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Surgery for Obstructed Colorectal Malignancy in an Asian Population: Predictors of Morbidity and Comparison Between Left- and Right-Sided Cancers

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Abstract
Introduction Surgical treatment of obstructed colorectal cancers has been associated with significant perioperative morbidity and mortality. This study was performed to review the spectrum of surgery and early outcome of patients with acutely obstructed colorectal cancers. The secondary aims were to compare right- and left-sided obstruction and to identify factors predicting morbidity and mortality in these patients.
Methods A retrospective review of all patients who underwent operative intervention for acute obstruction from colorectal malignancy from February 2003 to April 2008 was performed. Patients were identified from the hospital's operating records based on postoperative diagnosis codes of colorectal malignancy. The diagnosis of acute obstruction was confirmed through clinical assessment, radiological investigations, and surgical findings. All the complications were graded according to the classification proposed by Clavien and group.
Results Out of a total of 1,268 patients who underwent surgery for colorectal malignancy, 134 (10.6%) patients with a median age of 71 years (range, 34–97 years) were operated for acute obstruction. Left-sided malignancy accounted for 79.9% of the obstruction, with sigmoid colon being the most common site in 54 (40.3%) patients. A significant proportion (77.6%) of our patients had associated perioperative morbidity, and the mortality rate was 11.9%. Worse complications (grades of complications III to V) were more frequent in patients who had a higher American Society of Anesthesiologists score (3–4), are ≥60 years old, and had preoperative renal impairment. Stoma was created more frequently in left-sided pathology.
Conclusion In an Asian population, surgery in patients with acute colorectal malignant obstruction is associated with significant morbidity and mortality rates. Though left-sided malignant obstruction occurs more frequently and is associated with a higher incidence of stoma creation, primary resection and anastomosis is a safe option in selected patients.

Keywords Intestinal obstruction · Colorectal cancers · Surgery · Treatment outcome

Introduction

Colorectal malignancy is one of the most common cancers worldwide. The incidence of complete obstruction has been reported to be as high as 30%.[1–3] Urgent surgical treatment in obstructed colorectal cancers has been associated with prohibitive perioperative morbidity and mortality rates despite advances in surgical techniques and intensive care.[4,5] Some of the factors accountable for these dismal results included advanced age, American Society of Anesthesiologists (ASA) score, and site of malignancy.[4,5]

The ideal surgical option in malignant obstruction remains controversial.[6,7] Though primary anastomosis without stoma for obstructed right-sided colon malignancy has been considered safe,[7, 8] surgical options in malignant left-sided obstruction could range from defunctioning stoma, Hartmann's procedure, and primary anastomosis with or without diverting stoma.[8,9] Self-expanding metallic stenting of the malignant colorectal obstruction is another recent advance that is gaining in popularity in many institutions.[10,11]

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With the majority of the current literature based on data from the Western population, a true reflection of the impact and issues surrounding obstructed colorectal malignancy in Asians is lacking. There were reports documenting lower rates of right-sided malignancy but higher incidences of distal colonic and rectal malignancies in Asians.[12,13] Furthermore, other characteristics associated with Asians with colorectal cancers would include younger age of diagnosis and less advanced malignancy. This phenomenon has been attributed to genetic risk factors, cancer biology, or other uncharacterized carcinogens.[12,13]

Hence, we undertook this study with the primary aim to review the treatment and early outcome of patients who underwent emergency surgery for acute colorectal malignant obstruction. Our secondary aims were to evaluate the various factors predicting morbidity and mortality, to determine the differences between left-sided and right-sided pathologies, and to highlight the various surgical options.

Methods

Study Population

Tan Tock Seng Hospital is a 1,300-bed hospital, the second largest in Singapore, and provides secondary and tertiary medical care for about 1.5 million people. A retrospective review of all patients who underwent operative intervention for acute obstruction from colorectal malignancy from February 2003 to April 2008 was performed. Patients were identified from the hospital's diagnostic index and operating records. Right-sided pathologies were regarded if it was located from the cecum until the transverse colon while left-sided pathologies commenced from the splenic flexure.

All our patients had evidence of acute colorectal obstruction as suggested by Fielding et al.[14] These criteria were determined by clinical assessment, radiological investigations, and surgical findings, which include the symptoms of abdominal pain and constipation, signs of abdominal distension and abnormal bowel gaseous distension on plain radiographs, and operative findings of proximal bowel distension and edema. Computed tomographic (CT) scan with or without rectal contrast would be performed based on the surgeons' preference.

All patients underwent urgent surgical operation within 24 h of admission. Prior to the surgery, fluid resuscitation, parenteral antibiotics, optimization of their medical conditions, and nasogastric decompression would be administered to every patient. Resection of the tumor would be attempted in all patients except in cases of fixed and unresectable tumors or in patients who were hemodynamically unstable. All gastrointestinal anastomoses were either hand-sewn or stapled, while stoma created could be either a defunctioning or an end stoma.

The data collected included age, gender, ASA score, comorbid conditions, presenting signs and symptoms, and clinical parameters. Laboratory values, including full blood count and renal panel, were also recorded. In addition, operative findings and interventions, length of surgery, perioperative complications, mortality, and length of hospital stay were also documented.

All colorectal cancers were staged according to the guidelines of the American Joint Committee of Cancer (AJCC).[15] The grades of complications (GOC) were in concordance to the classification proposed by Clavien and group (Table 1).[16–18]

Statistical analysis was performed using both univariate and multivariate analyses. The variables were analyzed to the various outcomes using Fisher's exact test, and their odds ratio (OR) and 95% confidence interval (CI) were also reported. For the multivariate analysis, the logistic regression model was applied. All analyses were performed using the SPSS 16.0 statistical package (Chicago, IL, USA), and all p values reported are two-sided, and p values of <0.05 were considered statistically significant.

Results

During the study period, 1,268 (334 right-sided/934 left-sided) patients underwent colorectal-cancer-related surgery. Of this group, 134 (10.6%) patients presented with acute obstruction and were duly operated urgently. A total of 89 (66.4%) patients underwent preoperative CT scans while the remaining 45 (33.6%) were operated after clinical assessment and evaluation of their abdominal radiographs.

Table 1 Classification of Surgical Complications[16–18]

Grade I: any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions
Grade II: requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included
Grade III: requiring surgical, endoscopic, or radiological intervention
Grade IV: life-threatening complication(s) requiring ICU management (including organ dysfunction)
Grade V: death of a patient

Right-Sided Malignancy

There were 27 (20.1%) patients who presented with acute obstruction, which comprised 8.1% of all patients who had surgery for right-sided malignancy (Tables 2 and 3). The median age was 75 years (50–93 years). The majority (n=22, 81.5%) had an ASA score of 2 or 3. Nine patients (33.3%) had metastatic disease on presentation. The ileocecal valve was competent in nine cases (33.3%) while an unhealthy cecum (ischemic or perforated) was seen in five patients (18.5%). Apart from right hemicolectomy (n=25, 92.6%), ileo-sigmoid bypass and defunctioning loop colostomy were performed in one patient each, both with known metastatic disease. There were five (18.5%) mortalities in this group of patients with another five (18.5%) patients with grades III or IV complications. The median length of stay was 10 days (5–109 days).

Left-Sided Malignancy

A total of 107 (79.9%) patients presented with acute obstruction, which comprised 11.5% of all patients who had surgery for left-sided malignancy (Tables 2 and 3). Sigmoid colon was the most common site of involvement (n=54, 50.5%). The median age of this group was 70 years (34–97 years). The majority (n=87, 81.4%) had an ASA score of 2 or 3. Seventy-five (70.1%) patients had at least stage III or IV disease on presentation. Closed-loop obstruction due to the presence of a competent ileocecal valve was documented in 46 (43.0%) patients, and the cecum was noted to be unhealthy in 13 (12.1%) patients.

The commonest surgical procedure performed in this group of patients included anterior resection with (n=10, 9.4%) or without defunctioning stoma (n=22, 20.6%), Hartmann's procedure (n=31, 29.0%), and subtotal or total colectomy (n=20, 18.7%). A more extensive colonic resection (extended right hemicolectomy and subtotal or total colectomy) was performed in 30 (28.0%) patients. Majority of the patients (n=56, 52.3%) had stoma created. Eleven (10.3%) patients perished, with another 35 (32.7%) patients developing grade III or IV complications. The median length of stay was 10 days (3–99 days).

Of the 63 patients who had stoma created, only 13 patients (20.6%) had closure of their stoma. Eight had their

Table 2 Selected Characteristics of the Study Group

Characteristics	Right-sided (n=27) (%)	Left-sided (n=107) (%)	Total (n=134) (%)
Presentation			
Perforation of cecum from distal malignant obstruction	5 (18.5)	2 (1.9)	7 (5.2)
Malignant obstruction without perforation	22 (81.5)	105 (98.1)	127 (94.8)
Stenting			
Previous endoscopic stenting for obstructed cancer	0	2 (1.8)	2 (1.6)
Failed endoscopic stenting	0	1 (0.9)	1 (0.8)
CT scan			
Performed	23 (85.2)	66 (61.7)	89 (66.4)
Not performed	4 (14.8)	41 (38.3)	45 (33.6)
Site of malignancy			
Cecum	5 (18.5)		5 (3.7)
Ascending colon	7 (25.9)		7 (5.2)
Hepatic flexure	7 (25.9)		7 (5.2)
Transverse colon	8 (29.6)		8 (6.0)
Splenic flexure		8 (7.5)	8 (6.0)
Descending colon		19 (17.8)	19 (14.2)
Sigmoid colon		54 (50.5)	54 (40.3)
Rectosigmoid		10 (9.3)	10 (7.5)
Rectum		16 (14.9)	16 (11.9)
Staging of malignancy (AJCC classification)			
Stage I	1 (3.7)	1 (0.9)	2 (1.5)
Stage II	5 (18.5)	26 (24.3)	31 (23.1)
Stage III	12 (44.4)	41 (38.3)	53 (39.6)
Stage IV	9 (33.3)	34 (31.8)	43 (32.1)
Unknown	0	5 (4.7)	5 (3.7)

Table 3 Surgical Procedures, Techniques, and Outcome

Characteristics	Right-sided (n=27) (%)	Left-sided (n=107) (%)	Total (n=134) (%)
Surgery performed list by (R) vs (L)			
Right hemicolectomy ± stoma	25 (92.6%)	10 (9.3)	35 (26.1)
Left hemicolectomy	0	3 (2.8)	3 (2.2)
Anterior resection ± stoma	0	32 (29.9)	32 (23.9)
Hartmann's procedure	0	31 (29.0)	31 (23.1)
Subtotal/total colectomy	0	20 (18.7)	20 (14.9)
Loop colostomy	1 (3.7)	10 (9.3)	11 (8.2)
Bypass procedure	1 (3.7)	1 (0.9)	2 (1.5)
Status of cecum			
Unhealthy (Ischemic/gangrenous/perforated)	5 (18.5)	13 (12.1)	18 (13.4)
Healthy	22 (81.5)	94 (87.9)	116 (86.6)
Resection of cecum			
Yes	25 (92.6)	30 (28.0)	55 (41.0)
No	2 (7.4)	77 (72.0)	79 (59.0)
Type of anastomosis			
Hand-sewn anastomosis	3 (11.1)	11 (10.3)	14 (10.4)
Stapled anastomosis	17 (63.0)	39 (36.4)	56 (41.8)
Stoma creation	7 (25.9)	56 (52.3)	63 (47.0)
Grades of complications			
No complications	6 (22.2)	24 (22.4)	30 (22.4)
GOC I	5 (18.5)	17 (15.9)	22 (16.4)
GOC II	6 (22.2)	20 (18.7)	26 (19.4)
GOC III	2 (7.4)	11 (10.3)	13 (9.7)
GOC IV	3 (11.1)	24 (22.4)	27 (20.1)
GOC V (death)	5 (18.5)	11 (10.3)	16 (11.9)
Median length of stay (days)	10 (5–109)	10 (3–99)	10 (3–109)

ileostomy closed after an initial anterior resection, while only three patients who underwent Hartmann's procedure had their stoma reversed. The remaining two patients who had an initial defunctioning colostomy performed underwent a definitive left hemicolectomy and anterior resection 1 month after the creation of stoma. Another one patient who had an initial defunctioning sigmoid colostomy underwent an abdominoperineal resection for low rectal cancer after a period of radiotherapy and chemotherapy.

Comparison—Right-Sided Pathology vs. Left-Sided Pathology

These two groups of patients were similar in numerous aspects (Table 4). Factors such as age group, gender, ASA score, and premorbid condition were largely similar, and any differences were not statistically significant. Even the staging of the malignancy and complication rates were not vastly different. Stoma was created more frequently in left-sided pathology (OR 3.14, 95% CI 1.23–8.04, p 0.017), while surgery for left-sided pathology took longer than for right-sided lesions (OR 3.04, 95% CI 1.27–7.25, p 0.019).

Comparison—Extensive Resection vs. Limited or No Resection for Malignant Left-Sided Obstruction

The creation of stoma was much more evident in patients who had limited or no resection (OR 9.81, 95% CI 3.36–28.60, $p<0.001$; Table 5), while more extensive resection encompassing the cecum was expectedly more frequent in patients who had an unhealthy cecum ($p<0.001$). However, patients who had extensive resection did not have higher complication rates or longer duration of surgery. Though it would appear that patients with more advanced disease underwent a more limited resection or had no resection, the difference was not statistically significant (OR 2.03, 95% CI 0.80–5.12, $p>0.05$).

Analysis—Predictors of Worse Complications

After multivariate analysis, the independent variables predicting a worse perioperative outcome including death (GOC III to V) would include higher ASA score (3–4), ≥60 years old, and preoperative renal impairment (Table 6).

Table 4 Comparison Between Right Versus Left-Sided Malignant Obstruction

Characteristics	Right-sided pathology (n=27)	Left-sided pathology (n=107)	OR (95% CI)	p value
>60 years old	22 (81.5%)	78 (72.9%)	0.61 (0.21–1.77)	>0.05
Male gender	15 (55.6%)	59 (55.1%)	0.98 (0.42–2.23)	>0.05
ASA score 3–4	15 (55.6%)	62 (57.9%)	1.10 (0.47–2.58)	>0.05
≥1 premorbid condition	16 (59.3%)	58 (54.2%)	0.81 (0.35–1.92)	>0.05
WBC>10.0 g/dl	12 (44.4%)	58 (54.2%)	1.48 (0.63–3.46)	>0.05
Hb≥11.0 g/dl	16 (59.3%)	80 (74.8%)	2.04 (0.84–4.93)	>0.05
Urea>9.3	10 (37.0%)	30 (28.0%)	0.66 (0.27–1.61)	>0.05
Creatinine>110	8 (29.6%)	23 (21.5%)	0.65 (0.25–1.68)	>0.05
Competent ileocecal valve	9 (33.3%)	46 (43.0%)	1.51 (0.62–3.66)	>0.05
Unhealthy cecum	5 (18.5%)	13 (12.1%)	0.61 (0.20–1.89)	>0.05
Stage III or IV disease	21/27 (77.8%)	75/102 (73.5%)	0.79 (0.29–2.18)	>0.05
Creation of stoma	7 (25.9%)	56 (52.3%)	3.14 (1.23–8.04)	0.017[a]
Duration of surgery>120 min	13 (48.1%)	79 (73.8%)	3.04 (1.27–7.25)	0.019[a]
GOC III–V	10 (37.0%)	46 (43.0%)	1.28 (0.54–3.06)	>0.05

[a] Statistically significant after multivariate analysis

Factors such as gender, site and staging of malignancy, and duration of surgery were not related. A detailed list of all the complications can be seen in Table 7.

Discussion

Despite the increased awareness of colorectal cancers, the incidence of patients presenting with complete malignant colorectal obstruction has remained alarmingly high in up to 30%.[1–3] Operative intervention in these patients has often been associated with prohibitive morbidity and mortality rates.[1–3] Some of the contributing factors would include their poor nutritional state, the direct consequences of bowel obstruction such as dehydration, electrolyte imbalance, and the high risk of postoperative septic complications from operating on feces-filled bowel.[19,20] Hence, complications such as anastomotic dehiscence, intra-abdominal abscesses, wound infection, and death were more frequently seen in these patients.[19,20]

While the patient and disease factors are unlikely to improve much preoperatively to better the eventual outcome, the most appropriate surgical procedure would then be vital to ensure the best possible conclusion. Some of the key factors that must be taken into consideration while deciding the surgical procedure would include the following issues: clinical condition of the patient, stage of disease, resectability of the malignancy, and the site and severity of obstruction.

Table 5 Comparison Between Patients Who Had Extensive Resection Against Those with Limited or No Resection for Malignant Left-Sided Obstruction

Characteristics	Extensive resection (n=30)	Limited or no resection (n=77)	OR (95% CI)	p value
>60 years old	19 (63.3%)	59 (76.6%)	1.90 (0.76–4.72)	>0.05
ASA score 3–4	19 (63.3%)	43 (55.8%)	0.73 (0.31–1.75)	>0.05
≥1 premorbid condition	14 (46.7%)	44 (57.1%)	1.52 (0.65–3.56)	>0.05
WBC>10.0 g/dl	19 (63.3%)	39 (50.6%)	0.59 (0.25–1.41)	>0.05
Hb≥11.0 g/dl	24 (80.0%)	56 (72.7%)	0.67 (0.24–1.86)	>0.05
Urea>9.3	11 (36.7%)	19 (24.7%)	0.57 (0.23–1.40)	>0.05
Creatinine>110	6 (20.0%)	17 (22.1)	1.13 (0.40–3.22)	>0.05
Unhealthy cecum	13 (43.3%)	0 (0.0%)	NA	<0.001[a]
Creation of stoma	5 (16.7%)	51 (66.2%)	9.81 (3.36–28.60)	<0.001[a]
Duration of surgery>120 min	24 (80.0%)	55 (71.4%)	0.63 (0.23–1.74)	>0.05
Stage III or IV disease	19 (63.3%)	56/72 (77.8%)	2.03 (0.80–5.12)	>0.05
GOC III–V	13 (43.3%)	33 (42.9%)	0.98 (0.42–2.30)	>0.05

[a] Statistically significant after multivariate analysis

Table 6 Predictors of Worse Outcome (GOC 0–II Against GOC III–V)

Characteristics	GOC 0–II (n=78)	GOC III–IV (n=40)	GOC V (death) (n=16)	OR (95% CI)	p value
>60 years old	50 (64.1%)	35 (87.5%)	15 (93.8%)	4.67 (1.78–12.25)	0.001[a]
Male gender	41 (52.6%)	19 (47.5%)	14 (87.5%)	1.30 (0.65–2.59)	>0.05
ASA score 3–4	30 (38.5%)	31 (77.5%)	16 (100.0%)	8.36 (3.58–19.48)	<0.001[a]
≥1 premorbid condition	38 (48.7%)	24 (60.0%)	12 (75.0%)	1.90 (0.94–3.83)	>0.05
WBC>10.0 g/dl	45 (57.7%)	19 (47.5%)	6 (37.5%)	0.59 (0.30–1.18)	>0.05
Hb ≥11.0 g/dl	61 (78.2%)	26 (65.0%)	9 (56.3%)	0.46 (0.22–1.00)	>0.05
Urea>9.3	15 (19.2%)	16 (40.0%)	9 (56.3%)	3.39 (1.57–7.32)	0.002[a]
Creatinine>110	14 (17.9%)	9 (22.5%)	8 (50.0%)	1.99 (0.89–4.49)	>0.05
Left-sided malignancy	61 (78.2%)	35 (87.5%)	11 (68.8%)	1.28 (0.54–3.06)	>0.05
Competent ileocecal valve	35 (44.9%)	13 (32.5%)	7 (43.8%)	0.68 (0.34–1.38)	>0.05
Unhealthy cecum	9 (11.5%)	5 (12.5%)	4 (25.0%)	1.47 (0.54–3.97)	>0.05
Stage III or IV disease	56/74 (75.7%)	26/39 (66.7%)	14 (87.5%)	0.86 (0.39–1.90)	>0.05
Duration of surgery>120 min	52 (66.7%)	30 (75.0%)	10 (62.5%)	1.25 (0.59–2.64)	>0.05

[a] Statistically significant after multivariate analysis

Also seen in our series, surgery in these patients who are older and those with worse ASA score resulted in worse perioperative outcome.[21,22] Their limited physiological reserves are likely accountable for the abysmal results. Apart from these factors, patients who are in septic shock, had renal impairment, immunocompromised, and had higher APACHE II score and those who had blood transfusion are also likely to do worse.[22,23] Thus, though it would be prudent to optimize the patients' conditions preoperatively as best as possible, this must be balanced against the risks of delaying surgery.

Table 7 List of Complications in Our Series

Complications	Number of patients (n, %)
Death	16 (11.9)
Pulmonary complications	
Ventilatory support post surgery	−16 (11.9)
Pleural effusion	−5 (3.7)
Pneumonia	−12 (9.0)
Atelectasis	−10 (7.5)
Cardiovascular complications	
Myocardial infarction	−3 (2.2)
Arrhythmia	−8 (6.0)
Gastrointestinal complications	
Anastomotic leak	−4 (3.0)
Ileus	−15 (11.1)
Upper gastrointestinal tract hemorrhage	−4 (3.0)
Wound complication	
Wound dehiscence	−3 (2.2)
Superficial wound infection	−11 (8.2)
Other complications	
Urinary tract infection (UTI)	−3 (2.2)
Cerebrovascular accident (CVA)	−3 (2.2)
Septicemia/septic shock	−10 (7.5)
Deep venous thrombosis/pulmonary embolism	−2 (1.5)

While some may question the role of CT scan in the presence of radiological evidence of complete obstruction, its advantages in these patients must not be neglected.[24,25] In patients who were diagnosed preoperatively with metastatic or unresectable disease, proper counseling to the patient and the family could be performed to handle their expectations. In these situations, the possibility and implications of stoma creation or bypass surgery or palliative stent should be discussed.

Even if the diagnoses of advanced or metastatic disease were only achieved intraoperatively without preoperative imaging, extensive surgery in these patients should be minimized as they are unlikely to improve the long-term outcome and often result in unnecessary perioperative morbidity and mortality. As seen in our series, 13 (9.7%) patients underwent a bypass procedure or defunctioning stoma without resection of the malignancy. In addition, like in two of our patients with advanced rectal malignancy, defunctioning colostomy was performed initially, and this allowed neoadjuvant chemotherapy and radiotherapy to be administered subsequently. These two patients eventually had potentially curative surgeries performed.

CT scan is also useful to confirm the diagnosis especially in patients who had previous abdominal surgery or in those with known history of pseudo-obstruction. Other techniques that could ascertain the presence of the malignant obstruction include contrast enema or gentle endoscopic evaluation.[26,27] Furthermore, CT scan can garner information regarding the possibility of insertion of an endoscopic stent.[10,11] The site and length of the primary lesion and the severity of

obstruction are important considerations. Though left-sided tumors are preferred, low rectal lesions might not be suitable due to possibility of stent-related perianal trauma and severe tenesmus.[10,11] Stenting is usually preferred in patients who are not ideal surgical candidates due to disseminated disease and extremely high operative risk or simply to act as a bridge to convert an emergency surgery to an elective one by relieving the obstruction. The rate of technical and clinical success has been reported in up to 100%,[10,11] but some of its complications would include that of colonic perforation, tumor overgrowth, stent migration, and the cost of the stent itself.[10,11] Our institution favors one-stage resection with decompression and primary anastomosis where feasible and Hartmann's procedure if not, but in the light of recent randomized studies, we have started deploying endoscopic stenting as a bridge to surgery more frequently in recent years. This series documents our experience prior to adoption of stenting, and hence the few patients who were stented and managed nonoperatively were not included. The authors recognized this as a significant shortcoming of our study.

Not unlike other series, the majority of our patients (79.9%) who presented with acute obstruction had left-sided malignancy, with the sigmoid colon being the most common site. Resection and ileocolic anastomosis for right-sided obstructed tumor has always been considered safe and sound.[25,28] On the other hand, it was not surprising to note that patients who had surgery for left-sided obstruction were more likely to have a stoma created. The underlying rationale can be attributed to the reported higher associated anastomotic dehiscence rates in colocolonic or colorectal anastomoses compared to ileocolonic or ileorectal anastomoses.[24,29] Hence, as seen in our series, a defunctioning stoma after primary resection and anastomosis or an end colostomy is an attractive alternative in these circumstances.

Interestingly, a sizeable proportion of our patients (30.0%) with left-sided pathology underwent concurrent resection of the cecum despite the fact that only less than half of these patients had unhealthy cecum. In patients with unhealthy cecum such as associated perforation or gangrene, the decision to perform an extensive surgery is obvious. However, in the absence of these conditions, some of the justifications for concurrent resection of the right colon in left-sided malignancies would include the following: the appeal of an ileocolonic or ileorectal anastomosis as discussed above; the removal of any possibility of synchronous lesions in the right colon, which has been quoted to be in the region of 3–10%[29–31]; and easier manipulation and subsequent anastomosis through an en bloc resection of the feces-filled right colon as this would reduce the risks and implications of fecal spillage and contamination.[32] As shown by our series, despite the more extensive resection, it was not associated with higher perioperative complication rates or longer surgery. Unfortunately, one of the main longer-term complications following such extensive resection is usually severe diarrhea, but this often improves significantly with time and medications.[33,34]

The surgical procedures in tackling left-sided colonic obstruction have changed significantly in the past few decades. From an initial three-stage operation to the two-stage operation (Hartmann's procedure) to the increasing adopted one-stage primary resection and anastomosis without stoma.[9,35,36] This trend has been attributed to factors such as increased utilization of subtotal or total colectomy and encouraging data from centers that performed primary anastomosis after resection for obstructed left-sided malignancy, with or without on-table colonic lavage.[9,35,36] Some of the advantages of a one-stage resection and anastomosis would include avoidance of complications of a stoma, the risk of a second operation, and also offering a better quality of life especially for patients with incurable malignancies.[9,36]

In our institution, Hartmann's procedure is still frequently performed as it has been shown to be a safe surgical option in our patients, who are mostly of advanced age.[37] This procedure allows complete oncologic clearance and minimizes the risks associated with primary anastomosis and on-table lavage and shortens the operative time.[37,38] Unfortunately, reversal of Hartmann's procedure is often challenging and fraught with difficulties, resulting in numerous patients having a permanent stoma[37,38] as seen in over 90% of our patients with only three patients having their end colostomy reversed.

As with most studies, there were several limitations in the present study. This series of patients was enrolled from a single institution, and any retrospective study has inherent flaws. The relative small number of patients in our series may mask several other important factors that could be accountable for the outcomes measured. In addition, patients that were managed nonoperatively for obstructed colorectal malignancy were not included in our series as our focus was to uncover factors that could predict perioperative outcome and to highlight the various surgical options in these patients.

Although these limitations are significant, this study remains important in highlighting the various surgical issues surrounding acute malignant colorectal obstruction. The impact of the site of obstruction was also illustrated in our series. This study also highlighted the various factors that could account for significant morbidity and mortality after surgery in these patients.

Conclusion

In an Asian population, surgery in patients with acute colorectal malignant obstruction is associated with signif-

icant morbidity and mortality rates. Though left-sided malignant obstruction occurs more frequently (11.5% vs. 8.1%) and is associated with a higher incidence of stoma creation, primary resection and anastomosis is a safe option in selected patients.

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