

# Emergency surgery in colonic diverticulitis in an Asian population

Ker-Kan Tan · Jody Zhiyang Liu · Sharon Fengli Shen · Richard Sim

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## Abstract

**Introduction** Diverticulitis in Asians differs significantly from their Western counterparts in various aspects. This study was performed to highlight our institution's surgical experiences in patients with diverticulitis. The secondary aim was to compare the patients who underwent surgery for right- and left-sided diverticulitis.

**Methods** A retrospective review of all patients who underwent emergency surgery in patients with acute diverticulitis from July 2003 to April 2008 was performed. Right-sided pathology was regarded if it was located from the caecum till the transverse colon. Left-sided disease was regarded if it commenced from the splenic flexure.

**Results** The study group comprised of 104 patients, 68 (65.4%) of whom had right-sided diverticulitis. Caecum was the commonest site of disease, and the majority had only mild disease. In the 36 (34.6%) patients with left-sided diverticulitis, majority (63.8%) had an ASA score of three or four, with the sigmoid colon being the most common site of involvement. Most (91.7%) had worse peritoneal contamination with Hartmann's procedure being performed in 22 (61.1%) patients. Worse peri-operative outcome was also seen in this group. After multivariate analysis, the independent factors for right-sided disease were younger age, lower ASA score and no necessity for stoma.

**Conclusions** In an Asian population, surgery in right-sided diverticulitis is more commonly performed and is associated with lower morbidity and mortality. Patients who underwent surgery for right-sided diverticulitis were younger, with lower ASA score and less likely to have stoma created.

**Keywords** Emergency · Surgery · Diverticulitis · Treatment outcome · Asians

## Introduction

The appropriate management of patients with acute diverticulitis is dependent on the severity of the disease [1]. While antibiotics may suffice for uncomplicated colonic diverticulitis, surgery is necessary in patients with generalized purulent or faecal peritonitis. Fortunately, only up to 25% of patients with diverticulitis will require an urgent operation [2]. But these acute surgical interventions are often associated with significant morbidity and mortality [1, 2]. However, majority of the data and recommendations in the literature were based on left-sided diverticulitis because of the rarity of right-sided diverticulosis in the West.

Though the pathogenesis of left-sided diverticuli has been attributed to advanced age and the lack of dietary fibre [3, 4], the higher incidence of right colonic diverticulosis in Asians has not clearly elucidated [4, 5]. As a result, analysis of comparable numbers of right-sided and left-sided diverticulitis is lacking.

Surgical management of diverticulitis is perplexing. Right-sided diverticulitis often presents with symptoms similar to that of acute appendicitis and thus predisposes patients to unnecessary appendectomy [6]. The role of stoma in perforated left-sided diverticulitis has been extensively discussed, but evidence on the optimal surgical intervention in right-sided diverticulitis remains deficient [6–8].

With all the above considerations, this study was performed to review all patients who underwent surgery with the final diagnosis of acute diverticulitis and to identify associated peri-operative factors predicting mor-

K.-K. Tan (✉) · J. Z. Liu · S. F. Shen · R. Sim  
Department of General Surgery, Tan Tock Seng Hospital,  
11 Jalan Tan Tock Seng,  
Singapore 308433, Singapore  
e-mail: kerkan@gmail.com

**Table 1** Severity of diverticulitis as described by Hansen and Stock [9, 10]

Stage	Description	CT scan findings
0	Diverticulosis	Gas- or contrast-filled diverticulum
I	Acute uncomplicated diverticulitis	+ Intestinal wall thickening
II	Complicated Diverticulitis	
IIa	Peridiverticulitis, phlegmonous diverticulitis	+ Inflammatory reaction in pericolic fatty tissue
IIb	Abscess diverticulitis, covered perforation, fistulation	+ Mesocolic or retroperitoneal abscess, lower pelvis abscess
IIc	Free perforation	Free air, free fluid, abscesses where applicable
III	Chronic recurrent diverticulitis	Intestinal wall thickening, stenosis or fistula where applicable

bidity and mortality. The secondary aim was to compare the patients who underwent surgery for right- and left-sided diverticulitis.

## Methods

### Study population

Tan Tock Seng Hospital is a 1,400-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 emergency surgery for acute diverticulitis from July 2003 to April 2008 was performed. Patients were identified from the hospital's operating records based on the final post-operative diagnosis. Right-sided pathology was regarded if it was located from the caecum till the transverse colon. Left-sided disease commenced from the splenic flexure.

The data collected included age, gender, American Society of Anesthesiologists (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, indications for surgery, operative findings and interventions, peri-operative complications, mortality and length of hospital stay were also documented. In those patients that were diagnosed with diverticulitis intra-operatively, presence of diverticulosis was confirmed through histological evaluation of the resected specimen or via post-operative colonoscopy or barium enema 4 to 8 weeks later.

The severity of diverticulitis was assessed using the classification proposed by Hansen and Stock (Table 1) [9, 10]

with stage IIb and IIc regarded as severe, while the grades of complications (GOC) were in concordance to the classification proposed by Clavien and group [11–13] (Table 2).

Statistical analysis was performed using both univariate and multivariate analyses. The variables were analysed to the chosen outcomes using the chi-square test with their odds ratios and 95% confidence intervals reported. For the multivariate analysis, the logistic regression model was applied. All analyses were performed using the SPSS 16.0 statistical package (Chicago, Illinois). All *p* values reported are two-sided, and *p* values of <0.05 were considered statistically significant.

## Results

A total of 104 patients underwent emergency surgery for acute diverticulitis during the study period. The median age of the study group was 51 (range, 16–92) years, with a male majority of 62.5%. Thirty-nine (37.5%) patients had at least one comorbid condition, with hypertension being the commonest in 30.8%. Seven (6.7%) had previous appendectomy while six (5.8%) had previous episodes of diverticulitis treated conservatively. Table 3 illustrates the various characteristics of this study group, while Table 4 highlights the surgical procedures.

### Right-sided diverticulitis

There were 68 (65.4%) patients with right-sided diverticulitis, and the majority of these patients had either ASA score of 1 or 2 (Tables 3, 4 and 5). Pre-operative CT scan was performed in only 23.5%. Most (63.2%) had only mild diverticulitis, and the caecum was the most common site of disease in 50 (73.5%) patients. Appendectomy with or without diverticulectomy was performed in 39 (57.4%) patients. None of the patients with right-sided diverticulitis died in our series, and the majority (61.8%) was discharged well without any complication.

**Table 2** Classification of surgical complications [11–13]

**Grade I:** Any deviation from the normal post-operative 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

**Table 3** Characteristics of the 104 patients who underwent emergency surgery for diverticulitis

	Right-sided disease (n, %)	Left-sided disease (n, %)	Overall (n, %)
Median age, range (years)	43 (16–78)	71 (47–92)	51 (16–92)
≤50	45 (66.2)	4 (11.1)	49 (47.1)
>50	23 (33.8)	32 (88.9)	55 (52.9)
Gender			
Male	46 (67.6)	19 (52.8)	65 (62.5)
Female	22 (32.4)	17 (47.2)	39 (37.5)
ASA score			
1	36 (52.9)	3 (8.3)	39 (37.5)
2	23 (33.8)	10 (27.8)	33 (31.7)
3	8 (11.8)	16 (44.4)	24 (23.1)
4	1 (1.5)	7 (19.4)	8 (7.7)
Premorbid condition			
Hypertension	14 (20.6)	18 (50.0)	32 (30.8)
Diabetes mellitus	7 (10.3)	8 (22.2)	15 (14.4)
Hyperlipidaemia	10 (14.7)	7 (19.4)	17 (16.3)
Ischaemic heart disease	2 (2.9)	7 (19.4)	9 (8.7)
History of cerebrovascular accident	2 (2.9)	0 (0.0)	2 (1.9)
Number of premorbid condition			
Absent	51 (75.0)	14 (38.9)	65 (62.5)
Present (≥1)	17 (25.0)	22 (61.1)	39 (37.5)
Previous appendectomy	2 (2.9)	5 (13.9)	7 (6.7)
Previous diverticulitis	1 (1.5)	5 (13.9)	6 (5.8)
Pre-operative CT scan			
Not performed	52 (76.5)	13 (36.1)	65 (62.5)
Performed	16 (23.5)	23 (63.9)	39 (37.5)

#### Left-sided diverticulitis

There were 36 (34.6%) patients with left-sided diverticulitis, with the majority (63.8%) of them having a higher ASA score of three or four (Tables 3–5). Over 91.7% of these patients had severe diverticulitis with Hartmann's procedure being performed in 22 (61.1%) patients. Sigmoid colon was involved most commonly in 83.3%. All five (13.9%) mortalities in our series arose from this group of patients, while another 17 (47.2%) patients had more severe post-operative complications (GOC III–IV). In those patients with Hartmann's procedures performed ( $n=22$ ), four perished in the peri-operative period. Only six (33.3%) of the remaining 18 patients had their stoma reversed over a median period of 12 months (range, 4–38 months) post-surgery. There were no significant stoma-related readmissions in the rest of the patients.

#### Analysis—site of disease (right vs. left)

As shown in Table 6, some of the variables associated with right-sided disease in our study group included younger age, lower ASA score, absence of premorbid condition, less severe staging of diverticulitis and better outcome. There was also less likelihood of colonic resection and stoma creation. After multivariate analysis, the independent factors that were associated with right-sided disease were younger age, better ASA score and no necessity for stoma.

#### Discussion

Many algorithms exist to guide the surgical management of acute diverticulitis; however, these cannot be indiscriminately applied to Asians because of the significantly higher incidence of right-sided diverticulitis [2, 8, 14, 15]. Right-sided diverticulitis was present in over 65% of our patients who had emergency surgeries, while the corresponding incidence

**Table 4** Details of diverticulitis and types of surgeries performed in the study group

	n (%)
Indications for surgery	
Suspected appendicitis	47 (45.2)
Perforated diverticulitis on CT scan	48 (46.2)
Pneumoperitoneum on CXR or CT scan	4 (3.8)
Acute abdomen	5 (4.8)
Site of diverticulitis	
Caecum	50 (48.1)
Ascending colon	15 (14.4)
Hepatic flexure	1 (1.0)
Transverse colon	2 (1.9)
Splenic flexure	1 (1.0)
Descending colon	5 (4.8)
Sigmoid colon	30 (28.8)
Right-sided	68 (65.4)
Left-sided	36 (34.6)
Surgery performed	
Appendicectomy only	36 (34.7)
Appendicectomy + diverticulectomy	4 (3.8)
Anterior resection ± stoma	6 (5.8)
Right hemicolectomy ± stoma	29 (27.9)
Left hemicolectomy	2 (1.9)
Hartmann's procedure	22 (21.2)
Sigmoid colectomy	3 (2.9)
Total colectomy	1 (1.0)
Laparotomy with diverting loop colostomy	1 (1.0)
Median length of stay (days)	5 (2–95)

**Table 5** Severity, type of surgery and complications between right-sided and left-sided diverticulitis

	Right-sided disease (n, %)	Left-sided disease (n, %)	Overall (n, %)
Severity of diverticulitis			
Mild:			
Stage I	23 (33.8)	1 (2.8)	24 (23.1)
Stage IIa	20 (29.4)	2 (5.6)	22 (21.2)
Severe:			
Stage IIb	16 (23.5)	13 (36.1)	29 (27.9)
Stage IIc	9 (13.2)	20 (55.6)	29 (27.9)
Type of surgery			
Appendectomy ± diverticulectomy	39 (57.4)	1 (2.8)	40 (38.5)
Primary anastomosis after colonic resection	28 (41.1)	11 (30.6)	39 (37.5)
Creation of stoma ± colonic resection	1 (1.5)	24 (66.7)	25 (24.0)
Grade of complications			
No complications	42 (61.8)	7 (19.4)	49 (47.1)
Grade I	15 (22.1)	2 (5.6)	17 (16.3)
Grade II	4 (5.9)	5 (13.9)	9 (8.7)
Grade III	3 (4.4)	5 (13.9)	8 (7.7)
Grade IV	4 (5.9)	12 (33.3)	16 (15.4)
Death or Grade V	0 (0.0)	5 (13.9)	5 (4.8)

in Western population has been quoted to be less than 10% [6, 16]. Though the pathogenesis of left-sided disease has often been associated with old age and the lack of fibre, the higher incidence of right-sided disease in Asians has been postulated to be genetically related [6, 17, 18].

One of the important points that our series affirmed was that many patients with right-sided diverticulitis were still being operated upon for suspected appendicitis. This occurred in over 38.5% of our patients. One of the explanations has been the practice to perform appendectomy solely based on clinical suspicion without the aid of pre-operative radiological investigations such as CT scans. As seen in our series, only two patients who were operated for suspected appendicitis had pre-operative CT scan. This confusion between acute appendicitis and right colonic diverticulitis, especially in Asians, is not uncommon and has been attributed to their similar clinical features [14, 19]. Though some authors have described certain features differentiating these two entities, these were never validated and often perplexing [19, 20].

Furthermore, as shown from our series, most of these patients who were operated for suspected appendicitis had milder right-sided diverticulitis that would otherwise have been conservatively managed. On the other hand, the authors believed that any patient with similar clinical signs on the left at presentation would have been subjected to a CT scan and could have their condition managed non-operatively. CT scan can clearly define the site and extent of inflammation and help guide any subsequent management, which can range from conservative management with antibiotics to percutaneous drainage of any localized abscesses to immediate surgery [19, 20]. However, the authors opined that until the day CT scan becomes the standard investigation in patients presenting with right iliac fossa pain, many patients, especially the younger population, with right-sided diverticulitis will continue to be subjected to unnecessary appendectomy.

In this series, the severity of diverticulitis was graded by the classification proposed by Hansen and Stock [9, 10]. This grading system allows all degree of diverticular

**Table 6** Comparison of patients with right-sided against left-sided disease

Characteristics	Right-sided (n=68)	Left-sided (n=36)	OR (95% CI)	p value
>50 years old	23 (33.8%)	32 (88.9%)	15.65 (4.93–49.65)	<0.001 <sup>a</sup>
Female gender	22 (32.4%)	17 (47.2%)	1.87 (0.82–4.28)	>0.05
ASA score 3–4	9 (13.2%)	23 (63.9%)	11.60 (4.37–30.81)	<0.001 <sup>a</sup>
≥1 premorbid condition	17 (25.0%)	22 (61.1%)	4.71 (1.98–11.21)	0.001
WBC >10.0 ( $\times 10^9/L$ )	61 (89.7%)	22 (61.1%)	0.18 (0.06–0.51)	0.001
Hct <33.0 (%)	64 (94.1%)	32 (88.9%)	0.50 (0.12–2.13)	>0.05
Platelets (<170 or >420; $\times 10^9/L$ )	4 (5.9%)	10 (27.8%)	6.15 (1.77–21.39)	0.005
Serum urea >9.3 (mmol/L)	3 (4.4%)	12 (33.3%)	10.83 (2.81–41.75)	<0.001 <sup>a</sup>
Serum creatinine >110 (umol/L)	4 (5.9%)	16 (44.4%)	12.80 (3.84–42.72)	<0.001 <sup>a</sup>
Severe diverticulitis	25 (36.7%)	33 (91.7%)	18.92 (5.26–68.09)	<0.001
Creation of stoma	1 (1.5%)	24 (66.7%)	134.0 (16.53–1,086.2)	<0.001 <sup>a</sup>
Colonic resection	29 (42.6%)	35 (97.2%)	47.07 (6.09–363.82)	<0.001
GOC III–V	7 (10.3%)	22 (61.1%)	13.69 (4.89–38.36)	<0.001

<sup>a</sup> Statistically significant on multivariate analysis

disease to be classified, either from CT scan or perioperative findings, from uncomplicated to free perforation and even those patients with chronic diverticulitis, which was not possible in several other classifications.

Diverticulectomy and simple drainage for perforated right diverticuli has been described with good outcome in several Asian studies [14, 20]. This has led some authors to postulate that right-sided diverticulitis in Asians might be a milder disease entity compared to left-sided diverticulitis, supporting a less aggressive surgical option [14]. This procedure has also been performed in some of our patients with good outcome. The only contraindication is the inability to exclude an underlying malignancy for which colonic resection is warranted [14]. The authors felt that this procedure should only be performed selectively.

Not surprising, some of the factors predictive of patients who had surgery for left-sided diverticulitis included advanced age and a worse ASA score. This is consistent with the propensity of left-sided diverticuli developing in older patients. More aggressive surgery was also performed in left-sided diverticulitis because of the associated worse peritoneal contamination in these high-risk patients. In addition, this difference highlighted in our analysis was exemplified by the cases in whom only appendectomy ( $n=40$ , 38.5%) was performed. All these factors would have likely contributed to the worse outcome seen in our patients who underwent surgery for left-sided diverticulitis.

Recently, there has been a growing trend towards less aggressive surgical approach towards patients with perforated diverticulitis. Apart from faeculent peritonitis that still mandates aggressive surgery, laparoscopic lavage of the peritoneal cavity and drainage has been shown to be a feasible option in patients with even generalized purulent peritonitis [21–23]. Some of the quoted benefits included the reduction of the associated infective complications such as wound infection and dehiscence and the avoidance of colostomy. In addition, it could allow a subsequent elective laparoscopic procedure to be performed [21–23].

The debate regarding the need for stoma in diverticulitis has been extensively discussed. But this has often been limited to sigmoid diverticulitis. From our series, right hemicolectomy appeared to be a safe procedure associated with low complications without requiring any diverting stoma and this is supported by other series [24–26]. For left-sided pathologies, Hartmann's procedure is still frequently performed in our institution as it has been shown to be a safe and feasible procedure in undesirable clinical situations [27], especially in the elderly patients with numerous comorbid conditions. From our series and other reports, it would come as no surprise that patients who required stoma were often associated with worse outcome [28–30].

The morbidity of any stoma is not negligible. Furthermore, also seen in our series, the majority of the patients do

not have their stoma reversed due to both patients and technical factors expected from a reversal of Hartmann's procedure. Thus, the authors do not advocate Hartmann's procedure for all left-sided diverticular perforation. The option of anterior resection with defunctioning ileostomy is attractive as the ileostomy is able to limit the morbidity following any anastomotic leakage and is technically much easier to reverse compared to Hartmann's procedure [31]. This was seen in one of our patients. In addition, recent studies have shown the safety and benefits of a one-stage procedure, namely anterior resection or subtotal or total colectomy without any defunctioning stoma. While these procedures avoid the complications of a stoma and the risks of a second surgery, they are not without its own morbidity. Anastomotic leak is a genuine concern and could be catastrophic. In light of all the above considerations, the authors opined that the optimal surgery should remain at the discretion of the primary surgeon with paramount considerations given to the clinical condition of the patient and degree of contamination.

As with most studies, there were several limitations in the present one. This series of patients was enrolled from a single institution and any retrospective study has several inherent flaws. Even though our study is one of the largest in the literature focusing on the issues surrounding emergency surgery in acute diverticulitis, the sample size is still small with only 104 patients. Some of the important factors and outcome may still be unrecognized. More importantly, the decision for operation and the surgical technique to adopt is reliant on the surgeon with no fixed guidelines in our institution. We did not take into account those patients with acute diverticulitis that were managed conservatively as our intention was to highlight the numerous issues surrounding emergency surgery in acute diverticulitis, especially in an Asian population.

## Conclusions

In an Asian population, surgery for right-sided diverticulitis is more common and associated with lower morbidity and mortality than left-sided disease, which is mainly accounted for by suspected appendicitis being the indication for surgery in about half. Patients who underwent surgery for right-sided diverticulitis were younger, with lower ASA score and less likely to have stoma created.

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