Radiofrequency ablation (RFA) is widely used for patients with hepatocellular carcinoma (HCC). The reported complications of RFA include fever, pain, peritoneal hemorrhage, bile duct injury, bowel perforation, liver abscess and cancer seeding along the electrode tract [1]. Vascular injury resulting in liver infarction is rare, with an incidence ranging from 0.07% to 2.3% [2]. Injury of large vessels with massive liver damage, particularly if RFA was preceded by other therapies such as percutaneous pure ethanol injection and/or transcatheter arterial embolization. Here, we report a case of massive liver infarction after sequential use of both treatment modalities for hepatocellular carcinoma.

Hepatic infarction is a rare complication of radiofrequency ablation (RFA) for hepatocellular carcinoma. Hepatic infarction is thought to be caused by injury to either the hepatic arterial system or to both the hepatic arterial and portal venous supply. The efficacy of RFA is reduced in the presence of nearby vessels larger than 3 mm in diameter due to a heat-sink effect. Such an effect can be diminished by performing percutaneous pure ethanol injection prior to RFA. Although larger vessels are unlikely to be ablated or obliterated by RFA alone, it can happen and cause massive liver damage, particularly if RFA was preceded by other therapies such as percutaneous pure ethanol injection and/or transcatheter arterial embolization. Here, we report a case of massive liver infarction after sequential use of both treatment modalities for hepatocellular carcinoma.

Key Words: hepatic infarction, hepatocellular carcinoma, radiofrequency ablation

Radiofrequency ablation (RFA) is widely used for patients with hepatocellular carcinoma (HCC). The reported complications of RFA include fever, pain, peritoneal hemorrhage, bile duct injury, bowel perforation, liver abscess and cancer seeding along the electrode tract [1]. Vascular injury resulting in liver infarction is rare, with an incidence ranging from 0.07% to 2.3% [2]. Injury of large vessels with massive liver infarction is even rarer, because heat can be readily dissipated by convection of the blood flow [3]. We report a man aged 64 years who developed infarction of the left lateral sector of the liver after sequential treatment with percutaneous pure ethanol injection (PEI) and RFA for HCC. We discuss the underlying mechanism of this complication and review the literature.

CASE PRESENTATION

A man aged 64 years with hepatitis C virus-related cirrhosis was admitted for treatment of residual HCC after PEI. He had previously undergone transcatheter arterial embolization (TAE) for bilateral HCC in October 2006. Tumor recurrence in the left lateral sector of the liver, close to the umbilical portion of the left portal vein, was found in March 2007. The tumor was initially treated with PEI; however, a follow-up abdominal computed tomography (CT) scan with contrast enhancement performed in April still showed a residual tumor (Figure 1, black arrow).

As incomplete tumor ablation was considered, he was admitted for RFA treatment approximately 1 month after the previous PEI treatment. On admission, his serum aspartate aminotransferase (AST) was
Hepatic infarction after local ablation therapy

63 U/L (normal, 0–54 U/L), alanine aminotransferase (ALT) was 70 U/L (normal, 0–34 U/L), total bilirubin was 15.3 μmol/L (normal, 3.4–23.8 μmol/L), and α-fetoprotein was 38.72 ng/mL (normal, 0–20 ng/mL). RFA was performed using an internally cooled electrode with a 3-cm active tip (Cool-tip; Valleylab, Boulder, CO, USA). The ablation time was 6 minutes and the final temperature detected at the tip of the electrode was 84°C.

The serum biochemical test on the first day after RFA revealed: AST of 2,874 U/L; ALT of 2,186 U/L; and total bilirubin of 42.5 μmol/L. However, he had only mild fever and vague epigastric discomfort and was discharged 3 days after RFA.

One month later, a follow-up blood test revealed that the serum AST and ALT levels had returned to 69 U/L and 62 U/L, respectively, and total bilirubin was 18.7 μmol/L. In addition, serum α-fetoprotein level had also decreased to 28.4 ng/mL. The follow-up CT imaging unexpectedly showed a large unenhanced area that was representative of infarcted liver parenchyma involving the entire left lateral sector, along with obliteration of the left portal vein branches (Figure 2). Four months after RFA, the liver infarct had decreased in size on CT imaging (Figure 3).

DISCUSSION

Hepatic infarction is an uncommon complication of RFA and is diagnosed by the presence of a well-demarcated, low-attenuated, peripheral, wedge-shaped area on contrast CT imaging [2]. Hepatic infarction mainly results from insults to the hepatic artery supply or to both hepatic arterial and portal venous systems. Older patients, or those with larger tumors, are at risk of such complications [2]. Older patients have aged arterial systems that are prone to thermal injury. A larger tumor encases more liver segments and increases the risk of vascular injury during RFA. The main clinical features of hepatic infarction overlap with those of post-ablation syndrome, including fever, abdominal pain and malaise. Laboratory biochemistry only reveals nonspecific findings such as elevated aminotransferase levels caused by hepatic
necrosis [2]. According to a report by Kim et al, the serum levels of AST and ALT were similar between patients who underwent RFA with and without liver infarction, and the mean levels of AST and ALT after RFA were approximately 10-fold higher than the pre-ablation values [2]. Although our patient did not have severe abdominal pain or signs of liver decompensation, the extremely high serum levels of AST and ALT (AST >30-fold elevation) should have aroused suspicion of massive liver infarction related to local ablation therapy.

The presence of large vessels (i.e. >3 mm in diameter) adjacent to hepatic tumors will dissipate heat away from tissue during RFA, the so called “heat-sink” effect, and result in incomplete tumor necrosis [3]. To avoid incomplete tumor ablation, reduction of the vascular inflow to the liver using balloon catheter occlusion [4] or surgical clamping (i.e. the Pringle maneuver) is helpful [5]. Balloon occlusion of the hepatic artery or portal vein, however, is an invasive procedure and carries a high risk of post-occlusion portal thrombosis and subsequent liver atrophy [4]. The Pringle maneuver, involving directly clamping the hepatic inflow vessels, can be applied safely to a normal liver for up to 1 hour; however, the need for laparotomy or laparoscopy markedly increases the invasiveness on the RFA procedure [5]. PEI can cause coagulation and obliteration of small intratumoral vessels, reduce the convection of blood flow and, therefore, eliminate the heat-sink effect of large vessels [6]. In addition, the heated ethanol may have an additional effect in extending the area of tissue necrosis [7]. Consequently, combined treatment with PEI and RFA for HCC is recommended if the heat-sink effect is a concern. The efficacy and safety of combination therapy has been confirmed without hepatic infarction [7].

Lu et al evaluated the effect of vessel size on the heat-sink effect in piglets, and found that no vessel greater than 3 mm became thrombosed or occluded after RFA [8]. In our case, although the CT imaging before RFA did not show any thrombi in the portal vein and the diameter of the left portal vein branch near to the hepatic tumor was 7 mm (Figure 1, white arrow), the branch of the portal vein was still completely obliterated after RFA. Portal vein thrombosis can be a delayed complication of PEI, occurring 2 months after the procedure [9]. The left portal vein branch or even the left hepatic artery of this patient may have been damaged solely by RFA. However, it is also possible that these vessels were already compromised by PEI or TAE and were then completely obliterated by further RFA, which explains the high intratumor temperature after a relatively short duration of RFA.

Because of the advent of multiple treatment modalities, patients with HCC may undergo various local ablation therapies as well as TAE. Although these treatment modalities have been shown to be safe, unexpected complications may occur when combining them. In this case, the liver reserve of the patient was good and no liver decompensation was associated with the hepatic infarction. However, caution is warranted when RFA after PEI and/or TAE are planned to be performed at a site near a large vessel, particularly in patients with limited liver reserve.

REFERENCES

純酒精注射及射頻燒灼術治療肝癌併發大範圍肝梗塞 — 病例報告

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肝臟梗塞是肝癌射頻燒灼術所造成的少見併發症之一。單一肝動脈或合併門脈系統一同受損被認為是造成肝腫梗塞的原因。治療肝癌時，射頻燒灼的效果會受鄰近血管的熱沉效應影響而減低。當腫瘤附近有直徑大於 3 毫米的血管時，為了避免腫瘤燒灼效果不完全，可考慮在射頻燒灼術前先行於腫瘤鄰近血管處進行純酒精注射術。雖然單一射頻燒灼術不易造成大血管的損傷，但若之前曾使用其它治療術，如純酒精注射術或動脈導管栓塞術，則可能造成大血管受損而使肝腫梗塞壞死。我們在此報告一例，於系列使用三種治療術治療肝癌後，造成左葉肝腫大範圍梗塞之個案。

關鍵詞：肝腫梗塞，肝癌，射頻燒灼術

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