

Traumatic Rupture of the Right Hemidiaphragm: Diagnosis aided by Computerized Tomography and Image Reformation A Case Report

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تمزق رَضْحِيّ لِنِصْفِ الحِجَابِ الحَاجِزِ الأَيْمَنِ: تَشْخِصُهُ بِوِاسِطَةِ الأَشْعَةِ المِقطَعِيَّةِ

مع إعادة تشكيل الصور - تقرير حالة

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المخلص: تشخيص تمزق الحجاب الحاجز الرضحي الذي يحصل عادة نتيجة الإصابة المباشرة للبطن وأسفل الصدر. يشكل تحدياً لكل من أخصائي الأشعة والجراحين على الرغم من أنه غير شائع الحدوث. تعتبر إصابة الجانب الأيمن أكثر ندرة مقارنةً بالجانب الأيسر والخطأ في تشخيصها يعتبر أكثر وروداً. الأشعة المقطعة المحوسبة مع إعادة تشكيل الصور سهلت عملية التشخيص لهذا النوع من الإصابات وفي نفس الوقت ساعدت على تشخيص الإصابات المصاحبة. التشخيص والعلاج المبكر يقللان من المراضة وخطر الوفاة. نقدم هنا حالة لشباب عمره (16) سنة أصيب في حادث سير إصاباتٍ كليلّة في بطنه وصدره. تم تحويل هذا المريض إلى مستشفى جامعة السلطان قابوس في عمان حيث ساعدت الأشعة المقطعة للصدر والبطن مع إعادة تشكيل الصور على التشخيص المبكر لتمزق الحجاب الحاجز الأيمن الرضحي والبدء في علاجه مبكراً.

مفتاح الكلمات: الحجاب الحاجز الأيمن. التمزق الرضحي. الأشعة المقطعة المحوسبة. تقرير حالة. عمان.

ABSTRACT Traumatic rupture of the diaphragm (TRD) poses a challenge to both radiologists and surgeons. They are uncommon and occur following blunt abdominal or lower thoracic trauma. The right side involvement is less common than the left side and is easily missed. Spiral computed tomography (Spiral CT) with image reformation is very useful in the diagnosis of TRD and in identifying associated injuries. Early diagnosis and repair reduces mortality and morbidity. We present the case of a 16 year old boy who was involved in a high speed traffic accident with blunt injury to his thorax and abdomen. He was referred from a peripheral hospital in Oman for further management at Sultan Qaboos University Hospital. A spiral CT scan of thorax and abdomen with image reformation helped in the early diagnosis and management of the traumatic rupture of his right hemidiaphragm.

Key words: Right hemidiaphragm; Rupture; Computerized tomography; Case report; Oman.

WE PRESENT THIS CASE REPORT TO HIGHLIGHT the role of spiral computed tomography (CT) with image reformation in the early diagnosis and management of traumatic rupture of the right hemidiaphragm.

CASE REPORT

A 16 year old male patient who was involved in a high speed traffic accident with blunt trauma to chest and

abdomen was admitted to a peripheral hospital in the Sultanate of Oman. The patient was treated for a suspected haemothorax on the right side with intercostal tube drainage and transferred after five days to Sultan Qaboos University Hospital for further management.

An initial chest X-ray showed an elevated right hemidiaphragm with mild superomedial tenting and with normal pleural spaces. There were no rib frac-

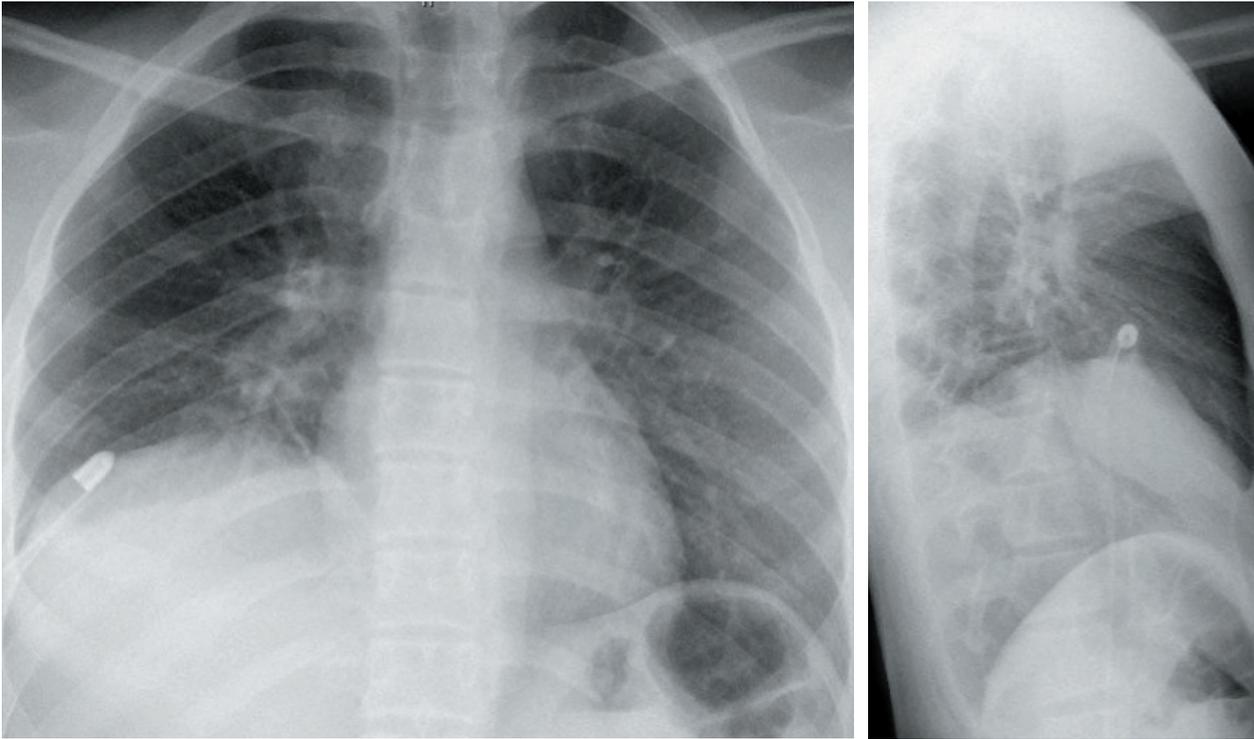


Figure 1: Chest X-ray frontal and lateral projections showing elevated right hemidiaphragm with superomedial tenting. An intercostal drainage tube is shown on the right side.

tures. It also showed a suboptimally placed right intercostal drainage catheter tube [Figure 1]. A follow-up spiral CT scan of thorax and abdomen showed features of right diaphragm rupture and liver herniation into the thorax [Figures 2 and 3]. The axial scans showed a subtle indentation on the posterolateral and medial aspects of the liver (arrow heads) which caused the 'collar sign'. The waist-like constriction in the liver and its herniation into the thorax are well shown in the reformatted coronal and sagittal oblique images. Associated injuries were liver contusion and a small subcapsular haematoma and thorax images showed a posterior segmental atelectasis of the right lower lobe [Figure 2].

The abdominal findings were confirmed at surgery and the diaphragm was repaired. No surgical intervention was performed for the liver injury as it was small. The suboptimally positioned intercostal catheter was removed.

DISCUSSION

Acute traumatic diaphragmatic ruptures are uncommon and occur in about 0.8-8% of major blunt trauma victims.¹ Left-sided tears are more common than right-sided tears.² Blunt trauma to lower thorax or abdomen

secondary to a motor vehicle accident is the most common cause of close rupture of the hemidiaphragm.^{1, 3} There are two possible mechanisms for rupture of a hemidiaphragm. One is a lateral impact which causes shearing of the diaphragm due to distortion of the chest wall; the other is frontal impact which leads to an increase in intra-abdominal pressure.⁴ Penetrating injuries can also cause diaphragmatic injuries but these are usually small.²

The injury to left hemidiaphragm is more frequent following blunt trauma, possibly due to a buffering effect of the liver on the right hemidiaphragm. However, the relative infrequency of right-sided injury may also be associated with under-diagnosis.¹ Associated injuries like liver injuries are also common.⁴

Chest X-rays and spiral CT scanning with image reformation are useful in the early diagnosis of TRD. On axial CT images, the axis of the image is tangential to the dome of the diaphragm, so axial images alone are suboptimal for the diagnosis of diaphragmatic rupture. CT is also helpful in identifying associated injuries with TRD as in our patient who also had liver contusion with subcapsular haematoma and right lower lobe segmental atelectasis. Other imaging mo-

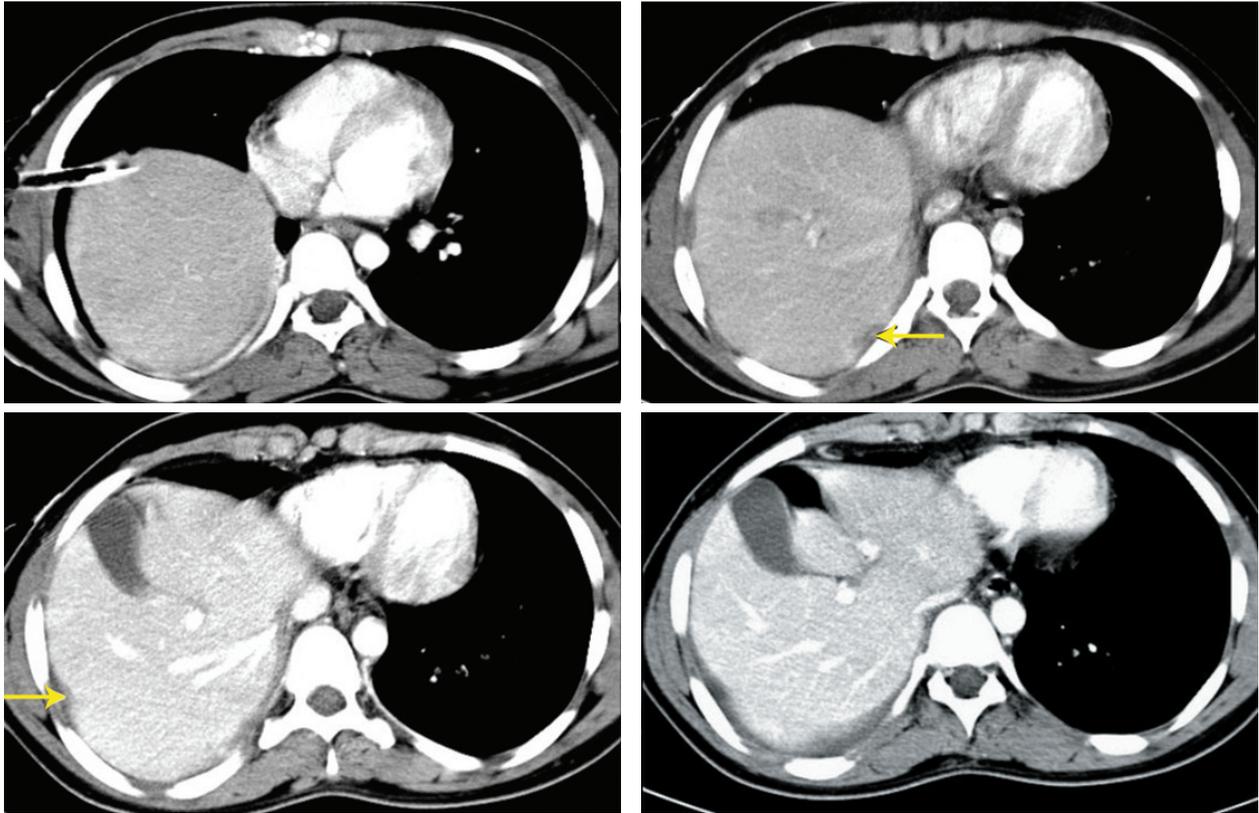


Figure 2: Axial contrast enhanced spiral CT. Shows ‘collar sign’. A subtle indentation (arrow heads) on the posterolateral and medial aspect of the liver. Note also the liver laceration.

dalities like ultrasound and magnetic resonance imaging are also used, however to a lesser extent in patients with polytrauma. Chest X-ray findings of TRD include elevation of hemidiaphragm, distortion or obliteration of the outline of the hemidiaphragm and contralateral movement of mediastinum.¹ Our patient showed a markedly elevated right hemidiaphragm with some “tenting” of the superomedial aspect [Figure 1]. Right diaphragm injuries are more difficult to detect on the radiograph. The liver serves to block the herniation of abdominal contents into the thorax. Herniation of the liver is often overlooked. The differential diagnosis for elevated right hemidiaphragm includes right lower lobe atelectasis, pleural effusion and pulmonary contusion.¹

The use of spiral CT has improved the accuracy in the diagnosis of TRD with an overall sensitivity of 71% and specificity of 100%.⁴ A recent study by Nchimi A et al, has suggested that diaphragmatic discontinuity, diaphragmatic thickening, segmental non-recognition of the diaphragm, intrathoracic herniation of abdominal viscera, elevation of the diaphragm, and both haemothorax and haemoperitoneum were strong

predictors of blunt diaphragmatic rupture.⁵ Other CT findings include the ‘collar sign’ a waist-like constriction of the hollow viscus or solid organ at the site of diaphragmatic tear and the dependent visceral sign.¹ In the dependent visceral sign, the diaphragmatic injury allows the upper portion of the liver to drop posteriorly against the ribs.

The collar sign on the right side [Figure 2] appears as a focal indentation of the liver (arrow heads). This is a subtle sign which can be easily overlooked. This requires careful analysis of the sagittal/coronal multiplanar reformatted images [Figure 3]. An increase in sensitivity from 16.7% to 50% in cases of right hemidiaphragm rupture with additional use of reformation images has been reported.⁶

Although spiral CT images with multiplanar reformation are quite useful one should be aware of the false positive and negative CT findings in the diagnosis of TRD. Not all diaphragmatic defects are specific for rupture. Posterolateral defects are shown in about 6% of asymptomatic adults which are mainly on the left side. Not all diaphragmatic defects are related to trauma, they can be congenital such as Bochdalek’s

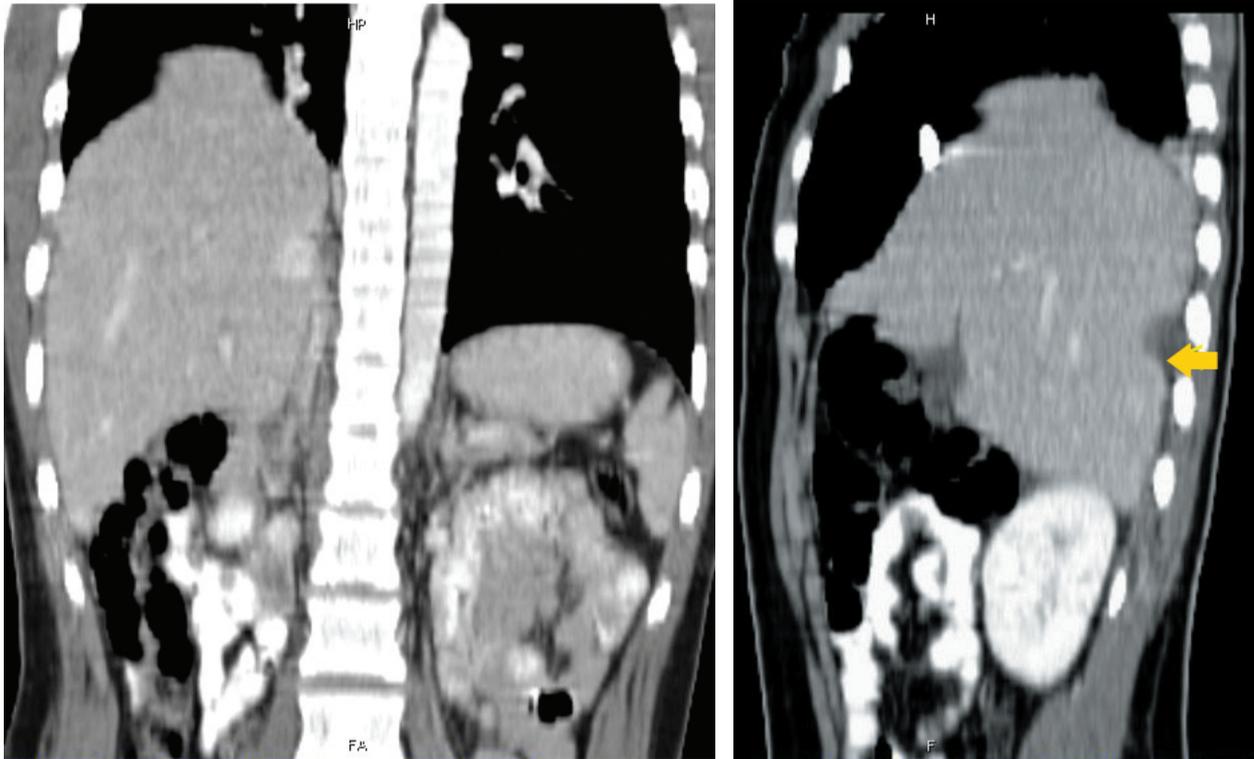


Figure 3: Image reformation coronal and sagittal-oblique planes shows the 'collar sign' better with liver herniation into the thorax.

foramen dorsally. It is also difficult to identify the margins of the hemidiaphragm following thoracic trauma because of pleural effusion, particularly in small tears and in the absence of intra abdominal contents herniation in to the thorax.¹

CONCLUSION

We report a case of a young patient with traumatic rupture of the right hemidiaphragm with liver herniation into the thorax. Spiral CT with image reformation helped in the early diagnosis and management of the patient. CT is also useful in assessing associated thoraco-abdominal injuries. Early diagnosis of this condition and repair of the diaphragmatic tear are desirable as it reduces the mortality and morbidity.

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