

## Patient with Multiple Rib Fractures Developed into Phrenic Hernia After Cardiopulmonary Resuscitation

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Received: 21 Sep 2021

Accepted: 12 Oct 2021

Published: 16 Oct 2021

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### Citation:

Hu Z. Patient with Multiple Rib Fractures Developed into Phrenic Hernia After Cardiopulmonary Resuscitation. Clin Surg. 2021; 6(8): 1-3

### Authors' Contributions:

Cheng S, Yang J, Peng L, Chen Y, Hu Z, all these authors are equally contributed to this work.

### Abbreviations:

ICU: Intensive Care Unit; CPR: Cardiopulmonary Resuscitation

### 1. Abstract

Phrenic hernia is a rare condition in patients with multiple rib fractures after cardiopulmonary resuscitation. We report a 28-year-old case of multiple injuries with multiple rib fractures who developed Phrenic hernia after cardiopulmonary resuscitation and underwent emergency surgery after sudden respiratory and cardiac arrest in ICU. This is the first report of Phrenic hernia after cardiopulmonary resuscitation after respiratory and cardiac arrest of multiple rib fractures in China.

### 2. Background

Cardiorespiratory arrest caused by a variety of critical diseases and accidents is a common emergency in the emergency department. Improper rescue and treatment will lead to new complications or death. Common complications of cardiopulmonary resuscitation include rib fracture, sternal fracture, hemothorax, pneumothorax, lung injury and bleeding, costal cartilage injury, rupture of liver, spleen and kidney, reflux of gastric contents, heart rupture and so on. However, there are few literatures about Phrenic hernia after cardiopulmonary resuscitation. We report a case of Phrenic hernia during cardiopulmonary resuscitation in a young woman with severe multiple injuries with multiple fractures of ribs.

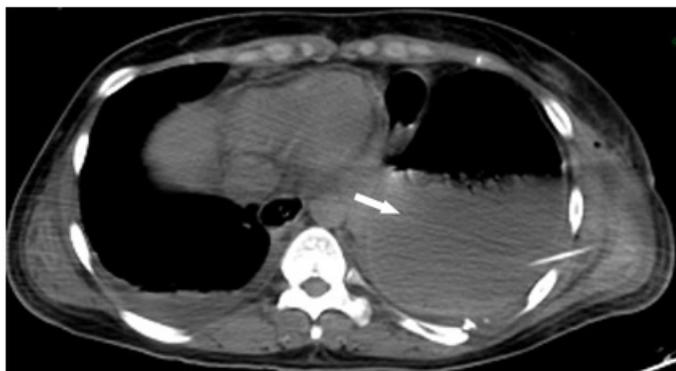
### 3. Case Presentation

A 28-year-old lady with severe multiple trauma injuries and multiple left rib fractures (Figure 1) and sudden cardiac and respiratory arrest in ICU after external fixation of pelvic fractures and interventional angiography and embolization. External cardiac compression and electrical defibrillation were implemented, she was rescued successfully and recovered finally. However, the broken ends of fractured ribs punctured the stomach and diaphragm during CPR, the whole stomach herniated into the left pleural cavity forming diaphragm hernia (Figure2, 3).

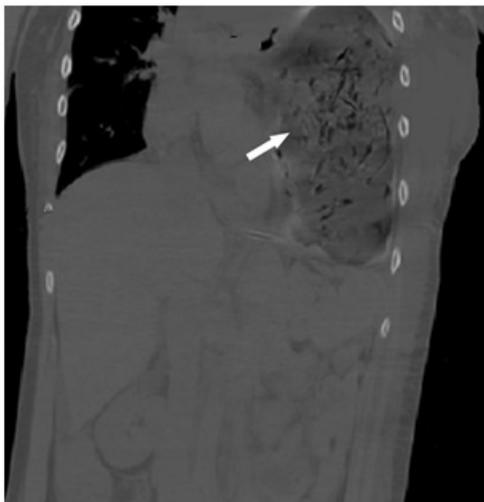
This patient had multiple fractures of the left ribs, and sudden cardiac and respiratory arrest in ICU after surgery. Cardiopulmonary resuscitation must be given immediately. The doctor on duty had no ability to open the chest for cardiac compression, and no abdominal pressure Cardiopulmonary Resuscitation (CPR) device in this ICU, so only chest compressions were chosen. Fortunately, the patient recovered heart rate and breathing successfully after chest compressions. Unfortunately, the fractured ribs pierced the stomach and the diaphragm, the whole stomach and part of the liver got into the left thoracic cavity after chest compressions. The emergency surgery was done again and the patient discharged without any related complications finally.



**Figure 1:** Multiple left rib fractures



**Figure 2:** In the chest CT, the stomach protrudes into the left chest



**Figure 3:** The stomach enters the left thoracic cavity and forms a Phrenic hernia

#### 4. Discussion and Review of the Literature

Phrenic hernia can be divided into traumatic Phrenic hernia and non-traumatic Phrenic hernia, and the latter can be divided into congenital and acquired types. The most common non-traumatic Phrenic hernia are esophageal hiatal hernia, thoracoabdominal

hiatal hernia, parasternal hernia and Phrenic absence. Esophageal hiatal hernia is the most common cause of esophageal hiatal hernia in more than 90% of Phrenic hernia. It is controversial that a few patients with congenital developmental disorders occur in infancy, but in recent years, it is believed that acquired factors are mainly related to obesity and chronic increase of intra-abdominal pressure.

Due to the existence of physiological negative pressure in the thoracic cavity, there is a 0.588-1.98Kpa (6-20cmH<sub>2</sub>O) pressure gradient between the chest and abdominal cavity when breathing calmly, and the pressure difference between the chest and abdomen can exceed 9.8Kpa (100cmH<sub>2</sub>O) if the maximum inspiratory force is applied [2]. The blunt crush injury directly acting on the lower chest and upper abdomen can suddenly increase the intra-abdominal pressure, increase the chest-abdominal pressure difference, and the diaphragm is subjected to a huge pressure shock, resulting in diaphragm rupture. The rupture of the diaphragm can be located anywhere in the diaphragm, or it can be completely avulsed from the attachment of the costal arch, either horizontally or longitudinally, but the left posterolateral radial rupture of the diaphragm is the most common. This is because this site has no liver buffer protection in the area of weak embryonic development and left diaphragm trauma.

Phrenic hernia is generally difficult to heal itself, once diagnosed, surgical treatment should be taken as soon as possible. For patients with multiple organ injuries, we should follow the principle of severe injury first and then treat diaphragmatic hernia; for patients with shock, we should actively fight shock and prepare for operation; for those with massive hemorrhage or progressive hemorrhage, we should immediately stop the bleeding. Because Phrenic hernia is very easy to cause respiratory and circulatory disorders and organ strangulation, obstruction or rupture, in this case, the patient's life was successfully saved by timely operation. But it also reminds us that in the cardiopulmonary resuscitation of multiple rib fractures, we should pay attention to standard compressions, avoid rough movements and reduce the complications of cardiopulmonary resuscitation. After the cardiopulmonary resuscitation is effective, the relevant examination should be reexamined in time to avoid missing the treatment time window.

#### 5. Conclusion

Generally, chest compressions are not appropriate in patients with rib fractures [1]. However, in special cases, when there is no condition or ability to guarantee thoracotomy, in order to save the patient's life, it is necessary to perform CPR in the presence of rib fractures, even if it may cause other injuries to the patient. While these often occur in pre-hospital, small hospitals or community hospitals. Therefore, it is necessary to find out a method or device that can be used for these special cases to conduct a safe and effective resuscitation for patients with cardiac arrest.

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