Systematic extended posterior right-sided sectionectomy with resection of subsegment IX

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Abstract

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

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Key words: parenchyma sparing surgery, extended posterior right sectionectomy, segment IX.

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

Key clinical message: parenchymal sparing surgery should be the strategy of choice for patients with bilobar liver metastases and lesions withing the central sites.

Introduction. 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, [?] 50% of CRC patients with a history of liver resection due to the metastatic lesions, have a risk of recurrent metastatic organ damage, which further requires 2^{nd}line chemotherapy (CTx) and repeated resection treatment. In our opinion, taking into account the duration and frequency of CTx and the resection optimal time, all the attempts to develop an effective algorithm have now become deadend due to misinterpretation of the CRC growth biology and metastasis, prompting clinicians to return to fundamental issues. CRC cells dissemination from the primary tumor occurs at much earlier stages of the disease (through genetically less mature malignant cells), and metastatic growth occurs in parallel 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 the stages of complex/surgical treatment of primary colon neoplasm, lead to a predicted early clinical manifestation of distant metastases [2]. It is argued that the micrometastases diffusion and the dormancy of CRC cells is currently the main argument against performing a wide resection margin ([?] 1 cm) and anatomically oriented liver surgery for such patients [3]. Such a tactic makes it impossible to perform re-resection of the subsequent waves of micrometastases progression in the parenchyma. That is why parenchymal sparing surgery (PSS) should be the strategy of choice for patients with bilobar liver metastases and lesions withing the central sites [4].

The purpose of our work is to demonstrate our own experience of PSS strategy adaptation in patients with bilobar metastatic liver injury.

Material and methods. A clinical case of a patient S. with metachronous bilobar metastatic liver disease (11 metastatic lesions) is presented. The primary tumor has been localized in the upper rectum. Previous treatment included total mesorectal excision (performed 11 months prior to the manifestation of metastatic disease). According to the results of real-time PCR analysis in patient S., the wild type of K-Ras gene has been determined. Given the bilobar spread and multiple lesions, 3 cycles of chemo (FOLFOX-6) with subsequent surgical treatment have been planned to conduct, in circs of the growth stabilization on the background of systemic anticancer therapy. According to computer tomography report, after 3 courses of FOLFOX-6, there was a stabilization of the growth of target lesions (according to RECIST 1.1 criteria). At the time of the last pre-operative CT scan in patient S., 11 metastatic lesions remained (Table 1).

The total functional liver volume, future liver remnant volume (S1c, S2, S3, S4) and body weight at the resection planning moment were 1522,6 cm^3, 561 cm^3 and 84 kg, respectively. The remnant liver volume to body weight ratio was 0,46% which required a two-stage hepatectomy and in that case associated with 30% "drop-out" due to the tumor progression after the 1-st surgical stage [5] (Fig. 1).

When choosing a «major liver surgery» strategy, patient S. could potentially have risk of acute liver failure in the early postoperative period and would require two-stage hepatectomy and right portal vein embolization. While PSS strategy allowed to plan a one-stage systemic extended posterior right sectionectomy with resection of the dorsal subsegment S1. This is an alternative surgical strategy in the PSS framework, which involves the implementation of the already described "Systemic extended right posterior sectionectomy" [5] and based on the complete mobilization of the IVC subhepatic segment of the "Piggy-back" type at the level of the dorsal (paracaval) part of S1d (IX segment by C. COUINAUD) and its subsequent resection [6].

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

Surgical stage. Surgical access based on the principle of minimal access involved a J-shaped mini laparotomy to the right with the intersection of the right rectus abdominis [8], revision and the right liver lobe mobilization according to the "Piggy back" principles with short veins ligation, draining the dorsal part of S1 in the IVC. The next step involved marking the anatomical boundaries of the posterior section, the projection of RHV, MHV and GP to the anterior section using intraoperative ultrasonic navigation (Fig. 3).

Liver parenchyma transection has been performed under the Pringle maneuver conditions, started at edge of the anterior/posterior sections, followed by the RHV visualization to its middle segment and the GP6 in the direction of main portal fissure. Using the Gleason unit S6 as a landmark, the transection has been completed at the level of the right portal vein confluence. Next, the parenchyma dissection with S8d removal and the middle hepatic vein (MHV) visualization; then, R1v skeletonization on the $\frac{1}{2}$ circle of the MHV has been performed. Completion of parenchyma transsection has been performed at the level of the main portal fissure by resecting S1d (SIX) with a metastatic lesion (Fig. 4). RPPV and RHV at the level of their orifices have been ligated and sutured, using vascular clamps. Upon completion of hemo- and cholestasis on the plane of transection, the characteristics of parenchymal blood flow were monitored (porto-fugal character of blood flow in the portal and lateral systems of parenchyma S5 and S8v has been excluded).

The total duration of normo-ischemia for patient S. lasted for 65 minutes, blood loss amounted to 275 ml. The postoperative period went smoothly.

Discussion. Today's understanding of the metastasis biology and the process of progression in patients with CRC, has become a trigger for commencing the search for independent prognostic factors and the development of personalized surgical treatment of such patients. The main unresolved problems of modern liver surgery include the study of the effectiveness of the principles of PSS liver surgery adaptation for CRC metastatic lesions localized in the central sites, and the assessment of the R1v strategy of vascular skeletonization of such patients in different clinical cases.

Recently published data proves that the use of large resections is accompanied by the challenge of performing R1 in 10-30% [9]. Moreover, the adaptation of intraoperative ultrasound and the improvement of CT and MRI diagnostics allowed to determine the presence of true tumor invasion into the intraparenchymal vessels walls with a high degree of accuracy (main hepatic veins and Gleason structures). This information allows performing rather alternative than classical approach of PSS resections, realized by combining US navigation, orientation in vascular structures of 1-4 order 3D anatomy and the use of R1 vascular skeletonization. From our point of view, the above-mentioned approach is an alternative in cases of centrally localized metastatic lesions (within the portal or caval confluence of the liver). The method of skeletonization of liver vessels in contact with metastatic lesions is not included in international standards, 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 [110,11].

Conclusions . Adaptation of PSS liver surgery in metastatic colorectal cancer has the greatest potential for development and implementation in modern medicine conditions.

Author contributions:

1. **Anton Burlaka -** collected the data, performed the analysis, wrote the paper.
2. **A. Gogo-Abite** – paper translation
3. **A.V. Paliichuk** – CT and MRI reconstructions, volumetry.
4. **D.E. Makhmudov, V.V. Zvirych, A.V. Lukashenko -** designed and directed the project

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Table 1

Segmental volumetry and metastatic lesions mapping

*GP - glissonean pedicle

Fig. 1. Liver CT mapping of patient S.'s metastatic lesions . A – 3D segmentation and volumetry with metastatic disease 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.

Fig. 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 (SIX: dorsal and caudal parts of the segment) [7].

Fig. 3. Picture and ultrasound data of patient S. MHV – median hepatic vein without signs of invasion, contacting at a distance of 3 cm on the [?] 1/2 semicircle to the metastatic focus (blue arrows); T – metastatic focus with vascular contact (white arrows).

Fig. 4. Intraoperative pictures of patient 1,2,3,4 - view after parenchymal transsection and removal of the specimen (S5 and S8v preserved). 5,6 - gross specimen (S6, S7, S8d and S1d) with 9 metastatic lesions. On picture 4, the arrows of the IVC after the completion of "Piggy back" and the skeletonized terminal segment of the MHV are indicated.