

**CASE REPORT**

**An Uncommon Life-Threatening Cause of Electric Alternans with Sudden Onset of Breathlessness and Chest Pain**

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**ABSTRACT**

Phasic ECG voltage changes or electrical alternans is a well-described ECG changes seen in the pericardial effusion and cardiac tamponade. Popular as once believed, this ECG features are no longer considered pathognomonic for pericardial effusion and cardiac tamponade. Electric alternans is observed in pneumothorax especially left-sided pneumothorax. This is a case of a 41-year-old man who presented with chest pain and breathlessness to the emergency department. Assessment in the emergency unit revealed an obvious distress man with a respiratory rate of 60 breaths/min with cyanosis. There were generalised rhonchi and prolonged expiratory breath sound appreciated. Chest X-ray (CXR) was done and diagnosed to have left tension pneumothorax. Initial electrocardiogram (ECG) showed electrical alternans in all leads. He was intubated for respiratory distress followed by chest tube insertion. His initial ECG findings resolved after treatment of the tension pneumothorax. Doctors need to evaluate the cardiac findings along with respiratory findings.

**INTRODUCTION**

Electric alternans is observed in pneumothorax especially left-sided pneumothorax<sup>1</sup>. The presentation of chest pain and shortness of breath offers few differential diagnoses ranging from a life-threatening condition such as acute myocardial infarction and dissection of the aorta to a benign condition like musculoskeletal pain<sup>2</sup>. Often the diagnosis

is reached following history and examination coupled with the appropriate investigation. CXR and ECG are the two most essential investigations in the emergency setting<sup>2</sup>. These investigations tend to complement each other. However, there are a few occasions where there are conflicting findings in CXR and ECG as illustrated in this case. Accurate clinical judgement is needed in treating such patient as the saying goes "Always treat the patient and not the investigation". There are numerous case reports on this association between tension pneumothorax and electric alternans dated back to 1979<sup>1,3,4</sup>.

### CASE PRESENTATION

A 41-year-old foreigner who was visiting his relatives in Malaysia presented with sudden onset of chest pain and breathlessness. He was walking to his relative's house when he felt a sudden pain over his chest. The pain was localised to his left anterior chest just below the clavicle, stabbing and pleuritic in nature without associated radiation, sweating, nausea or numbness over the neck, jaw and hands. The onset of pain was accompanied by breathlessness making him barely able to speak.

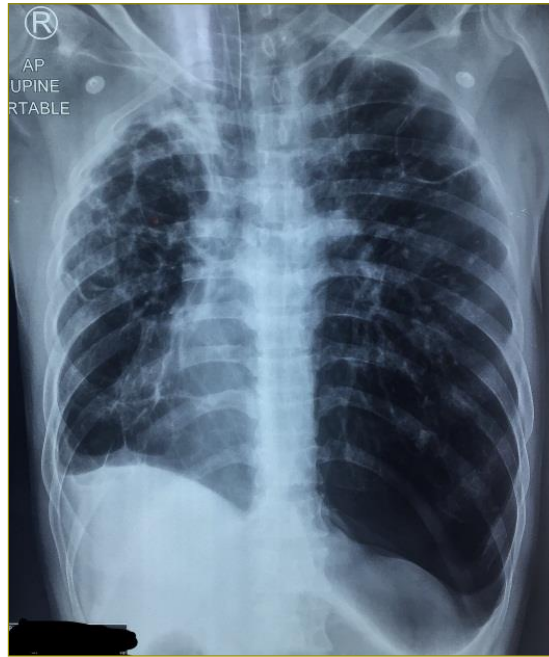
His medical history was significant for pulmonary tuberculosis treated in the year 2000. He denied a recent history of fever, chronic cough, loss of appetite and weight to suggest reactivation of tuberculosis. He worked as a manual labourer back in his country and visits Malaysia twice a year. Of note, he denied recent contact with an active tuberculosis case. He smokes 20 cigarettes per day and has a 20 packs/year smoking history. Since treated for TB in the year 2000, he enjoyed good health and rarely seeks healthcare attention in his hometown.

After the onset of symptoms, he was brought promptly by his relative to the nearest health clinic where he received his initial treatment. He was treated as severe exacerbation of obstructive lung disease and was transferred to the emergency department via ambulance.

Assessment in the emergency unit revealed an obvious distress man with a respiratory rate of 60 breaths/min with cyanosis. He was in a seated position, leaning forward with pursed-lip breathing. The jugular venous pressure was not assessed as the patient was too breathless to lie supine.

Vital signs were significant for oxygen saturation of 71% under room air, blood pressure 171/117 mmHg, heart rate of 130 beats/min and temperature of 37°C. Breath sound was audible bilaterally but slightly reduced over the left. There were generalised rhonchi and prolonged expiratory breath sound appreciated. Unfortunately, chest percussion was not performed during the assessment as the patient was too breathless to cooperate. He was intubated for respiratory distress followed by chest tube insertion upon discovery of pneumothorax in the chest X-ray. Both intubation and chest tube insertion were performed in the emergency department.

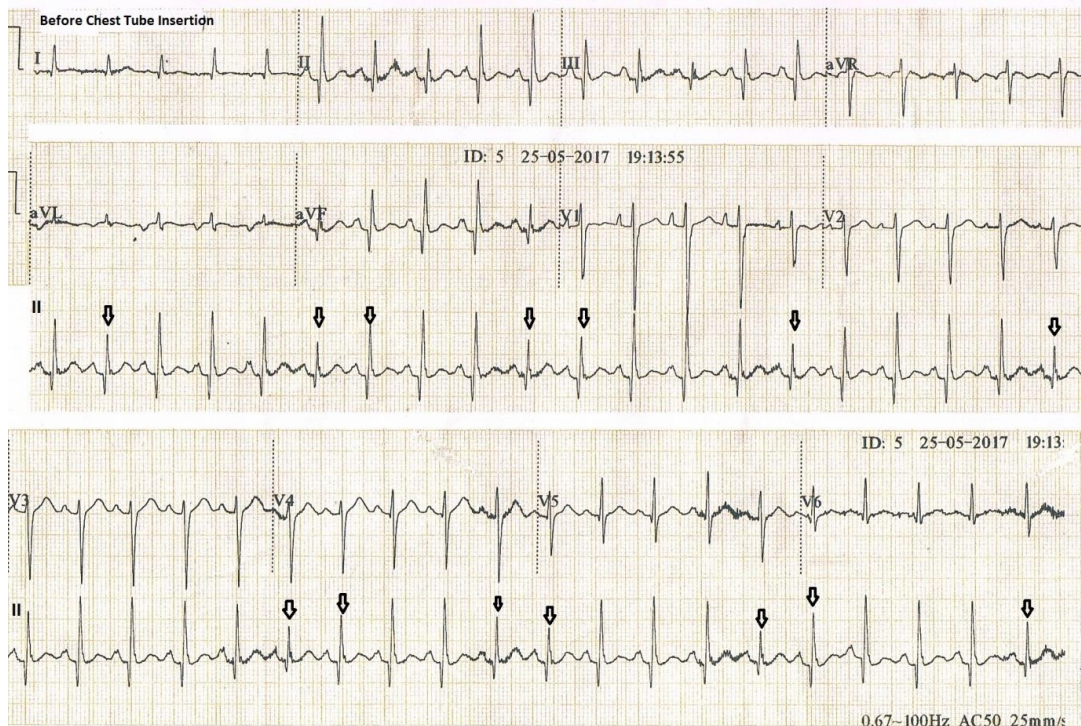
Arterial blood gases (prior to intubation) revealed pH 7.10; pO<sub>2</sub> 245 mmHg; pCO<sub>2</sub> 79 mmHg; HCO<sub>3</sub> 24.5 mmol/L; Base excess -7.3 and Lactate 3.7. The blood gases were taken under oxygen therapy with a rate of 10 L/min. A CXR was ordered post-intubation and was reviewed. CXR showed an extensive fibrotic change of both lungs with bullae. There was a hyperlucent rim over the left lung edges with a shifting of mediastinal structure to the right side. The CXR findings are consistent with secondary spontaneous pneumothorax in tension (Figure 1).



**Figure 1** Extensive fibrotic changes with multiple bullae involving both lungs

There was a hyperlucent rim over the left lung edges with the shifting of mediastinal structure to the right side consistent with significant left pneumothorax. Ruptured bullae were suspected as the cause for pneumothorax in this case.

Initial ECG prior to chest tube insertion displayed sinus tachycardia with a phasic variation of the QRS complex amplitude in all leads (Figure 2).

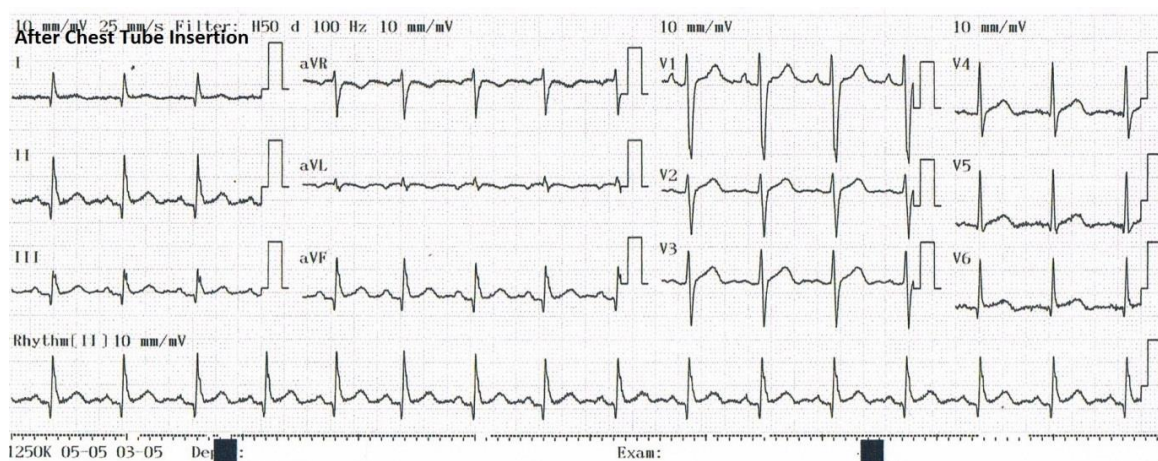


**Figure 2** ECG showed the phasic variation of QRS amplitude or electrical alternans (black arrows). This ECG tracing was recorded before chest tube insertion.

The differential diagnosis for a patient with acute breathlessness and chest pain is wide-ranging from life-threatening conditions, i.e. acute myocardial infarction and dissection of the aorta to more benign causes, i.e. musculoskeletal pain and functional disorder (panic attack). In an emergency setting, the former conditions need to be ruled out first before considering a less serious diagnosis.

Upon diagnosing pneumothorax, a chest tube size 28F was inserted over a safety triangle of the left chest. There was audible 'hissing sound' and bubbling appreciated when the tube connected to under water

drainage system. His vital signs improved after chest tube insertion with a blood pressure of 115/82 mmHg, heart rate 114 beats/min and SpO<sub>2</sub> 100%. Respiratory examination showed improvement of breath sound over the left side without any audible rhonchi. Repeated ECG showed sinus tachycardia with QRS complex of equal amplitude (Figure 3). Repeated bedside echocardiography via the subcostal echo window showed no pericardial effusion with good cardiac contractility. These observations confirmed the diagnosis of left tension pneumothorax with electrical alternans or phasic variation of QRS amplitudes.



**Figure 3** ECG tracing showed resolution of phasic variation of QRS amplitude/electrical alternans after chest tube insertion

He showed progressive improvement and was able to be weaned off from ventilator at day two of admission. The chest tube was off after five days without any recurrence of pneumothorax. His tuberculosis workup consisting of three good sputum specimens for acid-fast bacilli were negative, erythrocyte sedimentation rate of 15 mm/H (normal). His pneumothorax was attributed to ruptured bullae with a high risk of recurrence. A discussion with the patient was made for referral to a cardiothoracic centre however he declined referral. His refusal was understandable as he was a foreigner with both logistic and financial difficulties. CT of the chest was not done due to the same reason. His

case was later discharged with a letter to his homeland hospital for further management without any follow-up news.

## DISCUSSION

There are many possible causes when a patient presented with chest pain and breathlessness. The combination of these symptoms poses a challenge to doctor especially those working in the emergency department. Prompt, timely and appropriate intervention is lifesaving but in actual practice, this is not always the case. Often, emergency doctors are faced with patients with vague symptoms, at times history

is not obtainable due to patient's ill state (i.e. too breathless to speak) and overworked environment but needing prompt clinical acuity. Fortunately, in modern medicine, investigations have helps tremendously in diagnosing a patient's problem. CXR and ECG are mandatory in a patient with chest pain and breathlessness. Yet again, investigations are not without their errors in diagnosis.

ECG aids in detecting cardiac causes for a patient's symptom. For instance, in a patient with chest pain and breathlessness, ST-segment elevation in the ECG strongly indicates that patient is having an acute myocardial infarction. This needs to be coupled with typical history, physical findings and cardiac enzymes before treating as such. This is because ECG may show changes in non-cardiac diagnosis like pneumothorax. Literature has reported ECG changes in cases of pneumothorax<sup>1, 3, 4</sup>. Some of the ECG changes seen include electrical alternans, ST-T changes, bundle branch block morphology in pneumothorax<sup>1</sup>. There is also a case of ST-elevation morphology described for a patient with tension pneumothorax<sup>5</sup>.

The detection of electrical alternans or phasic variation of QRS amplitude, in this case, has made us considered pericardial effusion and cardiac tamponade. However, the whole clinical picture was not compatible. He had a left tension pneumothorax and the electrical alternans seen earlier resolved following chest tube insertion, supporting the notion that the ECG changes were due to the pneumothorax. Bedside echocardiography after chest tube insertion revealed normal findings.

Even though ECG changes in tension pneumothorax have been well described in the literature, these encounters remain rare in actual clinical practice. This case report intends to highlight these findings to the medical fraternity, especially to junior doctors working as front liners.

Electrical alternans or phasic variation of QRS amplitude in pneumothorax has been attributed to possible changes of heart anatomy and volume with respiration<sup>3</sup>. In a large pneumothorax, there will be a mediastinal shift with the respiratory cycle. This shift of mediastinal structure may cause oscillation of the heart causing electrical alternans recorded on ECG.

## **CONCLUSION**

This case report emphasizes the importance of considering history, physical examination, investigation in diagnosing and managing patient's clinical problem. All these diagnostic modalities are not absolute but rather complementary to each other. Doctors should have an open mind when dealing with patients in their daily practice as sometimes the presentation of common medical illness may be atypical from the norms, as illustrated in our case. Sound clinical judgement and decision save patient's life and this valuable quality is only achieved after years of clinical practice and reflection. ECG changes such as electrical alternans can be seen in tension pneumothorax as in this case.

## **CONFLICT OF INTEREST**

The author declares that there are no competing interests in publishing this article.

## **CONSENTS**

Verbal consent was obtained from the patient to publish the case with its related pictures. A copy of the written consent is available for review by the Chief Editor.

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