Percutaneous microwave ablation-induced hepatic artery-pulmonary artery fistula: A rare case report

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Abstract. Microwave ablation (MWA) is safe and effective for patients with unresectable primary and secondary hepatic tumors, but it also has a series of complications. The present study reported on the case of a 60-year-old male patient with progression of solitary liver metastasis who underwent multiple courses and lines of chemotherapy. Hepatic artery-pulmonary artery fistula due to thermal damage may occur after MWA for hepatic tumor adjacent to the diaphragm. Symptomatic improvement was achieved by trans-arterial embolization and hepatic arteriography indicated complete occlusion of the fistula. The postoperative course was uneventful and the patient was discharged three days later. This rare complication should be taken into consideration in clinical treatment.

Introduction

Microwave ablation (MWA) is a promising non-vascular interventional technique, with clear efficacy in local control. For the treatment of small primary and secondary hepatic tumors (<3 cm), MWA may be comparable to surgical resection (1-4). Furthermore, numerous clinical trials have indicated that trans-arterial chemoembolization (TACE) combined with MWA may significantly improve the rate of complete necrosis of tumors and prolong the survival of patients (5,6). However, for special lesions, such as those adjacent to the diaphragm, blood vessels, or the biliary or intestinal tract, MWA may also have a series of complications, which should be paid more attention to. For hepatic tumors adjacent to the diaphragm, there have been reports of complications, such as diaphragmatic perforation and hernia, biliary pleural fistula and biliary bronchial fistula caused by MWA thermal injury (7,8). The present study reports on a rare iatrogenic complication of hepatic artery-pulmonary artery fistula (HA-PAF) after MWA of a hepatic tumor adjacent to the diaphragm.

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Abbreviations: MWA, microwave ablation; TACE, trans-arterial chemoembolization; CT, computed tomography; HA-PAF, hepatic artery-pulmonary artery fistula

Key words: fistula, complications, microwave ablation, embolization

Case report

A 60-year-old male with a surgical history of colon cancer presented with progression of solitary liver metastasis after multiple courses and lines of chemotherapy. The patient did not have any symptoms. Physical examination did not reveal any abnormalities. Routine hematological, biochemical and coagulation functions were within the normal range. The levels of tumor markers [CEA (normal limit, <5.0 ng/ml), 120 ng/ml; CA19-9 (normal limit, <37.0 U/ml), 62.0 U/ml; CA125 (normal limit, <35.0 U/ml), 78.2 U/ml] were higher than normal. Abdominal contrast-enhanced computed tomography (CT) indicated a round-like mass of ~3.0x2.5 cm in hepatic segment VIII abutting the diaphragm, with obvious enhancement of the lesion in the arterial phase (Fig. 1A). Considering chemotherapy resistance, the decision to perform local interventional therapy was made after a multi-disciplinary discussion.

First, TACE was performed to label and embolize the hepatic tumor, using iodized oil (Laboratoire Andre Guerbet) as an embolic agent. Subsequently, MWA was performed percutaneously under the guidance of CT. The tumor exhibited intra-tumoral high-density iodized oil deposition (Fig. 1B) on a preprocedural CT scan. Under local anesthesia and conscious sedation, a single, 17-G, internally cooled antenna (MTC-3C MWA system, Vison Medical, Inc.) was introduced into the tumor via the right lower lung and diaphragm (Fig. 1C). The microwave power was set at 40 W and the ablation duration was 8 min. A follow-up CT scan obtained immediately after MWA indicated complete ablation with good ablative margin (Fig. 1D). The patient recovered smoothly and reported slight chest tightness and shortness of breath after discharge. One month later, a transhepatic arterial chemoinfusion was performed as

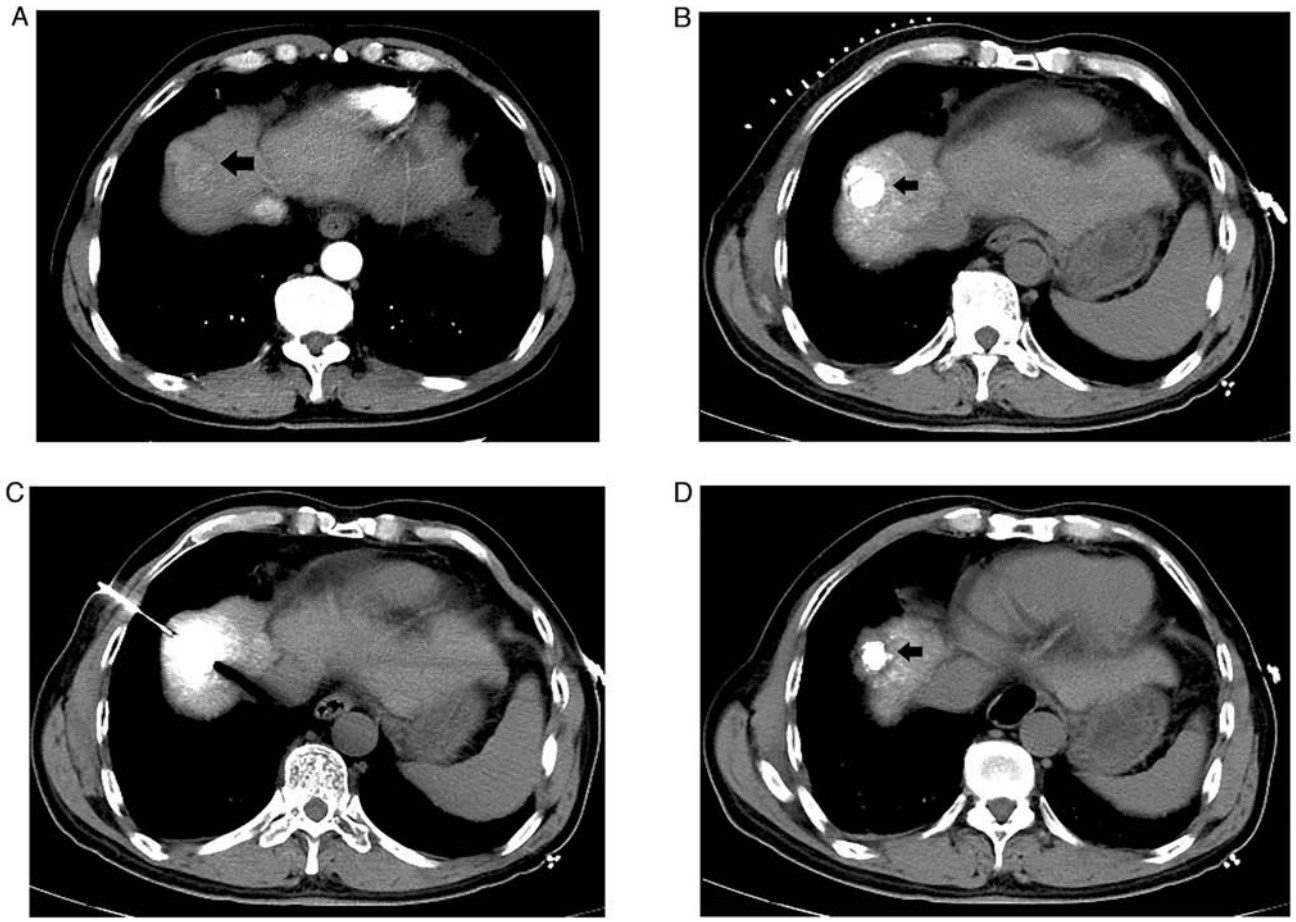

Figure 1. (A) Arterial phase axial CT image indicated a round-like mass measuring ~3.0x2.5 cm (arrow) in hepatic segment VIII, abutting the diaphragm. (B) After trans-arterial chemoembolization, the accumulation of iodized oil in the hepatic tumor area was confirmed (arrow). (C) Axial CT image confirming the final position of the MWA antenna tip in the center of the hepatic tumor. (D) Abdominal CT immediately after MWA indicates that the ablation zone (arrow) has adequately subsumed the tumor. MWA, microwave ablation.

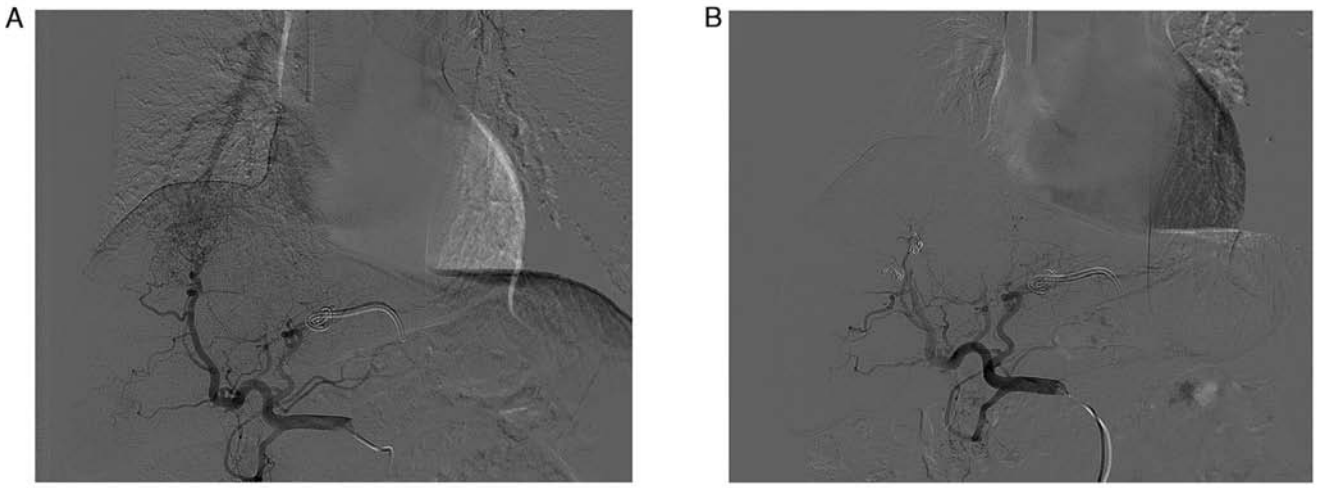

Figure 2. (A) Angiography displaying a fistula between the right intrahepatic artery and the right lower pulmonary artery one month after TACE and MWA. (B) Complete occlusion of the distal right intrahepatic artery was observed after microcoils embolization.

scheduled and the hepatic angiography revealed a fistula between the right hepatic artery and the right lower pulmonary artery (Fig. 2A). Subsequently, the HA-PAF was successfully occluded by trans-arterial embolization using three microcoils (MWCE-18S-3/2-TORNADO; COOK Inc.). Control hepatic arteriography at the end of the procedure indicated complete occlusion of the fistula (Fig. 2B). The postoperative course was uneventful and the patient

was discharged with symptomatic improvement three days later.

Discussion

HA-PAF, an abnormal communication between the hepatic artery and pulmonary artery, is a rare complication of MWA. To the best of our knowledge, so far, only one case report has presented a similar case, but no effective treatment was given (9). The early clinical symptoms are usually insidious and easily ignored by patients and clinicians. Imaging examinations (CT, magnetic resonance or ultrasound) frequently fail to detect the fistula, whereas only hepatic arteriography is able to confirm the diagnosis. When the pulmonary artery pressure increases gradually, the patient has an obvious cough, expectoration, chest tightness and dyspnea. If not treated in time, serious complications may occur, such as hemoptysis and heart failure, and they may even be life-threatening (10,11).

The formation of HA-PAF may be congenital or acquired, the latter being mainly caused by chronic inflammation, accidental trauma or iatrogenic collateral thermal damage. Thermal damage is caused by hyperthermic ablation (MWA), which is caused by heating the targeted tissue to >60˚C, leading to acute coagulative necrosis. In the present case, the cause of a HA-PAF was considered as follows: On the one hand, MWA performed with a high-power setting and long duration give rise to a large ablation area involving the diaphragm and lung tissue. Due to the local weakness of the thermal damaged tissue, delayed perforation and abnormal communication between blood vessels may occur after long-term respiratory movement. On the other hand, the tumor is located in the hepatic dome adjacent to the right diaphragm. The puncture path passes through the lung tissue and diaphragm, resulting in mechanical injury. Furthermore, iodized oil has good thermal conductivity, which may increase the temperature in the ablation area by improving heat conduction, causing heat accumulation and expansion of the ablation area.

Considering the high risk of thermal injury to the diaphragm around the tumor after MWA, precautionary measures should be taken to avoid collateral damage to adjacent organs. Results of a previous study suggested that the establishment of artificial ascites and/or pleural effusion was equivalent to the formation of a barrier zone, which may separate the adjacent blood vessels, liver and diaphragm from thermal ablation (12-14). The barrier zone may reduce heat energy conduction and avoid thermal injury, thereby protecting the diaphragm, lung tissues and its internal blood vessels. However, for patients who underwent surgical resection of liver tumors, or had peritonitis, it is difficult to establish artificial pleural effusion or ascites due to the peritoneal or pleural adhesions (12-14). While the patient of the present study underwent laparotomy prior to microwave therapy, microwave therapy with artificial pleural effusion or artificial ascites should have been opted for.

The ablation area may not completely cover the tumor, resulting in tumor residue. Thus, for hepatic tumor adjacent to the diaphragm, clinicians should be aware of the risk and potential complications of diaphragm injury. In addition, patients should be followed up regularly after MWA and provided with more attention to changes in their conditions. When there are symptoms of pulmonary hypertension, such as weakness, dizziness, chest tightness, shortness of breath and dyspnea, clinicians should be promptly alerted to the presence of HA-PAF and hepatic arteriography is required to make a clear diagnosis.

In conclusion, the present study reported a rare case of HA-PAF as an iatrogenic complication due to MWA thermal injury that was successfully managed by trans-arterial embolization. This may be an important observation for improving post-surgery monitoring and management after MWA in the clinic.

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Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Authors' contributions

BL and XGL were involved in the design and conception of the study and confirmed the authenticity of all the raw data. BL analyzed and interpreted the data, and was involved in drafting the manuscript. BL and XGL performed the treatment, acquired the data and critically revised the manuscript. XGL supervised the conduct of this report. All authors read and approved the final manuscript.

Ethics approval and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Patient consent for publication

Written informed consent was obtained from the patient for the publication of this report and any accompanying images.

Competing interests

The authors declare that they have no competing interests.

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