Surgical Treatment of Hepatocellular Carcinoma with a Tumor Thrombus Extending into the Right Atrium

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Hepatocellular carcinoma (HCC) is characterized by the ability to grow into hepatic vascular structures, typically portal or hepatic veins. Hepatic vein tumor thrombus may grow into the inferior vena cava (IVC) and extend into the right atrium (RA). Such tumors are associated with very poor prognosis arrest, massive pulmonary embolism, or acute hepatic vein obstruction [1,2]. There is currently no consensus on the management of patients with HCC and RA tumor thrombus. Treatment options include systemic chemotherapy, transarterial chemoembolization (TACE), external-beam radiation therapy, or surgery. Surgery in this setting is complex and associated with significant morbidity and mortality. The long-term benefit is unknown. A few small case series and case reports describe feasibility and safety of surgery in patients with HCC and RA tumor thrombus, with acceptable short- and long-term survival that compares favorably with the non-surgical treatment options (3-5).

PATIENT DESCRIPTION

We describe the case of a patient with liver cirrhosis presenting with HCC and a tumor thrombus extending into the middle hepatic vein (MHV), IVC, and RA, with imminent hepatic veins obstruction. The patient underwent complete resection of the tumor and tumor thrombus under veno-venous bypass (VVB), total vascular isolation, and in situ hepatic cooling with cold preservation solution. The patient recovered well, and survived more than 1 year postoperatively.

CASE PRESENTATION

A 62 year old male was referred to our clinic due to an elevated alpha fetoprotein (AFP) level. The patient was known to have chronic hepatitis B, was treated with entecavir, and had a viral load of 153 copies on his last examination, which occurred 3 months prior to presentation. The patient was in good general condition and was asymptomatic. His physical examination was normal, and laboratory findings on presentation were as follows: platelets 140 × 10^3/μl, bilirubin 0.6 mg/dl, aspartate aminotransferase (AST) 30, alanine aminotransferase (ALT) 25, albumin 4.2 mg/dl, international normalized ratio 1, and creatinine 0.7 mg/dl. AFP level was 170.

Contrast-enhanced computed tomography (CT) showed a single tumor located in liver segments 4 and 8, extending into the MHV, IVC, and RA [Figure 1]. The chest CT did not demonstrate lung metastases, and a technetium bone scan did not demonstrate lytic bone lesions. A transesophageal echocardiogram demonstrated a redundant multilobular mass penetrating the RA from the IVC, but not involving the tricuspid valve. During his hospitalization for evaluation, the patient developed an asymptomatic sudden elevation of liver function tests (LFTs), with a bilirubin of 3.5 mg/dl, AST 350, and ALT 400. On the following days, his LFTs normalized, and were attributed to transient liver outflow obstruction by the redundant floating tumor thrombus.

After careful planning and discussions with the patient and his family, the surgery was performed. Surgery began with a midline laparotomy and exploration, and was followed by midline sternotomy. The patient was placed on a VVB through the right femoral, inferior mesenteric, and subclavian veins. After control and occlu-

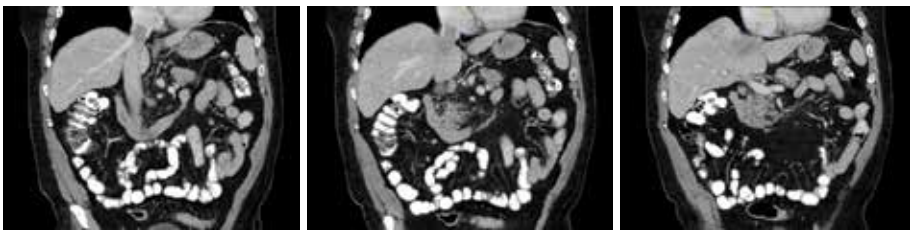

Figure 1. Computed tomography scan demonstrating central liver tumor penetrating the murine gammaherpesvirus, inferior vena cava, and right atrium

sion of infrahepatic IVC, hepatic inflow and subclavian vein, the RA was opened. Under direct vision the tumor thrombus was freed from the RA wall and pulled back into the IVC, followed by clamping of the IVC cephalad to the tumor to avoid dislodgement into the pulmonary circulation. This maneuver allowed the surgery to be completed on VVB and without the need for cardiopulmonary bypass.

Next, extra-Glissonian control of the right anterior portal pedicle was completed, the gastroduodenal artery was cannulated, the liver was perfused with a cold preservation solution, and fluid was drained through an incision in the IVC between the upper and lower clamps. The liver was packed with soft ice. Formal central hepatectomy of segments 4, 5, and 8 was performed under complete vascular isolation and cold perfusion. After completing the parenchymal dissection, the IVC was incised around the MHV and the tumor thrombus was extracted, en-block with the tumor. The IVC was closed using an autologous pericardial patch, followed by liver reperfusion, with a total cold ischemic time of 75 minutes. Total operation time was 540 minutes, with an estimated blood loss of 2000 cc, and administration of nine packed red blood cell units.

The patient had a reasonable postoperative course, was extubated on postoperative day 3, and discharged from the hospital on day 20 after surgery. The histological diagnosis was moderately differentiated HCC measuring 9 cm, with free surgical margins and gross hepatic vein invasion. Eight months after discharge, multifocal hepatic lung HCC recurrence was diagnosed and the patient died 5 months later.

COMMENT

HCC patients presenting with tumor venous thrombus have an extremely poor prognosis, with a median survival of several months. Extension of the venous thrombus into the IVC and RA is rarely encountered and is associated with a significant risk for sudden death resulting from massive pulmonary embolism, right sided heart failure, or acute occlusion of hepatic outflow [1,2]. Median survival of untreated patients with HCC and RA tumor thrombus ranges from 1 to 4 months from diagnosis. Our patient demonstrated his risk for imminent hepatic decompensation during his hospitalization, as evident by the acute rise in bilirubin and transaminase levels, probably secondary to transient hepatic outflow obstruction by the unstable tumor thrombus. We assumed that without effective treatment the patient would not survive long.

Treatment options available in this case included systemic treatment with sorafenib, trans-arterial chemoembolization, external beam radiation therapy, and surgery. There is very little data in the literature regarding the best management strategy for HCC with RA tumor thrombus, and most reports are small case series or single case reports. A review of the literature, performed by Inoue and colleagues [4] yielded 19 reports of hepatectomy performed for HCC with tumor thrombus extending into the RA, with a median postoperative survival of 11 months, ranging up to 56 months. Kurahashi and co-authors [5] reported a patient with HCC extending into the RA treated by TACE followed by surgery. This patient was disease free 6 years after surgery. These reports imply that surgical treatment, when feasible, is justified in patients with HCC and RA tumor thrombus, and offers a survival benefit compared to the alternative modalities.

From a technical point of view, resection of HCC extending into the RA is complex and requires careful surgical planning. It is crucial to avoid liver manipulation prior to control of the cardiac tumor thrombus because of the danger of thrombus dislodgement resulting in massive pulmonary embolism and sudden death. Control can be achieved as in this case by opening the RA, freeing the thrombus from the wall of the RA, lowering the liver and thrombus, clamping the IVC above the thrombus, and completing the hepatectomy with VVB. Alternatively, when this maneuver is not possible, surgery can be performed with the use of cardiopulmonary bypass. We planned for the hepatectomy to be done under total vascular exclusion, and our estimation was that the complex central hepatectomy and MHV resection with IVC reconstruction using a pericardial patch would require prolonged liver ischemia, that would not be tolerated by a cirrhotic liver. We therefore decided to perform the resection after perfusion of the liver with cold preservation solution and packing the liver with ice. This strategy allowed 75 minutes of cold ischemic time to be well tolerated without significant postoperative liver dysfunction.

CONCLUSIONS

Surgery for selected patients with HCC extending into the RA is complex but feasible and can offer these patients a survival benefit compared to alternative treatment modalities.

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"Most institutions demand unqualified faith; but the institution of science makes skepticism a virtue"

Robert King Merton, (1910–2003), American sociologist