pneumothorax pathophysiology.
- To describe the proper evaluation of a tension pneumothorax.
- To explore available innovative treatments and approaches.
- To understand the inter-professional teamwork in pneumothorax patient's recovery.

Keywords: Tension Pneumothorax, Mediastinal Shifts, Modified Medical Research Council (MMRC), Shortness of Breath (SoB), Glasgow Coma Scale (GCS), Lung Ultrasound, Intercostal Drain.

Introduction

Pneumothorax is a lung collapse caused by the accumulation of air between the parietal pleura and the visceral pleura of the chest. Air is outside the lungs and inside the chest cavity leading to pressure on the lungs and can cause them to collapse or change surrounding structures. Pneumothorax may be traumatic or non-traumatic.

Toffel, M et al describe that tension pneumothorax may occur in 1-2% of cases that initially present as idiopathic spontaneous pneumothorax. The reason for tension pneumothorax is unknown, maybe because trauma patients have already undergone decompression needle thoracotomy at the time of admission in the trauma center1.

Arao, K et al explained in their study that the CXR can illustrate the tension pneumothorax as the thinnest layer represents the visceral pleura's edge and the total ipsilateral collapse of the lung2.

Terada, T et al recommend that the patient identified with tension pneumothorax requires a chest drain tube for draining, and the prognosis is assessed by serial chest radiographs. Later, after patient recovery, when the lungs had expanded with air leaks, the drain tube can be removed[3].

Chen, K. C et al express that tension pneumothorax is a life-threatening health condition, and requires urgent intervention such as chest draining, experienced health care professionals like experienced nurses, surgeons, and respiratory therapists, and usually performed by experienced nurses[4].

Eguchi, M et al reports that the chest drains are sufficient in 90% of tension pneumothorax cases. Few cases only require surgical intervention, thoracotomy, and video-assisted thoracoscopic surgery (VATS)[5].

Leonhard, G et al reported tension pneumothorax in children of ages 5 and 10 years and the researcher also explains that 22G/2.5 cm or 18G/4.5 cm or 20G/3.2 cm are recommended for acute decompression[6].

Khalil, P. A et al published data narrated that the highest percentage (77%) of US paramedics were able to identify correctly tension pneumothorax through ultrasound[7].

The study by Seah, J. C et al showed that with the aid of AI, the pneumothorax both simple and tension was identified and compared with 750,000 chest radiographs, and described that chest x-rays were widely used, and can lead to human error of interpretation, all health care workers must have deep-learning of chest x-rays or start the usage of innovative inventions[8]. Diaz, R et al suggests that knowledge of emergency and necessary care for chest decompressive procedures and is required for all healthcare workers[9].

Case Study

Case History of Case Study

The case study patient is a 63-year-old male presented to the emergency department with Shortness of Breath (SoB), and grade IV of MMRC for 2 days. The patient had severe sweating. No history of palpitation, fever, and chest pain. The patient was a non-diabetic, and hypertensive patient with coronary artery disease (CAD). The patient was smoking for 25 years. On observation, the symptoms worsened; hence the patient was admitted for further investigation and treatment.

Primary Aassessments

The patient presented with patent symptoms of tachypneic breathing with a respiratory rate of 40, the Spo2 was 68%, and 94% with Non-Re-Breather Mask (NRBM) 15 liters/minute. The patient had decreased air entries on the left side, bile lateral extensive creps were found high on the left side than on the right side.

The blood pressure of the case study patient was 200/100 mmHg, heart rate was 120 beats/minute, Capillary Refill Test (CRT) was < 2 seconds and all peripheral pulses were equal. The patient's heart sounds S1 and S2 were heard, a-febrile, and without rash.

The patient showed GCS-E4V5M6 with good responses of eye, vocal, and motor responses. The blood sugar level was 140mg/dl. Sedated and paralyzed.

Provisional Diagnosis

- Hypertensive Pulmonary Edema (HPE)
- AECOPD
- ABG-Type 2 Respiratory failure (pH – 7.064, PCo2-82, PO2- 105, HCO3-26 mmol/l)

Management in Emergency Department

- As the patient showed respiratory distress and NIV was unsuccessful, endotracheal intubation was needed by the patient along with a mechanical ventilator.
- Urinary catheterization started.
- Nasogastric tube inserted.
- Furosemide 40 mg was given for edema.
- Planned for bedside CXR.

Bedside CXR

Figure 1- Bedside CXR

The findings of bedside CXR

- Suspected a tension pneumothorax and bullous

Rupture post intubation.

Observations noticed with tension post-intubation on mechanical ventilation

- BP-80/50, HR- 130/minutes.
- Reduced air entries (AE) on the left side.
- Raised jugular venous pressure (JVP).
- Hypotension

Figure 2- 5th Intercostals Draining

The Findings of lung ultrasound

- Lung sliding was absent in the left side of the lungs and bar code the sign was present.

After lung ultrasound finding

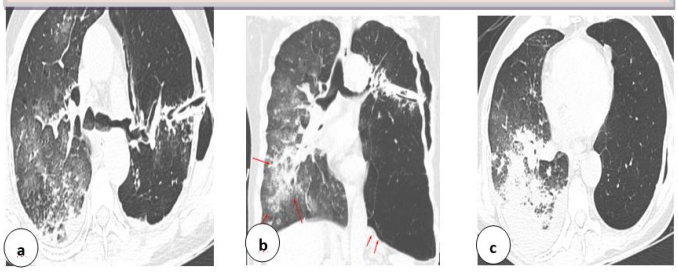
- The patient was planned for needle decompression on the left side intercostal drain at 5th intercostals space.
- Air bubbling present, column movement present in the tube post Implantable Cardioverter-Defibrillator (ICD).

Confirmative Diagnosis of Tension pneumothorax

HRCT THORAX

Chest CT showed multiple sub-pleural tension pneumothorax in the left lung.

Figure 3 HRCT-THORAX



HRCT Thorax: The Double-Wall sign

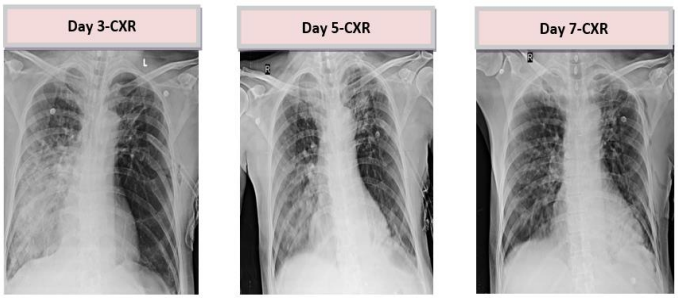
This double-wall manifestation occurs when air can be seen surrounding both sides of the chest wall. Signs of double walling, especially with compression of adjacent bullae, are not evident on all CT slices, but careful observation of multiple images will show this sign if pneumothorax is present and double-wall appearance will mimic tension pneumothorax.

Lesson Learned

HRCT Thorax: Pitfall of Double-Wall sign

A potential pitfall in evaluating the double-walled manifestation of pneumothorax is the presence of two large adjacent blisters. In this situation, an obvious double-walled sign mimicking a pneumothorax may occur. A careful inspection of serial images shows that absences of air in the pleural space, and bulla wall are not parallel to the chest wall or parietal pleura.

Importance of Serial X-rays



Serial X-rays show the image of tension pneumothorax in a different position and can aid in the diagnosis of tension pneumothorax, still, CT is the confirmative diagnostic tool.

When to Suspect pneumothorax?

- Compressed or consolidated lung
- Non-anatomic hyper-lucent appearance
- Immediate symptomatic relief and lung expansion at chest tube placement

Patient's Course in the Hospital

The patient was admitted to Medical ICU. The patient's ECG showed Sinus tachycardia, cardiac marker (enzymes) TNI -6.08, and BNP-889 were elevated, and the 2 D Echo test showed imaging of severe left ventricular dysfunction. The patient showed a 30% ejection fraction and inferior wall hypokinesia. The patient was started on vasopressors diuretics, and high-end antibiotics, and showed PS 12 PEEP – 5 FIO2 – 60% on PCV mode. The patient was recovered and discharged with continuous review.

Discussion

Hillis, J. M et al [10] studies identified 128 patients with tension Pneumothorax from 1000 chest X-rays, and our present case study also presented with tension Pneumothorax.

Sun, R et al [11] and Spiro, J. E et al [12] reported that due to mechanical ventilator high pressure, barotraumas lead to alveolar rupture leading to a life-threatening spontaneous tension pneumothorax occurrence in COVID-19 patients, and we also found in our present case study, the patient on the mechanical ventilator was identified with tension pneumothorax.

Mital, T et al [13] described in their study, it was difficult to diagnose tension pneumothorax in CXR, timely diagnosis was made by lung ultrasound, our case study patient's lung ultrasound showed lung sliding was absent on the left side of the lungs, bar code sign was present, and Air bubbling present, column movement present in the tube post-ICD.

Gaidhane, S. A et al [14] delineated that HRCT provided a timely result in the case of tension pneumothorax and hence considered HRCT as a confirmative diagnostic tool for tension pneumothorax.

Samanta, R. P et al [15] discussed in their study that the giant bullous emphysema mimicked spontaneous pneumothorax with a double-wall appearance, and we also found the double-wall appearance, but careful diagnosis showed tension pneumothorax.

Umar Shahzad, M et al [16] explained that repeated sequential CXR will be a useful diagnostic tool for the identification of tension pneumothorax, and in our present case study, we learned a lesson about the importance of serial X-rays in the identification of tension pneumothorax.

Flower, L et al [17] found in their study the lungs of the COVID-19 patients identified with tension pneumothorax showed compressed lungs with consolidation all around the lungs, and we also found compressed and consolidation of the lung in our case study patients.

Negussie, T et al [18] discussed in their study that tension pneumothorax shows avascular the hyper-lucent appearance that is separated, and we also found a non-anatomic hyper-lucent appearance in the identification of tension pneumothorax.

Al-Hurani, M. F et al [19] reported that after the needle decompression in tension pneumothorax, there is a complete resolution of pneumothorax and complete expansion of lungs was found. W in the case study also we found, our patient showed immediate symptomatic relief and lung expansion after needle decompression and chest tube placement.

In conclusion, with this case study of tension pneumothorax, we recovered the patient and learned lessons on the importance of serial CXR, double-wall sign, the pitfall of double-wall appearance, the best and most precise diagnostic tools for tension pneumothorax were lung ultrasound, and HRCT, hence we have presented this case study for all clinicians for timely, accurate identification of tension pneumothorax and to prevent misidentification that leads to the patients towards fatality as tension pneumothorax is a life-threatening health issue.

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