



The PVE & ALPPS Procedure for Hepatocellular Carcinoma

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Background

Hepatocellular carcinoma (HCC) develops in patients with damaged liver function and, therefore, extent of liver resection should be decided carefully. The extent of liver resection is decided on the basis of tumor condition and liver function. Even if resection of giant HCC requires right hepatectomy (RH), the procedure is safely indicated to patients with indocyanine green retention rate at 15 minutes (ICGR15) smaller than 10%. In order to indicate RH for patients with impaired liver function ($10\% \leq \text{ICGR15} < 20\%$), portal vein embolization (PVE) is clinically employed to increase safety. In this presentation, I will show you clinical results of PVE for patients with HCC. Furthermore, I will review literatures on Associating Liver Partition with Portal Vein Ligation for Staged Hepatectomy (ALPPS) procedure for HCC.

Patients and Methods

Between April 2000 and August 2014, 1478 patients underwent hepatic resection for hepatic tumors and biliary diseases. 152 (10.3%) of the 1478 patients underwent PVE. In 24 patients, RH was not performed due to advanced disease or poor liver function, in one, hepatectomy procedure was changed from RH to partial resection and, in one, PVE was performed twice. Finally, 126 patients underwent RH after PVE. The 126 patients were classified into HCC group ($n = 41$), Jaundice group ($n = 62$) and Meta group ($n = 23$). Pathologically, grade of fibrosis was classified into F0, F1, F2, F3 and F4. By volumetric study, increased volume (V1) of future liver remnant (FLR) (= volume of the left liver after PVE-volume of the left liver before PVE), increased rate of FLR (R1) (= $V1 \times 100/\text{volume of the left liver before PVE}$), increase of % FFLR (R2) (= $\% \text{ FFLR after PVE} - \% \text{ FFLR before PVE}$) and increased rate of % FFLR (R3) (= $\% \text{ FFLR after PVE} / \% \text{ FFLR before PVE}$) were estimated ($\% \text{ FFLR} = (\text{left liver volume} \times 100) / (\text{total functional liver volume})$).

Indication criteria of PVE

Liver function was evaluated by determining ICGR15, and ICGR15 of $< 10\%$ was considered normal. When liver



function is normal and the ratio of resected liver volume to whole liver volume (RR) is bigger than 60% or when there is mild liver dysfunction ($10\% \leq \text{ICGR15} < 20\%$) and RR is 40 - 60%, PVE is indicated.

Surgical techniques

In HCC group, PVE was preceded by TAE (Interval: 6-19 days). The trans-ileocolic vein approach was employed in all cases except for one case in whom the trans-hepatic approach was employed due to previous abdominal surgery. In the first 78 patients, the embolization material consisted of a mixture of 0.5 to 1.0 g of absorbable gelatin sponge powder, 500 to 2500 units thrombin, 10 to 20 ml diatrizoate sodium meglumine, 1.5 to 2 mL of suspended ionized oil and 40 mg gentamicin, and in the remaining 74 patients, portal branches were embolized with pure ethanol in combination with contrast material under fluoroscope. The combination rate of contrast material and ethanol is 2 to 8. In both approaches, later coil was placed for plugging the branch completely. The portal pressure was measured before and after embolization.

Results

There were 23 patients with F0, 63 with F1, 21 with F2, 15 with F3 and 3 with F4. There were no significant differences in V1, R1, R2 and R3 among the 5 groups. The medians of %FFLR before PVE were 34.8% (26.3 - 62.0), 34.1 (18.9 - 77.7), 32.6 (18.2 - 51.2), 42.2 (29.1 - 83.5) and 36.5 (22.0 - 38.5), respectively ($p = 0.0280$). There were also significant differences in ICGR15 after PVE ($p = 0.0163$), portal venous pressure before ($p = 0.0004$) and after PVE ($p = 0.0002$) and FLR after PVE ($p = 0.0452$) among the 5 groups. Furthermore, in all patients, the volume of FLR ($r = -0.3722$, $p < 0.0001$) and % FFLR ($r = -0.3842$, $p < 0.0001$) before PVE significantly correlated with R3. V1, R1, R2 and R3 of HCC group were 106.5 ml (-11.2 - 714.0), 26.2% (-1.8 - 138.9), 11.4% (-2.6 - 5.4), and 29.8% (-3.1 - 85.8), respectively. There were no significant differences in V1, R1, R2, and R3 among HCC, Jaundice and Meta groups.

ALPPS procedure for HCC

Most patients with HCC have impaired liver function and, therefore, may not tolerate extended liver resection or right trisectionectomy. Although more than 150 cases with ALPPS have been reported, only 9 cases had HCC. The indication, utility and limits will be discussed.

Conclusion

Our results suggest that the smaller the volume of the left liver before PVE is, the more the left liver will increase its volume, irrespective of grade of liver fibrosis. Even in HCC patients, liver regeneration is expected in the same manner of patients with other diseases. However, in HCC patients, PVE should be preceded by TAE.