

# Atypical flail chest developing due to a giant cavity in the chest wall: a case report

Kuthan Kavaklı (\*), Orhan Yücel (\*), Hasan Çaylak (\*), Sezai Çubuk (\*), Ersin Sapmaz (\*)

## SUMMARY

Flail chest is anatomically defined as the presence of four consecutive, unilateral ribs each fractured in two or more places. Herein, we present a case who had no paradoxical movement of a chest wall segment but had flail chest pathophysiology between left thoracic cavity and giant cavity in the chest wall occurring due to blast injury of a bullet. A 20-year-old man was admitted with bullet injury on the left chest. Chest x-ray revealed fractures in 4th and 5th ribs on the lateral side. The thorax computerized tomography revealed a giant cavity in the thoracic wall which was in combination with thoracic cavity. There was not significant contusion in lung parenchyma areas. However mechanical ventilation was performed for seven days, and then he was successfully extubated. The second thorax computerized tomography revealed obliteration of the cavity in the chest wall and parenchymal healing. We should consider in mind that a flail chest pathophysiology can occur when there is a giant cavity in the chest wall in combination with thoracic cavity occurring due to blast injury of a bullet.

**Key words:** Blast injury, flail chest, mechanical ventilation, pathophysiology

## ÖZET

**Göğüs duvarındaki dev kaviteye bağlı gelişen atipik yelken göğüs: olgu sunumu**

Yelken göğüs anatomik olarak arka arkaya dört veya daha fazla kaburganın, tek taraflı olarak her bir kaburga için iki veya daha fazla noktadan kırılması olarak tanımlanır. Bu yazıda paradoksal hareket eden bir segment değil de, göğüs duvarında merminin blast etkisi ile oluşan bir kavite ve bu kavitenin toraks kavitesi ile iştiraki sonucu yelken göğüs patofizyolojisinin oluştuğu bir olguyu sunduk. Yirmi yaşında erkek hasta sol göğüs duvarında ateşli silah yaralanması ile müracaat etti. Akciğer grafisinde 4. ve 5. kotların lateral tarafında bir noktadan kırık olduğu saptandı. Toraks tomografisinde sol göğüs duvarında kotlar ile kaslar arasında büyük bir kavitenin olduğu ve bu kavitenin toraks kavitesi ile iştiraki olduğu görüldü. Akciğer parankim alanlarında belirgin kontüzyon yoktu. Ancak, hastaya yedi gün süreyle mekanik ventilasyon uygulandı. Sonrasında hasta başarıyla ekstübe edildi. İkinci toraks tomografisinde kavitenin tamamen oblitere olduğu ve parankimin iyileştiği görüldü. Göğüs duvarında kurşunun blast etkisi sonucu oluşmuş belirgin bir kavite varlığı ve bu kavitenin toraks kavitesi ile iştirakinin izlendiği durumda bir yelken göğüs patofizyolojisinin oluşabileceğini aklımızda bulundurmamızdır.

**Anahtar kelimeler:** Blast yaralanma, yelken göğüs, mekanik ventilasyon, patofizyoloji

## Introduction

Flail chest is anatomically defined as the presence of four consecutive, unilateral ribs each fractured in two or more places. The unstable chest wall segment moves inwards during spontaneous inspiration when the chest moves outwards. Mortality in these patients ranges from 5% to 32.4% (1,2). Flail chest usually occurs following a significant blunt trauma due to traffic accident or crush injury to the chest. However there is, to our knowledge, not any presentation of flail chest occurrence due to blast injury in the literature. Demonstration of unstable chest wall segment moving paradoxically is sufficient for diagnosis. Herein, we present a patient who has had a pendelluft mechanism between left thoracic cavity and giant cavity in the chest wall that has occurred by blast injury of a bullet although there has been no paradoxical movement of a chest wall segment.

## Case Report

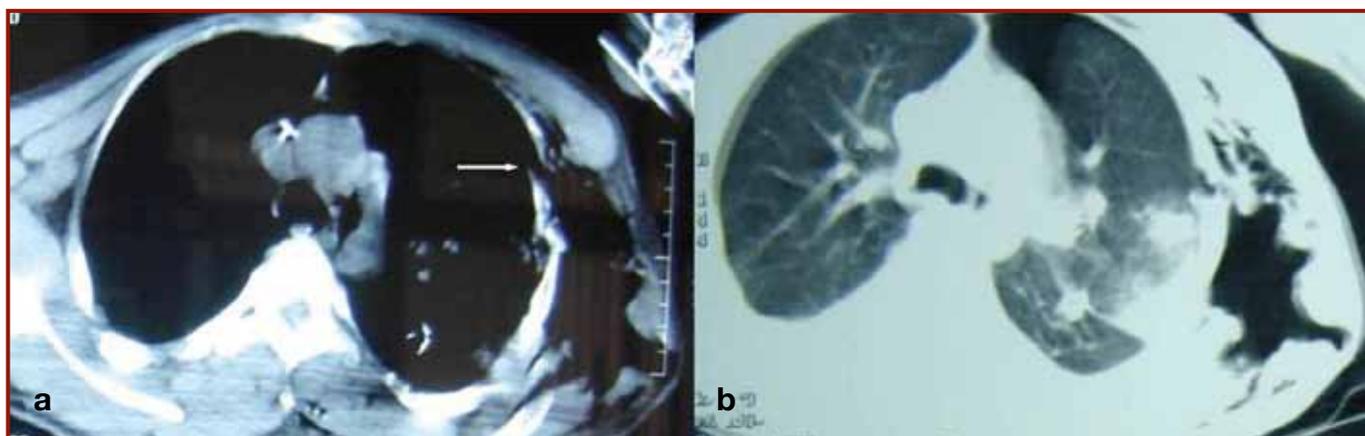
A 20-year-old man had been admitted to a military hospital with high-velocity bullet injury from the left chest and his right leg. The bullet had entered the left thoracic cavity from anterior axillary line at the level of fourth intercostal space and exited from the posterior axillary line at the level of fifth intercostal space. His first treatment had been performed at this hospital. A chest tube insertion was the only treatment for his left-sided pneumothorax. He was referred to our hospital by an ambulance airplane for the advanced treatment. The thorax computerized tomography (CT) revealed a giant cavity in the thoracic wall which was combined with thoracic cavity (Figure 1a,b).

The arterial blood gas analysis showed hypoxemia and hypocapnia (pH: 7.46, pO<sub>2</sub>: 34.7 mmHg, pCO<sub>2</sub>: 26.8 mmHg). He underwent debridement operation for his right leg injury. After the operation he did not tolerate the extubation and his arterial blood gas

\*Department of Thoracic Surgery, Gulhane Military Medical Faculty

**Reprint request:** Dr. Kuthan Kavaklı, Department of Thoracic Surgery, Gulhane Military Medical Faculty, Etlik-06018, Ankara  
**E-mail:** kkavakli@gata.edu.tr

Date submitted: October 21, 2010 • Date accepted: June 06, 2011 • Online publication date: August 15, 2012



**Figure 1.** The giant cavity is seen in the left chest wall between the ribs and the muscles of thoracic wall which is in combination with thoracic cavity (arrow). There is not significant contusion in the lung parenchyma (a,b)

analysis showed respiratory acidosis, hypoxemia and hypercapnia (pH: 7.20, pO<sub>2</sub>: 44.7 mmHg, pCO<sub>2</sub>: 59 mmHg). As he had 4th and 5th ribs fracture in one place on the lateral side after a careful examination and the clinical progress of the patient (Figure 2), we thought that a flail chest pathophysiology occurred. The pendelluft mechanism developed between left thoracic cavity and giant cavity in the chest wall which occurred secondarily by blast injury of the bullet (Figure 3).

Mechanical ventilation was performed for seven days. He was successfully extubated and thorax CT showed obliteration of the cavity in the chest wall and parenchymal healing (Figure 4a,b).

### Discussion

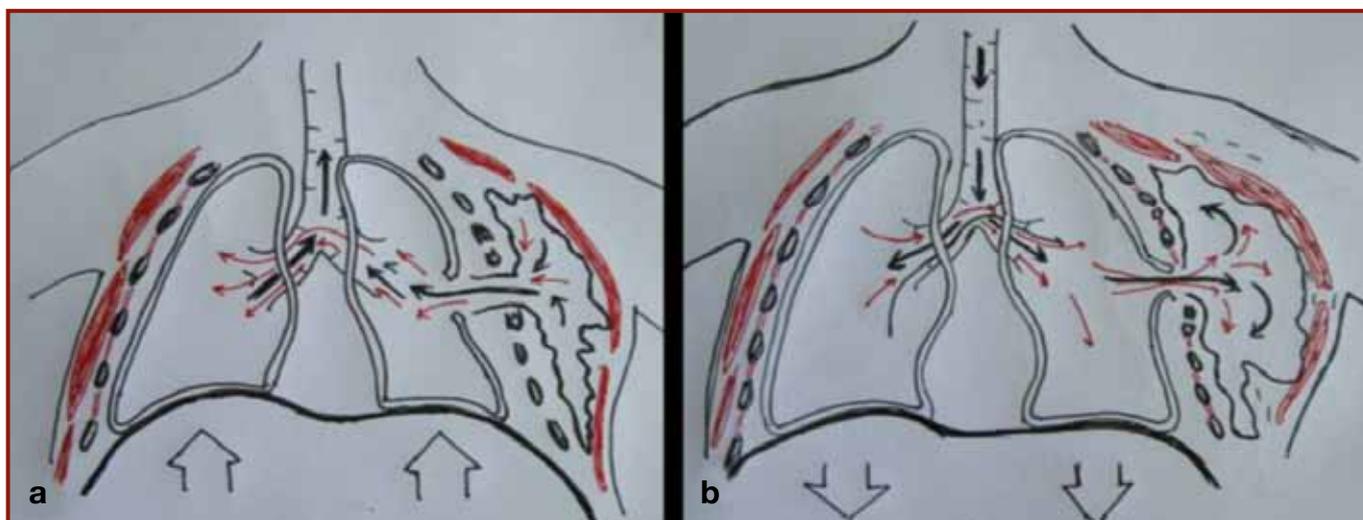
Flail chest is a clinical diagnosis usually determined after a severe blunt chest trauma and most often accompanied by significant underlying pulmonary parenchymal injuries, including pneumothorax, hemothorax, pulmonary contusion and pneumonia. Pulmonary contusion is a significant predictor in planning the treatment of flail chest because respiratory insufficiency associated with flail chest results from the underlying pulmonary contusion rather than paradoxical respiration (2). In patients with significant pulmonary contusions, operative fixation of flail chest is not appropriate (3,4). Internal pneumatic stabilization of flail chest with mechanical ventilation is another treatment choice which is frequently preferred (5-7). We treated our case with mechanical ventilation because the injury of patient was not suitable for surgical fixation or external fixation and traction. The ventilator support was performed



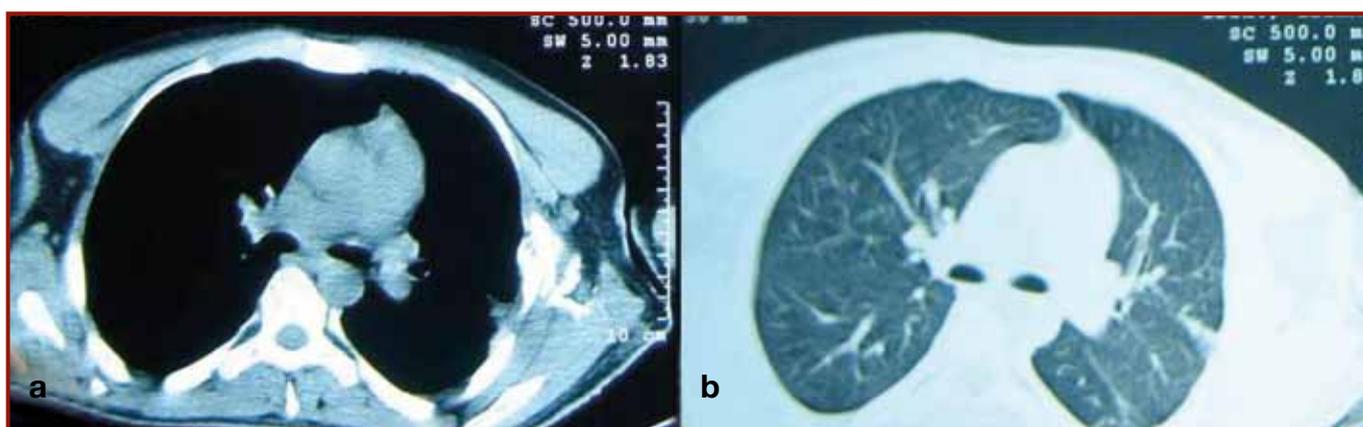
**Figure 2.** Chest X-ray revealed the fracture of two ribs and limited contusion in the left lower zone

for seven days and the treatment was completed after reduction of giant cavity in the chest wall.

Clinically a flail chest is diagnosed when an unstable segment of chest wall has a paradoxical motion on physical examination. The chest X-ray is the confirmatory diagnostic tool when it reveals 3 or more segmental rib fractures. The thorax CT is a very useful imaging method in determination of the severity of pulmonary contusions or exclusion of other life-threatening lesions such as rupture of a great vessel. The atypical presentation of our case was related with no evidence of paradoxical motion on physical examination, chest X-ray revealed only two rib fractures in one place and no significant pulmonary contusion was determined on thorax CT. However, his clinical course and blood gas analysis were in consistent with respiratory insufficiency.



**Figure 3.** Travel of air between left chest cavity and giant cavity situated in the left chest wall during expiration (a) and inspiration (b)



**Figure 4.** The obliteration of the cavity and paracymal healing were obtained after seven days of mechanical ventilation (a,b)

The pendelluft mechanism has lost its popularity in defining pathophysiology of flail chest. Because mechanics of breathing which are significantly impacted in patients with flail chest can not be explained just with pendelluft mechanism. A flail segment of the chest wall has three effects on respiratory system: inefficient ventilation, pulmonary contusion and atelectasis from hypoventilation (8). However we can explain the respiratory insufficiency of our patient with the pendelluft mechanism between left thoracic cavity and giant cavity in the chest wall.

In conclusion, we should consider in mind that a flail chest pathophysiology can occur atypically when there is a giant cavity in the chest wall which has a combination with thoracic cavity.

## References

1. Yücel O, Sapmaz E, Çaylak H ve ark. Hastaneye yatırılmayı gerektiren toraks travmalı 748 olgunun analizi. *Gülhane Tıp Derg* 2009; 51: 86-90.
2. Balci AE, Ozalp K, Duran M, et al. Flail chest due to blunt trauma: clinical features and factors affecting prognosis. *Ulus Travma Derg* 2004; 10: 102-109.
3. Voggenreiter G, Neudeck F, Aufmkolk M, Obertacke U, Schmit-Neuerburg KP. Operative chest wall stabilization in flail chest: outcomes of patients with or without pulmonary contusion. *J Am Coll Surg* 1998; 187: 130-138.
4. Simon B, Ebert J, Bokhari F, et al; EAST Practice Management Workgroup for Pulmonary Contusion-Flail Chest. Practice management guideline for "pulmonary contusion-flail chest". *Eastern Association for the Surgery of Trauma (EAST)*. 2006: 1-75.
5. Richardson JD, Adams L, Flint LM. Selective management of flail chest and pulmonary contusion. *Ann Surg* 1982; 196: 481-487.
6. Freedland M, Wilson RF, Bender JS, Levison MA. The management of flail chest injury: factors affecting outcome. *J Trauma* 1990; 30: 1460-1468.
7. Athanassiadi K, Gerazounis M, Theakos N. Management of 150 flail chest injuries: analysis of risk factors affecting outcome. *Eur J Cardiothorac Surg* 2004; 26: 373-376.
8. Davignon K, Kwo J, Bigatello LM. Pathophysiology and management of the flail chest. *Minevra Anestesiol* 2004; 70: 193-199.