CASE REPORT

Successful surgical rescue of delayed onset diaphragmatic hernia following radiofrequency ablation for hepatocellular carcinoma

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ABSTRACT

Radiofrequency ablation (RFA) has been established as the mainstay therapy for hepatocellular carcinoma (HCC) in patients deemed unsuitable for surgical resection. However, delayed diaphragmatic hernia can occur as a result of this procedure. There have been only seven other cases reported on this complication in the literature. Considering the recent growth in the popularity of the procedure, it is predictable that the incidence of the diaphragmatic hernia, due to RFA, will definitely increase. This case report is therefore vitally important as it increases clinical awareness of this currently rare complication, which could lead to improved survival rates in these patients. This case concerns an 81-year-old Asian man with a past medical history of cirrhosis and HCC (segment IV and VIII) who presented with a delayed, right diaphragmatic hernia and strangulated ileus 18 months after his original RFA procedure. It is important to implement extra measures to limit the risk of diaphragmatic, thermal injuries when RFA is performed. In particular, gastroenterologists, surgeons and accident and emergency staff should all be aware of this complication proceed with rapid diagnosis and management when patients, who previously underwent RFA, present with acute abdominal pain.

Key words: Delayed onset; diaphragmatic hernia; hepatocellular carcinoma; radiofrequency ablation.

INTRODUCTION

Radiofrequency ablation (RFA) for hepatocellular carcinoma (HCC) has gained significant popularity and interest among clinicians since its original introduction in 1995. Although the utilization of RFA for HCC has been shown to carry a poorer prognosis when compared to hepatectomy, RFA is now classified as the mainstay therapy for HCC in patients unsuitable for surgery.

Common complication of RFA can be divided into three categories: intrahepatic complications; extrahepatic complications; and systemic complications. Intrahepatic complications include injury to the hepatic duct, portal vein, hepatic artery, and hepatic vein. Extrahepatic complications include pleural effusion, ascites, and injury of the abdominal wall. Reported systemic complications include hepatic failure, acute respiratory failure, etc. Among these complications, delayed diaphragmatic hernia following RFA is quite rare. In this article, we report the case of a delayed diaphragmatic hernia, which subsequently caused strangulated ileus due to RFA for HCC.

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CASE REPORT

An 81-year-old man with a medical history of cirrhosis, HCC (segment [S] IV and VIII) due to hepatitis C complained of severe right upper quadrant (RUQ), abdominal pain and dyspnea. He had undergone RFA 18 months ago for S IV and VIII HCC measuring 19 and 24 mm, respectively, following transcatheter arterial embolization which had been performed 20 months earlier. Ultrasonographic guided RFA had been performed by means of a cool-tip radiofrequency probe (3 cm electrode, 15 cm length). The ablation for S VIII was approached from the epigastric fossa and involved three ses-

sions. Similarly, the S IV lesion was ablated twice. Each procedure did not cause any immediate, major complications. Magnetic resonance imaging and computed tomography (CT) was performed 3 months later in order to confirm the effectiveness of the RFA treatment and rule out any other lesions. These diagnostic imaging techniques did not reveal diaphragmatic injuries (DI).

He was admitted to our hospital with acute onset, severe, RUQ pain that started 8 hours previously and that remained constant in nature. He had no history of acute or traumatic injury. Arterial blood gas results revealed a reduced partial oxygen pressure (pO_2): 75.6 mmHg.

A chest US detected distended bowel loops in the right thoracic cavity. Furthermore, following a CT scan, it was confirmed that there was a right diaphragmatic hernia containing strangulated small intestine (Fig. 1). Subsequently, the patient underwent an emergency diaphragmatic hernia repair and small bowel resection.

There was a diaphragmatic hernia located in close, anatomical proximity to the S VIII HCC (Fig. 2a). Surgical visualization of the right hepatic lobe indicated significant atrophy as a result of chronic cirrhosis. Approximately 1 m of small bowel was found to have been incarcerated through a 5 cm defect of the right diaphragm (Fig. 2b and c). Via an incision of the hernial orifice, the incarcerated bowel was released, and the ischemic bowel was resected; after which the right diaphragm was repaired by using 3-0 prolene sutures in an interrupted manner (Fig. 2d). As his clinical course was stable and uncomplicated, he was discharged after 15 days of hospitalization. Currently, the patient is systemically well and with no signs of hernia.

DISCUSSION

RFA has gained popularity and has now become the mainstay procedure for HCC. Therefore, it can be argued that, although presently small, the incidence of complications such as diaphragmatic hernias as a result of RFA will inevitably increase.

Diaphragmatic hernia following RFA procedure can be categorized as DI. Delayed diagnosis of DI possibly lead to poor prognosis compared to early diagnosis: namely 30% (delayed) and 7.1% (early), respectively.[1] Interestingly, right-sided and left-sided DI might show a different outcome: right-sided DI face higher risk for strangulation than left-sided.[2] According to these discussions, it is a vital point to confirm early

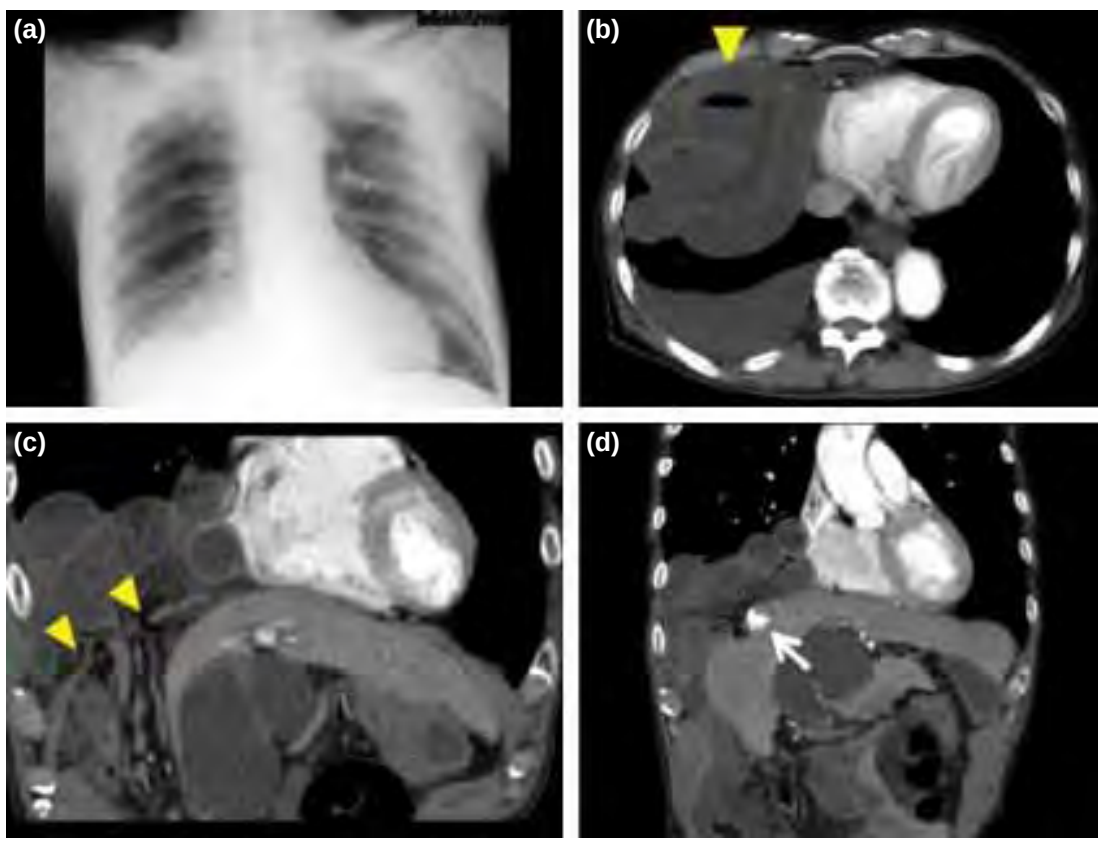

Figure 1. Computed tomography (CT) scan demonstrating the right diaphragmatic hernia. The hernial orifice was located in close proximity to the site of the segment (S) VIII hepatocellular carcinoma (HCC). **(a)** Chest radiograph, **(b)** horizontal enhanced CT scan, **(c and d)** sagittal enhanced CT scan. Figure 1b Yellow arrow head: strangulated small intestine in the right thoracic cavity, Figure 1c Yellow arrow head: diaphragmatic hernial orifice, white arrow: S VIII HCC.

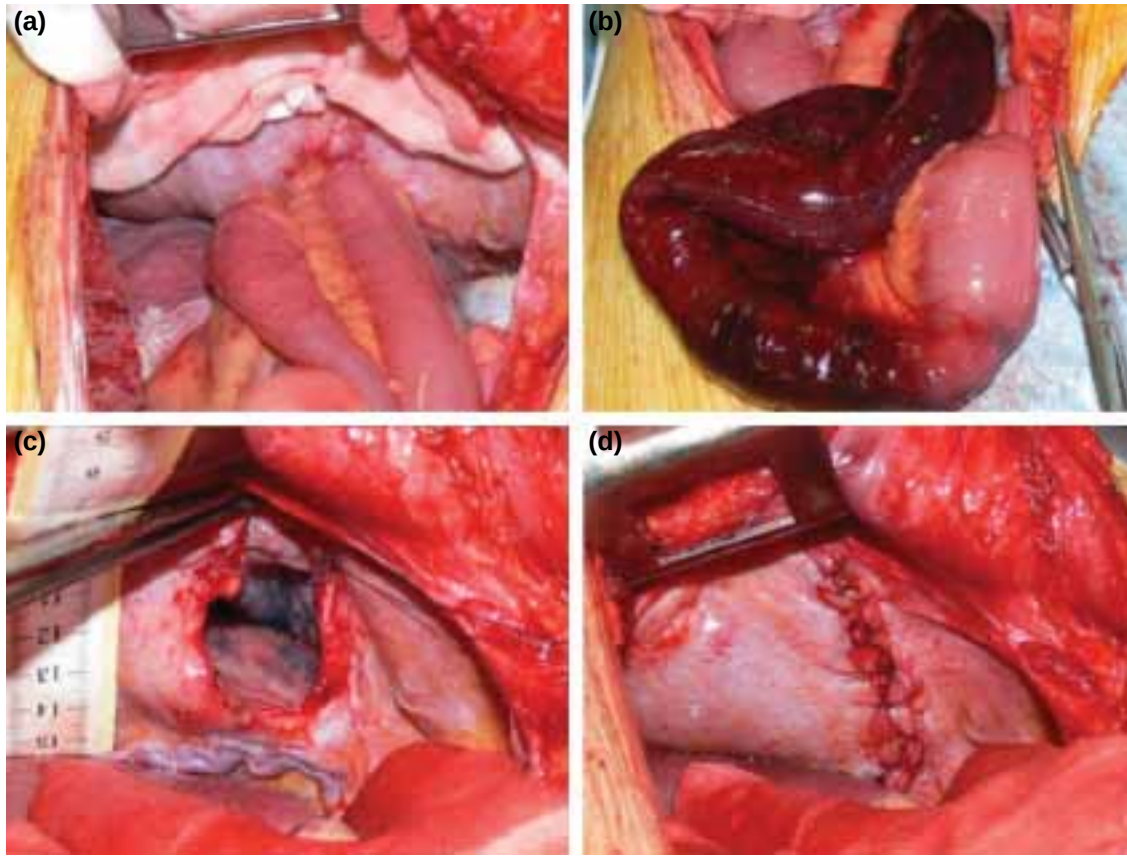

Figure 2. (a) Diaphragmatic hernia: small intestine was strangulated by the defect of the right diaphragm. **(b)** Strangulated small intestine demonstrated an irreversible, ischemic injury. **(c)** The defect size was roughly 5 cm. **(d)** The defect was closed with 3-0 prolene, interrupted sutures.

diagnosis of diaphragmatic hernia due to RFA where most of the reported lesions are located at right-sided as discussed in detail later, given difficulties of early diagnosis and leathal outcomes, Pekmezci et al.[3] had reported that thoracoscopy was an effective tool for the diagnosis, including subsequent surgical repair of DI. Furthermore, it is also capable of eliminating pleural collections which might cause pyothorax. Therefore, when the diagnosis is uncertain, thoracoscopy should be recommended.

It is also noteworthy that this patient developed a diaphragmatic hernia 18 months after the initial RFA procedure. All eight cases of delayed onset diaphragmatic hernia following RFA in the international literatures[4-9] have patients presenting with severe, abdominal pain between 9 and 20 months after their RFA procedure (Table 1). Furthermore, all eight cases describe RFA for HCC in S V-VIII which are in close proximity to the right diaphragm. Therefore, there seems to be a correlation between the increased incidence of diaphragmatic hernias, the anatomical location of the HCC lesions and their distance from the diaphragm. The onset of the diaphragmatic hernia with strangulated ileus seems to have a possible risk factor: Chilaiditi syndrome is defined as the transposition of colon between the diaphragm and liver. The condition generally involves the transverse colon, but can also refer to the small intestine. Chilaiditi syndrome usually remains as an asymptomatic, anatomical variant and is normally identified as an incidental radiological finding, when it is referred to as the Chilaiditi sign. It can occur as a direct result of abnormalities of the falciform or suspensory ligaments of the transverse colon or congenital transposition.[10] Furthermore, in the case of cirrhotic patients, the incidence of Chilaiditi syndrome inevitably increases, because the right lobe has a propensity to atrophy due to the cirrhosis and the subsequent generation of the space between the diaphragm and liver.[11] In our case, his standard liver volume was 1061 ml according to the Urata formula,[12] and his actual liver volume based on CT scan was 1009 ml. However, his right liver volume occupied just 50% of total due to cirrhotic atrophy, which was significantly smaller size compared to the standard size. Thus, it can be argued that when diaphragmatic hernia happens on cirrhotic patients, the incidence of subsequent strangulated ileus should be higher than on patients presenting without cirrhosis. In fact, Shibuya et al.[5] had indicated the patients demonstrated Chilaiditi syndrome before the onset of diaphragmatic hernia with strangulated ileus. Although there was no evidence of Chilaiditi syndrome in our case, it is important to be aware of its existence, whether the cirrhotic patients who underwent RFA demonstrate Chilaiditi syndrome or not.

Table 1. Summary of previous reported delayed diaphragmatic hernia following RFA for HCC

Reference	Age	Segment affected by HCC and medical history	CP score score and MELD	Onset of defect (months)	RFA needle	Strangulated ileus/prognosis	Thoracic cavity or intraperitoneal saline infusion/intraabdominal carbon dioxide
Koda et al., 2003[4]	61	IV, VI, VII, VIII HBV related	CP 9 (Class B) MELD unknown	13	Le veen	Existed/recovered well, but 1 month later died of hemorrhage due to rupture of HCC	No information
Shibuya et al., 2006[5]	72	IV, VIII Alcoholic liver cirrhosis	CP unknown MELD unknown	18	RITA	Existed/patient recovered well	No information
di Francesco et al., 2008[6]	49	VII	CP unknown MELD unknown	15	Cool-tip	No/patient recovered well	No/No
Nawa et al., 2010[7]	50	VIII	CP 6 (Class A) MELD 9	20	RITA	Existed/patient recovered well	No/No
Yamagami et al., 2011[8]	71	VII HCV related liver cirrhosis	CP 7-9 (Class B) MELD - unknown	9	Cool-tip	No/patient recovered well	No information
Singh et al., 2011[9]	46	II-III and V-VIII alcoholic and HBV related liver cirrhosis	CP 5-6 (Class A) MELD 2	19	Cool-tip	No/patient recovered well	No information
Nakamura et al., 2014	81	IV, VIII HCV related liver cirrhosis	CP 6 (Class A) MELD 2	18	Cool-tip	Existed/patient recovered well	No/No

HCC: Hepatocellular carcinoma; HCV: Hepatitis C virus; CP: Child–Pugh; MELD: Model for end-stage liver disease; RFA: Radiofrequency ablation; RTIA: Radiofrequency interstitial tissue ablation.

When RFA is utilized for HCC in close proximity to the diaphragmatic surface of the liver: S IV, VII, and VIII, it is necessary to protect the diaphragm in order to avoid the potentially lethal complications of a diaphragmatic hernia. Therefore, it is advised that before RFA is initiated, the use of either intraabdominal carbon dioxide, thoracic cavity or intraperitoneal carbon dioxide is warranted. In general, it can be argued that intraperitoneal saline infusion is more effective than intrathoracic cavity saline infusion in terms of the risk of developing diaphragmatic injury.[13]

It is of vital importance to make a rapid and accurate assessment of any patient, who having had previous RFA, complains of acute abdominal pain. Thoracoscopy should be performed as the occasion demands. As a result of this report, we would like to make clinicians more aware of the increasing incidence diaphragmatic hernias as possible complications of RFA for HCC. This can lead to improved patient survival rates from RFA.

Ethical Approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Conflict of interest: None declared.

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OLGU SUNUMU - *ÖZET*

Hepatoselüler karsinom için uygulanan radyofrekans ablasyon sonrası oluşan geç başlangıçlı diyafragma hernisinin başarılı cerrahi onarımı

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Cerrahi rezeksiyon için uygun olmadıkları düşünülen hepatoselüler karsinom (HSK) hastalarında temel tedavi olarak radyofrekans ablasyonun (RFA) rolü kanıtlanmıştır. Ancak bu işlem sonucunda geç dönemde diyafragma hernisi oluşabilmektedir. Literatürde bu komplikasyonu olan bu olgu dışında yalnızca yedi olgu bildirilmiştir. Bu işlemin popülaritesinde son zamanlarda oluşan artış göz önüne alınarak RFA'ya bağlı diyafragma hernisi insidansının kesinlikle artacağı öngörülebilir. Hastalarda bu halen nadir görülen komplikasyonla ilişkili sağkalım oranlarının iyileşmesine yol açabilen klinik farklındalığı artırdığı için bu olgu raporu yaşamsal önem taşımaktadır. Bu olgu, RFA prosedüründen 18 ay sonra geç başlangıçlı diyafragma hernisi ve boğulmuş fıtık belirtileriyle gelen, geçmişinde siroz ve HSK (IV. ve VIII. segmentler) öyküsü olan 81 yaşındaki Asyalı bir erkeğe ilişkindir. RFA uygulandığında diyafragmatik ve termal hasar riskini azaltmak için ekstra önlemler uygulamak önem taşır. Özellikle gastroenterologlar, cerrahlar, kaza cerrahisi ve acil cerrahi personeli tümüyle bu komplikasyonun farkında olmalı, daha önce RFA geçirmiş hastalar akut karın ağrısıyla geldiklerinde hızla tanı ve tedavi cihetine gitmelidir.

Anahtar sözcükler: Diyafragma hernisi; geç başlangıçlı; hepatoselüler karsinom; radyofrekans ablasyon.

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