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Modulated partial associating liver partition and portal vein ligation for staged hepatectomy for colorectal liver disease: a case report

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Abstract: Postoperative liver failure remains one of the most common causes of mortality after liver surgery. Many techniques have been developed to induce parenchymal increase to reduce the incidence of postoperative liver failure. In our video [online] we showed our technique, which we called "modulated partial associating liver partition and portal vein ligation for staged hepatectomy (ALPPS)," which aimed to minimize the surgical stress between the two phases of a two-stage hepatectomy. Our patient was a 49-year-old man affected by colorectal liver metastases who underwent a two-stage right hepatectomy through the modulated partial ALPPS technique. Postoperative CT scans revealed an increase in future liver remnants, that resulted sufficient for the patient to sustain liver resection. Although further studies would be necessary and true randomization is hard to obtain, in relation to the complexity of these cases, we propose a feasible technique that reduces the surgical stress between the two phases of a two-stage hepatectomy, improving the prognosis for patients affected by colorectal liver metastases.

Since hepatic surgery for colorectal liver metastases started, the main problems faced by every surgeon have always been the balance between R0 resection and the avoidance of postoperative liver failure, which remains the most common cause of mortality after extended hepatectomy.[1]

The amount of predicted functioning hepatic parenchyma after liver resection is defined as the future liver remnant (FLR). In the literature, it has been reported that at least 30% of FLR is required for noncirrhotic patients and 40% for cirrhotic patients.[2]

Adequate preoperative imaging[3] and other tools, such as the indocyanine green (ICG) clearance test,[4] are often employed to predict the postoperative outcome of a patient who undergoes a major hepatectomy.

In the last few decades, many techniques, such as portal vein ligation or portal vein embolization (PVE), aimed to induce a parenchymal increase in patients who were not suitable for hepatic resection because they had a very low FLR.[5,6]

Schnitzbauer et al.[7] described in 2012 an innovative technique based on a strong hypertrophic trigger given to the hepatic parenchyma originated from the vascular and parenchymal exclusion performed in a first surgery which allowed to a completion of the hepatectomy in a second surgery.

They reported a 74% increase in FLR volume over a mean period of 9 days between the two surgeries.

In 2016, de Santibañes et al.[8] proposed a less aggressive approach, combining an initial liver transection with a PVE. A 62.6% future liver remnant volume (FLRV) rate has been reported to have lower morbidity and mortality rates.

Therefore, we focused on reducing parenchymal stress between the two stages without removing the hypertrophic trigger. Thus, we proposed a "modulated" partial associating liver partition and portal vein ligation for staged hepatectomy (mpALPPS), in which we performed liver transection as well but without complete exclusion of the right portal system. In fact, we preserved the posterior portal sector to reduce ischemic shock between the two phases.

Our patient was a 49-year-old man with good general condition who underwent a colonoscopy due to hematochezia, which showed a stenosing neoplasm 10 cm from the anal verge and was positive for adenocarcinoma. Chest and abdominal computed tomography (CT) confirmed a rectal lesion and revealed multiple bilobar liver lesions.

Tumor markers were: Ca 19.9 16 U/ml, carcinoembryonic antigen (CEA) 15.4 ng/ml, alpha-fetoprotein (AFP) 3 ng/ml; Kirsten rat sarcoma virus (KRAS) was mutated.

After multidisciplinary discussion, the patient underwent systemic chemotherapy (CHT) with FOLFOXIRI plus bevacizumab. The patient received 10 cycles of this regimen.

However, 6 months later, a restaging CT showed a good response to CHT, and a new multidisciplinary evaluation was performed. The FLR before CHT was estimated as 20%, but unfortunately, the computation was not accurate enough because the patient underwent a CT scan in another center. The post-CHT FLR was calculated as 22%.

The patient was scheduled for a liver-first approach with a two-stage hepatectomy. We proposed a "modulated" partial ALPPS.

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Video content is available through direct URL citations in the HTML and PDF versions of this article (journals.lww.com/jisa).

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We decided not to perform a portal vein ligation or embolization essentially because of three reasons: first of all, considering the predicted volumes, we needed the strongest regenerative trigger possible; then, the left lobe had to sustain multiple resections in addition to thermal ablation, unlike the classical portal vein ligation or PVE cases; finally, the liver underwent several months of CHT, so we aimed for the largest volume possible, for we risked encountering a setting of "chemo liver."

The first stage consisted of liver mobilization with intraoperative ultrasound (US), which confirmed hepatic lesions. Thermal ablation of a lesion in S2-S3 that appeared hard to remove surgically was performed, followed by four left liver resections: three were R0 resections, whereas in S4 we needed to perform a "vascular" R1 resection, balancing both the oncological and hemorrhagic risk. Finally, right bile duct isolation and right anterior portal branch ligation were performed with partial transection of the liver parenchyma.

Postoperative CT images showed both the transection line and the preserved posterior portal branches directed to the posterior sector (P6-7).

However, 7 days later, the patient was scheduled for the second surgery.

In the second stage, we performed right anterior hilar plate transection through the hanging maneuver,[9] and then performed right posterior hilar plate transection with ligation of the right hepatic vein, eventually resulting in a right hepatectomy. For parenchymal transection, we used monopolar spray electrocoagulation through the "plow technique" that we previously described.[10]

The postoperative course between the two surgical procedures was uneventful. We observed no impairment in liver function (no increase in bilirubin level, coagulation abnormalities, or ascites). A postoperative CT scan showed an increase in the FLRV (32% vs. 22%). On postoperative day (POD) 90 from the second stage, the patient underwent laparoscopic anterior resection for primary tumor removal. At that time, a further CT scan showed a FLRV of 42%. Fortunately, adhesions were localized in the sovramesocolic area, so that we could afford the rectal surgery without particular critical issues.

In conclusion, ALPPS, pALPPS, and our mpALPPS represent extremely complicated surgical procedures, which, even when performed by experts, are not exempt from a high rate of morbidity and mortality. Several parameters must be considered: clinical background, perioperative setting (e.g., anesthesiologic support, well-prepared intensive care unit (ICU), dedicated nurses, etc.), and surgical skills.

We strongly believe that a reduction in surgical stress between phases 1 and 2 through our mpALPPS, despite a lower increase in liver parenchyma, improves clinical and surgical outcomes, as the patient would be in a better condition to undergo the second stage, than if they had undergone a more extended partition.

Unfortunately, the lack of selection criteria prevents randomized trials from being designed, so the available evidence in the literature remains poor, often limited to case reports or case series.

Centralization of these complex cases in highly experienced centers could support the development of a standardized approach, resulting in a better level of evidence and perhaps improving the survival of patients affected by multiple colorectal liver metastases.

Conflicts of interest

The authors declare that they have no conflicts of interest with regard to the content of this report.

Disclosure

Informed consent was regularly obtained from the patient.

References

1. Rahbari NN, Garden OJ, Padbury R, et al. Posthepatectomy liver failure: a definition and grading by the International Study Group of Liver Surgery (ISGLS). Surgery 2011;149:713–724.
2. Clavien P-A, Petrowsky H, DeOliveira ML, et al. Strategies for safer liver surgery and partial liver transplantation. N Engl J Med 2007;356:1545–1559.
3. Sun H, Tianqiang S. Hepatocellular carcinoma: advances in diagnostic imaging. Drug Discov Ther 2015;9:310–318.
4. Lau L, Christopher C, Vijayaragavan M. Intraoperative functional liver remnant assessment with indocyanine green clearance: another toehold for climbing the 'ALPPS'. Ann Surg 2015;261:e43–e45.
5. Aussilhou B, Lesurtel M, Sauvanet A, et al. Right portal vein ligation is as efficient as portal vein embolization to induce hypertrophy of the left liver remnant. J Gastrointest Surg 2008;12:297–303.
6. Makuuchi M, Thai BL, Takayasu K, et al. Preoperative portal embolization to increase safety of major hepatectomy for hilar bile duct carcinoma: a preliminary report. Surgery 1990;107:521–527.
7. Schnitzbauer AA, Lang SA, Goessmann H, et al. Right portal vein ligation combined with in situ splitting induces rapid left lateral liver lobe hypertrophy enabling 2-staged extended right hepatic resection in small-for-size settings. Ann Surg 2012;255:405–414.
8. de Santibañes E, Alvarez FA, Ardiles V, et al. Inverting the ALPPS paradigm by minimizing first stage impact: the Mini-ALPPS technique. Langenbeck's Arch Surg 2016;401:557–563.
9. Belghiti J, Guevara OA, Noun R, et al. Liver hanging maneuver: a safe approach to right hepatectomy without liver mobilization. J Am Coll Surg 2001;193:109–111.
10. Cotsoglou C, Bruno F, Lomaglio L, et al. The plow technique: an alternative method for the transection of liver parenchyma: anatomical/embryological principles and electromedical rationale. Il Giornale di Chirurgia-J Italian Surgical Association 2022;42:e09.