

Hepatic Resection for Colorectal Metastases to the Liver: The National Cancer Centre/Singapore General Hospital Experience

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Abstract

Objective: To review and evaluate trends for short and long-term outcomes of patients who have undergone liver resection for colorectal metastases in a single institution over a period of 7 years. **Materials and Methods:** A retrospective review and analysis of clinicopathologic data and outcome of potentially curative liver resection for colorectal metastases in a series of 96 patients from January 1994 to December 2001 was done. Data were statistically analysed. Perioperative mortality, morbidity, overall survival and disease-free survival rates were reported. **Results:** A total of 96 patients underwent potentially curative liver resection for colorectal metastases. There were 64 males (66.7%) and 32 females (33.3%) with a median age of 60 years. There was no perioperative mortality. Postoperative morbidity was 7.2%. The median length of follow-up for the entire cohort of post hepatic resection was 29 months with 1-year and 3-year overall survival rates of 99% and 71%, respectively. The disease-free survival rates were 76% and 48%, respectively. Minor resections for the liver metastases showed significantly better overall survival. Primary tumour in the colon compared to rectum, disease-free interval (DFI) <12 months and adjuvant chemotherapy showed a trend towards shorter overall survival. Carcinoembryonic antigen (CEA) levels greater than 100 ng/mL significantly shortens the disease-free survival. **Conclusion:** Liver resection for colorectal metastases in our institution is a safe and effective treatment option in properly selected patients, which currently represents the best chance for long-term survival and possibly "cure".

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Key words: Audit, Colorectal cancer, Liver metastases, Liver resection, Outcome

Introduction

Colorectal carcinoma is the fourth most common malignancy and the second leading cause of death worldwide.¹ Although surgical resection in combination with adjuvant chemotherapy in certain cases provide curative treatment, more than 50% will develop metastases in the course of their disease. The liver is the most common site of metastases from colorectal cancer, and among those who develop liver metastases, 15% to 25% are detected as synchronous lesions while about 20% develop later in the course of the illness.² Most recurrences or metastatic disease are detected within 2 years after the initial surgical procedure for the primary disease.³ The median time to detection of liver metastases amenable to surgery in patients with colorectal cancer is 14 months from the time of resection of the primary tumour.⁴

At present, liver resection is considered the gold standard of treatment for isolated liver metastases from colorectal

cancer. It offers the best chance of cure with 5-year survival rates of 20% to 45%, and even 10-year survival rates between 12% and 21% following resections with curative intent (Table I).⁴⁻²¹ This compares favourably to a median survival of only 7 to 15 months if surgery is not possible.^{22,23}

Tremendous advances in the understanding and treatment of metastatic disease to the liver over the past decade have justified liver surgery and liver-directed therapy for properly selected patients when extrahepatic metastases have been excluded. The criteria for definitive metastatic liver surgery have also changed significantly in the past decade. The criteria for resection used to be 3 lesions or less, the largest less than 3 cm in size and confined to 1 lobe of the liver. Today, surgical resection may be offered to patients with adequate hepatic reserve, no extrahepatic metastases, and when at least a 1-cm tumour-free margin after resection can be achieved. The size, location and number of metastatic

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TABLE I: RESULTS OF LIVER RESECTION OF COLORECTAL LIVER METASTASES

Authors	Year	n	Operative mortality (%)	Operative morbidity (%)	3-year (%)	5-year (%)	10-year (%)
Cady ⁵	1985	23	0	-	-	-	-
Hughes ^{6*}	1986	859	-	-	-	45	-
Nordlinger ⁷	1987	80	13	51	40	25	-
Bismuth ⁸	1988	32	0	-	33	-	-
Schlag ⁹	1990	122	4	34	-	-	-
Docì ¹⁰	1991	100	5	-	-	30	-
Scheele ¹¹	1991	207	5.5	22	41	31	21
AFG ^{12**}	1992	1818	2	24	41	26	12
Rosen ¹³	1992	280	4	33.6	-	25	-
Gayowski ¹⁴	1994	204	0	33	-	32	-
Scheele ¹⁵	1995	424	4.4	22	-	33	-
Wanebo ¹⁶	1996	74	7	38	-	24	12
Fong ¹⁷	1997	456	2.8	24	-	38	-
Goldberg ¹⁸	1998	222	-	-	-	23	-
Fong ¹⁹	1999	1001	2.8	31	57	37	-
Bleeker ⁴	2000	42	-	-	-	40	-
Sugawara ²⁰	2001	331	0	-	59	46	-
Choti ²¹	2002	226	0.9	18.6	57	40	-
Current study	2002	96	0	7.2	71	-	-

* Multicentric study; ** Association of French Surgeons

lesions are no longer contraindications to surgery if a curative resection with clear margin is possible.

This retrospective study examines the hepatic resectional experience for colorectal metastases in a newly established hepatobiliary unit over a period of 7 years.

Materials and Methods

All patients seen at the National Cancer Centre, Singapore and/or the Singapore General Hospital for hepatic surgery from January 1994 to December 2001 were identified. One hundred eighteen patients underwent laparotomy for possible liver resection for suspected colorectal metastases. A retrospective analysis of a prospectively collected database was performed on 96 patients after excluding those who underwent exploration only, palliative surgery, non-resectional, intraoperative ablative procedures (alcohol injection, radiofrequency ablation), combined surgical and ablative procedures, and those in which histology showed pathology other than the radiographically suspected colorectal metastases. Patients with colorectal liver metastases evaluated were selected for liver resection based on the following criteria: 1) fully controlled primary colorectal cancer, 2) no signs and radiologic evidence of extrahepatic metastases at the time of detection of liver metastases, 3) adequate liver function can be preserved after liver resection with curative intent, 4) a clear margin of tumour clearance can be attained, and 5) medically fit for laparotomy.

All patients had routine diagnostic imaging prior to surgery. A triphasic computed tomography (CT) is the

basic imaging for liver metastases identification, localisation and planning. Extrahepatic disease was excluded by radionuclear bone scan, CT thorax, CT brain and CT abdomen and pelvis for recurrence. Intraoperative ultrasound (IOUS) was routinely used to confirm and detect any other lesions not detected by CT at the time of diagnosis.

Data were extracted from the hospital's computerised records system, patient case notes and telephone contact when necessary. Death within 30 days of operation was considered perioperative mortality. All postoperative morbidities were identified and reported.

Data examined included demographics (age and sex), pathology of primary colorectal cancer, pathology of liver lesion, operative and perioperative details including preoperative carcinoembryonic antigen (CEA) levels, blood loss, hospital stay, morbidity and surgical outcome. Eleven patients did not have preoperative CEA levels. In 8 patients, the amount of blood loss was not recorded.

Extent of resection was defined accordingly. Minor resection refers to anatomical and or non-anatomical resections of between 1 and 3 segments including wedge resections. Major resection refers to anatomical resections of 4 or more segments and thus includes hemihepatectomies and extended hemihepatectomies. Tumours were defined as solitary or multiple, unilobar or bilobar.

Statistical analysis was performed using the SPSS Version 10 software. Survival analysis was by Kaplan-Meier method. Differences in survival were compared using the

log-rank test. Chi-square or Mann-Whitney U tests were used for univariate cross-tabulation analysis, while multivariate analysis was performed with Cox proportional hazard regression model. Differences were significant if *P* values were less than 0.05.

Results

Ninety-six patients underwent liver resection with curative intent for colorectal metastases in the Singapore General Hospital from January 1994 to December 2001. Those who had repeat hepatectomies were not included in the study. There were 64 males (66.7%) and 32 females (33.3%) with a median age of 60 years (range, 24 to 78 years). The number of liver resections per year gradually increased from 2 liver resections per year in 1994 and 1995 to an average of 12 per year thereafter. There were 23 deaths at the time of follow-up evaluation. Twenty deaths were secondary to recurrent disease and the remaining 3 were non-tumour related (Table II). The median follow-up duration was 29 months, with the longest follow-up duration of survivors at 76 months.

The primary lesion was in the colon in 70 cases (72.9%) and in the rectum in 26 cases (27.1%). Fifty-seven had nodal disease of which 74% were N1. Ninety per cent of the tumours were moderately differentiated adenocarcinoma on histological grading. Liver metastases presented synchronously with the primary colorectal tumour in 31.6% of cases. In the remaining 68.4% with metachronous lesions, the median time to occurrence was at 14 months (range, 3 to 72 months). Of these, 55.4% had positive nodal disease in the primary tumour. Fifty-two per cent of these patients presented with a rising trend in their CEA levels, while 46% of these metachronous lesions were asymptomatic, but lesions were found on routine follow-up radiographically and 2 others complained of pain and loss of weight, which prompted investigation.

Fifty-five patients presented with solitary lesions, while the remaining 38 patients had multiple metastases to the liver. Of the 38 multiple lesions, 20 patients had bilobar

disease while 12 patients presented with lesions confined to the right lobe and 6 had multiple lesions in the left lobe. The median size of the metastatic lesions was 3.5 cm (range, 0.7 to 21.5 cm) with 27 patients (28%) having tumours more than 5 cm in the widest diameter. Median preoperative CEA value was calculated at 14.0 ng/mL (range, 0.04 to 4007 ng/mL) and 17 patients had CEA levels greater than 100 ng/mL.

Forty-nine (51%) major resections and 47 (49%) minor resections were performed. Table III shows the distribution of hepatic resections performed. The median amount of blood loss was 500 mL (range, 100 to 1500 mL). Pringles manoeuvre was performed in 24 cases and there was no record of whether this was performed in 9 cases. Margins were grossly clear of tumour in all cases. Clips were applied in cases where margins were suspected to be close due to proximity to important vascular structures. Six cases (6.25%) were found to have microscopically involved margins. There was no 30-day mortality encountered and the median hospital stay was 7 days (range, 3 to 23 days). Postoperative complications are listed in Table IV. The morbidity rate was 7.2%. By far, the most common complications encountered were wound and chest infections. Only 1 patient required admission to intensive care unit for postoperative thyroid crisis in an unsuspected hyperthyroid patient.

Kaplan Meier curve for overall and disease-free survival is plotted in Figure 1.

The median survival from the time of resection of primary colorectal cancer was 88 months. The median length of follow-up after resection of liver metastases was 29 months, with an overall 1-year and 3-year survival rates of 99% and 71%, respectively. Disease-free survival was 76% at 1 year and 48% at 3 years, with a median recurrence-free survival of 32.2 months. At the time of follow-up evaluation, 47 out of 73 patients (64.4%) were alive without recurrence. The remaining 26 patients (35.6%) were alive with recurrence (Table II).

All factors were analysed to determine any relation to long-term outcome after liver resection. Sex and age of the

TABLE II: SURVIVAL STATUS AND RECURRENCE

Site of recurrence	Dead	Alive	Total
None	3	47	50
Liver	5	8	13
Lung	3	6	9
Liver and lung	6	2	8
Liver + others*	1	1	2
Lung + others*	0	2	2
Liver + lung + others	3	3	6
Others*	2	4	6
Total	23	73	96

* Others include bone, brain and peritoneal metastases

TABLE III: TYPE OF OPERATIONS PERFORMED

Operation	n
Wedge resection	5
Segmental resection	36
Left lateral resection	14
Left hemihepatectomy	14
Right hemihepatectomy	21
Extended left hemihepatectomy	1
Extended right hemihepatectomy	5
Total	96

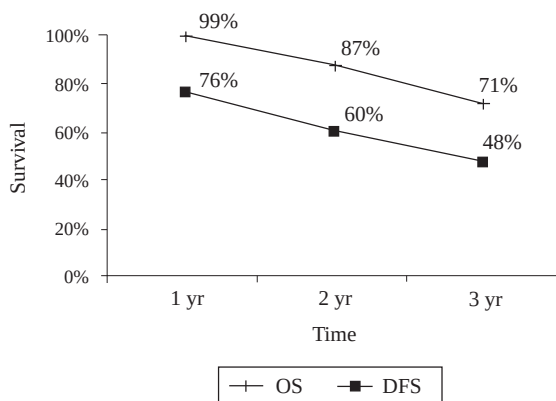


Fig. 1. Overall survival (OS) and disease-free survival (DFS) post hepatic resection for colorectal liver metastases.

TABLE IV: COMPLICATIONS

Complications	n
Liver failure	0
Bile leak	0
Bleeding postoperatively	0
Cardiac event	0
Major respiratory event	0
Infection	
Wound infection	2
Chest infection	3
Intra-abdominal	1
Others (thyroid crisis)	1
Total	7

patient at the time of liver resection did not appear to affect long-term outcome. However, the site of primary tumour seemingly predicted outcome. Patients whose primary tumour was in the colon had a median survival of 72 months as compared to those with primary rectal tumours at 53 months (Table V). Although nodal status of the primary tumour did not adversely affect long-term survival, (Table V) the node positive group showed a shorter 3-year disease-free survival of 34% as compared to 63% in the node negative group (Table VI).

There was a trend towards a better 3-year survival when disease-free interval from primary tumour to occurrence of liver metastases was more than 12 months (Table V). CEA level on the other hand did not affect long-term survival, but levels more than 100 ng/mL showed a shorter disease-free survival with a median of 11 months compared to those whose CEA levels were less than 100 ng/mL. This was statistically significant with a 3-year disease-free survival of 57% (Table VI).

Size, number and distribution of liver metastases did not show a difference in long-term survival and disease-free survival (Table V).

TABLE V: UNIVARIATE ANALYSIS OF OVERALL SURVIVAL

Variable	n	3-year survival (%)	P
Overall	96	52	
Age (years)			0.319
<60	52	72	
>60	44	71	
Sex			0.108
Male	64	65	
Female	32	90	
Primary site			0.079
Colon	70	78	
Rectum	26	60	
Primary tumour			0.454
Node-negative	39	74	
Node-positive	57	70	
Disease-free interval			0.076
<12 months	36	54	
>12 months	60	82	
CEA (ng/mL)*			0.312
<100	68	79	
>100	17	58	
No. of tumours			0.695
Solitary	58	71	
> 1	38	68	
Tumour size			0.939
<5 cm	68	74	
>5 cm	28	66	
Resection			0.036
Major	49	60	
Minor	47	80	
Margins			0.95
Clear	90	72	
Positive	6	75	
Chemotherapy			0.101
No	29	55	
Yes	67	79	

* CEA level obtained in only 85 cases

There were different views on the impact of resection margins on long-term survival.^{7,17,19,24-31} In our small cohort of patients, this was found to be not statistically significant. The majority of the subjects in this study had clear margins on gross (100%) and microscopic (94%) evaluation. Of the 6 patients with positive microscopic margin, 3 out of the 6 patients had recurrences. Of these 3, 1 had isolated liver recurrence near the margin, 1 had isolated lung recurrence and the third had bone and lung disease. There was only 1 death at 19.5 months post liver resection.

When the extent of resection was analysed, patients who had undergone minor resections have better long-term survival, which proved to be statistically significant with a 3-year survival of 61% versus 36% (Table V). This may be a reflection of the extent of liver involvement by the metastatic lesion.

There were no extrahepatic metastases noted at the time

TABLE VI: UNIVARIATE ANALYSIS OF DISEASE-FREE SURVIVAL

Variable	n	3-year survival (%)	P
Overall	96	48	
Age (years)			
<60	52	53	0.764
>60	44	38	
Sex			
Male	64	46	0.455
Female	32	52	
Primary Site			
Colon	70	50	0.709
Rectum	26	43	
Primary tumour			0.167
Node-negative	39	63	
Node-positive	57	34	
Disease-free interval			0.658
<12 months	36	40	
>12 months	60	51	
CEA (ng/mL)			0.004
<100	68	57	
>100	17	22	
No. of tumours			0.256
Solitary	58	49	
>1	38	42	
Tumour size			
<5 cm	68	70	0.154
>5 cm	28	47	
Resection			0.403
Major	49	40	
Minor	47	54	
Margins			0.574
Clear	90	50	
Positive	6	53	
Chemotherapy			0.861
No	29	48	
Yes	67	48	

* CEA level obtained in only 85 cases

of all liver resections for colorectal metastases in the population studied, although 1 patient underwent a right hemihepatectomy plus excision of the right rectus muscle for tumour invasion through the abdominal wall.

Twenty-four out of 30 (80%) patients with synchronous metastases and 45 out of 66 (68%) patients with metachronous liver metastases received adjuvant chemotherapy. Of the 39 patients who had a Duke's C primary lesion, 23 received adjuvant chemotherapy after resection of the primary colorectal cancer and 10 received adjuvant treatment post liver resection. On the other hand, 12 out of 27 patients with Duke's B primary received adjuvant chemotherapy after resection of the primary tumour and 5 received adjuvant treatment post liver resection. Although our data showed a trend towards better 3-year survival in those who received chemotherapy, there was no standardised protocol as to which group of patient was subjected to adjuvant treatment (Table V).

When patterns of recurrence were analysed, a total of 29 recurrences in the liver developed over time. Thirteen patients had recurrence confined to the liver. Only 1 of them had microscopically positive margin from the first liver resection after a left hemihepatectomy. Of the 13 patients with recurrence in the liver only, 7 patients had major resections while 6 had minor resections. Only 2 recurrences in these 13 patients occurred adjacent to the surgical margin, although the margins were grossly and microscopically clear previously. In the remaining 16 patients who had extrahepatic metastases concurrently, 12 patients previously had minor resections and 4 patients had major resections in which margins were all clear. The numbers are probably too small for meaningful interpretation.

Using disease-free interval, CEA level, nodal status of the primary tumour, size and number of liver metastases, surgical margins, adjuvant chemotherapy and patterns of recurrence as variables, Cox regression analysis was performed. Due to the small number of subjects studied, none were found to be independent predictors of survival except recurrent disease, although positive nodal status followed by multiple liver metastases showed a trend towards poorer long-term survival.

Discussion

Colorectal cancers will invariably recur in up to 50% of cases and approximately half of these will be confined to the liver only. Identification of patients with isolated liver metastases is the goal of follow-up protocols for colorectal cancer, with the hope that recurrent or spread of disease may be detected early and made amenable to curative liver resection. Several risk factors for the development of hepatic metastases were determined from the various published series of patients with metastatic colorectal carcinoma, the most consistent and strongest risk factor being the stage of the primary tumour. Other risk factors of note were vascular invasion and the site of the primary lesion. Although venous invasion of the tumour correlates with increased risk of metastases, its role as an independent prognostic factor remains unclear because venous invasion correlates with tumour stage.^{32,33}

The differing patterns of venous drainage from the colon (portal system) and the rectum (systemic venous drainage) have been proposed as a reason for a colonic primary to have a greater risk for hepatic metastasis than a rectal primary. Two series with a total of over 3000 patients showed a trend towards higher incidence of liver metastases from colon primaries.³³ In patients presenting with liver metastasis, the primary tumour is in the colon in 75% and rectum in 25% of the cases.³⁴ Data from our study concurred with these findings.

Apart from history and careful physical examination, multiple diagnostic options such as CEA levels, colonoscopy and imaging modalities are used in the follow-up of patients with colorectal cancer to screen and identify recurrences and metastases. In most cases, a rising CEA will call for at least an ultrasound (US) of the liver to detect any metastatic lesions in the liver. Although sensitivity of US is low compared to CT, it is widely used as the first step in the screening process because of its cost advantage. However, CT is recognised as being more accurate and better for detecting as well as characterising liver lesions. However, an optimum CT examination includes one with intravenous contrast to enable characterisation of the lesions. Valls et al³⁵ reported an overall detection rate of 85% with a positive predictive value of 96.1% and a false positive rate of 3.9% on helical CT. Resectability rate was established at 94.1%. In our practice, the triphasic CT is the workhorse imaging modality for confirming metastatic disease and planning therapy.

The use of IOUS is regarded as a reliable method of detecting hepatic metastases that may be missed on CT. Comparisons performed on a 'lesion-by-lesion' basis reported superior sensitivities for IOUS compared to preoperative US and CT findings. IOUS has been reported to detect impalpable and preoperative undetected lesions in 14% to 24%.³⁶ Zacherl et al³⁷ reported that IOUS offered new information in about 20% of patients with colorectal metastases that had an impact on surgery and influenced the extent of hepatic resection in 21.3%. Concerning the oncologic goal of curative surgery, IOUS was an important aid in guiding resection and determining margins. As reported in the literature, introduction of IOUS beneficially influenced the surgical outcome.^{21,37,38} We routinely use IOUS to confirm preoperative CT findings, detect missed lesions if any and reassess location of tumours and its proximity to vital structures to guide the surgical procedure. Based on our experience, IOUS detected lesions missed by CT in 8.3% of cases and changed the preoperative surgical decision in 11 cases (11.5%) (data not shown).

To date, surgical resection of liver metastasis from colorectal cancer is the only hope for long-term survival if not for cure. This can be performed with less than 5% mortality and an acceptable morbidity.³⁹ Published data show a 25% to 40% 5-year survival following liver resections with curative intent. The largest multicentric study of the French Surgical Association implied definite cure by surgery with a 10-year survival of 12% to 21% in some patients.⁴⁻²¹

The value of surgical resection of metastatic liver disease from colorectal cancer is confirmed when compared with the natural history of untreated hepatic metastases where the median survival is 7 to 15 months.^{22,23} Although at

present there are no prospective randomised comparative studies to validate the results of surgical resection, the benefit of liver resection for metastatic colorectal cancer remains consistent as the only acceptable treatment that provides long-term survival. In fact, it has been suggested that patients that are disease free 5 years after liver resection are likely to have been cured although they should be aggressively followed-up for recurrence because of the potential for further treatment then and longer-term survival.⁴⁰

However, careful preoperative assessment of candidates for surgical resection of colorectal metastasis to liver must be done based on the following premises: 1) extrahepatic disease must be excluded, 2) at least a 1-cm tumour free margin can be obtained, and 3) patient must have sufficient hepatic functional reserve.⁴¹⁻⁴³

Various clinical and pathological features have been studied by different institutions to suggest prognostic factors and criteria for resection of colorectal metastases to the liver.^{29,41-47} The following factors were associated with a better survival rate after a liver resection with a curative intent in univariate analysis: 1) N0-N1 stage of the colorectal primary, 2) largest metastasis was less than 7 cm in diameter, 3) postoperative normalised CEA level (in patients whose preoperative CEA were elevated >4 ng/dL), 4) wedge resection as compared to hemihepatectomies. The N stage and size of the largest metastatic lesion specifically influences disease-free survival.^{28,29} Conversely, negative prognostic factors included: 1) detection of metastatic disease from clinical signs and symptoms, 2) markedly elevated CEA level, 3) more than 6 lymph nodes involved in the primary lesion, 4) a satellite pattern of metastases in the liver, 5) bilobar hepatic disease, 6) a positive resection margin, 7) extrahepatic nodal involvement, and 8) poorly differentiated primary tumour. A multivariate analysis of prognostic factors in 3427 patients with resected hepatic metastasis showed that the disease-free interval, grading and number of metastatic deposits are independent variables in 50% of the analyses.⁴¹

A retrospective study of 456 consecutive patients done by Fong et al¹⁷ concluded that the only absolute contraindications to hepatic resection are extrahepatic metastases and tumours larger than 10 cm in diameter. These factors were associated with only 13% and 14% 5-year survival rates, respectively. In our series, extrahepatic disease was a definite contraindication, although size alone was not. There were 11 cases of tumours, 10 cm or larger, resected with a reasonable 3-year survival rate of 86% although the numbers were small and the cases well selected.

A follow-up study was recently published in which a clinical risk scoring (CRS) system for predicting recurrence after hepatic resection was formulated based on a

TABLE VII: SITES OF RECURRENCE AFTER INITIAL HEPATECTOMY

Study	Curative resections	Recurrence	Liver	Lung	Others*
Hughes ⁶	607	424 (70%)	191 (31%)	96 (16%)	57 (9%)
Ekberg (quoted in Hughes ⁶)	68	53 (78%)	44 (65%)	15 (22%)	22 (32%)
Scheele (quoted in Hughes ⁶)	173	106 (61%)	74 (70%)	50 (47%)	16 (15%)
Nakamura (quoted in Hughes ⁶)	64	45 (70%)	31 (48%)	16 (25%)	16 (25%)
Rees ⁴²	89	49 (55%)	34 (69%)	16 (33%)	6 (12%)
Fujita ⁵¹	97	68 (70%)	41 (60%)	21 (30%)	12 (17%)
Current	96	46 (48%)	29 (30%)	25 (26%)	16 (17%)

* Others include bone, brain and peritoneal metastases

retrospective analysis of 1001 consecutive patients.¹⁹ The following factors were considered significant predictors and given one point each: node positive primary, disease-free interval less than 12 months, more than one lesion, size more than 5 cm and CEA >200 ng/mL. A CRS of 0, 1 and 2 have a highly favourable outcome and resection is undoubtedly reasonable and encouraged whenever possible. Patients with a CRS of 3 or 4 have a guarded prognosis and resection should be planned in the context of adjuvant therapy. A score of 5 implies very poor outcome and therefore, surgery is highly questionable. This clinical risk score may serve to either improve patient selection for curative resection or to validate the necessity for aggressive adjuvant therapy to eradicate residual microscopic disease in the setting of poor clinical scores. Likewise, this may serve as a score to deselect patients as well and encourage the potential roles of additional imaging modalities and aggressive evaluation for improved detection of metastatic disease. We looked at the same factors to predict long-term survival and recurrence in our study. Due to the immature data and insufficient number of patients, our data did not show statistically significant results, although there was a trend towards poor long-term survival in those with rectal primaries, node positive primaries and disease-free interval of less than 12 months. While higher CEA levels did not significantly affect overall survival, it significantly affects disease-free survival. Likewise, our study showed that those who underwent minor resections have a better 3-year survival rate. This may be attributed to the small sized tumours and adequate resection margins.

The role of adjuvant chemotherapy after potentially curative liver resections for colorectal metastases is indeterminate.^{48,49} Some studies showed that adjuvant chemotherapy did not improve survival mainly due to the adverse side effects of chemotherapy even though these were administered regionally as hepatic arterial infusions. Figueras et al⁵⁰ recently proposed the benefit of adjuvant

systemic chemotherapy after curative liver resection. They have shown that 5-year survival rates increased from 25% to 53% when adjuvant chemotherapy was administered post resection. Although this study provided some evidence that postoperative chemotherapy improved long-term outcome, most of the subjects who received adjuvant chemotherapy were younger and had synchronous metastases of which a big proportion had not received chemotherapy previously. Thus, adjuvant chemotherapy post liver resection deserves to be elucidated by further randomised-controlled trials.

Despite a significant improvement in survival of patients who underwent curative resections, up to 75% of patients will experience recurrence in one or more sites within the first 2 years.^{3,5,25,30,31,33} In most series, the liver is still the most common site of recurrence followed by the lungs and peritoneal dissemination. Our data showed a similar pattern of recurrence although the recurrence rate at 48% is lower when compared to most series (Table VII).

The management of metastatic disease from colorectal cancer continues to be a challenge. In the setting of an established hepatobiliary unit, 0% mortality, low morbidity rate at 7.2%, median blood loss of 500 mL and a median hospital stay of 7 days can be achieved for liver resections for colorectal metastatic disease. Although our series is small and early in experience, our preliminary results show a respectable 3-year survival of 71% and a projected 5-year survival of 52% on Kaplan Meier analysis (to be validated on long-term follow-up). A combination of careful patient selection and improvements in surgical techniques has enabled some form of control for this common problem after apparent curative therapy for a colorectal primary.

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