Clinical Case Report

Medicine®

OPEN

Cardiac tamponade after radiofrequency ablation for hepatocellular carcinoma

Case report and literature review

Min-Woo Chung, MD[a], Sang-Yoon Ha, MD[a], Jung-Ho Choi, MD[a], Hyuk-Jin Park, MD[a], Dae-Seong Myung, MD, PhD[a], Sung-Bum Cho, MD, PhD[a], Wan-Sik Lee, MD, PhD[a], Jin-Woong Kim, MD, PhD[b], Hyung-Hoon Oh, MD[c], Young-Eun Joo, MD, PhD[a,*]

Abstract

Rationale: Radiofrequency ablation (RFA) is a safe and effective local treatment modality with a low complication rate and is commonly used to treat hepatocellular carcinoma (HCC). The clinical outcome of RFA may be closely related to the location, size, and shape of index tumors, and major complications, including hemorrhage, liver abscess, infarction, visceral organ perforation, hemothorax, pneumothorax, tumoral seeding, and hepatic failure. Cardiac tamponade is a rare and serious life-threatening complication associated with RFA. To date, a review of the medical literature reported 5 cases of cardiac tamponade after RFA for HCC. Herein, we report another case of cardiac tamponade after RFA for HCC in a 56-year-old man.

Patient concerns: He had suffered from liver cirrhosis due to alcohol abuse. He had chronic obstructive pulmonary disease. Magnetic resonance imaging showed a 3.0-cm exophytic subcapsular HCC in segment IVa of left hepatic lobe. As the patient was at high risk for surgery because of poor lung function, RFA was selected as the treatment of choice. The index tumor was located in the vicinity of the diaphragm and colon. During RFA procedure, thermal injury to the adjacent diaphragm and colon was minimized by introducing artificial ascites. Bleeding or tumoral seeding was prevented by ablating the electrode track during electrode retraction.

Diagnosis: Two hours after RFA, the patient presented with dyspnea, chest discomfort, and low blood pressure (80/60 mm Hg), suggesting cardiac tamponade. Immediate follow-up contrast-enhanced computed tomography image depicted the slightly high attenuated hemopericardium. Transthoracic echocardiography (TTE) showed a moderate amount of pericardial effusion with tamponade and a large hematoma.

Interventions: Under fluoroscopy and portable echocardiography guidance, a cardiologist immediately inserted a 7-French pigtail catheter into the pericardial space and collected more than 200 cc of bloody pericardial fluid.

Outcomes: After pericardiocentesis, the patient's symptoms and hemodynamic status were dramatically improved. Follow-up TTE showed scanty amount of pericardial effusion and the drainage catheter was removed. The patient was discharged.

Lessons: When treating HCC in the left lobe (especially segments II and IVa), attention should be paid to cardiac tamponade. The early diagnosis and immediate treatment of cardiac tamponade may increase the chance of cure.

Abbreviations: COPD = chronic obstructive pulmonary disease, CT = computed tomography, HCC = hepatocellular carcinoma, MRI = magnetic resonance imaging, RFA = radiofrequency ablation, TTE = transthoracic echocardiography, US = ultrasound.

Keywords: cardiac tamponade, hepatocellular carcinoma, radiofrequency ablation

1. Introduction

Hepatocellular carcinoma (HCC) is one of the leading causes of cancer-related morbidity and mortality worldwide. The selection of treatment of HCC is based on tumor number, tumor size, tumor location, distant metastasis, and underlying liver function, and many treatment modalities, including surgical resection, liver transplantation, transarterial chemoembolization, radiofrequency ablation (RFA), microwave ablation, percutaneous ethanol injection, cryo-ablation, radiotherapy, systemic chemotherapy, and molecular-targeted agents, are available.[1–3]

The therapeutic effect of RFA relies on thermal ablation by electrical energy, resulting in heating, cauterization, or denaturation of the tumor tissue and coagulative necrosis. RFA is the most widely used 1st-line treatment in selective patients with HCC and metastatic liver cancer and is usually safe and well tolerated.[4–6] However, previous studies reported the occurrence of major complications associated with RFA, including hemorrhage, liver

Editor: N/A.

M-WC and S-YH contributed equally to this work.

The authors have no funding and conflicts of interest to disclose.

[a] Department of Internal Medicine, Chonnam National University Medical School, [b] Department of Radiology, Chosun University College of Medicine, Gwangju, [c] Office of the Surgeon General, ROK Navy, Korea.

[*] Correspondence: Young-Eun Joo, Department of Internal Medicine, Chonnam National University Medical School, 8 Hak-Dong, Dong-ku, Gwangju 501-757, Korea (e-mail: yejoo@chonnam.ac.kr).

Medicine (2018) 97:49(e13532)

Received: 16 August 2018 / Accepted: 12 November 2018

http://dx.doi.org/10.1097/MD.0000000000013532

abscess, hepatic infarction, bile duct injury, gastrointestinal perforation, hemothorax, pneumothorax, tumoral seeding, and hepatic failure.[7–10] The rates of major complications and mortality associated with RFA were 4.1% (range: 3.3–5.1) and 0.15% (range: 0.08–0.23), respectively.[7–10]

The incidence rate of cardiac tamponade after RFA is extremely rare; however, this complication is important because of the high mortality rate. To date, 5 cases of cardiac tamponade after RFA for HCC have been documented in literature.[11–14] Herein, we report another case of a 56-year-old man with cardiac tamponade after RFA for HCC and review the literature on this condition.

2. Case report

A 56-year-old man was admitted to our hospital for evaluation of HCC. He had suffered from liver cirrhosis due to alcohol abuse for several years. In addition, he was a heavy smoker (30 pack years) and had chronic obstructive pulmonary disease (COPD). The laboratory test results on admission were as follows: white blood cell count, 9500/mm^3 (normal range, 6000–10,000/mm^3); hemoglobin level, 10.6 g/dL (normal range, 12–16 g/dL); platelet count, 134,000/mm^3 (normal range, 130,000–450,000/mm^3); serum albumin level, 3.6 g/dL (normal range, 3.0–5.0 g/dL); aspartate aminotransferase level, 94 U/L (normal range, 5–37 U/L); alanine aminotransferase level, 26 U/L (normal range, 5–40 U/L); alkaline phosphatase level, 96 U/L (normal range, 39–117 U/L); γ-glutamyl transpeptidase level, 957 U/L (normal range, 7–49 U/L); total bilirubin level, 1.02 mg/dL (normal range, 0.2–1.2 mg/dL), with a direct fraction of 0.66 mg/dL (normal range, 0.05–0.3 mg/dL); alpha-fetoprotein level, 9.82 IU/mL (normal range, 0.74–7.29 IU/mL); and protein induced by vitamin K absence-2 level, 27 mAU/mL (normal range, 0–40 mAU/mL). Coronal T2-weighted magnetic resonance imaging (MRI) showed a 3.0 cm exophytic subcapsular HCC in segment IVa of left hepatic lobe (Fig. 1). The patient was at high risk for general anesthesia and surgery because of poor lung function due to underlying COPD. Therefore, RFA was selected as the treatment of choice. RFA was performed under sedation and local anesthesia, and the patient's hemodynamic status was continuously monitored during the entire procedure. The index tumor was located in the vicinity of the diaphragm and colon. Thermal injury to the adjacent diaphragm and colon was minimized by introducing artificial ascites using 1 L of 5% dextrose solution before inserting electrodes under ultrasound (US) guidance. After that, a single 15-gauge internally cooled electrode with a 3-cm exposed tip (STARmed Co Ltd, Goyang, Korea) was inserted in the index tumor at a depth of <3.5 cm via the intercostal route under US guidance. RFA was performed using a monopolar radiofrequency generator (CC-1; Valleylab, Boulder, CO) with sequential activation of the electrodes. Radiofrequency current was produced with the generator set to deliver the maximal power in the automatic impedance control mode. The temperature of the electrode tip was maintained below 20°C by continuously circulating ice-cold physiologic saline through the cooling catheter, which was connected to the electrode by a peristaltic pump (Watson Marlow, Wilmington, MA). Tumor ablation was performed for 8 minutes after electrode placement. RFA was finished when the index tumor was fully covered by a transient hyperechoic ablated zone on US images. Bleeding or tumoral seeding was prevented by ablating the electrode track during electrode retraction. Two hours after RFA, the patient presented with dyspnea, chest discomfort, and low blood pressure (80/60 mm Hg), suggesting cardiac tamponade. Immediate follow-up contrast-enhanced coronal computed tomography (CT) image after US-guided RFA depicted high at low attenuated ablated zone which sufficiently covers the tumor and the slightly high attenuated hemopericardium (Fig. 2A). Transthoracic echocardiography (TTE) showed a moderate amount of pericardial effusion with tamponade and a large hematoma (Fig. 2B). Under fluoroscopy and portable echocardiography guidance, a cardiologist (HJP) immediately inserted a 7-French pigtail catheter into the pericardial space via the subcostal route (Fig. 3) and collected more than 200 cc of dark, bloody pericardial fluid. After immediate pericardiocentesis, the patient's symptoms and hemodynamic status were dramatically improved. At 7 days after pericardiocentesis, follow-up TTE showed the presence of a scanty amount of pericardial effusion (Fig. 4), and the drainage catheter was removed. The patient was discharged. The patient visited outpatient department after 1 month of RFA. Dynamic abdomen CT was checked and slight involution of RFA zone was shown in segment IVa of the liver without local tumoral progression. He was scheduled to undergo regular follow-up.

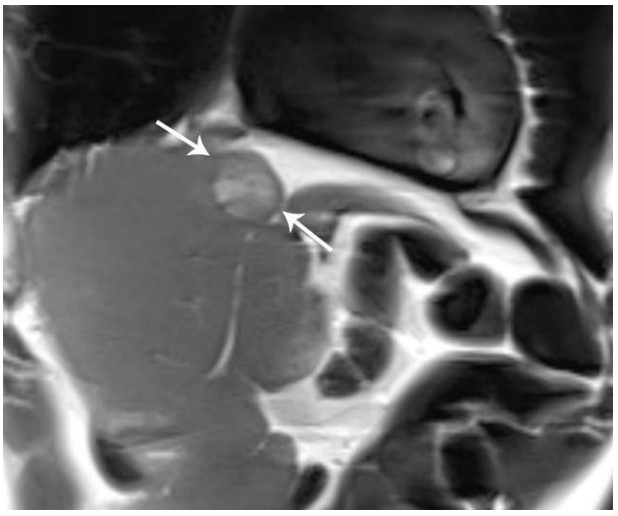

Figure 1. Coronal T2-weighted magnetic resonance image shows a 3.0-cm exophytic subcapsular hepatocellular carcinoma (arrows) in segment IVa of left hepatic lobe.

Informed written consent was obtained from the patient for publication of this case report and accompanying images. In our study, ethical approval was not necessary, as this article is a case report, which is based on the clinical information of the patient.

3. Discussion

The RFA is a safe and effective treatment with a low complication rate. This treatment is used in selective patients with HCC with up to three nodules smaller than 3 cm in size and patients without extrahepatic disease. In RFA, an electrical current is delivered to the tumor tissue through a needle electrode under imaging guidance and causes heat-based thermal cytotoxicity.[4–6] However, complications associated with RFA also occur during thermal injury. Although most of these complications are usually minor and self-limited, major complications may be fatal in cases in which diagnosis and treatment are delayed and inappropriate. The major complications of RFA are hemorrhage, hepatic abscess, hepatic infarction, visceral organ/bile duct injury, hemothorax, pneumothorax, tumor seeding, and hepatic failure.[7–10]

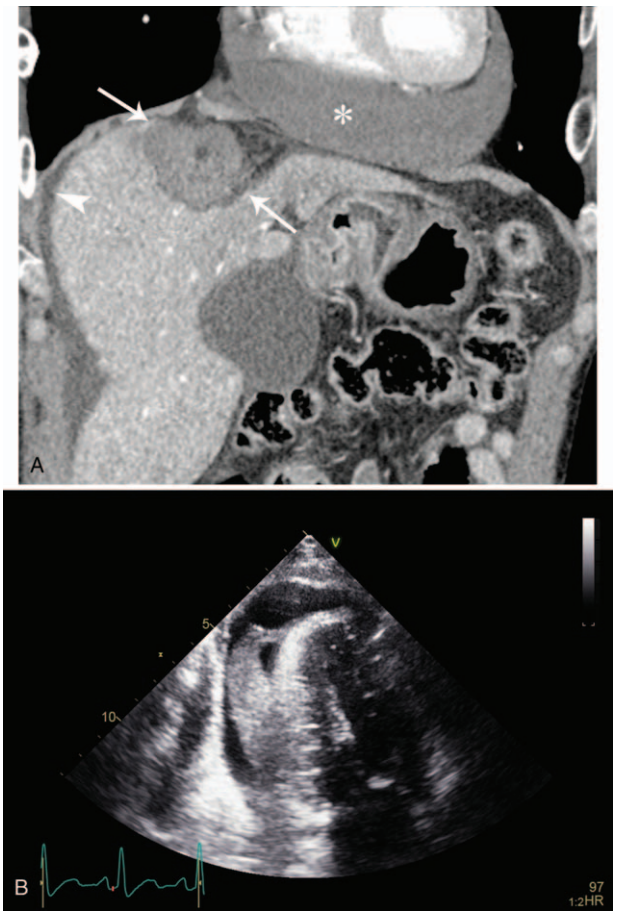

Figure 2. (A) Immediate follow-up contrast-enhanced coronal computed tomography image after ultrasound-guided radiofrequency ablation depicts high at low attenuated ablated zone (arrows) which sufficiently covers the tumor, compared with Figure 1. Note the slightly high attenuated hemopericardium (asterisk) compared with infused low attenuated artificial ascites (arrowhead, 5% dextrose solution). (B) Transthoracic echocardiography showing a moderate amount of pericardial effusion with tamponade and a large hematoma.

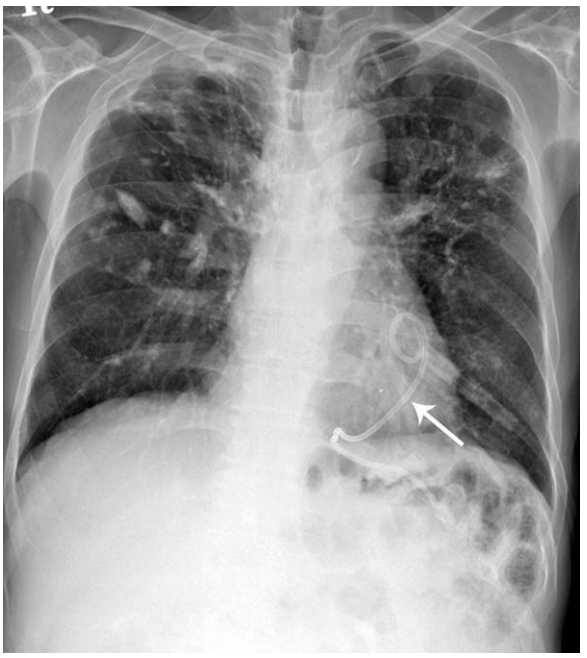

Figure 3. Chest radiogram demonstrates a 7-French pigtail drainage catheter (arrow) after emergency percutaneous ultrasound-guided pericardiostomy for the hemopericardium.

The incidence rate of cardiac tamponade after RFA is extremely rare. To date, a literature review reported 6 cases of cardiac tamponade after RFA for HCC (including the present case) (Table 1).[11–14] We have reviewed 6 cases of cardiac tamponade after RFA for HCC. The patients were aged 56 to 79 years (mean age, 68.7 years) and consisted of 4 men and 2 women. The causes of liver cirrhosis and HCC were hepatitis B (2 cases), alcohol abuse (2 cases), hepatitis C (1 case), and cryptogenic cirrhosis (1 case). The mean tumor size was 3.1 cm.

All identified tumors were located in the left lobe (4 in segment II and 2 in segment IVa), indicating that the anatomical location of left lobe tumors in the vicinity of the diaphragm and heart base was an important risk factor for cardiac tamponade after RFA.

In cases in which index tumors are located in the vicinity of vulnerable organs such as the diaphragm and visceral organs, and the electrodes are inadvertently placed in vulnerable organs, thermal conduction may damage these organs, leading to several complications after RFA.[7–10] Therefore, the position of the electrodes is usually checked under US or image-guided CT to prevent thermal injury before commencing the procedure. In all cases, the electrodes were inserted under real-time image guidance (4 cases under CT guidance and 2 cases under US guidance). However, the conduction and distribution of heat in vivo may be unpredictable, and any structure damaged by heat may bleed, become inflamed, or undergo necrosis.

The size of the electrodes used in RFA was 15-gauge in most cases. Electrodes with a larger diameter produce a larger ablation volume by delivering a larger amount of radiofrequency energy but may increase the rate of complications. In this respect, it was shown that 15-gauge electrode produced larger ablation volumes than smaller ones; however, there was no statistical difference in the complication rates between 15-gauge electrodes and smaller ones.[15]

In this case, the tumor location was in the left lobe in the vicinity of the diaphragm which may be the risk factor for the

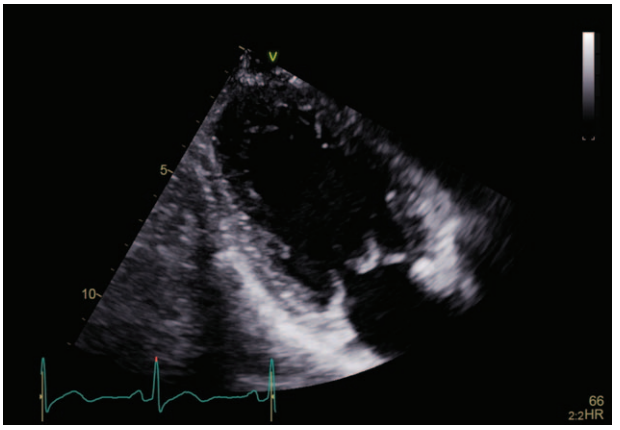

Figure 4. Follow-up transthoracic echocardiography showing a scanty amount of pericardial effusion.

Table 1

Summary of the reported cases of cardiac tamponade after radiofrequency ablation for hepatocellular carcinoma.

Case no.	Author (reference)	Age, y /gender	Causes of liver cirrhosis and HCC	Tumor size and location	Type of image-guidance and size of RFA electrode	Diagnosis of cardiac tamponade	Treatment	Outcome
1	Moumouh et al[11]	74/M	Alcohol abuse	2.0 cm (S II)	US, 15-G	TTE	Pericardiocentesis	Died
2	Jun et al[12]	79/F	Hepatitis C	3.7 cm (S II)	CT, NA	CT	Pericardiocentesis	Survived
3	Loh et al[13]	56/M	Hepatitis B	4.3 cm (S IVa)	CT, 15-G	CT	Pericardiocentesis	Died
4	Silverman et al[14]	76/M	Cryptogenic	2.8 cm (S II)	CT, 15-G	CT	Pericardiocentesis	Survived
5	Silverman et al[14]	71/F	Hepatitis B	2.5 cm (S II)	CT, 15-G	CT	Pericardiocentesis	Survived
6	Present case	56/M	Alcohol abuse	3.0 cm (S IVa)	US, 15-G	CT, TTE	Pericardiocentesis	Survived

CT = computed tomography, G = gauge, HCC = hepatocellular carcinoma, NA = not available, RFA = radiofrequency ablation, S = segment, TTE = transthoracic echocardiography, US = ultrasonography.

cardiac tamponade after RFA. The size of the electrodes used in RFA was 15-guage. Although electrodes were inserted under real-time image guidance, as electrode had large diameter, it may have delivered large amount of radiofrequency energy and lead to cardiac tamponade.

Cardiac tamponade is caused by an abnormal accumulation of fluid in the pericardial sac and constitutes a medical emergency. This condition causes tachycardia, dyspnea, hypotension, and cardiogenic shock[16,17] and can be reversed by early detection and appropriate management.[16,17] The diagnosis of cardiac tamponade was confirmed by TTE (2 cases) and CT (4 cases). Pericardiocentesis was used to treat cardiac tamponade after RFA in all cases. Of the 6 analyzed patients, 4 survived and 2 died. Pericardiocentesis is performed to remove pericardial fluid from the pericardial sac. This procedure is often performed in cases of pericardial tamponade to restore cardiac output using real-time imaging guidance, including TTE or fluoroscopy, and to reduce the risk of procedure-related complications.[16,17]

To prevent cardiac tamponade after RFA, preprocedural assessment is important to identify the high risk group such as patients who have tumor location in the left lobe and coagulopathy. For patients who have coagulopathy, coagulation profile must be corrected before RFA. Also proper use of real-time imaging in monitoring the RFA needle position will prevent injury of adjacent organs due to the malposition of the RFA needle. Routine CT follow-up right after RFA may help to detect complications early.

In summary, cardiac tamponade is a rare and serious complication that occurs after RFA, especially in left lobe HCC. The early and accurate diagnosis of cardiac tamponade, and if feasible, immediate pericardiocentesis may increase the chance of cure.

Author contributions

Conceptualization: Wan-Sik Lee.
Resources: Hyuk-Jin Park, Dae-Seong Myung, Sung-Bum Cho, Jin-Woong Kim.
Supervision: Young Eun Joo.
Visualization: Jung-Ho Choi.
Writing – original draft: Min-Woo Chung, Sang-Yoon Ha.
Writing – review & editing: Hyung-Hoon Oh.

References

[1] Balogh J, Victor D3rd, Asham EH, et al. Hepatocellular carcinoma: a review. J Hepatocell Carcinoma 2016;3:41–53.
[2] Hartke J, Johnson M, Ghabril M. The diagnosis and treatment of hepatocellular carcinoma. Semin Diagn Pathol 2017;34:153–9.
[3] Testino G, Leone S, Patussi V, et al. Hepatocellular carcinoma: diagnosis and proposal of treatment. Minerva Med 2016;107:413–26.
[4] Puijk RS, Ruarus AH, Scheffer HJ, et al. Percutaneous liver tumour ablation: image guidance, endpoint assessment, and quality control. Can Assoc Radiol J 2018;69:51–62.
[5] Salati U, Barry A, Chou FY, et al. State of the ablation nation: a review of ablative therapies for cure in the treatment of hepatocellular carcinoma. Future Oncol 2017;13:1437–48.
[6] Giorgio A, Merola MG, Montesarchio L, et al. Percutaneous radiofrequency ablation of hepatocellular carcinoma in cirrhosis: analysis of complications in a single centre over 20 years. Br J Radiol 2017;90:20160804.
[7] Kwon HJ, Kim PN, Byun JH, et al. Various complications of percutaneous radiofrequency ablation for hepatic tumors: radiologic findings and technical tips. Acta Radiol 2014;55:1082–92.
[8] Rhim H, Yoon KH, Lee JM, et al. Major complications after radiofrequency thermal ablation of hepatic tumors: spectrum of imaging findings. Radiographics 2003;23:123–34.
[9] Bertot LC, Sato M, Tateishi R, et al. Mortality and complication rates of percutaneous ablative techniques for the treatment of liver tumors: a systematic review. Eur Radiol 2011;21:2584–96.
[10] Lahat E, Eshkenazy R, Zendel A, et al. Complications after percutaneous ablation of liver tumors: a systematic review. Hepatobiliary Surg Nutr 2014;3:317–23.
[11] Moumouh A, Hannequin J, Chagneau C, et al. A tamponade leading to death after radiofrequency ablation of hepatocellular carcinoma. Eur Radiol 2005;15:234–7.
[12] Loh KB, Bux SI, Abdullah BJ, et al. Hemorrhagic cardiac tamponade: rare complication of radiofrequency ablation of hepatocellular carcinoma. Korean J Radiol 2012;13:643–7.
[13] Gao J, Sun WB, Tong ZC, et al. Successful treatment of acute hemorrhagic cardiac temponade in a patient with hepatocellular carcinoma during percutaneous radiofrequency ablation. Chin Med J (Engl) 2010;123:1470–2.
[14] Silverman ER, Lai YH, Osborn IP, et al. Percutaneous radiofrequency ablation of hepatocellular lesions in segment II of the liver: a risk factor for cardiac tamponade. J Clin Anesth 2013;25:587–90.
[15] Park HJ, Lee MW, Song KD, et al. Comparison of therapeutic efficacy and safety of radiofrequency ablation of hepatocellular carcinomas between internally cooled 15-G and 17-G single electrodes. Br J Radiol 2014;87:20130534.
[16] Kearns MJ, Walley KR. Tamponade: hemodynamic and echocardiographic diagnosis. Chest 2018;153:1266–75.
[17] Appleton C, Gillam L, Koulogiannis K. Cardiac tamponade. Cardiol Clin 2017;35:525–37.