Case report

Cough-induced rib fracture and diaphragmatic rupture resulting in simultaneous abdominal visceral herniation into the left hemithorax and subcutaneously

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Abstract

Violent coughing is associated with a multitude of complications including rib fractures and diaphragmatic rupture. In this report we present a case of a 70-year-old male with the rare combination of both complications resulting in herniation of bowel into the left hemithorax and subcutaneously between the separated ribs. Surgical repair was performed via a left thoracotomy, the hernia reduced and the diaphragmatic and chest wall defect repaired primarily with excellent patient recovery and relief of symptoms.

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1. Case report

We report a rare case of a cough-induced left costal margin rib fracture with separation of the ribs and diaphragmatic disruption resulting in abdominal visceral herniation into the thoracic cavity and subcutaneously.

A 70-year-old male was referred by his general medical practitioner to the Accident and Emergency Department with shortness of breath and pain over the left lower anterior chest wall following a bout of violent coughing. There was no significant past medical history or prior trauma.

The initial chest X-ray showed a left sided pleural opacity suggestive of a small fluid collection. His symptoms improved and he was discharged from hospital and reviewed with serial X-rays. The chest X-ray 2 months following an acute illness demonstrated air fluid levels within the left hemithorax (Fig. 1A).

CT scan of the thorax showed a defect in the antero-lateral wall of the left diaphragm with herniation of small and large bowel into the left hemithorax and then between the ribs into the anterior abdominal wall (Fig. 1B and C). There was marked volume loss of the left lung due to the hernia.

On examination he was tachypnoeic with reduced air entry at the left lung base and a soft non-tender reducible hernia between ribs 8 and 9 anteriorly at the costal margin. Surgical repair was carried out via a left thoracotomy approach. Loops of small and large bowel were found in the chest cavity herniating through a defect in the antero-lateral wall of the diaphragm (Fig. 2A and B). The bowel was reduced into the abdominal cavity without bowel resection. The defect in the diaphragm was repaired in two layers with continuous silk suture (Fig. 2C). The chest wall was reinforced by double breasting the anterior chest wall muscles. Postoperatively the patient made an excellent recovery and was discharged home 7 days later. On 6-week review he has had complete resolution of his shortness of breath with no evidence of recurrent herniation radiologically.

2. Discussion

The combination of cough-induced rib fracture and diaphragm rupture resulting in abdominal visceral thoracic and subcutaneous herniation has not been reported to date.

Violent coughing is associated with a host of complications including syncope, rupture of subconjunctival nasal and anal veins, bradycardia, pneumomediastinum [1], pneumothorax, incontinence, rupture of muscles, herniation of lung through intercostal spaces [2], and fracture of ribs [3].

It is postulated that two theories could explain cough-induced fractures. The first mechanism is similar to that of stress fractures [4,5]. Namely, if a force is applied to an object, the stress causes deformation which, when it exceeds the elastic limit, results in inelastic deformation of the object, in this case the rib. Repeated paroxysms of coughing produce...
inelastic deformation in the most vulnerable part of the ribs, either at the costochondral junctions or in osteoporotic bone, usually the middle third between the fifth to tenth ribs [5]. This may result in minor cracks in the bone and, if the trauma continues, extends to complete fracture.

The second mechanism, though not validated, is thought to be related to opposing muscle forces acting on the ribs. An early study by Oechsli [6] describes a fracture line starting from a point 4 cm from the costochondral junction of the fourth rib and running obliquely caudad and laterally to the ninth rib in the mid-axillary line. This line falls on the muscular attachments of the external oblique and serratus anterior muscles. Opposing action of these muscles on the same rib may result in fracture. Simultaneous contraction of the shoulder girdle muscles, especially serratus anterior, which pull the ribs upward and laterally, and the abdominal muscles, which pull the ribs medially and downward, may also be contributory to rib fracture [6].

Trauma is the most common cause of diaphragmatic rupture. Seven percent of thoracic injuries and 22% of thoracoabdominal injuries are associated with diaphragmatic injury. Left sided rupture is five times more common than right [7]. During forced expiration the abdominal wall muscles contract and push the diaphragm upward and the ribs inwards and downwards. Sudden and forceful Valsalva maneuvers can result in a lack of coordination in the different expiratory muscles, contributing to the rupture of the diaphragm [8]. Since the abdominal muscles and the diaphragm are attached to the lower ribs, opposing action of this kind can result in rib fractures. In existing rib fractures, antagonistic action of muscles on different rib fragments may also contribute to diaphragmatic tears.

3. Conclusion

Abdominal herniation following cough-induced rib fracture and diaphragmatic rupture has been described [9] but there are no reported cases of abdominal contents herniating into the thorax and simultaneously subcutaneously between the separated ribs following this injury. This case adds to the long list of complications following violent coughing.

Cough-induced rib fractures are easily missed but generally the history is characteristic. Delayed diagnosis can lead to the progression of complications as in this case. However, careful preoperative imaging and correct operative approach in this case via thoracotomy is associated with an excellent outcome.

References