CASE REPORT

The Macklin Effect - Pneumomediastinum and Pneumopericardium Following Blunt Chest Trauma

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Summary

Pneumomediastinum and pneumopericardium following blunt chest trauma are rare. Diagnosis is by chest radiograph and CT Scan. They have to be identified and treated accordingly. Usually, pneumomediastinum and pneumopericardium are self-limiting requiring no specific therapy. However, vigilance and a continuous monitoring of the vital signs are necessary.

Key Words: Pneumomediastinum, Pneumopericardium, Blunt chest trauma, Rare, Self-limiting

Introduction

Pneumomediastinum, also known as mediastinal emphysema, is due to air collections surrounding the mediastinum. It is reported that up to 10% of patient with blunt chest trauma will develop pneumomediastinum and in less than 2% of patients, pneumomediastinum results from blunt tracheobronchial lesions[1]. Pneumopericardium in adults is a rare disorder and may be seen most commonly after blunt chest trauma in combination with pneumothorax or pneumomediastinum[2].

Case Report

A previously healthy 14 year old Malay boy, was admitted to ORL ward with a two weeks history of progressive difficulty in breathing associated with neck and chest discomfort after he was assaulted by his school mates which included being punched and kicked on the chest. There was slight dysphagia but there was no odynophagia, fever or cough. He denied ingesting any corrosive agent. He was a non-smoker and a Form 2 student at a secondary school.

Upon admission, he was slightly tachypnoeic but pink, pulse oxymeter reading was 100% under room air, vital signs were normal and no stertor or stridor were noted. There was slight tenderness over both sides of the neck with evidence of subcutaneous emphysema down to the level of the clavicle and also in the right axilla. Tenderness also was elicited at the upper part of the sternum. No evidence of bruises or swelling were seen. The lung was clear with good air entry. The chest X-ray (Figure 1) showed air collection in the mediastinum but no evidence of pneumothorax while the lateral neck X-ray showed air collection at the prevertebral space extending from the base of skull to the thoracic inlet.

Urgent CT scan of the neck and thorax (Figure 2) revealed extensive pneumomediastinum extending up to the root of aorta. The aorta and root of pulmonary vessels were distinctly seen. The mediastinal pleural layers were stripped off and the air was also seen stripping to the pericardium region with features of a pneumopericardium. Sternal fracture was seen but there was no rib fractures. There was also extensive surgical emphysema noted at the prevertebral space, anterior to the strap muscle, both carotid spaces

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extending to both axillary regions. There was no pneumothorax, haemothorax, lung contusion or pleural effusion.

He was monitored closely with arrangement ready for emergency resuscitation if necessary. His condition improved over five days in the ward. The subcutaneous emphysema resolved clinically and he did not experience any more breathing difficulty. Repeat CXR and lateral neck showed remarkable resolution of the air collection. He was then discharged home well.

Discussion

The development of pneumomediastinum in general may result from one or more disruption of anatomic structures: (1) direct air leak from rupture of trachea, bronchus, or esophagus into the mediastinum; (2) tears in the pulmonary parenchyma resulting in leakage of air into the pulmonary interstitium: air can further dissect along the fascial sheaths and the adventitia of blood vessels and bronchi to the hilum and eventually into the mediastinum (Macklin Effect); (3) perforation of a hollow abdominal viscus with subsequent dissection of air into the mediastinum via the diaphragmatic hiatus or (4) air may reach the mediastinum through and along the potential spaces and fascial planes of the neck.

The pathophysiology of pneumomediastinum was first described by Macklin in 1939 (Macklin effect) [3]. The basic pathology is explained by the "pressure gradient" theory. It involves an increase in the pressure gradient between the air-filled alveoli and their surrounding interstitial space sufficient to cause alveolar rupture with air getting into the pericapillary interstitial pulmonary space seen in this case from blunt trauma. This space is continuous with the periarterial, peribronchial, and perivenous sheaths, which then rupture and allow air to get into the mediastinum. This air extends to the subcutaneous tissues by dissecting through the fascial planes connecting the cervical soft tissues with the mediastinal, retroperitoneal spaces and may extend upward to the prevertebral space. This explains the findings of subcutaneous emphysema and pneumomediastinum in our patient.

Pneumothorax may develop if the visceral pleura is disrupted while pneumopericardium develops if there is a pericardial tear. In our patient there was no pneumothorax but there was pneumopericardium without the evidence of a pericardial tear. The development of pneumomediastinum and pneumopericardium in our case without a pneumothorax is explained by the Macklin effect [3] as

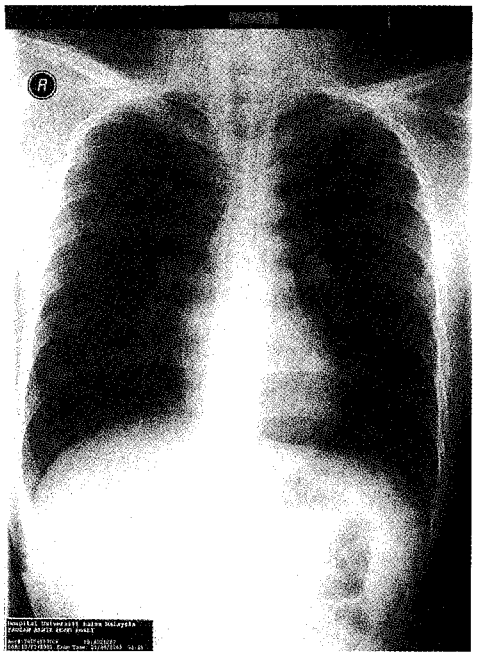

Fig 1: CXR on admission - air collection seen in superior mediastinum extending into the neck

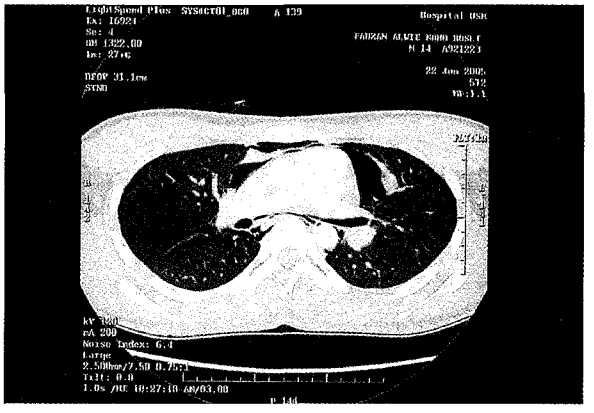

Fig 2: CT Scan Chest showed pneumomediastinum and pneumopericardium

the air can reach the pericardial space by extending along the pulmonary vessels.

The Macklin effect may also be involved in various other conditions such as asthma crises, neonatal respiratory distress syndrome, positive-pressure mechanical ventilation and valsalva maneuvers.

Treatment of subcutaneous emphysema is primarily directed at treating the underlying cause. Inspiration of 100% oxygen helps promote subcutaneous air resorption[4]. The pneumomediastinum may resolved spontaneously with proper rest and observation. Sternal fracture will heal spontaneously.

Pneumomediastium associated with pneumopericardium is rare after a blunt chest trauma. In most cases, they are self-limiting and do not require additional therapy.

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