



Abnormal Respiratory Pattern After Thoracic Compression Injury

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Case Presentation

A 58-year-old male railway worker was trapped between a train and a wall when the train was backing into a garage. He was extricated and sent to the emergency department. The initial physical examination showed a respiratory rate of 25 breaths per minute, a heart rate of 91 beats per minute, blood pressure of 202/102 mmHg, and oxygen saturation of 98% by pulse oximetry. During inspiration, his anterior chest wall retracted, while the other part of the chest wall and abdominal wall distended; during expiration, his anterior chest wall protruded, while the other part of the chest wall and abdominal wall retracted, which indicated the paradoxical respiration (Video 1). A chest X-ray revealed multiple bilateral rib fractures with displacement and pulmonary contusion (Fig. 1). He was intubated because his oxygenation deteriorated gradually. A bilateral tube thoracostomy was performed to treat the pneumothorax. He recovered fully with intensive, non-surgical care and was discharged three weeks after admission.

Discussion

Normally, the chest and abdominal walls move outward together on inspiration and inward on expiration. During inspiration, the contraction of the diaphragm moves the abdominal contents downward and outward, and the contraction of the external intercostal



Video 1. The physical examination revealed that the anterior chest wall retracted, the other part of the chest wall and the abdominal wall distended during inspiration. The anterior chest wall protruded, the other part of the chest wall and the abdominal wall retracted during expiration.

Please see Video 1 at: [http://doi.org/10.6705/j.jacme.202009_10\(3\).0006](http://doi.org/10.6705/j.jacme.202009_10(3).0006).

muscles moves the chest wall outward. During expiration, the relaxation of the diaphragm and external intercostal muscles moves the abdominal contents and chest wall inward.¹ A flail chest refers to the paradoxical motion of the chest wall that results when two or more adjacent ribs fracture at two points with displacement, allowing the flail segment of the chest wall to move independently.² The paradoxical respiratory pattern in the

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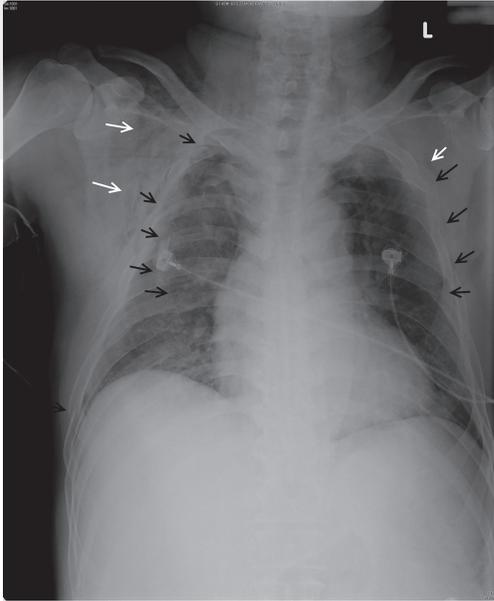


Fig. 1. This chest X-ray shows multiple bilateral rib fractures with displacement (black arrows), bilateral subcutaneous emphysema (white arrows), and increased infiltration indicating pulmonary contusion in both lung fields.

inspiratory phase occurs because the abdominal wall moves outward as the diaphragm contracts, but the chest wall moves inward because the ambient pressure is higher than the pressure inside the lungs. In the expiratory phase, the abdominal wall moves inward as the diaphragm relaxes, and the chest wall moves outward because the ambient pressure is lower than the pressure inside the lungs.^{1,2} The motion of the flail segment may be limited by the surrounding intercostal muscles, so that the actual number of ribs that must be broken to give rise to a flail chest varies and depends on the extent and severity of the rib fractures.

This case serves as a reminder of the clinical presentations of flail chest, and the mechanisms and etiologies of paradoxical respiration. Emergency physicians must recognize this respiratory pattern during the primary survey in thoracic trauma patients.

References

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