

ORIGINAL ARTICLE

One-stage resection of primary colorectal cancer and hepatic metastases using the Habib Device: analysis of 40 consecutive cases treated in a Unit of general surgery

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ABSTRACT

BACKGROUND: More than 50% of patients with colorectal cancer (CRC) present or develop hepatic metastases (HM). The intraoperative use of the Habib 4X[®] radio frequency probe device is safe in resetting HM and allows a one-stage resection of both CRC and HM with a similar mortality rate than a two-stage surgical treatment.

METHODS: After an exhaustive residential training at the reference center for hepato-biliary surgery of the Imperial College of London, we treated at our unit of general surgery 40 consecutive patients with CRC and HM with the one-stage resection, using the Habib 4X[®] intraoperative radiofrequency probe device to reset HM.

RESULTS: None of the 40 patients died during the intra-operative and post-operative periods, none presented liver failures during the postoperative course nor complication related to the Habib's resection procedure (e.g. bleeding, abscess, bile leak). The amount of intra-operative liver bleeding was minimal. New HM arose in 10 (25%) cases, with a mean disease-free interval of 13 months, but the hepatic tissue close to previous resections remained cancer-free. The 69.7% of patients were disease-free at month 24 of the post-operative follow-up and 5-year rate was about 70%.

CONCLUSIONS: The data suggest that surgeons well trained at a reference center for hepato-biliary surgery may perform with excellent results the one-stage CRC and HM resection with the Habib 4X[®] device even in a Unit of general surgery.

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KEY WORDS: Colorectal neoplasms; Neoplasm metastasis; Surgical procedures, operative.

More than 50% of patients with colorectal cancer (CRC) develop hepatic metastases (HM) overtime^{1, 2} and 30-50% of them show synchronous hepatic secondaries at first observation.³

In such cases surgery is the treatment of choice, when feasible, since it provides an ac-

ceptable disease-free interval and good survival.⁴ Until 2008 surgeons did not normally perform a one-stage resection of CRC and synchronous HM,⁵ but two stages sequential treatment was usually preferred⁶ to avoid an increase in surgical time, mortality risk and prolonged recovery.

The improvement in surgical techniques and

the availability of new technologies, along with better pre- and postoperative care, allow performing the one-stage resection of both CRC and HM with oncologic results like those provided by the two-stage surgical treatment. Compared with the two-stage resection the one-stage procedure offers several advantages, even more if a specific device like Habib 4X[®] is used. The advantages of one stage resection adopting Habib's procedure are: a single anesthesiologic procedure, considerable reduction in perioperative blood loss, no post-operative liver abscess, decreased bile leaks, less use of materials such as clips, sutures, topical sealants, a reduced liver mobilization, the possibility of avoiding Pringel's maneuver, an overall reduction in operating time and a significant reduction in intensive care units (ICUs) stay and in global hospitalization times.

This paper describes the feasibility and the outcome of the one-stage resection of CRC and HM performed in 40 consecutive patients treated at our surgical unit with the use of the intraoperative Habib 4X[®] radio frequency probe device.

Materials and methods

From 2009 to 2013, 40 consecutive patients with CRC and HM were treated with open one-stage surgical resection at our General Surgery Unit, Department of Advanced Biomedical Sciences, University of Naples Federico II, Naples, Italy.

At the time of first observation, all patients signed an informed consent to undergo the pre-operative procedures and cooperated with the investigators to fill-out a pre-coded questionnaire including demographics, presence of co-morbidities and ASA grade. The pre-operative procedures included laboratory basic analyses, liver function tests, oncological markers, GI endoscopy, colonoscopy, abdomen ultrasound, abdomen, and pelvic contrast CT scan and, for rectal cancer patients, endoscopic US were also performed. In selected cases we performed also whole-body CT scan, CT/PET scans, MRI, contrast-enhanced liver ultrasound.⁷

After this preoperative stage, 40 patients matched the following inclusion criteria: age >18 years, presence of a primary CRC and of 1-3 HM (even in two lobes) sized <5 cm with a presumed

residual healthy liver tissue after liver resection of at least 70% and an ASA grade I-III (Table I, II). Exclusion criteria included the involvement of hilar lymph nodes and presence of general contraindications to major surgery like severe coronary heart disease, reduced general constitution, severe chronic obstructive pulmonary disease, peritoneal carcinomatosis and colonic perforation.⁸ Patients were also tested for HBsAg, anti-HCV, total anti-HBc, and anti-hepatitis B surface antibody (HBs) using specific commercial immunoenzymatic assays.⁹⁻¹⁷

Each patient signed an informed consent to the surgical intervention and gave the permission to collect and use anonymously their clinical data for scientific investigation and publication.

In each case HM, resection was performed immediately after colectomy using the bipolar radiofrequency device the Habib 4x[®] probe for metastasectomy and/or partial or wedge liver resection.¹⁸⁻²⁴ This technique implies the identification of hepatic hilum, the preventive application of vessel loop, avoiding the Pringel's maneuver (only in the initial period because after the first 10 patients we didn't perform preventive application of vessel loop on hepatic hilum any more) and intraoperative US to localize and characterize HM, tattooing of the liver with an electric scalpel including a margin of at least 1 cm of healthy tissue (Figure 1); the electrodes were then inserted in the liver (Figure 2), first in two rows parallel to the guide and afterwards in one row perpendicular to the first two. Once the probe was introduced, the electrodes were activated to determine a controlled area of coagulative necrosis involving blood vessels and bile ducts. Finally, the necrotic areas were resected by a scalpel blade and removed (Figure 3, 4).²⁵

The operative time, perioperative blood loss, and intra- and postoperative complications were all registered (Table III). The disease-free survival (DFS) and the overall 2 and 5-year-survival rate were evaluated in relation with the oncologic results.

Results

The 40 patients enrolled in the present study had a median age of 57 years (range 48-74), and

TABLE I.—CRC and HM side.

Patients	CRC and HM side			
	Side of CRC	HM hidden segment	size (cm)	Stage
1.	Right	VI and VII	3 and 3	T2N1M1
2.	Left	VI	3	T3N1M1
3.	Sigmoid	VII	3	T3NOM1
4.	Right	II and III	1.5 and 2.5	T3NOM1
5.	Sigmoid	III	2	T4N1M1
6.	Left	II	1,2	T2NOM1
7.	Sigmoid	IV	4	T3N1M1
8.	Rectum	VI and VII	3 and 4.5	T2N1M1
9.	Right	VI-	3,5	T1NOM1
10.	Sigmoid	VII	4	T2NOM1
11.	Sigmoid	IV and V	2 and 4	T3NOM1
12.	Rectum	IV	2,5	T2N1M1
13.	Right	V	3.5	T1NXM1
14.	Left	VIII and IV	4 and 2	T3N1M1
15.	Sigmoid	VIII	4	T2NOM1
16.	Right	IV	2	T3NOM1
17.	Right	III	3	T1NOM1
18.	Sigmoid	III	2.5	T2N1M1
19.	Sigmoid	VIII	5	T3N1M1
20.	Rectum	IV	2.5 and 1	T3NOM1
21.	Right	IV	2.5	T3NOM1
22.	Left	IV	3	T4N1M1
23.	Sigmoid	VII and II and III	4.5 and 2.4 and 1	T2NOM1
24.	Rectum	VI	3.5	T3N1M1
25.	Right	VII and VI	3 and 3	T2N1M1
26.	Left	VII	3	T1NOM1
27.	Sigmoid	VI	3	T2NOM1
28.	Right	VII	3,5	T3NOM1
29.	Right	II	5	T2N1M1
30.	Left	III	3	T1NXM1
31.	Sigmoid	V and IV	1.5 and 3	T3N1M1
32.	Right	IV	2,5	T2NOM1
33.	Right	VI	2	T3NOM1
34.	Left	III and VII	0.4	T1NOM1
35.	Left	VII	0.9	T2N1M1
36.	Rectum	III and V and VII	1 and 1	T3N1M1
37.	Right	II and V and VII	1 and 1	T3NOM1
38.	Left	V and VII	1 and 3	T3NOM1
39.	Sigmoid	V and IV	2 and 3.5	T4N1M1
40.	Right	VI and VII	3 and 3	T2NOM1

57.5% of them were males. Of these 40, 4 had ASA grade I (10%), 20 (50%) ASA grade II and 16 (40%) ASA grade III; 25 (62,5%) of them presented co-morbidities (Table II).

As for CRC resection, 14 (35%) patients underwent right colectomy, 12 (30%) sigmoid colectomy, 9 (22.5%) left colectomy and 5 (12.5%) anterior rectum resection (Table IV). While the surgical choice for HM resection has been as follows, 15 (37.5%) wedge resections, 12 (30%) segmentectomies, 10 (25%) metastasectomies, and 3 (7.5%) left lobectomies (Table V).

The differences in operative time, operative

TABLE II.—Characteristics of 40 Italian patients who underwent a one-step CRC and HM resection.

Data	Number (%)
Nationality	
Italian	40 (100)
Mean age	
Years (range)	57 (48-74)
Gender	
Male	23 (57.5)
Female	17 (42.5)
ASA Score	
I	4 (10)
II	20 (50)
III	16 (40)
Comorbidities	25 (62.5)
Cardiovascular disease (hypertension, heart attack)	11 (27.5)
Diabetes mellitus	1 (2.5)
Other malignancies	2 (5)
Respiratory disease	7 (17.5)
Hypercholesterolemia	4 (10)
Alcohol intake >2 drinks a day	4 (10)
Injective drug users	0



Figure 1.—Electric scalpel tattoo of affected liver area.

blood loss, duration of hospitalization and intra- and postoperative complications between patients with colon cancer and those with rectal cancer were small and not significant to statistical analysis (Table III). No complication related



Figure 2.—The Intraoperative application of Habib® 4X Probe.



Figure 3.—Hepatic section.

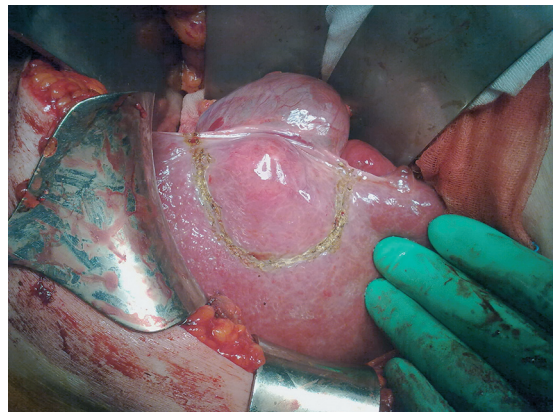


Figure 4.—Removed specimen.

to the Habib's resection procedure (*e.g.* bleeding, abscess, bile leak, late hepatic failure) had occurred and the overall intraoperative and postoperative complication rate did not differ from that reported in literature for the two-stage CRC and HM resection.^{18, 24, 26-28} In addition, the operating time and the intraoperative blood loss registered in our series (Table III) did not significantly dif-

TABLE IV.—Surgical resection of CRC in 40 patients.

	Number	%
Colorectal cancer		
Surgical option		
Right colectomy	14	35%
Left colectomy	9	22.5%
Sigmoid colectomy	12	30%
Rectum anterior resection	5	12.5%

TABLE V.—Surgical option for HM resection in 40 patients.

	Number	%
HM of CRC patients		
Surgical option		
Segmentectomy	12	30%
Wedge resection	15	37.5%
Lobectomy (left)	3	7.5%
Metastasectomy	10	25%

TABLE III.—Morbidity and mortality.

	Intraoperative blood loss (cc)	Mean increase in operative time for metastasectomy (minutes)*	Mortality	Mean hospitalization time (days)
Colon (35 cases)	120 mL (range 80-320 cc)	20 (15-30)	0	11
Rectum (5 cases)	200 cc (range 100-400 cc)	20 (15-30)	0	12

*The procedure duration was longer during the first years of our study and for multiple lesions.

fer from that reported in literature for CRC resection.^{18, 24, 26-28}

The 69.7% of the 40 treated patients remained disease-free throughout the 2-year follow-up; new HM arose only in 10 cases (25%), with a mean disease-free interval of 13 months, but the hepatic tissue close to previous resection remained cancer-free. The overall 2 year-survival rate at month 24 was 85%; 3 patients died of cancer progression, one of ischemic heart disease, one of chronic obstructive pulmonary disease present at the time of first observation and one of complications of chemotherapy.²⁹⁻³¹ We have a complete 5-year-follow-up for all the 40 patients. During the follow up period between 2 and 5 years other 6 patients died for disease progression, those patients where all included among them who at 2 year follow-up already showed the arising of new HM. Finally, the overall 5 year-survival rate at is about 70%.

Discussion

Although no clear suggestions come from international guidelines on which clinical conditions require simultaneous CRC and HM resection instead of two-stage resection (as above), some studies point out that surgeons generally prefer the one-stage resection both in case of right colon cancer and small HM,^{32, 33} or in the case of rectal cancer and HM^{24, 27, 32, 34} or even in the presence of massive HM.³⁵⁻³⁷ Indeed, the complication rates reported in different studies is quite similar for the one-stage and the two-stage CRC and HM resection.^{38, 39} Furthermore, some authors point out that excellent results in the simultaneous resection of CRC and HM are obtained by surgeons well-trained in reference centers for hepatobiliary surgery.^{32, 40, 41}

Our surgical unit, although strongly interested in hepatobiliary surgery, has not had a high volume of surgical interventions in this sector until 2009 and consequently until then the treatment of CRC with HM was performed in two stages, resection of CRC before and radiofrequency for HM after.³⁵ Subsequently, after an exhaustive residential training at the liver surgery at the hepato-biliary unit of the Imperial College London, the Habib's Procedure resulted easy to

perform and safe in our hand. We mostly appreciated that in the Habib's Procedure hemostasis is achieved without Pringle's maneuver, which avoids prolonged and uncontrolled hypoxia potentially inducing an acute liver failure as well as an intestinal mucosal edema, anastomotic leakages, bacterial translocation and liver abscesses.

It is common opinion that the excellent results of the Habib procedure are based on various factors such as the effective hemostasis, the possibility of atypical or minimal resections, the favorable possibility of avoiding the Pringle maneuver, the possibility of preserving an important portion of the liver parenchyma and therefore to minimize the onset of liver failure. In addition, the use of the Habib procedures in the one-stage CRC and HM treatment provides other significant advantages we mentioned above in the Introduction Section.⁴²

The exhaustive training at Imperial College London has led us to achieve a great experience in the one-stage CRC and HM treatment with the Habib's Procedure, as shown by the results of this study: no intraoperative hepatic complications nor mortality, small not significant increase in operating time as compared with colectomy, minimal liver bleeding, an overall intraoperative blood loss similar to the standards reported for colectomy and never exceeding 200 mL.⁴³⁻⁴⁷ In addition, no liver failure nor mortality occurred during the postoperative course and the oncologic outcome was like that reported for CRC resection.^{24, 27, 34, 38} There valuable advantage of the Habib's procedure are the possibility to perform atypical resections and the easiness in obtaining and removing necrotic cancer wedges with tumor-free margins.⁴⁸ The results of our study combined with technological progress allows the hypothesis that one stage resection is possible also in mini invasive surgery.^{49, 50}

Conclusions

The adoption of the Habib's procedure in the one-stage CRC and HM surgical treatment was successful in all 40 treated cases. In fact, no intraoperative or postoperative death had occurred. The complication rate was comparable to that reported in literature for the two-stage sequential

treatment. HM has also been removed from otherwise difficult to reach segments without massive resection, significant areas of healthy liver parenchyma were saved and, as compared with the two-stage CRC and HM resection, the overall operative time and hospital stay were reduced.

Although several Authors have suggested to perform the one-stage CRC and HM resection in high volume hepato-biliary Centers, our data suggest that surgeons well-trained at a referral high volume hepato-biliary center may obtain excellent results even in surgical centers with a low/moderate hepato-biliary volume using a careful selection of patients and the Habib 4x device for HM resection. The results of our study moreover suggested that at nowadays, after an intensive residential training in high volume centers, and in consideration of continuous technological progression and consequential mini invasive procedures, one stage CRC and HM resection will be possible in surgical units who are not high volume for hepatic surgery also with a mini invasive approach.

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