CLINICAL STUDY

Analysis of Preoperative Portal Vein Embolization Outcomes in Patients with Hepatocellular Carcinoma: A Single-Center Experience

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ABSTRACT

Purpose: To analyze outcomes of patients with hepatocellular carcinoma (HCC) undergoing preoperative portal vein embolization (PVE).

Materials and Methods: A retrospective analysis of survival, recurrence, and complications was performed in 82 patients with HCC undergoing preoperative PVE and surgical treatment with curative intention from June 2006 to December 2014.

Results: Rate of major adverse events after PVE was 11% with no mortality. Twenty-eight (34.1%) patients showed radiologic progression of HCC after PVE; 72 patients (87.8%) eventually were accepted as surgical candidates. Median interval between PVE and surgery was 37 days, and 69 patients (84.1%) ultimately underwent surgical resection. At 1 and 3 years, disease-free survival rates were 81.3% and 53.1%, respectively, and overall patient survival rates were 77.5% and 63.1%. Compared with patients accepted as surgical candidates, patients who did not undergo surgery had a higher median number of HCC tumors (1 [range, 1–5] vs 2 [range, 1–4], $P = .031$). At 1 and 3 years, patients with disease progression after PVE but who still underwent surgical resection showed similar recurrence-free (90% vs 79.6% and 75% vs 48.6%) and overall (72.2% vs 78.4% and 57.8% vs 64%) survival rates as the rest of the patients who underwent resection.

Conclusions: PVE is a safe technique with good outcomes that potentially increases the number of patients with initially unresectable HCC who can be offered resection. Radiologic progression after PVE should not be seen as a contraindication to offer resection if it is still deemed possible.

ABBREVIATIONS

CI = confidence interval, FLR = future liver remnant, HCC = hepatocellular carcinoma, IQR = interquartile range, PVE = portal vein embolization, TLV = total liver volume, ^{90}Y = yttrium-90

Hepatic resection is the only accepted curative option for patients with large hepatocellular carcinoma (HCC), but it is often precluded in patients with advanced liver disease because of their high risk for postoperative hepatic insufficiency, morbidity, and mortality (1,2). There are many considerations regarding adequacy of resection candidacy, with future liver remnant (FLR) size being a major one. To overcome this issue, portal vein embolization (PVE) has been used increasingly in liver tumors to redirect the portal flow toward the nonexcluded side and induce growth of the FLR (3,4).

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Table 1. Demographic Parameters of Patients

Parameter	Value
Age, y, median (range)	61 (56.8–68)
Sex, male/female	68/14
Primary liver disease, n (%)	
HCV	18 (21.9%)
HBV	44 (53.7%)
ETOH/NASH	11 (13.4%)
Other/none	9 (11%)
MELD score, median (range)	6.5 (6–12)
Child-Pugh score, median (range)	5 (5–7)
UNOS staging, n (%)	
T2	20 (24.4%)
T3	58 (70.7%)
T4a	4 (4.9%)
BCLC, n (%)	
Early	22 (26.8)
Intermediate	60 (73.2%)
Number of tumors, median (range)	1 (1–5)
Size of largest nodule, cm, median (range)	6.4 (1.5–16)
Bilobar tumors, n (%)	14 (17.1%)
Type of embolization material, n (%)	
NBCA glue	52 (63.4%)
STS foam	25 (30.5%)
Other	5 (6.1%)
Procedures previous to PVE, n (%)*	
Transarterial chemoembolization	33 (40.2%)
RF ablation	1 (1.2%)
^{90}Y	1 (1.2%)
Procedures after PVE, n (%)*	
Transarterial chemoembolization	23 (28%)
RF ablation	7 (8.5%)
^{90}Y	5 (6.1%)

BCLC = Barcelona Clinic Liver Cancer; ETOH = ethanol; HBV = hepatitis B virus; HCV = hepatitis C virus; MELD = Model for End-Stage Liver Disease; NASH = nonalcoholic steatohepatitis; NBCA = *N*-butyl cyanoacrylate; PVE = portal vein embolization; RF = radiofrequency; STS = sodium tetradecyl sulfate; UNOS = United Network for Organ Sharing; ^{90}Y = yttrium-90.
*Some patients underwent > 1 type of procedure.

Current indications for preoperative PVE are any primary or metastatic liver cancer requiring a major liver resection but with an initially insufficient FLR (3). In some cases, the indication for PVE can require sequential procedures, such as transarterial chemoembolization or yttrium-90 (^{90}Y) infusion, which help to maximize the effect of PVE and minimize tumor progression because of the increased arterial flow after PVE (5–7). In patients with HCC, who commonly present with liver parenchymal injury because of underlying viral hepatitis or alcoholic liver fibrosis and/or cirrhosis, PVE is indicated only in patients with well-preserved hepatic function who should achieve a minimal FLR volume to safely undergo major hepatectomy (3,4,8). Clinical results show that PVE in patients with HCC can be performed safely and helps to improve survival after major hepatectomy (8,9). However, assessment of the clinical results and value of PVE in patients with HCC from published series remains difficult because these studies frequently are small and have heterogeneous selection criteria (8,10). For all these reasons, the present study analyzed the clinical characteristics and results of patients with HCC who have undergone preoperative PVE at a single center.

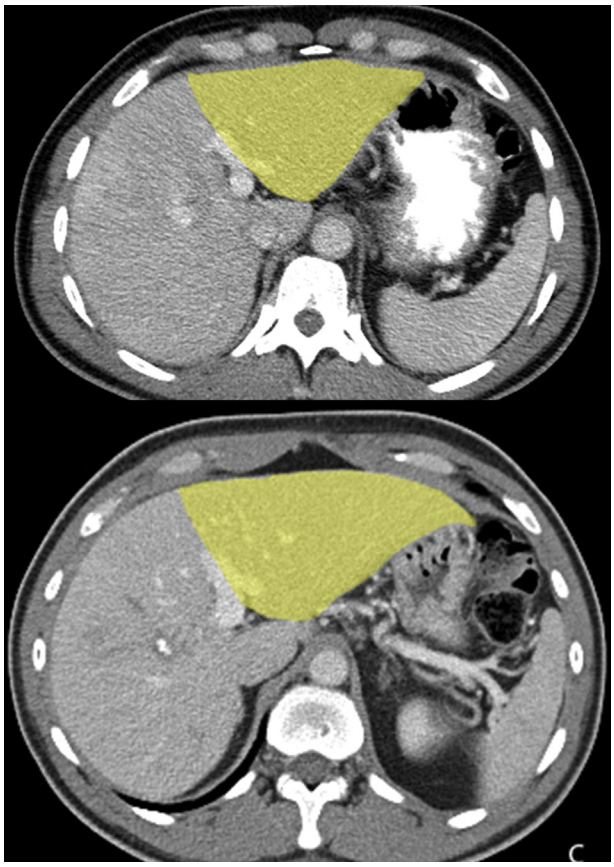

Figure 1. Comparison of predicted FLR before (upper image) and after (lower image) PVE.

MATERIALS AND METHODS

Study Cohort

This is a retrospective analysis of patients with radiologically diagnosed HCC who underwent preoperative PVE that would allow surgical treatment with curative intention (defined as aiming for an R0 resection) at a single center from June 2006 to December 2014. All data from PVE, surgical resection, preoperative status, pathology, and follow-up were obtained from patients' charts after approval from the Institutional Review Board.

Baseline Characteristics

During the study period, 82 patients underwent PVE. Most patients were men with a mean age of 60 years and with hepatitis B infection as the main cause for underlying liver disease. All patient had a performance status of 0 or 1. Of patients, 40% underwent a procedure before PVE, with