Radiofrequency Ablation-Associated Delayed Diaphragmatic Hernia Treated with the Thoracolaparotomy Approach: A Case Report

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Abstract

Background: Radiofrequency ablation (RFA) is an effective treatment for hepatocellular carcinoma (HCC). However, rare but serious complications may occur after RFA. We describe a case of diaphragmatic hernia associated with RFA. Case Presentation: A 68-year-old man with a history of hepatitis C-related liver cirrhosis was admitted to our hospital because of lower abdominal pain. Three years earlier, he underwent RFA for HCC in segment 8. Computed tomography revealed that the intestine was intruding into the right thoracic cavity through a diaphragmatic hernia. On the basis of the diagnosis of right diaphragmatic hernia with a strangulated ileus, an emergency operation was performed. Perforation of the strangulated transverse colon into the right thoracic cavity was suspected, and a combined approach of laparotomy and thoracotomy was utilized. The operative findings showed that the diaphragmatic hernia was 3.5 × 2.0 cm in diameter, and it was simply sutured with a nonabsorbable suture material. Resection of the intruded ischemic transverse colon was completed, and a covering ileostomy was performed. The patient was discharged without any complications. Conclusions: RFA is widely used for the treatment of HCC. Reports of early- and late-phase complications indicate that heat damage contributes to the fragility of neighboring organs. The occurrence of diaphragmatic hernia after RFA is one of the delayed complications. Although it rarely occurs, this complication requires emergency surgery. In conclusion, if perforation of the intestine into the thoracic cavity is suspected, thoracolaparotomy should be considered as a treatment option to

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prevent postoperative massive empyema.

Keywords
Diaphragmatic Hernia, Hepatocellular Carcinoma, Radiofrequency Ablation

1. Introduction
Hepatocellular carcinoma (HCC) is a common cancer and the third most frequent cause of cancer-related death [1]. Because of the advances in surgical techniques and perioperative management methods, liver resection can enhance the long-term survival of patients, with a 5-year overall survival rate of approximately 60% [2] [3]. Radiofrequency ablation (RFA) is being increasingly used for the treatment of HCC because of its minimal invasiveness and positive long-term outcomes, which is equivalent to those of surgery in patients with Child-Pugh class A and a tumor diameter of <3 cm [4].

RFA therapy is considered a safer and less invasive intervention than hepatectomy [4]. However, it often causes complications such as intrahepatic abscess, bleeding, and biloma [5] [6]. RFA-related complications are subdivided into two categories: early- and late-phase complications. Direct organ injury is the main cause of early complications, and can lead to massive bleeding and perforation of the colon. Late-phase complications are difficult to precisely diagnose in the clinical setting. Diaphragmatic hernia has been reported as a rare late-phase complication. We report a case of delayed diaphragmatic hernia with a strangulated ileus after RFA for HCC, which was successfully treated with surgery.

2. Case Presentation
A 68-year-old man with a history of a duodenal ulcer and chronic cirrhosis caused by hepatitis C and recurrent HCC was admitted to our hospital for lower abdominal pain. He had previously undergone transcatheter arterial chemoembolization (TACE) and RFA for HCC in segments 8 and 4. He had received TACE treatment for recurrent HCC in segments 8 and 4 seven times in the last 36 months (Figure 1). On admission, he was afebrile and showed a normal consciousness level. His vital signs were unremarkable. The abnormal laboratory values obtained were as follows: total bilirubin, 2.4 mg/dL (reference, 0.4 - 0.8 mg/dL); albumin, 3.0 mg/dL (reference, 3.9 - 4.5 mg/dL); and prothrombin activity, 62% (reference, 70% - 130%). On the basis of laboratory data, the patient’s disease was classified as Child-Pugh class B. A chest radiograph showed deviation of bowel gas across the right diaphragm. Computer tomography (CT) showed a dilated transverse colon that was intruding into the right thoracic space, with pleural effusion (Figure 2). These findings led to a preoperative diagnosis of diaphragmatic hernia with a strangulated ileus. Perforation of the transverse colon was strongly suspected, and an emergency operation with thoraco-laparotomy was performed. The operative findings showed a right diaphragmatic hernia (3.5 × 2.0 cm in diameter), through which a large portion of the intestine...
Figure 1. Previous computed tomography images. (a) Preoperative computed tomography image showing atrophy of the liver and the tumor in segment 8 before radiofrequency ablation (RFA) and transcatheter arterial chemoembolization (TACE) (white arrow); (b) Image showing the tumor and no evidence of injury to the diaphragm after RFA and TACE.

Figure 2. Preoperative images. (a) Chest radiograph showing transverse colonic gas in the right thoracic cavity (white arrow); (b) Computed tomography image taken on admission showing diaphragmatic herniation of the large intestine into the right thoracic cavity (white arrow).

was intruded and dilated (Figure 3). The hernia orifice was repaired with running suture of 3-0 Vicryl. After a colectomy, a covering ileostomy was performed. No postoperative complications developed, and the patient was discharged 24 days after the emergency surgery. He was continuously treated for recurrent HCC, and has showed no evidence of recurrent hernia during the 2-year follow-up period.

3. Discussion

RFA is an effective treatment option among several possible interventions for HCC. The incidence of complications after RFA has been reported to be approximately 2.4% - 9.5% [5] [6] [7]. Rhim et al. [5] reported that the major complications after RFA were hepatic abscess, peritoneal hemorrhage, biloma, and
Diaphragmatic hernia after RFA seems to be caused by thermal damage to the diaphragm. The characteristic feature of a diaphragmatic hernia is its delayed onset after RFA. This delay occurs because the thermal damage induced by RFA causes a brittle point in the diaphragm. This brittle point weakens over time, resulting in the formation of a diaphragmatic hernia. The factors involved in the formation of a diaphragmatic hernia are delayed wound healing due to liver cirrhosis and increased abdominal pressure due to ascites [8]. To prevent thermal injury to organs during RFA, artificial ascites have been used to create a space between the liver and the skin or diaphragm [9]. Treatment of the primary disease such as hepatitis, to prevent progression to cirrhosis or hepatic atrophy, and control of ascites to decrease abdominal pressure are important to prevent the development of a diaphragmatic hernia.

We reviewed 13 case reports [8] [10]-[20] documenting the occurrence of diaphragmatic hernia after RFA for HCC, including our case. In the 13 cases, the diagnosis of diaphragmatic hernia after RFA was made after a mean period of 24.1 months (range, 7 - 96 months). The mean age of patients at diagnosis was 65.5 years (range, 46 - 81 years), and there were eight men and five women. The most common chief complaints were abdominal pain in nine patients (69.2%) and dyspnea in seven patients (53.8%). Five of the 13 patients (38.5%) had right upper quadrant pain, and 2 patients including the present case patient (15.4%) had lower abdominal pain. Among the 13 cases, surgical treatment was performed to repair the hernia in 11 cases including our case (Table 1) [8] [10]-[18].
Table 1. Summary of previously reported surgeries of diaphragmatic hernia after radiofrequency ablation.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Age (years)</th>
<th>Sex</th>
<th>CP class</th>
<th>Onset of defect</th>
<th>Intestinal resection</th>
<th>Approach</th>
<th>Method of hernia orifice closure</th>
<th>Outcome (postoperative hospital stay, days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koda et al. [10]</td>
<td>61</td>
<td>F</td>
<td>B</td>
<td>13</td>
<td>–</td>
<td>LT</td>
<td>Unknown</td>
<td>Dead</td>
</tr>
<tr>
<td>di Francesco et al. [12]</td>
<td>50</td>
<td>M</td>
<td>Unknown</td>
<td>17</td>
<td>–</td>
<td>LT</td>
<td>Simple sutures</td>
<td>Alive (8)</td>
</tr>
<tr>
<td>Boissier et al. [14]</td>
<td>65</td>
<td>F</td>
<td>A</td>
<td>7</td>
<td>+</td>
<td>LT</td>
<td>Vicryl patch</td>
<td>Alive (27)</td>
</tr>
<tr>
<td>Zhou et al. [8]</td>
<td>61</td>
<td>F</td>
<td>Unknown</td>
<td>12</td>
<td>+</td>
<td>LT</td>
<td>Simple suture</td>
<td>Alive (60)</td>
</tr>
<tr>
<td>Nakamura et al. [15]</td>
<td>81</td>
<td>M</td>
<td>A</td>
<td>18</td>
<td>+</td>
<td>LT</td>
<td>Simple sutures</td>
<td>Alive (15)</td>
</tr>
<tr>
<td>Nomura et al. [16]</td>
<td>62</td>
<td>M</td>
<td>C</td>
<td>96</td>
<td>+</td>
<td>LS</td>
<td>Mesh repair</td>
<td>Alive (8)</td>
</tr>
<tr>
<td>Saito et al. [17]</td>
<td>81</td>
<td>M</td>
<td>C</td>
<td>33</td>
<td>–</td>
<td>LT</td>
<td>Unknown</td>
<td>Dead</td>
</tr>
<tr>
<td>Abe et al. [18]</td>
<td>72</td>
<td>F</td>
<td>B</td>
<td>15</td>
<td>–</td>
<td>LT</td>
<td>Simple sutures</td>
<td>Alive</td>
</tr>
<tr>
<td>Present case</td>
<td>68</td>
<td>M</td>
<td>B</td>
<td>36</td>
<td>+</td>
<td>LT, TT</td>
<td>Simple sutures</td>
<td>Alive (24)</td>
</tr>
</tbody>
</table>

CP class, Child-Pugh class; M, male; F, female; LS, laparoscopy; LT, laparotomy; TT, thoracotomy.

Two cases [19] [20] were followed with conservative management. The laparotomy approach was used in eight cases, and the thoracolaparotomy approach was performed in our case alone. We performed thoracolaparotomy because the preoperative findings raised the suspicion of both necrosis and perforation with a strangulated intestine. Moreover, it was difficult to pull the strangulated and expanded intestine out of the hernia orifice. In two recent cases [13] [16], the laparoscopic approach was performed to treat the diaphragmatic hernia. This method is less invasive for patients with a liver function disorder. Our patient recovered without complications and was discharged 24 days after the surgery. The length of hospital stay after surgery in our case was comparable to that in other reports (mean, 20.3 days; range, 6 - 60 days). The surgical methods for the hernia repair were as follows: simple ligation in six cases, Vicryl patch in one case, and mesh in one case. Nomura et al. [16] performed closure by using a mesh without intestinal resection. Concerning the surgical outcomes, no infectious complications occurred in patients with Vicryl patch and mesh.

4. Conclusion

We report a case of diaphragmatic hernia with a strangulated ileus after RFA. We suggest that thoracolaparotomy is an effective treatment approach for diaphragmatic hernia when perforation of a strangulated intestine into the thoracic cavity is suspected. Treatment of HCC with RFA must be performed carefully to prevent thermal injury to the diaphragm, and follow-up for HCC recurrence and complications is necessary.

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Competing Interests

We have no financial or personal relationships with other people or organizations that could have influenced our work.

Informed Consent

Written informed consent was obtained from the patient for the publication of this case report.

References


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