Original Article

Analysis on Stage Operation in Complicated Diverticulitis

Chin-Hsin Chen[1]
Chien-Yuh Yeh[1,2]
Reiping Tang[1,2]
Jinn-Shiun Chen[1,2]
Pao-Shiu Hsieh[1,2]
Hsin-Yuan Hung[2]
Jy-Ming Chiang[1,2]
Wen-Sy Tsai[1,2]
Jeng-Fu You[1,2]
Chung-Rong Changchien[1,2]
Cheng-Yi Wang[1,2]
[1]*Division of Colon and Rectal Surgery, Department of Surgery, Chang Gung Memorial Hospital, Taipei*
[2]*College of Medicine, Chang Gung University, Taoyuan, Taiwan*

Key Words
Colon diverticulitis;
Complicated;
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Purpose. To investigate whether stage operations have better clinical outcomes with regard to morbidities and days of stay in hospital, and to investigate risk factors of morbidity in patients with complicated diverticulitis post operation.
Materials and Methods. We collected general data of hospitalized patients from January 2000 to December 2003 with the diagnosis of acute diverticulitis. By reviewing their medical records, all these patients who were diagnosed and received operation for complicated diverticulitis were enrolled in this study. Further analysis on mortality, morbidity and days of hospital stay used SAS software.
Results. 335 cases were diagnosed as acute diverticulitis from Jan. 2000 to Dec. 2003 at Chang Gung Memorial Hospital in Taiwan, Linko. Among these cases, 57 were uncomplicated and with colonoscopy or LGI series confirmed, 87 were clinically diagnosed, and 92 were diagnosed using CT scan. Anther 46 cases were further diagnosed not complicated diverticulitis cases (ex: cancer, ulcerative colitis, colitis…etc) by colonoscopic biopsies. Forty-six complicated diverticulitis cases which received operation were enrolled for this study; another 7 complicated diverticulitis cases were excluded due to no operation performed. We classified the complications of 46 cases as: phlegmon: 4 (8.7%), abscess or fistula 34 (73.9%) and perforation 8 (17.4%). Operation methods were: 1-stage operation 30 (65.2%); 2-stage operation 13 (28.3%) and 3-stage operation 3 (6.5%). Further analysis revealed significant relationship on operation method and morbidity ($p < 0.0016$), and also between operation method and hospital stay ($p < 0.00005$).
Conclusion. In our retrospective study, stage operations have significant relation with total admission duration and operation morbidity. In our analysis, one-stage operation had lowest risk of long hospital stay and operative morbidity; moreover, operation method had significant relation with long hospital stay comparing with age, phases, lesion sites and patient conditions.
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Diverticular disease is a common disorder, and increasing uniformly with age[1,2] which has uncommon complications.[3] However, when complications occurred, they may be totally different and lead

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Correspondence to: Dr. Chien-Yuh Yeh, Division of Colon and Rectal Surgery, Chang Gung Memorial Hospital, No. 199, Tung Hwa North Road, Taipei, Taiwan. Tel: 886-3-328-1200 ext. 2101; Fax: 886-3-327-8355; E-mail: chnyuh@gmail.com

to high mortality and morbidity.[3] Stollman et al.[1] reported a prevalence of diverticulosis affected 50% of people by the fifth decade, and 67% by the eighth decade in western countries; whereas a report from Hong Kong[4] noted 25% prevalence of diverticulosis among 858 lower GI series done in 18 months, with the peak prevalence of age being among 50 to 79 year-olds. Over 10-25% of patients with diverticulosis will develop diverticulitis, and among them, 15-20% will develop significant complications.[5-7] A complicated diverticular disease is identified as diverticulitis associated with abscess, fistula, obstruction, phlegmon, bleeding, or perforation.[8-13]

Large case series show that the mortality rate associated with emergent operation for complicated diverticulosis ranging from 12-36%.[14-21] Current study also reports that elective resection for multiple (> 2) diverticulitis episodes' patients have no benefits for better outcomes.[22,23]

Aim

The purpose of this study was to investigate which operation choice have better clinical outcome, regarding morbidities, days of stay in hospital, as well as to investigate risk factors of morbidity in patients with complicated diverticulitis postoperatively.

This retrospective study collected general data from Chang-Gang Memorial hospital in-patients with acute diverticulitis from January 2000 to December 2003. All these patients whom had been operated for complicated diverticulitis were enrolled in this study. Several independent variables were collected for analysis: patients' general data, complications, stage operations (one, two or three), mortality, morbidity, and admission duration.

Materials and Methods

From January 2000 to December 2003, 335 consecutive admitted patients who were diagnosed with acute diverticulitis were enrolled from a prospective database. Among these cases, 57 were uncomplicated and with colonoscopy or LGI series confirmed, 87 were clinically diagnosed, and 92 were diagnosed using CT scan. Anther 46 cases were further diagnosed not complicated diverticulitis cases (ex: cancer, ulcerative colitis, colitis…etc) by colonoscopy biopsies. Another 7 complicated diverticulitis cases were excluded due to no operation being performed or elective resection due to recurrent attack. Our inclusion criteria were based on reviewing medical records, if operation for complicated diverticulitis had been performed, and surgical resection with pathology proven to be diverticulitis/diverticulosis with chronic inflammation, or ruptured diverticulum/perforate diverticulitis. After carefully reviewing, there were 46 complicated diverticulitis cases which had received operations entered for this study.

These 46 cases were then grouped by the type of complications according to Hinchley classification. (Table 1)[24] We further combined phase III and phase IV as a group. The patients were grouped by modified classifications according to pathology reports, image findings, and operative findings (Table 2) The operation methods and patients with modified classification showen in Table 3.

Mortality was defined as death related to surgery itself or surgical complications. Morbidity were recorded according to medical records, including: anastomosis leakage (with pelvic abscess, or need intervention or operation due to leakage), ostomy complications (retraction, periostomy abscess), wound complications (fascia dehiscece, deep wound infection), lung complications, cardiovascular complications, genitourinary complications, and ileus (both paralytic or adhesive).

The statistical analyses were performed using SAS software (version 9.1, SAS Institute Inc., Cary, NC, USA). The univariate correlation between variants was tested using Fisher's exact test for p value. A p value of < 0.05 was considered significant. The

Table 1. Hinchley classification for perforate diverticulitis

•Hinchley classification: (Hinchley et al., 1978)
Phase I: Microperforation (with/without phlegmon)
Phase II: Abscess
Phase III: Generalized suppurative peritonitis (perforation)
Phase IV: Faecal peritonitis (free perforation)

a. originated from: Hinchey EF, Schaal PG, Richards GK. Treatment of perforated diverticular disease of the colon. *Adv Surg*. 1978;12:85-109.

Table 2. Modified hinchley classification for complicated diverticulitis requiring surgery

Phase I. Diverticulitis with phlegmon
Phase II. Diverticulitis with abscess or fistula
Phase III. Perforate diverticulitis (free or generalized peritonitis)

Classified by:
a. Imaging study: including computer tomography or barium enema X-ray series.
b. Operative findings.
c. Pathological report.

means were presented as ± standard deviation.

Results

Among 46 cases, the mean age was 60 ± 15 years old (28-84 years), 27 (58.7%) were male patients, and 19 (41.3%) were female. Total hospital stays (if stage operation was performed, each admission associated with planned operation was counted) ranged from 7-238 days, mean stays were 37 ± 40 days. Details are listed in Table 3 and Table 4. There are 4 mortality cases, all of these deaths were related to surgical complications; and 19 morbidity cases were recorded, 8 of them have more than one morbidity. We found morbidity and hospital stay were statistically different in different stage operations. The results are listed in Table 5 and Table 6.

Discussion

Diverticulitis occurred in about 10-25% of diverticulosis patients; among them, 15%-20% would develop complicated diverticulitis.[5-7] As to complications requiring surgery, it occurred in only approximately 1% of diverticulitis cases.[25] Our study focused on those patients with complicated diverticulitis and need surgical treatment. We compared the relationship among stage operation and several variants: mortality, morbidity, and lesion sites (left or right colon). The results showed no significant relationship among stage operation with mortality, or lesion sites. Only significant relationship between stage operation and morbidity, and that between stage operation and hospital stay were noted.

Table 3. Presentation of complicated diverticulitis and operative method

	One-stage op	Two-stage op	Three-stage op	
Phase I	3	0	1	4
Phase II	21	11	2	34
Phase III	6	2	0	8
	30	13	3	46

Definition of stage operation
a. One-stage operation:
Resection, primary anastomosis without converting ostomy.
b. Two-stage operation:
Hartmann's procedure + reversal of Hartmann's procedure
Primary resection, primary anastomosis with converting ostomy + closure of ostomy.
c. Three-stage operation:
Drainage of abscess with diverting ostomy + resection + closure of ostomy.

Explanation of this result may due to small case numbers. Also the selection of operation type was actually according to the surgeon's experiences and clinical conditions, which might not be shown in medical documents and led to overestimate one-stage operation.

The choices of operation method for complicated diverticulitis are still controversial. Most surgeons fa-

Table 4. Demographics and preexisting conditions

Gender	
Male	27 (58.7%)
Female	19 (41.3%)
Age (year-old)	28-84 (mean 60 ± 15)
Phase of complicated diverticulitis	
Phase I	4 (8.7%)
Phase II	34 (73.9%)
Phase III	8 (17.4%)
Stage operation	
One-stage	30 (65.2%)
Two-stage	13 (28.3%)
Three-stage	3 (6.5%)
Lesion site	
Right colon (cecum to T-colon)	25 (54.3%)
Left colon (D-colon to S-colon)	21 (45.7%)
Hospital stay (day)	7-238 (mean: 37 ± 40)
≦ 40 days	34 (73.9%)
> 40 days	12 (26.1%)
Complications	
Mortality	4 (9%)
Morbidity	19 (41%)

Table 5. Stage operation and independent variants

	1 stage operation	2 stage operation	3 stage operation	*p* value
Mortality (%)	10.0	0	33.33	0.1967
Morbidity (%)	23.33	76.92	66.67	0.0016
Long hospital stay (> 40 days) (%)	6.67	69.23	33.33	$< 4.978 \times 10^{-5}$
Lesion site (%) (left side)	23.33	92.31	66.67	1.66×10^{-5}

Table 6. Morbidity/long hospital stay and independent variants

	Morbidity (%)	Long stay (%)
Phase of diverticulitis		
I	5.3%	0%
II	78.9%	25.00%
III	15.8%	75.00%
	$p = 0.742$	$p = 0.376$
Gender		
M	63.2%	58.3%
F	36.8%	41.7%
	$p = 0.606$	$p = 0.976$
Recurrent attack		
N	78.9%	83.3%
Y	21.1%	16.7%
	$p = 0.501$	$p = 0.461$

vor 1- and 2-stage operation instead of 3-stage operation due to the development of new modalities, such as laparoscopic surgery, antibiotics, and autosutures, etc. Also literature reviews published in 1980s supported that the 2-stage operation indeed had had a reduction of mortality to about half that for 3-stage operation.[26,27] A more recent multicenter randomized controlled trial found that a one-stage procedure significantly reduced rates of postoperative peritonitis and emergent reoperation compared with a two-stage operation, without adversely affecting operative mortality.[19]

In our results, we can find statistical significance in univariant analysis of stage operation and lesion site (Table 5). This result revealed that the choice of operation method by surgeons was actually influenced by lesion site. Surgeons tended to perform 2-stage operation for left side lesion rather than other operations; this may resulted from anatomic limits (insecured anastomosis, more easily to develop anastomosis insufficiency, etc). We also found that there was no phase I patient who underwent 2-stage operation, and no phase III patient underwent 3-stage operation (Table 3).Theoretically, if we considered phase III is more severe form of complicated diverticulitis, it should have multiple operations as 3-stage operation, but it was not the truth (Table 3). A further prospective study should be designed for confirming this hypothesis.

Our study also showed significant relation between stage operation and hospital stay. The reason may be due to re-entry of the abdomen leading to longer recovery; additionally, the patients' condition might be different during each admission. Also, in our definition, Hartmann's procedure and reversal of Hartmann's procedure are considered as a 2-stage operation, this may cause high admission duration in 2-stage operation group. The concept that surgical complications rate during each operation should be considered: the more operation patients take, the higher possibility of getting complications.

Conclusion

In this study, the relationship between stage operations and morbidity, and that between stage operations and total hospital stay duration, both showed statistical significance. One-stage operation had the relatively lowest risk for long hospital stay and operative morbidity. Also, phase, gender, or recurrent attack had no significant relation with operative morbidity.

To sum up, operation method has significant relation with long hospital stay and morbidity. One-stage operation should be the treatment of choice for complicated diverticulitis after our study and reviewing the literature data. However, the choice still relay on experienced surgeons. As new technology and equipment develops, so do our attitudes towards complicated diverticulitis.

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原　著

論階段性手術在複雜性大腸憩室炎之必要性

陳芝忻[1]　葉建裕[2]　唐瑞平[2]　張簡俊榮[2]　陳進勛[2]　王正儀[2]
江支銘[2]　謝寶秀[2]　蔡文司[2]　洪欣園[2]　游正府[2]

[1]林口長庚醫院　大腸直腸外科
[2]長庚醫學大學　臨床醫學研究所

目的　了解是否階段性手術在複雜性大腸憩室炎上有術後併發症及住院天數上的不同，暨調查是否階段性手術會減低術後併發症，是否有術後併發症好發相關的危險因子。

方法　收集自民國 89 年一月至民國 92 年十二月所有因複雜性憩室炎入住長庚醫院的病例。查詢病歷並紀錄相關資料，選擇出有因複雜性大腸憩室炎進行手術之病例，回溯其病歷資料並紀錄相關之手術併發症，住院天數，基本資料等，再以 SAS 統計軟體進行統計分析。

結果　自民國 89 年一月至民國 92 年十二月，共有 335 個病例因大腸憩室炎入住林口長庚紀念醫院。其中有 57 個病例有大腸鏡或大腸鋇劑攝影診斷並且非複雜性憩室炎，有 87 個病例是臨床診斷非複雜性憩室炎，92 個病例為電腦斷層診斷非複雜性憩室炎。共有 46 例診斷為複雜性憩室炎且有施行手術。在這 46 例當中，有 4 例 (8.7%) 為組織膿炎 (phlegmon)，有 34 例 (73.9%) 為膿瘍或廔管，8 例 (17.4%) 為穿孔破裂。其中有 30 例 (65.2%) 施行一階段手術，13 例 (28.3%) 施行兩階段手術，3 例 (6.5%) 施行三階段手術。統計結果為一階段性手術和病人術後併發症有顯著相關 ($p < 0.0016$)，階段性手術及病人住院總天數也有顯著相關 ($p < 0.00005$)。

結論　在本次回溯性統計當中，發現階段性手術和病人術後併發症，及和病人住院總天數有顯著相關。在本次統計中，不論年齡，複雜性憩室炎之分期，一階段手術的病人在術後併發症有最低的發生風險，在總住院天數上有最好的預測值。

關鍵詞　複雜性大腸憩室炎、階段性手術、手術併發症。