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Laparoscopic Repair of Diaphragmatic Perforation with Colonic Herniation Following Hepatic Radiofrequency Ablation: A Case Report

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Abstract

Background: Diaphragmatic hernia is a rare complication after hepatic radiofrequency ablation (RFA). We herein present a case of a patient who underwent laparoscopic repair of diaphragmatic perforation with colonic herniation occurring 12 months after hepatic RFA.

Case presentation: An 80-year-old man underwent RFA under computed tomography guidance using a cool-tip radiofrequency probe with a short trans-thoracic root for hepatocellular carcinoma in segment VIII. Twelve months later, he developed a large amount of right pleural effusion and a right diaphragmatic hernia containing the colon and mesentery. After drainage of the right pleural effusion, the patient underwent laparoscopic repair of the diaphragmatic perforation with colonic herniation. Severe adhesion was noted between nearly the entire herniated colon and lung; however, we were able to remove the herniated colon from the thoracic cavity safely. Bowel resection was not required. Finally, simple running sutures of the diaphragmatic defect using 2-0 Vicryl were laid down. There were no postoperative complications, and the patient was discharged nine days after surgery.

Conclusions: Diaphragmatic hernia is rare but should be recognized as a late complication following hepatic RFA. Surgical repair of a diaphragmatic hernia, including minimally invasive surgery using the laparoscopic approach, especially for patients with cirrhosis, should be considered in order to avoid acute intestinal obstruction or perforation.

Keywords: Radiofrequency ablation; Diaphragmatic hernia; Colonic herniation; Laparoscopic surgery; Çomplication

Abbreviations: RFA: Radio Frequency Ablation; HCC: Hepatocellular Carcinoma; CT: Computed Tomography

Introduction

Radiofrequency ablation (RFA) is a minimally invasive treatment for hepatocellular carcinoma (HCC) and widely accepted as an effective treatment for HCC [1,2]. The algorithm of the National Comprehensive Cancer Network guideline states that RFA is categorized as locoregional therapy, and tumors ≤3 cm are optimally treated with RFA [3]. Recent developments in RFA technology have made it possible to necrotize a large volume of tissue (≥3 cm in diameter) [4,5]. RFA was reported to be relatively safe, with a mortality rate of 0.3% [6]. However, major life-threatening complications, including intestinal perforation, biliary stenosis, and tumor rupture, occasionally develop after RFA [2].

Diaphragmatic hernia is defined as the protrusion of the abdominal viscera into the thoracic cavity through a defect in the diaphragm, usually caused by traumatic injury or as a complication after abdominal surgery [6-9]. Diaphragmatic hernia after RFA is very rare and was unrecognized as a complication after RFA until recently, when it was reported as a delayed complication of RFA [10-16]. To treat diaphragmatic hernia, open laparotomy has generally been used. However, only two cases of laparoscopic treatment have recently been reported for the treatment of diaphragmatic hernia after RFA.

We herein report a rare case of a patient who underwent laparoscopic repair of diaphragmatic perforation with colonic herniation 12 months after hepatic RFA.

Case Report

An 80-year-old man with a history of hepatitis C cirrhosis was admitted to our hospital for the treatment of HCC in segment VIII, 11 mm in diameter (Figure 1a). RFA was performed under computed tomography (CT) guidance using a cool-tip radiofrequency probe (Figure 1b). HCC was approached using a short trans-thoracic route.

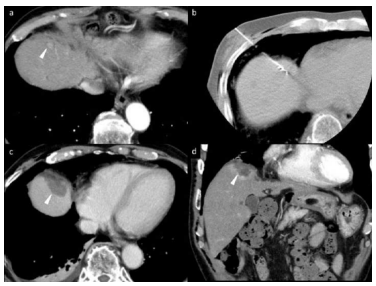

Figure 1: a. CT image in the arterial phase showing HCC in segment VIII of the liver, 11 mm in diameter (arrowhead). **b.** Real-time CT-fluoroscopic image of the needle tip of radiofrequency ablation advancing into the target tumor. **c.** Axial CT image of complete necrosis of the ablated tumor (arrowhead). **d.** Coronal CT image of complete necrosis of the ablated tumor (arrowhead).

We tried to induce artificial pleural effusion before RFA, but he had adhesion in the thoracic cavity, so this was not possible. Twelve-minute ablation was performed. After the treatment, he developed mild pneumothorax without hypoxemia; however, he recovered without any thoracic drainage. He was discharged three days after RFA. A large hypovascular area corresponding to the treated zones was confirmed by CT (Figures 1c and 1d).

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Twelve months later, he had been suffering from dyspnea for two weeks and presented to another hospital. He had pleural effusion in the right thoracic cavity and was referred to our hospital for treatment. On admission, he had mild right-sided chest pain and hypoxemia. There was no history of chest or abdominal trauma. Laboratory tests showed severe hypoalbuminemia with serum albumin levels of 1.8 g/dL. Aspartate aminotransferase and alanine aminotransferase levels were elevated to 263 U/L and 125 U/L, respectively. C-reactive protein levels were mildly elevated to 4.31 mg/dL. Hemoglobin levels and platelet counts were mildly decreased to 13.3 g/dL and 12.8 × 10^4/μL, respectively. Child-Pugh classification was B. A chest radiograph showed a large amount of right pleural effusion and bowel gas in the right thoracic cavity (Figure 2a). CT showed a large amount of right pleural effusion and a right diaphragmatic hernia containing the colon and mesentery. A diaphragmatic defect was visualized by coronal CT images (Figure 2b). Fortunately, the herniated colon was well-enhanced, and there were no symptoms of strangulation or obstruction.

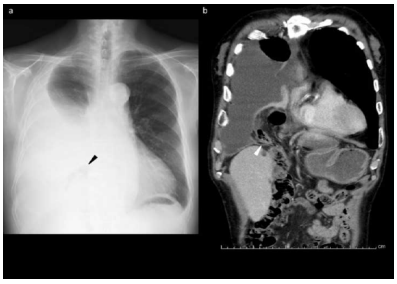

Figure 2: a. Chest radiograph showing a large amount of right pleural effusion and bowel gas in the right thoracic cavity (arrowhead). **b.** Coronal CT image of diaphragmatic perforation with the herniated transverse colon in the thoracic cavity (arrowhead).

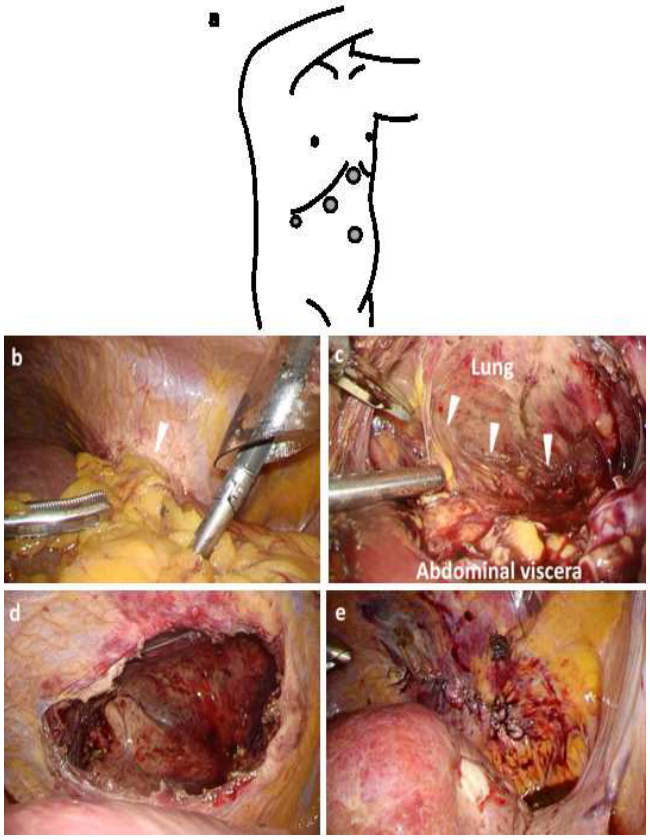

Figure 3: a. The patient was fixed in a left semi-lateral position and four ports were inserted (umbilicus, 12 mm: epigastric region, 12 mm; right subcostal area, 12 mm; and right flank region, 5 mm). **b.** Transverse colon with omentum was herniated to the thoracic cavity via the approximately 5 cm perforated hole in the diaphragm (arrowhead). **c.** Severe adhesion (arrowhead) was noted between nearly the entire herniated colon and lung in the thoracic cavity. **d.** The diaphragmatic defect, which was opened about 10 cm in length, was visible by laparoscope before closure. **e.** Simple running sutures of the diaphragmatic defect were performed.

We first performed a tap of the pleural effusion and confirmed that the pleural effusion was sero-bloody discharge and did not contain any bacteria. Closed drainage of the pleural cavity was administered. After drainage of the right pleural effusion, since repairing the hernia laparoscopically was believed to reduce the postoperative complications in patients with liver cirrhosis, the patient underwent laparoscopic repair of the diaphragmatic perforation with colonic herniation.

We fixed the patient in a left semi-lateral position and inserted four ports (Figure 3a). Transverse colon with omentum was herniated to the thoracic cavity via the approximately 5 cm perforated hole in the diaphragm (Figure 3b). Thermal damage to the diaphragm was confirmed to be adjacent to the RFA-treated region. Due to the difficulty in pulling down the whole colon through only the initial diaphragmatic hole, we opened the diaphragm about 10 cm in length. Severe adhesion was noted between nearly the entire herniated colon and lung (Figure 3c). We carefully detached the herniated colon from the lung and were ultimately able to remove the colon safely from the thoracic cavity (Figure 3d). We made an additional incision (4 cm long) around the navel and directly confirmed the good blood flow of the herniated colon and lack of any injury to the transverse colon. Bowel resection was not required. Finally, thoracic irrigation and simple running sutures of the diaphragmatic defect using 2-0 Vicryl (Ethicon co. Ltd, NJ, USA) were performed (Figures 3d and 3e). The overall surgery time was 308 minutes, and the amount of bleeding was 401 ml. There were no postoperative complications, and the patient was discharged nine days after surgery. The patient did not develop recurrence of diaphragmatic perforation in 4 months following the operation.

Discussion

Since its introduction, RFA has become a universally prevalent procedure due to its lower invasiveness. However, with the accumulation of cases, late-onset complications, such as heat damage have become evident. Mulier et al. [17] reported that the incidence of diaphragmatic injury after RFA was 0.1%. Diaphragmatic perforation and herniation are rare but serious complications of hepatic RFA. Since Koda et al. [14] reported the first case of diaphragmatic hernia following RFA, there have been only 12 reported cases of RFA-associated iatrogenic diaphragmatic hernia written in English according to PubMed (Table 1), [10-16,18-21].

The cause of diaphragmatic hernia after hepatic RFA is thermal damage to the diaphragm [3]; however, the cause of delayed perforation is unclear. Nomura et al. [18] mentioned that the temporal adhesion between the thermally-damaged diaphragm and the liver surface released due to the atrophy of the cirrhotic liver and develop a delayed diaphragmatic hernia. Singh et al. [10] advocated that the thermal injury to the diaphragm did not cause a defect immediately, with the partial thermal injury instead resulting in an inflammatory response that led to fibrosis, ultimately weakening and causing a defect.

Various techniques have recently been used to minimize the risk of diaphragmatic injuries and associated complications with RFA. Intraperitoneal saline injection was introduced to prevent diaphragmatic

No	Authors	Sex	Age	Tumor location	Period from RFA, months	Surgical method	Prognosis
1	Koda et al.	F	61	S6 and S8	13	Open	Dead
2	Shibuya et al.	M	72	S4/8	18	Open	Alive
3	di Francesco et al.	M	49	Right lobe	17	Open	Alive
4	Boissier et al.	F	65	S8	7	Open, bowel resection	Alive
5	Singh et al.	F	46	S2/3 and S5/8	19	Laparoscopic	Alive
6	Yamagami et al.	F	71	S7	9	Conservative	Alive
7	Kim et al.	M	61	S5 and S8	22	Conservative	Alive
8	Zhou et al.	F	61	S8	12	Open, bowel resection	Alive
9	Nomura et al.	M	70	S8	96	Laparoscopic	Alive
10	Nakamura et al.	M	81	S4 and S8	18	Open, bowel resection	Alive
11	Saito et al.	M	81	S5, S7 and S5/8	33	Open	Dead
12	Our case	M	81	S8	12	Laparoscopic	Alive
RFA: radiofrequency ablation							

Table 1: Reported cases of diaphragmatic hernia occurring after radiofrequency ablation.

injury and avoid contact with adjacent visceral organs during hepatic RFA. [22] Diaphragmatic hernia is rare but should still be recognized as a late complication following hepatic RFA. The possible presence of diaphragmatic hernia following hepatic RFA adjacent to the diaphragm should be considered, especially in patients developing bowel obstruction, dyspnea, chest pain, or pleural effusion. Surgical repair for diaphragmatic hernia should be considered in order to avoid acute intestinal obstruction or perforation.

Of the 11 reported cases of diaphragmatic hernia after RFA, two were treated conservatively, and were successfully followed up without any symptoms [12,21]. The remaining 9 patients were required surgical treatment. Open hernia repair was usually performed in the earlier cases. However, owing to modern advances in laparoscopic surgery laparoscopic repair has frequently been performed in more recent cases. Laparoscopic approaches to diaphragmatic repair have been introduced in the elective setting [10,18]. The laparoscopic approach is widely accepted as the safer surgical approach in patients with HCC and cirrhosis reducing ascites or pleural effusion than conventional laparotomy [23]. In addition to reducing the risk of postoperative complications due to liver cirrhosis, a laparoscopic approach also provides a better intraoperative view than an open procedure. In our case, the patient had severe adhesion between almost the entire herniated viscera and the lung. Had we tried to treat this diaphragmatic hernia by open laparotomy, it might have been difficult to achieve detachment of the adhesion between the herniated viscera and the lung in the thoracic cavity via the diaphragm. In addition, larger skin incision and thoracotomy would have been necessary to acquire a better intraoperative view. Laparoscopic surgery may have advantages over open laparotomy in the surgical treatment of adhesion in the thoracic cavity via small diaphragmatic hernia, especially in cases having severe adhesion between the herniated abdominal viscera and the lung.

Diaphragmatic hernia sometimes induces the development of strangulated ileus, necessitating additional bowel resection. In the present study, it was difficult to confirm a sufficient blood flow and the absence of intraoperative injury in the herniated colon after removing the herniated viscera from the thoracic cavity using laparoscopy alone, so we made an additional incision around the navel (4 cm long) and directly confirmed the good blood flow and absence of intraoperative injury of the herniated colon. A pure transthoracic approach-without an abdominal incision-would be possible for diaphragmatic hernia repair; however, it would be difficult to safely confirm the blood flow and the absence of any injury to the herniated viscera by this approach.

In conclusion, diaphragmatic hernia is rare but should be recognized as a late complication following hepatic RFA. Surgical repair of a diaphragmatic hernia, including minimally invasive surgery using the laparoscopic approach, especially for patients with cirrhosis, should be considered in order to avoid acute intestinal obstruction or perforation.

References

1. Rossi S, Di Stasi M, Buscarini E, Quaretti P, Garbagnati F, et al. (1996) Percutaneous RF interstitial thermal ablation in the treatment of hepatic cancer. AJR Am J Roentgenol 167: 759-768.
2. Livraghi T, Goldberg SN, Lazzaroni S, Meloni F, Solbiati L, et al. (1999) Small hepatocellular carcinoma: Treatment with radio-frequency ablation versus ethanol injection. Radiology 210: 655-661.
3. Livraghi T, Solbiati L, Meloni MF, Gazelle GS, Halpern EF, et al. (2003) Treatment of focal liver tumors with percutaneous radio-frequency ablation: Complications encountered in a multicenter study. Radiology 226: 441-451.
4. Yamasaki T, Kurokawa F, Shirahashi H, Kusano N, Hironaka K, et al. (2002) Percutaneous radiofrequency ablation therapy for patients with hepatocellular carcinoma during occlusion of hepatic blood flow. Comparison with standard percutaneous radiofrequency ablation therapy. Cancer 95: 2353-2360.
5. Tiong L, Maddern GJ (2011) Systematic review and meta-analysis of survival and disease recurrence after radiofrequency ablation for hepatocellular carcinoma. Br J Surg 98: 1210-1224.
6. Boyce S, Burgul R, Pepin F, Shearer C (2008) Late presentation of a diaphragmatic hernia following laparoscopic gastric banding. Obes Surg 18: 1502-1504.
7. Peer SM, Devaraddeppa PM, Buggi S (2009) Traumatic diaphragmatic hernia-our experience. Int J Surg 7: 547-549.
8. Hanna WC, Ferri LE, Fata P, Razek T, Mulder DS (2008) The current status of traumatic diaphragmatic injury: Lessons learned from 105 patients over 13 years. Ann Thorac Surg 85: 1044-1048.
9. de Meijer VE, Vles WJ, Kats E, den Hoed PT (2008) Iatrogenic diaphragmatic hernia complicating nephrectomy: Top-down or bottom-up? Hernia 12: 655-658.
10. Singh M, Singh G, Pandey A, Cha CH, Kulkarni S (2011) Laparoscopic repair of iatrogenic diaphragmatic hernia following radiofrequency ablation for hepatocellular carcinoma. Hepatol Res 41: 1132-1136.
11. Zhou M, He H, Cai H, Chen H, Hu Y, et al. (2013) Diaphragmatic perforation with colonic herniation due to hepatic radiofrequency ablation: A case report and review of the literature. Oncol Lett 6: 1719-1722.
12. Yamagami T, Yoshimatsu R, Matsushima S, Tanaka O, Miura H, et al. (2011) Diaphragmatic hernia after radiofrequency ablation for hepatocellular carcinoma. Cardiovasc Intervent Radiol 34: S175-177.
13. Boissier F, Labbe V, Marchetti G, Valade S, Djibre M (2011) Acute respiratory distress and shock secondary to complicated diaphragmatic hernia. Intensive Care Med 37: 725-726.
14. Koda M, Ueki M, Maeda N, Murawaki Y (2003) Diaphragmatic perforation and hernia after hepatic radiofrequency ablation. AJR Am J Roentgenol 180: 1561-1562.

15. Shibuya A, Nakazawa T, Saigenji K, Furuta K, Matsunaga K (2006) Diaphragmatic hernia after radiofrequency ablation therapy for hepatocellular carcinoma. AJR Am J Roentgenol 186: S241-243.

16. di Francesco F, di Sandro S, Doria C, Ramirez C, Iaria M, et al. (2008) Diaphragmatic hernia occurring 15 months after percutaneous radiofrequency ablation of a hepatocellular cancer. Am Surg 74: 129-132.

17. Mulier S, Mulier P, Ni Y, Miao Y, Dupas B, et al. (2002) Complications of radiofrequency coagulation of liver tumours. Br J Surg 89: 1206-1222.

18. Nomura R, Tokumura H, Furihata M (2014) Laparoscopic repair of a diaphragmatic hernia associated with radiofrequency ablation for hepatocellular carcinoma: Lessons from a case and the review of the literature. Int Surg 99: 384-390.

19. Saito T, Chiba T, Ogasawara S, Inoue M, Wakamatsu T, et al. (2015) Fatal diaphragmatic hernia following radiofrequency ablation for hepatocellular carcinoma: A case report and literature review. Case Rep Oncol 8: 238-245.

20. Nakamura T, Masuda K, Thethi RS, Sako H, Yoh T, et al. (2014) Successful surgical rescue of delayed onset diaphragmatic hernia following radiofrequency ablation for hepatocellular carcinoma. Ulus Travma Acil Cerrahi Derg 20: 295-299.

21. Kim JS, Kim HS, Myung DS, Lee GH, Park KJ, et al. (2013) A case of diaphragmatic hernia induced by radiofrequency ablation for hepatocellular carcinoma. Korean J Gastroenterol 62: 174-178.

22. Raman SS, Lu DS, Vodopich DJ, Sayre J, Lassman C (2002) Minimizing diaphragmatic injury during radio-frequency ablation: efficacy of subphrenic peritoneal saline injection in a porcine model. Radiology 222: 819-823.

23. Kanazawa A, Tsukamoto T, Shimizu S, Kodai S, Yamazoe S, et al. (2013) Impact of laparoscopic liver resection for hepatocellular carcinoma with F4-liver cirrhosis. Surg Endosc 27: 2592-2597.