

Laparoscopic combined colorectal and liver resection for primary colorectal cancer with synchronous liver metastases

Ciprian Duta, Dan Brebu, Cristi Tarta, Amadeus Dobrescu

Surgical Clinic 2, University of Medicine and Pharmacy, "V.Babes", Timisoara, Romania

Abstract— *The simultaneous resection of colorectal cancer (CRC) and of synchronous liver metastases is a debate topic related to the postoperative morbidity as compared to the staged resection. The purpose of this study is to analyze the results found in a series of eight patients with CRC and synchronous liver metastases who benefitted from combined colorectal and liver laparoscopic surgery. A prospective assessment was performed in terms of patients' characteristics, tumours' characteristics, operative variables and postoperative results. The primary tumour was localized at the level of the colon in six patients, and at the level of the rectum in two patients, while the synchronous liver metastases were predominantly solitary. A laparoscopic approach was applied to all 8 patients, who underwent colorectal resection (R0), as well as metastasectomies and hepatic wedge resections. There was no need to convert to classic surgery. The sample was extracted by pararectal incision or by transverse suprapubic incision. The median operative time was approximately 313 minutes (range 151-394 minutes), with an average blood loss of 600 ml (range 200-850 ml). The postoperative length of stay varied between 6 and 14 days. On the basis of this initial experience of a single centre, the laparoscopic simultaneous resection of colorectal cancer and the hepatic resection can be performed on the selected patients suffering from CRC and SLM, with satisfactory short-term results.*

Index Terms— colorectal cancer, laparoscopic surgical approach, liver metastases

I. INTRODUCTION

Liver is the most frequent site of hematogenous dissemination of colorectal cancer (CRC) (1, 2). Liver metastases are present in 10-25% of the patients during the surgical intervention for colorectal malignancy (3). The surgical resection is the most efficient and potentially curative treatment for the liver metastases of CRC (4). The treatment strategies and the results for these patients developed and underwent several changes due to the technical innovations (5-6). Laparoscopic surgery improves the accuracy of the surgical approach, the postoperative recovery, it minimizes the postoperative pain, reduces the rate of abdominal wall infection, decreases the hospital length of stay, allows a more rapid return to normal activities, has better cosmetic results and it does not compromise the oncologic result (7,8).

There are several treatment options for the patients suffering from CRC with synchronous liver metastases

(SLM), depending on the location of the primary tumor (rectum or colon) and on the extent of liver disease. The controversies are related to the concept that the patient better tolerates the staged resection of the primary tumor and of the liver metastases. Recently, a systemic analysis has shown that synchronous colorectal and hepatic resection led to a shorter hospital stay and to fewer complications, as compared to a staged resection (9). The specialized literature shows that the staged laparoscopic resection, initially of the primary tumor and subsequently of the hepatic lesions is more documented than the combined laparoscopic resection of CRC and SLM, for which there are only a few references.

The purpose of this study is to assess the initial experience of the simultaneous laparoscopic resection of CRC and SLM and to monitor the evolution and the prognosis of these cases on the short term.

II. MATERIAL AND METHODS

Between January 2012 and March 2013 the Second Surgery Clinic of Timisoara County Hospital had 48 laparoscopic surgery cases for patients suffering from CRC, of which 15 also suffered from SLM. Of the 15 patients, 8 patients with CRC and SLM were selected to benefit from combined laparoscopic colorectal and liver surgery. The other 7 patients required major hepatectomy and they were excluded from the study. The data were prospectively collected and analyzed for this study. The assessed parameters were the following: the patients' characteristics, the tumors' characteristics, the operative variables and the postoperative results.

Multimodal treatment of CRC and SLM

For the patients suffering from CRC and SLM, the decision for the best treatment was established depending on the location of the primary tumor, the complexity of the primary tumor resection, the location of the liver metastases, as well as their size and number, the feasibility of the laparoscopic approach and the general condition of the patient. For the series under study we performed simultaneous resection in patients undergoing colorectal resection with anastomosis in elective settings (T1-T3) and a single or multiple liver lesions (up to 3 lesions) with a peripheral location on segments 2-6, which allowed a limited hepatic resection.

Neoadjuvant therapy was administered for the primary rectal tumors (2 patients), consisting of short-course

radiotherapy (5 x 5 Gy), followed by 3 to 5 systemic chemotherapy cycles (capecitabine). A multidisciplinary team, the treatment being adapted to each particular case and well argued, has analyzed all the cases. The protocol of our clinic was respected in terms of laparoscopic approach. The other patients underwent classic surgery or a staged approach.

Surgical approach

The laparoscopic approach of colorectal tumors was a medial-to-lateral approach. A right Para rectal incision was performed for the right hemi colectomy in order to extract the resection specimen, as well as to perform an extracorporeal anastomosis. A Pfannenstiel incision was performed on the left colon in order to extract the resection specimen, followed by an intracorporeal colorectal anastomosis with circular stapler. The surgeon standing between the legs of the patient performed the laparoscopic liver resection. Hepatic wedge resections were performed for the peripheral metastases and metastasectomies. For the laparoscopic liver resection, 2-3 additional trocars were mainly used, as compared to the ones necessary for the approach of the colorectal primary tumor. The 10 mm trocar situated at the level of the umbilicus to ensure the view, initially used for the approach of the primary lesion, is used for the subsequent approach of the liver lesions. 2 additional trocars of 5 mm are placed in the upper abdomen, left and right. When needed, an additional 5 mm trocar was used.

Enseal® advanced technology instruments (advanced bipolar technology) or LigaSure™ instruments were used for the transection of the hepatic parenchyma, and Tachosil® absorbable fibrin sealant patch was used for the additional hemostasis of the hepatic section surface. The hepatic resection specimen was placed in a plastic bag and extracted through the pararectal incision and the Pfannenstiel incision, respectively.

III. RESULTS

6 men and 2 women diagnosed with CRC and SLM were included in the study. The preoperative diagnosis of CRC and SLM on the basis of the investigations performed was assigned to 6 patients. During the laparoscopic surgery, two patients were diagnosed with SLM in segments 2 and 6 and they were included in the protocol for simultaneous resection. The average age was 68 years (range 54-76 years). The characteristics of each patient are shown in Table I. The average body mass index was 29.0 (range 24.9-31.2) kg/m². A patient suffered an emergency laparoscopic cholecystectomy 2 months before, for a phlegmonous lithiasic acute cholecystitis. During laparoscopy, a hepatic lesion was identified and subsequently investigated. The colonoscopy revealed a tumor in the sigmoid colon. The preoperative treatment of the rectal cancer consisted of a short-course radiotherapy (5 x 5 Gy) and an associated systemic chemotherapy (capecitabine). All the 8 laparoscopic resections were successfully completed. There were no

conversions to classic surgery. The surgical results are shown in Table II.

The following procedures have been performed: laparoscopic right hemi colectomy and wedge resection of segment 2/3 with extraction of the specimens through the right pararectal incision, laparoscopic sigmoidectomy with metastasectomies in segments 3, 4, and 6 with extraction of the specimens through the Pfannenstiel incision, rectal anterior resection and metastasectomies in segments 3 and 6 with extraction of the specimens through the Pfannenstiel incision. The incision used to extract the specimens varied between 5 and 10 cm.

Table I. Patient characteristics and preoperative data

Patient Number	Sex	Age	Medical history	Primary tumor or location	Hepatic metastasis location	No. of metastasis	Neoadjuvant treatment
1	M	63	Appendectomy Hypertension	Sigmoid	Segment 6	1	No
2	M	54	None	Sigmoid	Segment 3	1	No
3	M	72	Hypertension Anemia	Cecum	Segment 2/3	3	No
4	F	68	Acute cholecystitis Laparoscopic cholecystectomy	Sigmoid	Segment 2	1	No
5	M	77	Hypercholesterolemia Coronary heart disease	Ascending colon	Segment 3	1	No
6	F	70	Angina pectoris Hypertension Hypothyroidism	Rectum	Segment 6	1	5x5 Gy
7	M	67	Appendectomy	Rectum	Segment 3	1	5x5 Gy
8	M	69	Hypercholesterolemia	Ascending	Segment	2	No

			olemia	ing	t 2		
			Atrial	colo			
			fibril-	n			
			lation				

Table II. Surgical results

Patient Number	Type of operation	Operation time (Min)	Blood loss (ml)	Postoperative hospital stay (days)	Resumption of bowel (hours)
1	Sigmoidectomy and metastasectomy of segment 6	275	650	8	36
2	Sigmoidectomy and metastasectomy of segment 3	181	200	6	30
3	Right hemicolectomy and atipicresection of segments 2/3	230	500	9	48
4	Sigmoidectomy and metastasectomy of segment 2	260	450	8	36
5	Right hemicolectomy and metastasectomy of segment 3	190	550	14	72
6	Rectal anterior resection	354	600	9	48

	and metastasectomy of segment 6				
7	Rectal anterior resection and metastasectomy of segment 3	315	750	8	48
8	Right hemicolectomy and metastasectomy of segment 2	210	350	10	72

The median operative time was 280 minutes (range 181-354 minutes), with a total estimated blood loss of 600 ml (range 200- 750 ml). The intraoperative complications consisted of the bleeding at the level of the section surface, solved with suture with Prolene 4-0 and by the introduction of an additional trocar. A patient showed a Pfannenstiel wound infection, and 2 patients suffered from delayed gastric emptying that required a nasogastric tube. Other postoperative complications: a patient developed a lower urinary tract infection and Hypertension episodes that were managed by the administration of antibiotics and antihypertensive. The average hospital stay was 9 days, ranging between 6 and 14 days. There were no records of postoperative mortality. The R0 resection of the primary tumor and of the hepatic lesions was performed to all patients. Details regarding the pathological examination are shown in Table III.

Table III. Pathological examination

Patient number	p/yTN stage	Radically	Diameter SLM (cm)	Resection margin SLM (mm)
1	pT2N1	R0	1.5	6
2	pT3N0	R0	2.4	8
3	pT2N2	R0	2/1.5/0.9	>10
4	pT3N0	R0	1.8	8
5	pT2N1	R0	1.5	7
6	yT1N1	R0	1.3	5

7	yT2N0	R0	2	6
8	pT2N2	R0	2.1/1.6	5

IV. DISCUSSION

The advantages of the laparoscopic approach in colorectal surgery or the hepatic resections performed by experienced surgeons (8) led to a significant increase in the number of such interventions during the last years. The separate laparoscopic approach of colorectal cancer and of colorectal cancer metastases was proven and resulted in a more rapid recovery and a low morbidity rate, with oncologic results similar to those obtained by open surgery (7,8). This suggests that a combined laparoscopic approach both for the primary tumor and for the liver metastases may be beneficial for patients who candidate for a simultaneous resection.

Moreover, the open surgery for the resection of the colorectal primary tumor and of synchronous metastases may require an extended incision, which may sometimes be lacerating, especially when the tumors have opposite location (for instance the rectum and the right liver lobe). Using the laparoscopic approach, the exposure can be improved even when from an anatomical point of view there is a narrow pelvis and sites to which access is difficult, in the upper abdominal area. The feasibility of the simultaneous laparoscopic approach was proven by our initial experience in 8 cases, and the results obtained confirm the data found in the specialized literature for this topic, presenting series of a comparable size (Table IV).

Table IV. NR: not reported, LH: left hemihepatectomy, LLS: left lateral sectionectomy, M: metastasectomy, S: segmentectomy, RH: right hemihepatectomy, RFA: radio frequency ablation, *13 resections in 10 patients.

Author	Year	Nr. of patients	Laparoscopic liver resection (type)	Time (min)	Blood loss (ml)	Post-operative hospital stay (days)
Geiger et al. [10]	2006	1	LLS	330	600	4
Leung et al. [11]	2006	1	LLS	350	500	7
Vibert et al. [12]	2006	8	NR	NR	NR	NR
Law et al. [13]	2008	4	NR	NR	NR	NR
Bretagnol	2008	1	1 LLS 2 M	NR	NR	NR

et al. [14]						
Pessaux and Panaro [15]	2009	3	1 M + RFA	NR	NR	NR
Sasaki et al. [16]	2009	9	2 LLS	418	219	9
			7 M	(215-520)	(32-745)	(7-26)
Cascia et al. [17]	2010	1	1 LLS	455	NR	12
Lee et al. [18]	2010	10*	6 LLS	401	500	10
			5 M	(230-620)	(60-1000)	(7-15)
			1 S	NR	NR	NR
			1 RH	NR	NR	NR
Hayashi et al. [19]	2011	2	NR	(270-575)	(40-330)	(7-14)
Trancharth et al. [20]	2011	2	1 LH	310	200	4
			1 RH	345	200	6

The patients with a single metastasis located in segments 2-6 are the ideal candidates for the simultaneous laparoscopic resection. Besides the standard location of trocars in laparoscopic colorectal surgery, 2 additional trocars are required, for a good access to perform the hepatic resection. Both resection specimens can be extracted through a single incision. In the case of lesions located in segments 7-8, or in the case a major hepatectomy was required, the simultaneous resection combined approach was aborted, and these patients were excluded from the study. However, certain authors with experience in laparoscopic liver surgery have proven that the laparoscopic major hepatectomy performed simultaneously with the laparoscopic colorectal resection is also feasible (18,20). The major hepatectomy specimen is extracted through a Pfannenstiel incision, which has been proven to have the lowest rate for the occurrence of an incisional hernia (21).

The theoretical arguments against simultaneous resection would be the combination between a clean operation and a contaminated one, and the deficiency on protein synthesis following the hepatic resection could lead to an increase of the infection risk and could compromise the healing of the anastomosis. Another hypothesis is related to the Pringle

maneuver, when the resulted venous congestion could lead to intestinal edema. Nevertheless, the specialized literature based on 14 comparative studies reveals that the combined resection shows a lower morbidity rate (9). This led to the conclusion that simultaneous resection can be performed to patients selected by surgical teams specialized both in colorectal surgery, and in hepatobiliary surgery. The correct assessment of the patients, as well as their selection are essential for this type of complex surgery, and the multidisciplinary team must decide upon the optimal moment when the multimodal treatment must be applied.

As a result of the improvement of the surgical techniques in liver surgery, of the medical technical innovations and of the systemic chemotherapy, the life expectancy of the patients with colorectal metastases increased. An initial laparoscopic approach results in a reduced formation of peritoneal adhesions and it facilitates a repeated hepatic resection, which was proven in the case of patients with HCC that subsequently needed a liver transplant (22). The benefits of laparoscopy in this case can be seen in the improved oncologic results, in the improvement of the quality of life, the integrity of the abdominal wall and the cosmetic advantages.

V. CONCLUSION

The simultaneous resection of CRC and SLM continues to be a controversial issue. There are no randomized clinical studies comparing the simultaneous resection to the staged one. The recently communicated data of the prospective series are difficult to interpret because of the selective character of the patients. Our initial experience, correlated with the specialized literature, indicates that simultaneous resection of CRC and SLM is feasible and can be chosen for the patients selected, provided that a team performs it with adequate experience in this field.

REFERENCES

- [1] Cummings LC, Payes JD, Cooper GS. Survival after hepatic resection in metastatic colorectal cancer: a population-based study. *Cancer*. 2007; 109(4):718-726.
- [2] Grundmann RT, Hermanek P, Merkel S, et al. Diagnosis and treatment of colorectal liver metastases-workflow. *Zentralblatt fur Chirurgie*. 2008; 133(3):267-284.
- [3] Popescu I. Rezeecia hepatică. In: Popescu I, editor. *Chirurgia ficatului*. București: Editura Universitară „Carol Davila”, 2004: 537-662.
- [4] Popescu I, Ionescu M, Alexandrescu S, Ciurea S, Hrehoreț D, Sârbu-Boeți P, Boroș M, Croitoru A, Anghel R. Surgical treatment of liver metastases from colorectal cancer. *Chirurgia* 2006; 101(1):13-24.
- [5] González HD, Figueras J. Practical questions in liver metastases of colorectal cancer: general principles of treatment. *HPB*. 2007; 9(4):251- 258.
- [6] Yang AD, Brouquet A, Vauthey JN. Extending limits of resection for metastatic colorectal cancer: risk benefit ratio. *Journal of Surgical Oncology*. 2010; 102(8):996-1001.
- [7] Kuhry E, Schwenk WF, Gaupset R, Romild U, Bonjer HJ. Long-term results of laparoscopic colorectal cancer resection. *Cochrane Database of Systematic Reviews*. 2008; (2, article CD003432) .
- [8] Reddy SK, Tsung A, Geller DA. Laparoscopic liver resection. *World Journal of Surgery*. 2011; 35:1478-1486.
- [9] Hillingsø JG, Wille-jørgensen P. Staged or simultaneous resection of synchronous liver metastases from colorectal cancer-a systematic review. *Colorectal Disease*. 2009;11(1):3-10.
- [10] Geiger TM, Tebb ZD, Sato E, Miedema BW, Awad ZT. Laparoscopic resection of colon cancer and synchronous liver metastasis. *Journal of Laparoendoscopic and Advanced Surgical Techniques A*. 2006; 16(1):51-53.
- [11] Leung KL, Lee JFY, Yiu RYC, Ng SSM, Li JCM. Simultaneous laparoscopic resection of rectal cancer and liver metastasis. *Journal of Laparoendoscopic and Advanced Surgical Techniques A*. 2006; 16(5):486-488.
- [12] Vibert E, Perniceni T, Levard H, Denet C, Shahri NK, Gayet B. Laparoscopic liver resection. *British Journal of Surgery*. 2006; 93(1):67-72.
- [13] Law WL, Fan JKM, Poon JTC, Choi HK, Lo OSH. Laparoscopic bowel resection in the setting of metastatic colorectal cancer. *Annals of Surgical Oncology*. 2008; 15(5):1424-1428.
- [14] Bretagnol F, Hatwell C, Farges O, Alves A, Belghiti J, Panis Y. Benefit of laparoscopy for rectal resection in patients operated simultaneously for synchronous liver metastases: preliminary experience. *Surgery*. 2008; 144(3):436-441.
- [15] Pessaux P, Panaro F. Advantages of the first-step totally laparoscopic approach in 2-staged hepatectomy for colorectal synchronous liver metastasis. *Surgery*. 2009; 145(4): 453.
- [16] Sasaki A, Nitta H, Otsuka K, Takahara T, Nishizuka S, Wakabayashi G. Ten-year experience of totally laparoscopic liver resection in a single institution. *British Journal of Surgery*. 2009; 96(3):274-279.
- [17] Casaccia M, Famiglietti F, Andorno E, di Domenico S, Ferrari C, Valente U. Simultaneous laparoscopic anterior resection and left hepatic lobectomy for stage IV rectal cancer. *Journal of the Society of Laparoendoscopic Surgeons*. 2010; 14(3):414-417.
- [18] Lee JS, Hong HT, Kim JH, et al. Simultaneous laparoscopic resection of primary colorectal cancer and metastatic liver tumor: initial experience of single institute. *Journal of Laparoendoscopic and Advanced Surgical Techniques*. 2010; 20(8):683-687.
- [19] Hayashi M, Komeda K, Inoue Y, et al. Simultaneous laparoscopic resection of colorectal cancer and synchronous metastatic liver tumor. *International Surgery*. 2011; 96(1):74-81.
- [20] Tranchart H, Diop PS, Lainas P, et al. Laparoscopic major

hepatectomy can be safely performed with colorectal surgery for synchronous colorectal liver metastasis. *HPB*. 2011; 13(1):46-50.

- [21] DeSouza A, Domajnko B, Park J, Marecik S, Prasad L, Abcarian H. Incisional hernia, midline versus low transverse incision: what is the ideal incision for specimen extraction and hand-assisted laparoscopy? *Surgical Endoscopy and other Interventional Techniques*. 2011; 25(4):1031-1036.
- [22] Laurent A, Tayar C, Andréoletti M, Lauzet JY, Merle JC, Cherqui D. Laparoscopic liver resection facilitates salvage liver transplantation for hepatocellular carcinoma. *Journal of Hepato-Biliary-Pancreatic Surgery*. 2009; 16(3):310-314.
- [23] Laparoscopic-assisted combined colon and liver resection for primary colorectal cancer with synchronous liver metastases: initial experience Kim SH¹, Lim SB, Ha YH, Han SS, Park SJ, Choi HS, and Jeong SY. *World J Surg*. 2008 Dec;32(12):2701-6. doi: 10.1007/s00268-008-9761-z.