Radio-frequency-assisted Liver Partition With Portal Vein Ligation (RALPP) for Liver Regeneration

To the Editor:

Since the original article on Associating Liver Partition and Portal vein ligation for Staged hepatectomy (ALPPS) published in *Annals of Surgery* in March 2012 by Schnitzbauer et al, we have been reading with great interest the discussion surrounding this approach.1,2

Our group, in 2012, was the first to report on the feasibility of ALPPS in right trisectionectomy: a safe procedure to avoid postoperative liver failure.3,4 Schnitzbauer et al5 proposed and slung with a nonabsorbable suture duct behind the right hepatic artery. When-carefully separated from the common hepatic of the right portal vein. The portal vein was hilar dissection for identification and ligation between the left and right lobes of the liver was clearly visible. Then, radio-frequency ablation with either Cool-tip radio-frequency ablation probe (Covidien, Hampshire, UK) for open case (n = 1) or Habib Sealer (LH4X, Rita) for laparoscopic case (n = 4) was performed for completion of RALPP along the line of the demarcation to segment VIII of the liver above the right hepatic vein superiorly and to segment V above the hilus on the left side of the gallbladder. A 5-port (2 × 10-mm working ports on each side of abdomen) technique was used for laparoscopic operation. All patients had a restaging computed tomographic scan with contrast to assess the liver volume before right hepatectomy.

We also examined a historical cohort of 5 patients who underwent PVE, matched for age, sex, initial liver function, and pathology, and compared the percentage increase in the FLR volume, 90-day morbidity and mortality, time to second operation, and liver function after completion hepatectomy on postoperative days 1 to 5. Liver volumes were calculated using ImageJ (Image Processing and Analysis in Java, National Institutes of Health) as previously described.6 The FLR was measured as the left lobe of the liver to the left of the Cantlie line.

All patients had a right hepatectomy for colorectal liver metastases after either RALPP (n = 5) or PVE (n = 5). RALPP was performed laparoscopically as planned in 4 patients, as a part of stage I resection for bilobar disease with tumorectomy from segment II (n = 1), segment III (n = 2), and segment IV (n = 1). The median length of operation for these 4 cases was 140 minutes (range, 105–180 minutes). One patient had an open operation for RALPP, as it was felt intraoperatively that her tumor had progressed while waiting for operation and she would require a right hepatectomy to achieve R0 resection for her tumor, but her FLR was inadequate. One patient who had RALPP and a wedge resection of segment II metastases laparoscopically was readmitted a week after discharge with recurrent chest pain. She was known to have multiple pulmonary emboli after her colectomy and had had an inferior vena cava filter inserted. Although it was unclear whether she had a new or old pulmonary embolus, she was treated with intravenous heparin. There was no other morbidity in RALPP group. In the PVE group, one patient developed a large pleural effusion posthepatectomy requiring drainage. No patients developed a postoperative bile leak in either group. There was no mortality at 90 days.

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References:


5. Yokoyama Y, Nishio H, Ebata T, et al. Value of indocyanine green clearance of the future liver rem-


10. Sugimoto H, Okochi O, Hirota M, et al. Early de-


RALP could significantly increase the FLR by a median of 62.3% (range, 53.1%–95.4%) in a much shorter length of time (mean = 21.8 ± 9.4 days) than by PVE, which increased the FLR by a median of 24.6% (range, 8.4%–35.4%) after 55.4 days, reflecting a significant gain of FLR by 38.0% (P = 0.0079) with a significant reduction of 34 days to achieve this (P = 0.003) (Figs. 1, 2). There was no difference in liver function between the 2 groups on days 1 to 5 post-hepatectomy.

ALPPS is superior to PVE in terms of FLR but is associated with a greater morbidity and mortality, particularly from bile leaks and hemorrhage after the initial procedure. In the current RALPP study, a high hypertrophy rate of 62.3%, similar to ALPPS, was achieved with no mortality and a morbidity rate of 20.0%. No bile leaks were seen in patients on liver resection after RALPP. The hypertrophy rate is far greater than that reported in PVE studies and, indeed, in this case-controlled study, where the FLR was analyzed with the same method of volume calculation. The physiological mechanism for this greater increase in FLR is not known but may be in response to surgical trauma and a complete transection of the parenchyma, thereby stopping any cross-portal circulation. Both these mechanisms may create a regeneration stimulus. The rapid regeneration response of a mean of 21.8 days in our study and 9 days in the original ALPPS article has certain benefits. Importantly, there is less time for additional micro- and macro-metastatic diseases to develop. Indeed, in 12.0% of patients, hepatic resection after PVE is not possible due to tumor progression, thought to be due to a more rapid growth of tumor than liver parenchyma after PVE. Whether this is significantly improved with ALPPS must be determined in an awaited clinical trial. The major drawback to ALPPS is the high morbidity rate, in particular from bile leaks, and an increased mortality rate. We believe that RALPP is a better alternative than ALPPS because it limits the invasiveness of the first stage of the procedure while capitalizing on the liver hypertrophy without high morbidity and mortality rates associated with ALPPS. It can easily be performed laparoscopically and can be performed at the same time as a stage 1 liver resection for patients with bilobar disease.

Although only 5 patients were reported here who had undergone RALPP, it has been demonstrated that it is a feasible and safe alternative to ALPPS to achieve a rapid liver regeneration in the contralateral lobe of the liver without the increased morbidity and mortality associated with ALPPS. We are setting up a randomized controlled trial to further evaluate the technique compared with PVE and ALPPS.

FIGURE 1. The percentage increase in the size of the FLR after both RALPP and PVE (median, error bars depict the range). **P = 0.0079, calculated using the Mann-Whitney U test.

FIGURE 2. The number of days between either RALPP or PVE and completion hepatectomy (median, error bars depict the standard deviation. **P = 0.003, calculated using the Student t test (2-tailed).

REFERENCES

Reply: W e present 3 letters to the editor in response to an original contribution by Schnitzbauer et al. This inaugural article introduced a novel method to induce liver...