CASE REPORT

Laparoscopic microwave ablation for the management of hemorrhage from ruptured hepatocellular carcinoma

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Abstract
Background: Treatment of ruptured hepatocellular carcinoma (HCC) focuses on hemorrhage control and utilizes tumor vascular anatomy to palliate or temporize selected patients with hepatic artery embolization (HAE). Radiofrequency ablation (RFA) and microwave ablation (MWA) are feasible alternatives or adjunct modalities to resection of HCC; the method of energy delivery in MWA allows uniform coagulative necrosis in shorter time compared with RFA.
Case description: We present the case of an 82-year-old man who presented with a ruptured liver tumor with active intraperitoneal bleeding on angiography. The patient remained hemodynamically stable with evidence of ongoing bleeding following HAE. Tumor destruction and definitive hemostasis were obtained with minimally invasive MWA.
Conclusion: Tumor rupture remains a negative prognostic factor in the course of HCC. In select patients, MWA allows definitive hemorrhage control with minimal surgical morbidity. Hippokratia 2016, 20(2): 169-171

Keywords: Hepatocellular carcinoma, cirrhosis, minimally invasive surgical procedures, ablation techniques

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Introduction

Spontaneous rupture of hepatocellular carcinoma (HCC) is associated with a mortality rate of 18.2-55.6 %, which highlights potential hemodynamic compromise and underlying hepatic dysfunction[1,2]. Treatment of ruptured HCC focuses on hemorrhage control and utilizes tumor vascular anatomy to palliate or temporize selected patients with hepatic artery embolization (HAE)[1-3]. As an alternative or adjunct to resection of HCC, multiple ablative techniques are utilized, including chemical injection, radiofrequency ablation (RFA), cryoablation, and microwave ablation (MWA). RFA, often performed via laparotomy[1], can achieve hemorrhage control via coagulative tissue necrosis but often requires long ablation times and produces unpredictable ablation zones[4]; previous studies also suggest a 3-cm limit on lesion size[4]. MWA generates heat within tissue via rapidly alternating alignment and realignment of water molecule dipoles[5,6]. Unlike RFA, the shorter wavelength and higher frequency of MWA energy delivery achieve uniform coagulative necrosis within the microwave near field, yielding more predictable ablation zones. We present a patient with ruptured HCC successfully treated with minimally invasive MWA for control of hemorrhage.

Description of case

A previously healthy 82-year-old man presented with severe right upper quadrant (RUQ) abdominal pain and tachycardia. No scleral icterus or jaundice was evident, though examination demonstrated tender hepatomegaly. A contrasted abdominal computed tomography (CT) scan revealed a 10-cm central liver lesion replacing segment 4 and extending into segments 5 and 8 with active intraperitoneal contrast extravasation suggestive of ruptured hepatoma.

The patient remained hemodynamically stable and underwent hepatic angiography. Active extravasation from a segment 4 arterial branch was noted (Figure 1) and the right hepatic artery was embolized to stasis. An α-fetoprotein (AFP) level of 11,361 ng/mL supported the diagnosis of HCC. Based on imaging, laboratory values, and clinical history, this patient had well-compensated cirrhosis with Child-Pugh score of 6(A) and a MELD-Na score of 6. Tumor-specific findings yielded an AJCC/UICC Stage IIIC, BCLC stage B lesion with Okuda Stage 1. Despite hemodynamic stability after HAE, progressive anemia prompted exploratory laparoscopy, which revealed an 8-cm, partially exophytic liver mass with active hemorrhage. Tumor debris was scattered across the RUQ

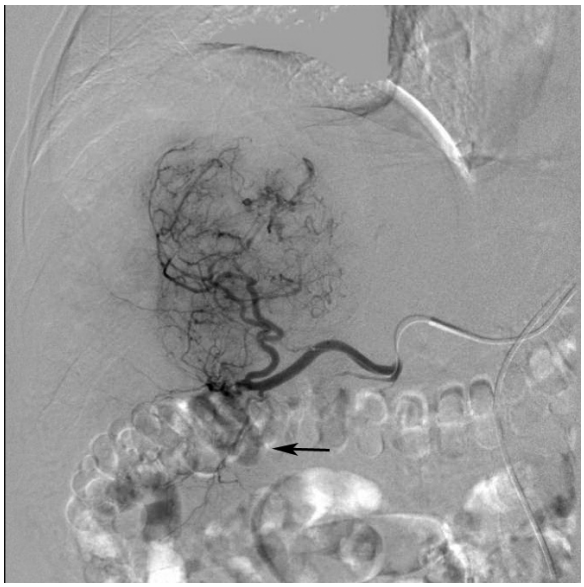

Figure 1: Hepatic angiogram demonstrating a large hypervascular mass as well as active intraperitoneal contrast extravasation (arrow) from a segment 4 branch of the right hepatic artery.

with 1 L of blood and clot in the abdomen.

Two 1.8-mm transcutaneous MWA antennae were guided to the tumor-liver interface with laparoscopic ultrasonography, and a 2.45-GHz microwave generator was used to circumferentially ablate the tumor at its interface with ultrasonographically uninvolved hepatic parenchyma for successful hemorrhage control and tumor destruction. The dual microwave array was used for 62 minutes at 140 watts (520.8 kJ). Following ablation, flow in the left hepatic artery and all three hepatic veins was confirmed by ultrasound.

Pathology confirmed well-differentiated HCC, and the patient was discharged on postoperative day 8. Postoperative imaging revealed no residual enhancement adjacent to the ablation defect (Figure 2), but this remained a palliative procedure given tumor debris seeding of the peritoneal cavity and the primary objective of hemorrhage control. Enhancing omental lesions were noted on follow-up imaging.

Discussion

Undiagnosed HCC presenting with rupture has been reported with rates of 3.6 % and 2.87 % in Chinese and Italian cohorts, respectively[1,2], but may be decreasing as screening improves in regions with endemic viral hepatitis[7]. Current algorithms suggest temporization or definitive treatment of active hemorrhage from ruptured HCC via HAE in hemodynamically stable patients with laparotomy reserved for unstable patients[1-3]. Surgical interventions have historically been performed via laparotomy with concomitant increased morbidity and mortality risks for the physiologically compromised cirrhotic patient[1-3].

Previous large series describing the open operative management of ruptured HCC have sought to minimize

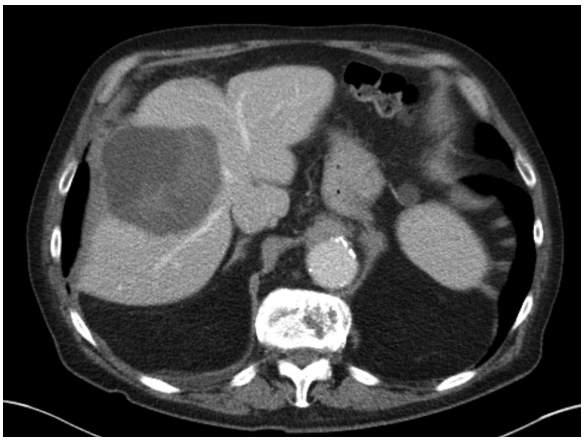

Figure 2: Representative image from the patient's 1-month postoperative computed tomography scan demonstrating the ablation defect without surrounding arterial-enhancing tissue that would suggest incomplete ablation. The ablation defect extends posteriorly to the surface of the hepatic veins.

morbidity and mortality when possible by transarterial therapy in cirrhotic patients[3]. Bassi et al[2] and Uchiyama et al[8] reserve operative intervention in ruptured HCC for well-compensated cirrhotic patients after nonoperative stabilization or those unstable despite nonoperative management, advocating that patients with preserved hepatic function benefit from an elective open hepatectomy with the intention of oncologic clearance of HCC despite the association of tumor rupture with intraperitoneal and distant intrahepatic recurrence; the outcomes cited are based on obtaining an R0 resection and having an adequate post-resection cirrhotic liver remnant. Series describing surgical management of ruptured HCC highlight the survival advantage of resection[8-10] while population studies including all patients presenting with tumor rupture, including those who did not receive surgery, find worsened survival compared with pre-rupture tumor stage[7], clearly identifying rupture as a negative prognostic factor in the evolution of HCC regardless of pre-rupture tumor staging.

For the arrest of hemorrhage following ruptured HCC, MWA requires shorter ablation times and expeditiously induces parenchymal coagulative necrosis[4,11]. Minimally invasive laparoscopic MWA allows for evacuation of hematoma, treatment of ongoing hemorrhage, and minimization of surgery-related morbidity and mortality in cirrhotic patients. In the elective treatment of HCC, minimally invasive operative MWA is effective, with reduced surgical morbidity and enhanced efficiency of tissue coagulation[4,11]. Changes in surgical paradigm to include minimally invasive MWA may mitigate the procedure-related morbidity of open hepatectomy in cirrhotic patients with limited hepatic reserve while also accomplishing hemostasis, suggesting that appropriately selected patients presenting with ruptured HCC may benefit from minimally invasive MWA as part of a multidisciplinary algorithmic approach to the management of bleeding liver tumors.

Conflict of Interest

Dr. Iannitti is a consultant for Medtronic, Inc. All remaining authors declare no relevant conflict of interests. No funding was received for this work.

References

1. Cheung TT, Poon RT, Chok KS, Chan AC, Tsang SH, Dai WC, et al. Management of spontaneously ruptured hepatocellular carcinomas in the radiofrequency ablation era. PLoS One. 2014; 9: e94453.
2. Bassi N, Caratozzolo E, Bonariol L, Ruffolo C, Bridda A, Padoan L, et al. Management of ruptured hepatocellular carcinoma: implications for therapy. World J Gastroenterol. 2010; 16: 1221-1225.
3. Liu CL, Fan ST, Lo CM, Tso WK, Poon RT, Lam CM, et al. Management of spontaneous rupture of hepatocellular carcinoma: single-center experience. J Clin Oncol. 2001; 19: 3725-3732.
4. Swan RZ, Sindram D, Martinie JB, Iannitti DA Operative microwave ablation for hepatocellular carcinoma: complications, recurrence, and long-term outcomes. J Gastrointest Surg. 2013; 17: 719-729.
5. Brace CL Microwave tissue ablation: biophysics, technology, and applications. Crit Rev Biomed Eng. 2010; 38: 65-78.
6. Lubner MG, Brace CL, Hinshaw JL, Lee FT Jr. Microwave tumor ablation: mechanism of action, clinical results, and devices. J Vasc Interv Radiol. 2010; 21: S192-S203.
7. Aoki T, Kokudo N, Matsuyama Y, Izumi N, Ichida T, Kudo M, et al. Prognostic impact of spontaneous tumor rupture in patients with hepatocellular carcinoma: an analysis of 1160 cases from a nationwide survey. Ann Surg. 2014; 259: 532-542.
8. Uchiyama H, Minagawa R, Itoh S, Kajiyama K, Harimoto N, Ikegami T, et al. Favorable Outcomes of Hepatectomy for Ruptured Hepatocellular Carcinoma: Retrospective Analysis of Primary R0-Hepatectomized Patients. Anticancer Res. 2016; 36: 379-385.
9. Cheng CH, Lee CF, Wu TH, Chan KM, Chou HS, Wu TJ, et al. Evaluation of the new AJCC staging system for resectable hepatocellular carcinoma. World J Surg Oncol. 2011; 9: 114.
10. Ou D, Yang H, Zeng Z, Luo Y, Yang L Comparison of the prognostic influence of emergency hepatectomy and staged hepatectomy in patients with ruptured hepatocellular carcinoma. Dig Liver Dis. 2016; 48: 934-939.
11. Groeschl RT, Pilgrim CH, Hanna EM, Simo KA, Swan RZ, Sindram D, et al. Microwave ablation for hepatic malignancies: a multiinstitutional analysis. Ann Surg. 2014; 259: 1195-1200.