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Laparoscopic Surgery for Splenic Flexure Cancers: Short and Long-Term Outcomes in Comparison with Conventional Open Surgery

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Abstract

Background: Laparoscopic resection of splenic flexure cancers remains controversial. This study reviews the management of splenic flexure tumours, comparing outcomes between laparoscopic (LR) and open (OR) resections.

Methods: All patients undergoing surgery for a splenic flexure colonic carcinoma at two tertiary level institutions between January 2000 and July 2011 were identified. Data were collected on patient demographics, operative detail, histological data and follow up status. Data was analysed using SPSS version 19.

Results: A total of 111 patients were included in the study: 40 LR and 71 OR. The overall conversion rate in the LR group was 7.5%. Oncological outcomes between the two groups were similar, with no statistically significant differences observed with regards to lymph node yield, margin status, overall survival and recurrence rates. The median length of stay in the laparoscopic group was 10 days compared to 18 days in the open group (p=0.05). No significant differences were seen between the two groups with regards to post-operative morbidity, with rates of 35.1% and 25.7% in the laparoscopic and open group respectively, p=0.30. However, the grade of complication was significantly lower in the laparoscopic group compared to the open group, with grade III Clavien-Dindo rates of 7.7% and 42.1% respectively, p=0.05.

Conclusion: Our study adds to the growing evidence base advocating laparoscopic surgery as technically safe and feasible option in the operative management of splenic flexure tumours, with comparable oncological and clinical outcomes compared to open surgery.

Keywords: Splenic flexure cancer; Laparoscopic surgery

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Introduction

Splenic flexure tumours account for 3-8% of all colonic malignancies, and are traditionally associated with a high risk of obstruction and poor prognosis [1]. The management of splenic flexure tumours is challenging, with a range of surgical options available from segmental resection to subtotal colectomy. The role of laparoscopic surgery has not been fully elucidated in the management of this group of tumours, as splenic flexure tumours were not included in the previous randomised controlled trials [2,3]. There are a number of technical considerations when considering laparoscopic resection in this group, including type of operation, lymph node yield, high tie evaluation and potential for splenic injury.

This study reviews our experience in managing splenic flexure tumours, comparing outcomes between laparoscopic and open resections.

Methods

All patients undergoing surgery for a splenic flexure colonic carcinomaat two tertiary level hospitals between January 2000 and July 2011were identified retrospectively. Local ethical approval was sought for the study. A splenic flexure carcinoma was defined as a carcinoma located between the distal third of the transverse colon and the first part of the descending colon [4]. Pre-operative workup included physical examination, colonoscopy, staging computed tomography of the thorax, abdomen and pelvis. Definitive diagnosis of a splenic flexure cancer was confirmed intra-operatively

Table 1: Classification of Surgical Complications – The Clavien- Dindo Classification.

Grade	Definition
I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Allowed therapeutic regimens are: drugs as anti-emetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included
III	Requiring surgical, endoscopic or radiological intervention
IIIa	Intervention not under general anaesthesia
IIIb	Intervention under general anaesthesia
IV	Life-threatening complication (including CNS complications)* requiring IC/ICU management
IVa	Single organ dysfunction (including dialysis)
IVb	Multi-organ dysfunction
V	Death of a patient

*Brain haemorrhage, ischemic stroke, subarachnoid bleed, but excluding transient ischemic attacks. CNS: Central Nervous System; IC: Intermediate Care; ICU: Intensive Care Unit

Table 2: Patient and Operative Demographics.

Variable	No (%)
Median Age	68 years
Gender	
Male	62 (55.4)
Females	49 (43.8)
Operative Approach	
Laparoscopic	40 (35.7)
Open	71 (64.3)
Urgency	
Elective	86 (77.5)
Emergency	25 (22.5)
Operative Procedure	
Left Hemicolectomy	35 (31.5)
Extended Right Hemicolectomy	45 (40.5)
Subtotal Colectomy	22 (19.8)
Segmental Resection	8 (7.2)
Panproctocolectomy	1 (0.9%)
Multivisceral Resection	
Yes	13 (11.6)
No	98 (88.4)
Splenic Injuries	7 (6.6)

Table 3: Post-Operative Outcomes.

Variable	No (%)
30 Day Mortality	5 (4.5)
30 Day Morbidity	32 (28.8)
30 Day Re-operative Rates	5 (4.5)
Complication Type	
Anastomotic Leak	4 (12.5)
Wound Infection	4 (12.5)
Ileus	5 (15.6)
Intra-abdominal collection	4 (12.5)
Enterocutaneous Fistulae	2 (6.3)
Pneumonia	5 (15.6)
Urosepsis	5 (15.6)
Myocardial Infarction	1 (0.9)
Seizure	1 (0.9)
Small Bowel Obstruction	1 (0.9)
T Stage	
T1	3 (2.7)
T2	7 (6.3)
T3	55 (49.1)
T4	41 (36.6)
Unknown	5 (4.5)
Nodal Status	
N0	57 (51.4)
N1	41 (36.9)
N2	8 (7.2)
Unknown	5 (4.5)
Dukes Stage	
A	10 (9.0)
B	44 (39.6)
C	44 (39.6)
D	6 (5.4)
Unknown	7 (6.3)
Margin Status	
R0	99 (89.2)
R1	2 (1.8)
R2	1 (0.9)
Unknown	9 (8.1)

by visualisation of the lesion or a tattoo.

Inclusion criteria for the study included a histologically confirmed adenocarcinoma located at the splenic flexure in an adult patient. Exclusion criteria included patients with synchronous colonic cancers and patients undergoing an elective palliative operation.

Data were collected on patient demographics, presentation of disease, operative detail, multimodal therapy, histological data and follow up status. All complications were graded according to the Clavien-Dindo classification. This is an acceptable and validated method of documenting surgical complications. The system is divided into 7 grades, reflecting the varying severity of post-operative complications (Table 1).

Statistical analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 19.0 (SPSS™, Chicago, Illinois). Survival analysis was performed using the Kaplan-Meier method, with differences between the curves tested using the log-rank test. Differences between the groups were analysed using the independent t-test or chi-squared test as appropriate on an intention to treat basis. A P value of <0.05 was used to denote statistical significance.

Results

One hundred and eleven patients, including 49 (43.8%) female underwent surgery with curative intent. Median age at time of surgery was 68 (IQR 60-77) years. Twenty-five (22.3%) patients underwent emergency surgery for an obstructing or perforated malignancy. Forty (35.7%) patients underwent a laparoscopic resection, 3(7.5%) patients had a laparoscopic procedure converted to an open procedure. Thirteen (11.6%) patients underwent a multivisceral resection to gain optimal oncological control. Iatrogenic injury requiring splenectomy was observed in 7 (6.6%) cases. Patient demographics and operative details are outlined in (Table 2).

Post-operative outcomes

Thirty-day mortality was 4.5%. Thirty-day morbidity rate was

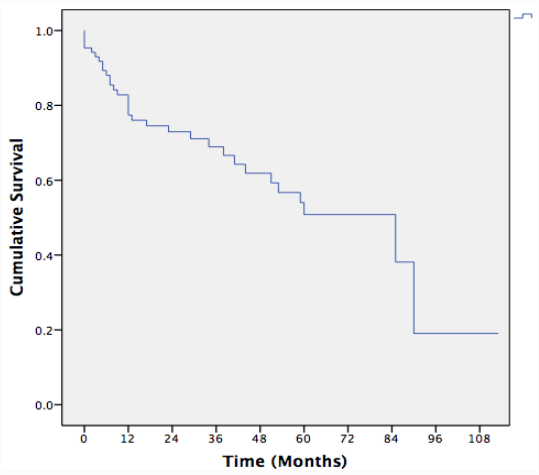

Figure 1: Overall Cumulative Survival.

28.8%, with a total of 32 complications observed. Re-operation rate was 5 patients (4.5%); 3 for an anastomotic leak, 1 for small bowel obstruction and 1 for drainage of an intra-abdominal collection. Median overall length of stay was 12 (IQR 6-20) days. Post-operative and histological data are outlined in (Table 3).

Survival outcomes

Median overall follow up from time of surgery to death or last clinical encounter was 26.5 months (IQR 7 – 57), with a mean follow up of 31.4 months. Mean follow up in the laparoscopic group was 27.2 months compared to 39.4 months in the open group (p=0.05).

Overall five year survival was 49%, 5 year disease free survival was 64% with an overall median survival of 85 months (Figure 1). Locoregional relapse occurred in 22 (15.2%) patients, with local recurrence in 8 (7.1%) patients, hepatic metastases in 5 (4.5%), pulmonary metastases in 2 (1.8%) patients, hepatic and pulmonary metastases in 1 (0.9%) patient and pulmonary and cerebellar metastases in 1 (0.9%) patients.

Laparoscopic vs. open surgery

There was no statistically significant difference between age and gender in the laparoscopic and open groups (Table 4). A significantly higher proportion of patients underwent an open operation when presenting as an emergency, with rates of 31.1% vs. 5.4% for laparoscopic surgery, p=0.02. A higher proportion of advanced T4 splenic flexure cancers were observed in the open group compared to the laparoscopic group, with rates of 44.3% vs. 27.8%, p=0.02. A higher proportion of patients in the open group underwent a multivisceral resection compared to the laparoscopic group, with

Table 4: Comparison of Outcomes in the Laparoscopic versus Open Group.

Factor	Laparoscopic Group No (%) N=37	Open Group No (%) N=74	P Value
Median Age	68	66	0.896
Sex M:F	17: 20	45:29	0.25
Urgency of Operation			
Elective	35 (94.6)	51 (68.9)	
Emergency	2 (5.4)	23 (31.1)	0.02
Operation Type			
Segmental Resection	18 (48.6)	16 (21.6)	
Extended Right Hemicolectomy	11 (29.7)	34 (45.9)	
Left Hemicolectomy	3 (8.1)	20 (27.0)	
Subtotal Colectomy	4 (10.8)	4 (5.4)	0.01
Panproctocolectomy	1 (2.7)	0 (0.0)	
T Stage			
T1	3 (8.3)	0 (0.0)	
T2	4 (11.1)	3 (4.3)	
T3	19 (52.8)	36 (51.4)	0.02
T4	10 (27.8)	31 (44.3)	
N Stage			
N0	24 (66.7)	33 (47.1)	
N1	9 (25.0)	32 (45.7)	0.11
N2	3 (8.3)	5 (7.1)	
Dukes Stage			
A	7 (19.4)	3 (4.4)	
B	16 (44.4)	28 (41.2)	
C	11 (30.6)	33 (48.5)	0.23
D	2 (5.6)	4 (5.9)	
No of Splenectomies	0 (0.0)	7 (6.6)	0.05
Median No of Lymph Nodes Harvested	19	20	0.63
No of Multivisceral Resections	1 (2.7)	11 (17.1)	0.03
No. of R0 resections	35 (97.2)	64 (97.0)	0.23
No of Complications	13 (35.1)	19 (25.7)	0.30
Clavien-Dindo Grade of Complication			
I	1 (7.7)	6 (35.0)	
II	11 (84.6)	5 (26.3)	
III	1 (7.7)	8 (42.1)	0.05
Median Length of Stay (Days)	10	18	0.05
Mean Length of Survival (Months)	27	34	0.45
No of Recurrences	5 (13.5%)	17 (23.0%)	0.29

rates of 17.1% vs. 2.7%, p=0.03. No splenectomies were carried out in the laparoscopic group compared to 6 in the open group (p=0.05). Median survival in the laparoscopic group was 27 months vs. 34 months in the open group (p=0.45). The median length of stay in the laparoscopic group was 10 days compared to 18 days in the open group (p=0.05). No significant differences were seen between the two groups with regards to post-operative morbidity, with rates of 35.1% and 25.7% in the laparoscopic and open group respectively, p=0.30. However, the grade of complication was significantly lower in the laparoscopic group compared to the open group, with grade III Clavien-Dindo rates of 7.7% and 42.1% respectively, p=0.05.

Discussion

There has been much debate around the validity of laparoscopic surgery in the management of splenic flexure tumours, with the main controversy surrounding the issue of optimal oncological clearance, with regards to the correct operation and adequate lymph node yield. Lymph node status has oncological implications, dictating the need for further treatment in the form of chemotherapy. Consequently, the oncological and surgical outcomes of laparoscopic management of this group have not been examined in previously published randomised controlled trials [5,6]. Our study is the one of the largest series documenting outcomes in splenic flexure tumours and drawing comparisons between open and laparoscopic resections.

Tumours located at the splenic flexure pose a range of technical dilemmas due to its variable blood supply and dual lymphatic drainage. In 89% of cases the blood supply to the splenic flexure is carried by the inferior mesenteric artery via the left colic, and by the superior mesenteric artery via the middle colic artery in 11% [7]. The middle colic artery is absent in between 5 – 22% of patients [7]. This has led to ongoing debate in the literature with regards to the optimal operation, vascular high tie and adequate lymph node yield in this cohort of patients, with some authors advocating extended resection in the form of right hemicolectomy [8], whilst others advocate segmental resection [9,10]. Typically, the operation type undertaken is left to the discretion of the operating surgeon, depending on stage of tumour, adjacent organ involvement, patient age and co-morbidities. In this series, a range of operations were undertaken, with no differences in survival observed based on operation type. Furthermore, a higher proportion of splenic flexure tumours requiring multivisceral resection were carried out in the open group compared to the laparoscopic group (17.1% vs. 2.7%, p-0.03).This is further reflected by the significantly higher proportion of T4 tumours observed in the open group, with 44% of T4 tumours in this group, thus suggesting there is a selection bias towards open surgery in advanced splenic flexure cancers.

With advancing knowledge and experience in laparoscopic surgery combined with advances in laparoscopic instrumentation there is increasing interest in undertaking laparoscopic resections for transverse colonic and splenic flexure tumours. Kim et al. [11] reported no statistically significant difference in oncological outcomes between laparoscopic and open surgery in 87 patients with transverse colonic cancer, of which 20 were located at the splenic flexure. Interestingly, this group reported a higher lymph node yield in the laparoscopic group Vs. the open, with 26.1 and 22.7 nodes obtained respectively (p>0.05). Schlachta et al. [12] compared laparoscopic outcomes between transverse colon tumours, including tumours located at the splenic flexure, and other colonic tumours. This group reported a statistically significant greater yield of lymph nodes in the transverse colon group compared to other colonic lesions. We did not observe this in our study, however we documented a comparable lymph node yield, with a median of 19 in the laparoscopic group compared to 20 in the open group, p=0.63. However, our study identified lymph node status to be a statistically significant prognostic factor of overall survival (p=0.01). These observations have important oncological implications with regards to further treatment and overall survival, thus suggesting a laparoscopic approach is oncologically safe, and is a comparable mode of surgery in this cohort.

Previous literature documenting outcomes in splenic flexure tumours have drawn comparisons with a heterogeneous control group, consisting of tumours located in various positions around the colon [9,12], with potential biological differences effecting outcomes. Benedix et al support this observation reporting a higher number of prognostically unfavourable tumours located at the splenic flexure compared to other colonic sub sites [13]. Our study addresses this by comparing the mode of surgery in a single cohort of tumours, thus eliminating any bias secondary to tumour biology based on colonic location.

The rate of inadvertent splenic injury in splenic flexure tumours has been reported to be 6%, compared to 2% in descending colon tumours and 1% in transverse colon tumours. McGory et al. [14] reported a statistically significant reduction in survival in patients with colonic cancer and inadvertent splenic injury, with an increased probability of death by 40% (p=0.001). We were unable to reproduce a similar statistically significant relationship, between inadvertent splenic injury and survival, however we observed a similar trend. Our rate of inadvertent splenic injury is comparable at 6.6%, with no injuries observed in the laparoscopic group (p=0.05). It postulated the reduced rate of inadvertent splenic injuries in this group is due to a combination of factors including: improved views, using angled scopes and high definition optics, less likelihood of injury due to reduced tissue traction during laparoscopic dissection and less advanced tumours.

In keeping with previously published data on colectomy [15], we observed a statistically significant shorter length of stay in the laparoscopic group compared to the open surgery. Laparoscopic colorectal surgery is associated with a shorter length of stay, reduced post-operative morbidity and reduced blood loss, with comparable oncological outcomes to open surgery [16], thus making it an acceptable and attractive mode of surgery. Our data concur with a smaller study by Ceccarelli et al on laparoscopic splenic flexure tumour resection, They had acceptable operating times, with a mean of 183.6 minutes, mean blood loss of 98mls, mean lymph node harvest of 9.2 nodes and an overall post-operative morbidity rate of 13.3% [17]. Similar to our study, this group did not observe any splenic injuries.

There are several important limitations to our study. Firstly, the use of non-randomisation of patients leads to selection bias which means the data should be interpreted with caution. Secondly, differences in the follow up period between the two groups may lead to survival bias, with the overall follow up period in the laparoscopic group being too short to currently assess long term outcomes.

Conclusion

Our study adds to the growing evidence base advocating laparoscopic surgery as technically safe and feasible option in the operative management of splenic flexure tumours, with comparable

oncological and clinical outcomes compared to open surgery.

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