ORIGINAL ARTICLE

Stereotactic Excision of Additional Lesions Detected with Intraoperative Ultrasound Examination During Radiofrequency Dissecting Sealar (Habib®) Assisted Hepatic Metastasectomy: Report of 4 Cases

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Abstract Intraoperative ultrasound has been using to achieve a proper resection strategy in patients undergoing a hepatic colorectal metastasectomy. This study aims to describe and reveal the place of stereotactic metastasectomy in nonpalpable colorectal liver metastases (CLM). A chart review was initiated for all patients underwent resection for CLM between 2006 and 2011. The data concerning perioperative data and intraoperative strategy were abstracted. Among the 58 patients, who underwent a resection for CLM, 4 (6.9 %) (all men, median age 65.5, range 49–72, years) necessitated a stereotactic metastasectomy. Preoperative evaluations showed 1 ($n=1$), 2 ($n=2$), or 3 ($n=1$) lesions, and intraoperative ultrasound (IUS) found an additional lesion in a case. Stereotactic marking was performed for nonpalpable lesions located in segments IVA, II, and VI and at the junction of segments V and VI. The margins were negative for all lesions both resected with conventional and stereotactic techniques. The examinations of the stereotactic resection materials revealed metastatic adenocarcinoma (patients $n=2$), focal nodular hyperplasia ($n=1$), and abnormal benign liver histology probably induced by chemotherapy ($n=1$). The median (range) operation and hospitalization periods were 217.5 (150–310) minutes and 5.5 (2–9) days. No complications were observed except biliary fistula in a case, which spontaneously disappeared within 2 weeks. A patient died due to systemic disease including hepatic metastases 33 months after the liver surgery. Stereotactic metastasectomy may be feasible for the removal of nonpalpable CLM. Further evaluations are necessitated to understand the accurate place of this novel technique.

Keywords Hepatic metastasectomy · Stereotactic excision · Radiofrequency dissecting sealar

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Introduction

Colorectal liver metastases (CLMs) are common and have a significant influence on survival. Since metastasectomies offer by far the best opportunity for cure from colorectal cancer, they have been proposed regarding the aspects of patient's fitness for operation, anatomic and functional possibility of tumor respectability, and tumor biology [1, 2]. The radiofrequency dissecting sealer (Habib®) (RFDS) is an instrument that uses radiofrequency energy to divide and seal tissue. Although a randomized trial has showed that RFDS is not superior to the clamp-crushing technique, other studies have revealed that the device may be effective in

achieving intraoperative hemostasis and facilitating liver parenchymal transection [3–6].

CLMs are often missed at laparotomy or even preoperative diagnostic tools, including multislice contrast-enhanced computed tomography or magnetic resonance imaging, which have higher sensitivity rates for the disease [7, 8]. Thus, intraoperative ultrasound (IUS) has been routinely used for detecting additional lesions which were not identified with preoperative radiological evaluations [9, 10]. IUS may also expand the number of the lesions and facilitate the accurate localization of CLM at the time of surgery, especially if they are too small or too deep to palpate or located in a segment inaccessible in view [11]. However, it may not be so easy to follow the extended surgical plan because of an additional lesion observed by IUS, since the bleeding from the transected liver may complicate the precise resection line. In addition, an RFDS-assisted surgery may threaten an ideal resection of the metastases with an adequate surgical margin for two reasons: first, the exact localization of the tumor may be lost, and the second, the device creates a solid 6–10 mm in diameter structure after the sealing of liver parenchyma, through which a bloodless resection will be achieved. Inspiring from the experience of nonpalpable breast tumors, we have hypothesized to perform a stereotactic removal of small hepatic lesions observed with IUS during the resection of CLM. The aim of the current study is to present the results regarding the stereotactic excision of the additional lesions detected with IUS during RFDS-assisted hepatic metastasectomy, which is the routine practice for the treatment of resectable CLM.

Methods

The Institutional review board at Kartal Education and Research Hospital approved the design and content of the study (reference number: B104ISM4340029/1009/42). A chart review was initiated for all patients who underwent a, RFDS-assisted resection for CLM between 2006 and 2011 in our institution. Those who underwent a hepatic resection for primary liver lesions or metastases originating from other locations were excluded. In addition, missed or confirmative information was obtained from computer-based records that have been used to collect prospective data in our unit since 2006. Among the abstracted cases, selective analysis focused on those who received a stereotactic excision of hepatic lesion detected with IUS. This was the routine practice for all hepatic metastasectomy patients in our department. These factors were studied: demographics, details of primary operation (location of the tumor, type of the procedure, interval between two operations), patient-related factors (presence/absence of comorbidity, the grade according to American Society of Anesthesiology [ASA]),

aspects concerning preoperative evaluation (level of carcinoembryonic antigen [CEA], ultrasonography [US], computed tomography [CT], magnetic resonance imaging [MRI], positron emulsion tomography [PET]), intraoperative features (amount of bleeding and transfusion, operation time, extent of hepatic resection, segment of stereotactic resection, additional abdominal procedures), postoperative parameters (time at intensive care unit, complications, hospitalization period), pathological characteristics (type and size of the tumor, nature of the stereotactic resection material, margin status), and follow-up and survival. All R0 resections with the absence of microscopic tumor invasions were considered as negative surgical margins without regarding the length of actual tumor-free extension [12]. Data were given as medians and ranges.

Operative Technique

The abdomen is entered via a bilateral subcostal incision. The liver is totally mobilized. A radiology expert on liver ultrasound scrubs in, and completes the liver examination with IUS. In case of a nonpalpable additional lesion, detected with IUS, a stereotactic procedure is initiated, since RFDS creates a thick and tough tissue, which makes the localization of the additional lesion impossible. A-20 gauge 10 cm breast localization needle (Gallini Medical, Mantova, Italia) is inserted in the additional lesion through the nearest border of the liver (Figs. 1 and 2). Then the lesion is excised using RFDS, or the resection border of the primary mass is extended in order to embrace the additional lesion.

Results

Among the 58 patients who underwent an RFDS-assisted resection for CLM, 4 (6.9 %) (all men, median age 65.5,
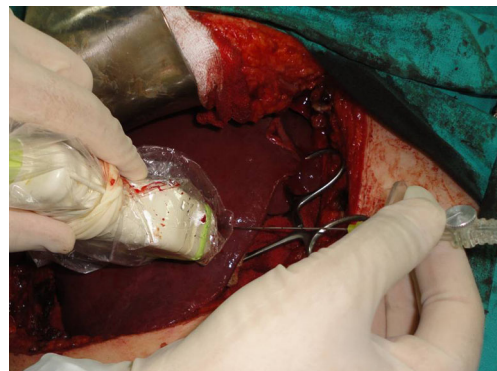

Fig. 1 A marking needle is inserted in the lesion through the nearest border of the liver with the guidance of IUS

range 49–72, years) necessitated a stereotactic metastasectomy after elective (*n*=3) or emergent (*n*=1), anterior (*n*=2) or low-anterior (*n*=2) resection either in our (*n*=2) or outside (*n*=2) hospitals. Cases with rectal tumors received preoperative chemoradiation therapy of 45–55 Gy in 5 weeks (5-fluorouracil was given during the first and last weeks of the treatment) before primary operation, and all patients received chemotherapy mainly based on a protocol (Folfiri regimen) including 5-fluorouracil, oxaliplatin, and leucovorin for 6 months after the initial surgery. The median (range) interval between the primary surgery and the metastasectomy was 19 (6–64) months. Additional comorbidities were detected in two cases including hypertension (*n*=2) and chronic lung disease (*n*=1); thus, the patients were classified as grades 2 (*n*=2) and 3 (*n*=2) according to ASA classification. CEA was elevated in two cases and the levels were 8.72 and 22.91 ng/ml. (A value less than 5 ng/ml was accepted as normal in our laboratory. Preoperative evaluations were done with US (*n*=4), MRI (*n*=4), PET (*n*=2), and CT (*n*=1) (Fig. 3).

Preoperative evaluations showed one (*n*=1), two (*n*=2), or three (*n*=1) lesions, and IUS found an additional lesion in a single case. The operative strategies were as follows: In case 1, three lesions ranging 1.5–3 cm in diameter were detected preoperatively in segments V, VI, VII, and VIII (Fig. 2). IUS showed an additional suspicious lesion located at IVA, which was marked with stereotactic needle placement. After a right hepatectomy, a stereotactic excision was performed. In case 2, two lesions ranging between 0.5 and 1 cm in diameter were detected preoperatively in segments VI and VIII, respectively. In case 3, a lesion 1.7 cm in diameter was detected preoperatively in segment V. In case 4, two lesions ranging between 1.5 and 1 cm in diameters
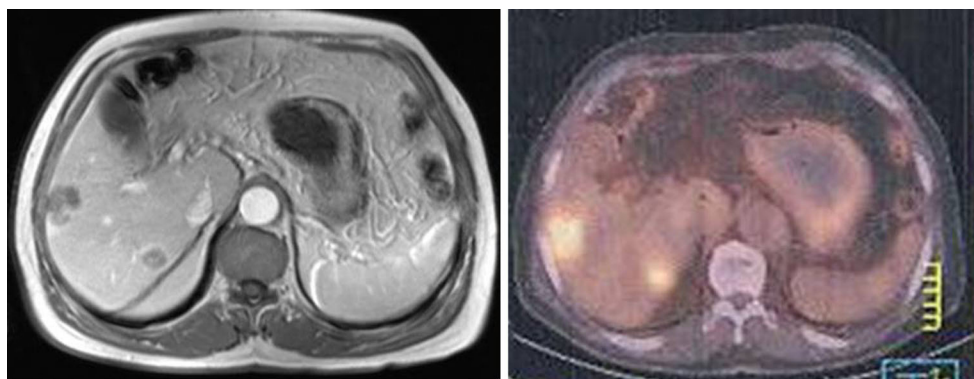
were detected at the junctions of II and III, and V and VI, respectively. Any additional lesion was ruled out with IUS in these cases. However, the location of a smaller lesion was not identified with tactile sensation; thus, a stereotactic marking was decided to achieve a tumor-free margin. Consequently, stereotactic marking was performed for the lesions located in segment II, segment VI, and at the junction of segments V and VI in cases 2, 3, and 4, respectively. Accordingly, wider resections were performed including segments VI, VII, and VIII, segment V and segments II, III, V, and VI in these patients. The sizes of the lesions, removed with the guidance of the IUS, ranged from 0.5 to 1.7 cm in diameter. In addition to hepatic procedures, cholecystectomy was performed in all cases, whereas an ileostomy closure was done in case 2. Pathological evaluation of the specimens revealed that all metastases were resected with tumor-negative margins. However, the examinations of the stereotactic resection materials revealed metastatic adenocarcinoma with negative margins (*n*=2), focal nodular hyperplasia (*n*=1), and abnormal benign liver histology probably induced by chemotherapy, characterized with degeneration in parenchymal cells, moderate inflammatory reactions, proliferation in portal areas, and moderate fibrosis (*n*=1). In summary, pathological results confirmed removal of metastases with negative margins in three, and complete removal of focal nodular hyperplasia in one (Fig. 4).

The median (range) intraoperative bleeding was 400 (100–600) ml. Intra- or postoperative transfusion was not necessitated in any cases. The median (range) operation, ICU, and hospitalization periods were 217.5 (150–310) minutes, 0, and 5.5 (2–9) days, respectively. No complications were observed except biliary fistula in a case, which spontaneously disappeared within 2 weeks. A patient (case 4) died due to systemic disease including hepatic metastases 33 months after the liver surgery. Remaining three cases are alive without any recurrence 4, 6, and 7 months after the metastasectomy.

Discussion

The resection of the hepatic metastases with tumor-free margins is the single approach achieving an acceptable survival in patients with CLM; however, they may be realized in less than 25 % of the cases [13]. In addition, hepatic recurrence of the disease has been addressed to happen in almost two-thirds of the cases after resection for curative intent [14, 15]. Thus, these patients should be followed with some valuable diagnostic tools including blood CEA levels, CT or MRI examinations, and endoscopic evaluations. Despite the value of these evaluations in detecting intraperitoneal disease and multiple liver metastases, preoperative accuracy in evaluating the feasibility of the surgery has been

Fig. 2 The marking needle is inserted with the guidance of IUS (single arrow and double arrows show the needle and the lesion, respectively)

controversial [16–19]. Some has suggested that patients should be considered for laparoscopic evaluations if they have two of the following characteristics including a lymph node-positive primary tumor, a CEA level greater than 200 ng/ml, more than 1 hepatic tumor, disease-free interval less than 12 months, and a hepatic tumor greater than 5 cm [20]. Besides, IUS has been recommended to be used routinely to confirm preoperatively detected lesions and to identify additional metastases, which were not seen with previous diagnostic tools. It has been observed that IUS may discover new aspects in up to one-fourth of patients, and consequently change the operative strategy in 18 % of procedures [17–19]. RFDS-assisted metastasectomy may be an easy and bloodless technique; however, the use of the device may cause smaller lesions to be missed, since it creates a solid structure through which IUS cannot be properly used. Thus, inspiring from the experience of nonpalpable breast tumors, we have speculated that a stereotactic marking may be used for nonpalpable hepatic lesions. Current study has shown that it may be a bright idea to employ this technique for lesions smaller than 1 cm, especially if an RFDS-assisted resection is initiated, since a complete resection of the identified lesion was achieved in all cases.
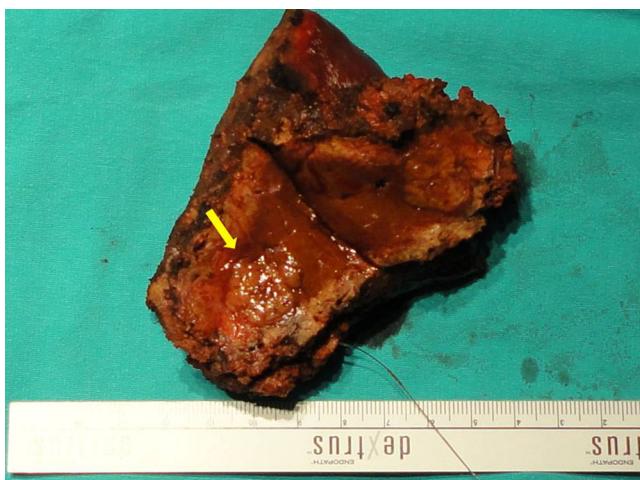

Fig. 4 Stereotactic metastasectomy specimen—the lesion was removed with negative margins

It may be suggested that IUS was not properly used for the patients participated in the study since pathological examinations had revealed that not all lesions were metastases. But we believe that the technique is feasible for some reasons: first, all lesions identified with IUS were smaller than 1 cm in diameter, which were difficult to detect or localize. Second, IUS discovered an additional lesion in a case, which was not preoperatively known. Thirdly, all patients had received chemotherapy, which might cause fatty degeneration in liver, and consequently might affect the sensitivity of IUS [21]. Finally, complete resection was achieved with negative margins including a case with true metastasis. Furthermore, stereotactic marking is not a routine use in our hands, and was decided in less than 10 % of all cases. We decided to indicate this technique for the lesions which were not palpable, but were detected with IUS. We believe that stereotactic metastasectomy may not be reasonable for larger lesions or for those located peripherally, which can be easily detected or which are palpable, and consequently are candidates for standard resection. In short, although current data are pioneer on this particular subject, it is hard to find out the precise value of stereotactic metastasectomy in nonpalpable liver metastases. Since our experience has included only limited number of patients, it may be speculated that this technique deserves to be tested in further studies, and also it may have a place in the algorithm of treatment of nonpalpable hepatic metastases.

In conclusion, stereotactic metastasectomy may be feasible for the removal of CLM, particularly for those smaller than 1 cm in diameter, especially when RFDS-assisted resection is being planned. Further evaluations are essential to understand the accurate place of this novel technique.

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