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CASE REPORT

Systematic extended posterior right sectionectomy with simultaneous resection of the dorsal part of segment 1 and middle hepatic vein detachment

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Abstract

Parenchymal sparing surgery should be the strategy of choice for patients with bilobar liver metastases and lesions within the central liver sites.

KEYWORDS

extended posterior right sectionectomy, parenchyma sparing surgery, vascular detachment

1 | INTRODUCTION

Parenchymal sparing surgical (PSS) strategy allowed to plan a one-stage systemic extended posterior right sectionectomy with resection of the dorsal subsegment S1 in a patient with 11 bilobar CRC metastases. PSS liver surgery has the greatest implementation potential in modern medicine.

The history of colorectal cancer (CRC) therapy is an example of the impact of technological progress on the strategic paradigm. Despite the rapid development of anticancer therapy over the past decade, surgical removal of the primary tumor and all sites affected by metastatic disease remains a priority for such patients' survival.

However, more than 60% of CRC patients with liver resection due to the metastatic lesions have a risk of

recurrent metastatic organ damage. Thus, further treatment with 2nd line chemotherapy (CTx) and repeated liver resection is required. In our opinion, considering the duration and frequency of CTx and the optimal resection time, all the attempts of developing an optimal algorithm have become ineffective due to the misinterpretation of the biology of CRC growth. CRC cells dissemination from the primary tumor occurs at a much earlier stages of the disease (through genetically less mature malignant cells), and metastatic growth occurs simultaneously with the progression of the primary tumor, due to the more malignant phenotype.[1] Disseminated CRC adenocarcinoma cells, in which the process of proliferation gradually continues at all stages of primary tumor treatment, lead to a predicted early clinical manifestation of distant metastases.[2] Currently, the main argument against performing a wide resection margin and anatomically oriented liver surgery is the dormancy of CRC micrometastases.[3]

There is currently no consensus on surgical principles in CRC cases with bilobar metastatic lesions. Surgical strategy of anatomically oriented operations, which is mostly implemented due to large liver resections (two-stage strategies with artificial stimulation of parenchyma), basically limit further re-resections due to the lack of liver the parenchyma.[4] With the paradigm shift of understanding of the biology of metastasis, some surgeons began to defend the surgical tactic of preserving the liver parenchyma, which is still being studied.[5] Initially, the "cherry picking" principle of the liver parenchyma sparing was adopted only for multiple peripheral (S2, S3) and subcapsular metastatic lesions.[6] Separate clinical studies have proven the oncological effectiveness of this surgical strategy, which involves the detachment of the main hepatic veins and Gleasonean structures (1–2 order) from metastatic lesions and which provides the R1vascular resection margin.[7] Moreover, it is believed that PSS adaptation in CRC patients has the potential to "personalize" the surgery. The oncological and surgical results of PSS strategy within the deep sites of the right lobe (right "venous core," portal and caval confluence, dorsal part of the S1) remain unclear.

The purpose of our paper is to demonstrate our experience of PSS strategy in patients with bilobar metastatic liver lesions.

2 | MATERIAL AND METHODS

A clinical case of a patient S. with metachronous bilobar metastatic liver disease (11 metastatic lesions) is presented. The primary tumor was located in the upper rectum. The primary tumor was located in the upper

TABLE 1 Segmental volumetry and metastatic lesions mapping

Functional volume, cm^3	Functional volume, %	Metastatic lesions characteristics
S1 (IX)–51,2	3.3	Metastatic mass that replaces most of the parenchyma of the dorsal part (S1) and extends to S8 parenchyma
S2–177	11.7	1 peripheral metastasis
S3–71,1	4.7	1 peripheral metastasis
S4–288,4	19.1	No metastatic lesions detected
Left lobe (S1c,S2,S3,S4)–561	36.8	
S5–195	12.8	Metastatic lesion with invasion to the dorsal portion of S5
S6–188	12.4	2 lesions that replace the parenchyma of the S6 up to 80%
S7–196,9	12,9	No metastatic lesions detected
S8–355	23.3	Metastatic lesions that invade the right hepatic vein and spreads to the parenchyma of S8d, S7, and S1d. And 2 metastatic lesions in the S8d parenchyma
S8v–175	4.9	No lesions detected
Total functional liver volume - 1522.6	100.0	

Abbreviation: GP, Glissonean pedicle.

rectum. Previous treatment included total mesorectal excision which was performed 11 months prior to the detection of metastatic disease. Further, real-time PCR confirmed wild-type K-ras gene mutation. Given the bilobar spread and multiple lesions, three cycles of CTx (FOLFOX-6) with subsequent surgical treatment have been administered. According to the computer tomography report, after receiving three courses of CTx, the partial regression of target lesions has been observed and 11 metastatic lesions remained (Table 1). Three weeks after—the serologic concentration of the carcinoembryonic antigen was 3.9 ng/ml.

The total functional liver volume, future remnant liver volume (S1, S2, S3, S4), and body weight were 1522.6 cm^3, 561 cm^3, and 84 kg, respectively. Patient S. could potentially have risk of acute liver failure in the early postoperative period. The remnant liver volume to body weight ratio was 0.46% which required a two-stage hepatectomy. In that case, there could be risk of 30% "drop-out" due to the tumor progression after the first surgical stage[8,9] (Figure 1). While the PSS strategy allowed us to plan a one-stage systemic extended posterior right sectionectomy with the resection of the dorsal portion of S1. This is an alternative surgical strategy in the PSS framework, which involves the implementation of the "Systemic extended right posterior sectionectomy" which has already been published.[10] The procedure is based on the mobilization of the inferior vena cava (IVC) with "Piggy-back" maneuver at the level of the dorsal (paracaval) part of S1d (IX segment by C. COUINAUD) and its subsequent resection.[11]

The IX segment is an anatomical zone which is filled with parenchyma, having an independent inflow into the system of the right portal vein (Figure 2). Therefore, it is limited by the posterior surface of RHV, anteriorly by the MHV, medially by the subhepatic segment of IVC, and in the oblique plane from PRV level to the terminal divisions of main hepatic veins.[12]

3 | SURGICAL STAGE

A J-shaped mini-laparotomy to the right with the transection of the right rectus abdominis muscles was done. The revision and the right liver lobe mobilization were performed with short veins ligation to the IVC. The next steps involved marking the anatomical margins of the posterior section, and the projection of the RHV, MHV, and GP to the anterior section was identified using intraoperative ultrasonic navigation (Figure 3).

Liver parenchyma transection has been performed under the Pringle maneuver. The liver parenchyma transection was started at the edge of the anterior and posterior sections and followed by the RHV visualization to its middle segment and the GP6 in the direction of the main portal fissure. Using the GP6 as a landmark, the transection was completed at the level of the right portal vein confluence. Furthermore, the parenchyma dissection with S8d removal paved way for the middle hepatic vein (MHV) visualization. This was followed by the detachment on the ½ circle of the MHV. The parenchyma transection has been completed at the level of the main portal fissure with a simultaneous S1d resection due to the metastatic lesion localizaion (Figure 4). RPPV

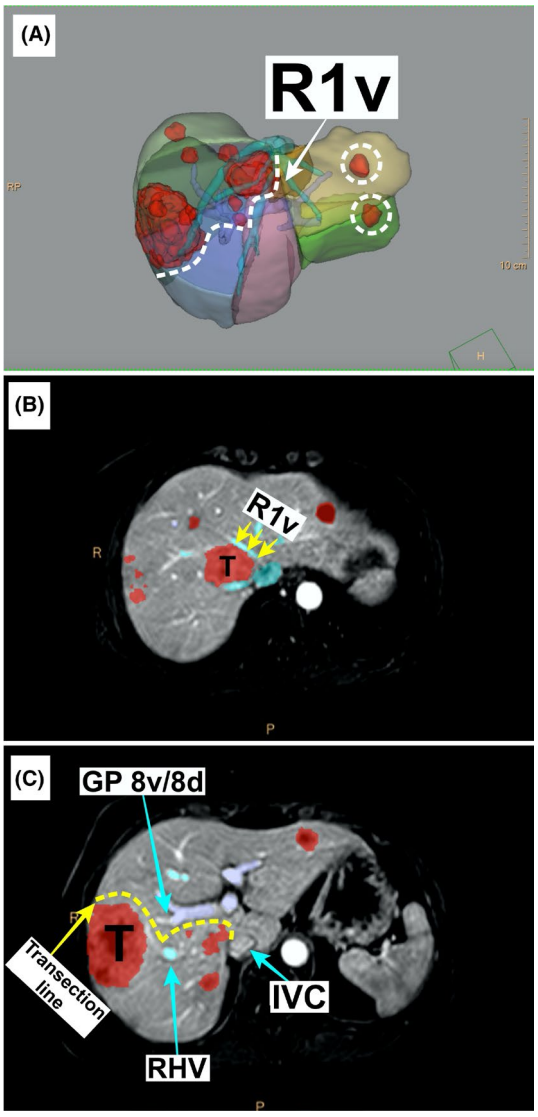

FIGURE 1 Liver CT mapping of patient S.'s metastatic lesions. A – 3D segmentation and volumetry with metastatic lesions mapping, parenchymal transection lines. B and C—CT data in the axial plane. R1v is the zone of vascular contact of one of the metastatic lesion in S8/S1. T—metastatic lesions. GP8v/8d—Glissonean pedicles for ventral and dorsal portions of S8, respectively. IVC, inferior vena cava. RHV, right hepatic vein

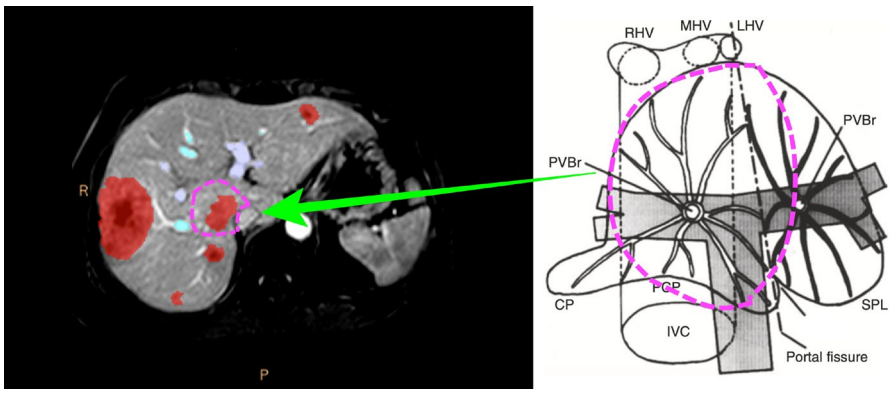

FIGURE 2 Computer tomography data of CRC metastatic lesion spread of patient S. on the dorsal part of S1d and schematic representation of the anatomy of S1 (dorsal and caudal parts of the segment)[7]

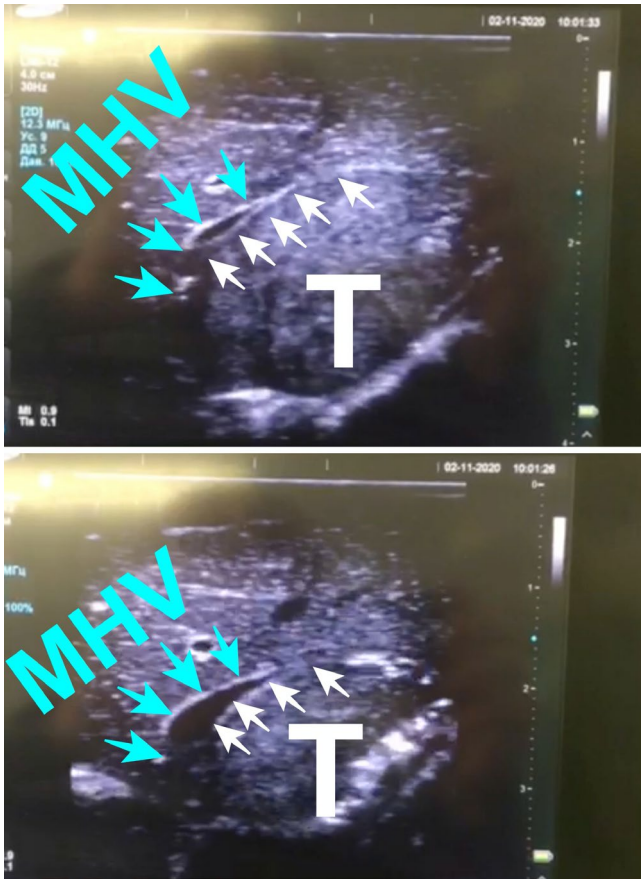

FIGURE 3 Picture and ultrasound data of patient S. MHV, middle hepatic vein without signs of invasion, contacting at a distance of 3 cm on the ≤½ semicircle to the metastatic lesion (blue arrows); T, metastatic lesion with vascular contact (white arrows)

and RHV were ligated and sutured at the level of their origins, using vascular clamps. Upon the completion of hemostasis, the characteristics of parenchymal blood flow were monitored (the porto-fugal character of blood flow in parenchyma S5 and S8v had been excluded). The total duration of normo-ischemia for patient S. was 65 min, blood loss was 275 ml. The 90-day postoperative period was uneventful.

4 | DISCUSSION

Today's understanding of the metastasis biology and its progression in CRC patients has become a trigger for commencing the search for independent prognostic factors and the development of personalized surgical treatment. The main unresolved issues of modern liver surgery include the study of the effectiveness of PSS adaptation for CRC metastatic lesions localized in the central liver sites and the assessment of the vascular detachment strategy.

Recently, published data prove that 10%–30% of the major liver resections are accompanied by the challenge of performing R1 resection.[13] Moreover, the intraoperative ultrasound adaptation and the MRI diagnostics improvement allowed us to determine with a high degree of accuracy the presence of true tumor invasion into the intraparenchymal vessels walls. This information allows us to perform the PSS rather than classical approach by combining ultrasound navigation, orientation in vascular structures of 1–4 order, 3D anatomy, and the use of vascular detachment. In our opinion, the above-mentioned approach may serve as an alternative in cases of centrally localized metastatic lesions. The method of liver vessels detachment in case its contact with metastatic lesions has not yet been included in international consensus. However, according to a number of promising studies published in 2020, R1v in combination with modern CTx can achieve the oncological effect equivalent to R0.[14]

Such a tactic makes it impossible to perform re-resection of the subsequent waves of micrometastases progression in the parenchyma. That is why we consider that PSS should be the strategy of choice for patients with bilobar liver metastases and lesions within the central sites.

5 | CONCLUSIONS

Adaptation of PSS liver surgery in metastatic colorectal cancer has the greatest potential for further development and implementation.

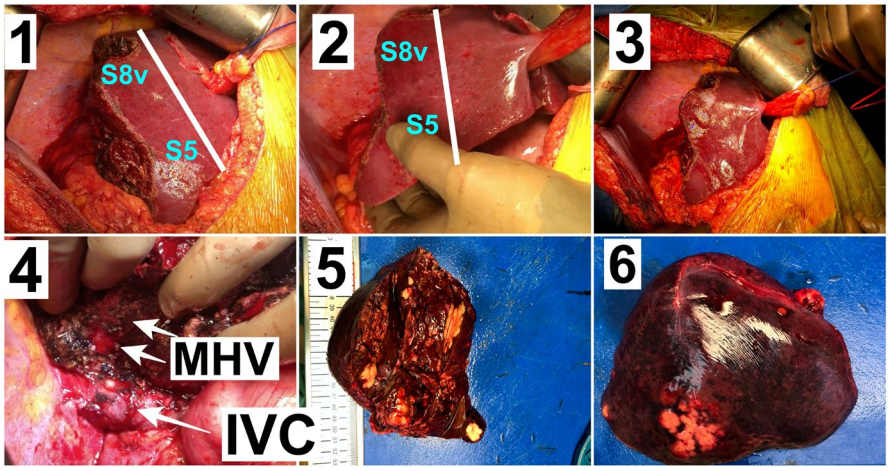

FIGURE 4 Intraoperative pictures of patient 1,2,3,4—view after parenchymal transection and removal of the specimen (S5 and S8v preserved). 5,6—gross specimen (S6, S7, S8d, and S1d) with 9 metastatic lesions. In picture 4, the arrows of the IVC after the completion of "Piggy back" and the detached MHV are indicated

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CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

AUTHOR CONTRIBUTIONS

Anton Burlaka collected the data, performed the analysis, and wrote the paper. A. Gogo-Abite involved in paper translation. A.V. Paliichuk involved in CT and MRI reconstructions, and volumetry. D.E. Makhmudov, V.V. Zvirych, and A.V. Lukashenko designed and directed the project.

CONSENT

All the participants signed informed consent and voluntarily joined the study before treatment.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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