Management of Pericardial Effusion following Cardiac Perforation during Radiofrequency Ablation of Hepatocellular Carcinoma

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Radiofrequency ablation (RFA) is a well-established technique in the management of hepatocellular carcinoma (HCC) and at many institutions is the treatment of choice in small lesions in early-stage disease.¹ Major complications occur in 2 to 3% and include intraperitoneal bleeding, hepatic abscess, bile duct injury, pneumothorax, and hemothorax.² Pericardial effusion is a rare but potentially life-threatening complication of RFA. This article describes such a complication and its management.

Case Report

A 58-year-old woman with hepatitis C cirrhosis was referred for RFA of a segment 4a HCC. She had undergone successful RFA for a segment 5 HCC 2 years previously. The new 2-cm lesion was in the dome of the liver close to the right atrium and was not visible on ultrasound. Three previous attempts to target this lesion under computed tomographic (CT) guidance were unsuccessful despite the use of a noncommercially available optical navigational device. The procedures were also poorly tolerated by the patient under intravenous sedation and analgesia. The case was re-discussed at tumor board, where a repeat RFA was deemed the best curative option.

A fourth ablation attempt was performed under CT guidance with the aid of a magnetic navigational device, which had been developed to improve on an existing optical navigational system for improved positional accuracy. The procedure was performed under general anesthesia to improve patient comfort and to control the phase of breathing during electrode placement.

An initial triple-phase CT of the liver was performed in full expiration. This showed the lesion had increased in size from 2 to 3.5 cm from the initial scan 13 months previously when the lesion was first noted (►Fig. 1). An optimal axial image

was chosen that would act as the target for the magnetic navigational device. A suitable percutaneous route was identified from a right lateral intercostal approach, and the skin entry site was marked. The sensor of the navigational device was attached to the end of a 17-gauge Cool-tip RFA electrode (Covidien, Boulder, CO). The chosen target CT image of the lesion was shown on a television screen in the room with a “needle and target” image displayed over the lesion. With the patient apneic on full expiration, the electrode was advanced toward the lesion keeping the “needle” at the center of the “target.” The “needle” would become shorter as the electrode was advanced further toward the lesion (►Fig. 2) until it became a dot at the center of the target resulting in a “bulls eye” appearance, indicating the needle tip should be at the center of the target lesion.

An interval CT after the first attempt showed the electrode tip was inferolateral to the lesion. Therefore, the electrode was repositioned and advanced slightly deeper and more medially. However, a repeat interval CT showed the electrode tip was in the right atrium, close to the right coronary artery (►Fig. 3). No significant pericardial effusion was seen at this time, and the patient was hemodynamically stable with no electrocardiographic changes.

A decision was made by the lead interventional radiologist to abandon the planned RFA procedure to focus on the management of this unexpected complication. The electrode was left in place, while prompt consultations took place with anesthesiology, cardiothoracic surgery, and cardiology colleagues to decide on the best course of action. As the patient was hemodynamically stable, it was agreed there was no immediate need to transfer the patient to the operating room under cardiothoracic surgery, and the anesthesiologist was willing to manage the patient in the IR suite. The following plan was agreed upon:

Figure 1 Pretreatment contrast-enhanced (A) axial and (B) coronal CT images demonstrate a 3.5-cm arterially enhancing lesion in segment 4A of the liver (arrow). Note its position high in the dome in close proximity to the right atrium and right coronary artery.

Figure 2 Illustration of the “needle and target” of the navigational device displayed over the target CT image. (A) The red circle is stationary and is centered on the lesion while the tip of the yellow line moves in the direction of the electrode. (B) As the electrode is advanced closer to the target, the yellow line becomes shorter until it becomes a dot. The aim is to position the yellow dot at the center of the red target.

Figure 3 Unenhanced axial CT image following electrode placement shows the electrode tip (arrow) lies within the right atrium close to the right coronary artery. There is no significant associated pericardial effusion.

1. The anesthesiologist would maintain general anesthesia, additional intravenous and intra-arterial access would be used to monitor and support hemodynamic status, and inotropic support would be available if required.
2. The cardiologist would perform a transesophageal echocardiogram (TEE) to assess the degree of pericardial effusion and the exact position of the electrode tip.
3. The interventional radiologist would remove the electrode under real-time TEE and be ready to perform pericardiocentesis should tamponade develop.
4. The cardiothoracic surgery team and operating room would be on standby should surgical involvement become necessary.

The TEE showed a small pericardial effusion around the right atrium and ventricle, approximately 8 mm in size. The electrode tip was clearly visualized just within the right atrial chamber. The electrode was retracted slowly under real-time TEE, which demonstrated minimal increase in effusion

volume. The patient remained stable and there was no bleeding from the puncture site. She was transferred to a cardiac care unit where serial echocardiograms showed no increase in pericardial effusion. She remained stable and was discharged 3 days later. The case was discussed again at tumor board, and the patient underwent successful transarterial chemoembolization (TACE) 1 month later.

Discussion

Pericardial tamponade from liver RFA is a rare complication with only three cases reported in the literature.^{3–5} In all cases, the target lesions were close to the diaphragm and the heart in segments 2 and 4a of the liver. These cases were different from the one presented here in that the complications reported in the literature occurred after the lesions were ablated, and the pericardial effusions were large resulting in tamponade. Tined electrodes were used in all three cases and direct puncture of the cardiac vein by a tine was suspected in one case. Two patients died, one on the table after failed pericardiocentesis, and the other after both pericardiocentesis and open surgery. One patient survived after successful pericardial drainage. The authors advised careful patient selection, close monitoring to aid early detection of tamponade, and prompt management of this life-threatening complication.

Similar and additional lessons may be learned from the case presented here. First, patients should be selected carefully for suitability for RFA, especially in lesions high in the dome of the liver and in close proximity to the heart. Second, after three failed attempts to ablate this lesion, a further attempt was probably not advisable in this case. The

lesion was known to be in a high-risk location so it may have been more prudent to pursue alternative therapies such as TACE at an earlier stage. Third, it is important to know when to stop and abandon the proposed procedure if a major complication is encountered. All efforts should be aimed at the successful management of the complication, rather than be distracted by attempts to salvage the procedure. Finally, cross-specialty collaboration can bring about innovative solutions when faced with a difficult and unexpected problem. The successful management of this potentially fatal complication was largely due to the prompt response of a multidisciplinary team and the willingness of all parties to facilitate one another to achieve a common goal.

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