

Urgent surgery for sigmoid diverticulitis.

Retrospective study of 118 patients



Ann. Ital. Chir., 2011 82: 41-48

Michelangelo Miccini, Ottavia Borghese, Massimo Scarpini, Diletta Cassini, Matteo Gregori, Stefano Amore Bonapasta, Adriano Tocchi

Department of Surgery, "La Sapienza" University Medical School, Rome, Italy

Urgent surgery for sigmoid diverticulitis. Retrospective study of 118 patients

OBJECTIVE: Aim of our study was to identify the risk factors for operative morbidity and mortality after urgent surgery for complicated sigmoid diverticulitis. A further end point was define the adequate surgical approach in these patients.

METHODS: Data from 118 patients who were admitted for emergency surgery between 2000 and 2009 for non-haemorrhagic complicated diverticulitis of the sigmoid colon were retrospectively evaluated and analysed. Operative options included resection with primary anastomoses (PA), Hartmann's procedure (HP) and colostomy. All operative complications were noted and potential risk factors listed.

RESULTS: One hundred eighteen patients were enrolled in this study. Surgery for peritonitis was indicated for 102 patients and for intestinal obstruction in the remainder. Overall morbidity and mortality rates were 37.3% and 9.3%, respectively. Primary resection was performed on 113 patients (95.8%). Age greater than 70 years, diffuse peritonitis, Mannheim Peritonitis Index (MPI) above 18, and symptoms lasting longer than 24 hours are considered as independent risk factors for operative morbidity and mortality.

DISCUSSION: Our results confirmed that while age older than 70 years and delaying treatment (>24h) are independent risk factors for operative morbidity and mortality, comorbidity is not. According to general guidelines, first target of surgery was to attempt a primary resection of the diseased colon (95.8% of our patients). In our series an high rate of Hartmann procedure (HP) in Hinchey's class 2 patients was observed. This unusually high number is explained by the rate (68.4%) of pelvipertonitis diagnosed in these patients. Extended pelvic peritonitis is generally defined as a local peritonitis (class 2 Hinchey), which is not accurate. Colonic resection in these cases would not completely remove peritoneal contamination and renders the indication for PA questionable

CONCLUSIONS: Emergency surgery for complicated diverticulitis is characterised by high rates of morbidity and mortality. Age greater than 70 years, symptoms lasting longer than 24 hours, MPI above 18, and diffuse peritonitis were significant predictors. Early eradication of septic focus is the main goal of surgery. Primary anastomosis is recommended only if sepsis is completely removed.

KEY WORDS: Complicated diverticulitis, Sigmoid diverticulitis, Sigmoidectomy

Introduction

Diverticulosis of the sigmoid colon is a ubiquitous condition in the western world. Thirty percent of the pop-

ulation older than 45 and perhaps 60% older than 75 are presently considered to be affected by diverticulosis.¹⁻⁹ Twenty-five percent of patients affected by diverticulosis will develop acute diverticulitis; half of these will require urgent hospitalisation.¹⁻⁴

Most patients with first attacks of diverticulitis will benefit from medical treatment. However, in 20% of cases complications such as perforation or obstruction will develop, requiring emergency surgery. The indication for emergency surgery increases with successive attacks.^{2,10-12} The choice of procedures for non-elective surgery for sigmoid diverticulitis has shifted since the 1980s, from

Pervenuto in Redazione Luglio 2010. Accettato per la pubblicazione Ottobre 2010

Corresponding To: Adriano Tocchi, MD, FACS, Via Bruno Bruni, 94, 00189 Rome, Italy, (e-mail: Adriano.Tocchi@Uniroma1.it)

three-stage to two- and one-stage procedures^{13,14}. High rates of operative morbidity and mortality after a three-stage procedure, depending on the diseased colon left in situ, have prompted surgeons to remove the diseased colon during the initial surgery^{11,15-18}. Hartmann's procedure (HP) represents the first step toward this practice and presently is still recommended when treating diverticulitis of Hinchey class 3 and 4 peritonitis. Resection with primary anastomosis (PA) is also considered safe in the urgent treatment of diverticulitis, but there is still controversy about its use in treating diffuse peritonitis^{19,20}.

Age of patients, immune status, comorbidity, delay of treatment, site of diverticulitis, and grade of peritoneal contamination are considered the major factors affecting operative morbidity and mortality after emergency surgery for complicated diverticulitis^{11,16,21-24}.

The goal of the present study was to identify the risk factors for mortality and morbidity in patients undergoing emergency surgery for complicated non-haemorrhagic sigmoid diverticulitis.

Methods

Records of all patients who were admitted between January 1999 and December 2008 to the Departments of Surgery of La Sapienza Medical School in Rome and admitted for emergency surgery for complicated diverticulitis were reviewed. Information was extracted from the case notes and analysed. Patients with haemorrhagic complications and those with previous intestinal surgery were excluded from this study as well as Hinchey I patients successfully treated by CT-guided percutaneous drainage.

TABLE I - Demographic and clinical data of patients

Median age (yr)	64.3 ± 10.2 (43-81)
Older than 70	48 (40.7%)
Gender Male	54 (45.7%)
Female	64 (54.3%)
Clinical episode (1st - 2 nd - 3 rd)	19 (16.1%) - 81 (68.6%) - 18 (15.3%)
Fistula	4 (3.4%)
Enteral	3
Vescical	1
Surgical indication	
Peritonitis	102 (86.4%)
Obstruction	16 (13.6%)
Hinchey classes	
1	16 (13.5%)
2	38 (32.2%)
3	38 (32.2%)
4	26 (22.1%)
Delay (h)	
< 24	50 (42.4%)
> 24	68 (67.6%)
WBC (x10 ³ /ml)	13.3 ± 2.75 (8-21)
Comorbidity	51 (43.2%)
Diabetes	13 (25.5%)
Hypertension	16 (31.3%)
Coronary disease	9 (17.7%)
Chronic pulmonary disease	8 (15.7%)
Cirrhosis	3 (5.9%)
Renal failure	2 (3.9%)
MPI (pts)	18.0 ± 8.9 (0-32)
ASA score (I-II-III)	67 (56.8%) - 35 (29.7%) - 16 (13.5%)
Length of stay (d)	13.3 ± 3.8 (9-26)

TABLE II - *Surgical procedures.*

Surgical procedures	
colostomy	5 (4.2%)
Resection-anastomosis	28 (23.7%)
Hartmann	85 (72.1%)
Duration of procedure (min)	109 ± 18 (80-160)
Blood loss (ml)	191.5 ± 71.4 (100-600)
Blood transfusion (U)	0 ± 0.4(0-2)
Conversion	80/98 (81.6%)

TABLE III - *Operative morbidity and mortality.*

Patients	Aforbidity	Afortality
Overall (118)	44 (37.3%)	11 (9.3%)
Hinchey 2 (38)	6 (16%)	1 (2.6%)
- Pelvipерitonitis (26)	4 (15.4%)	1 (3.9%)
Localized peritonitis (12)	2 (16.6%)	0 (0.0%)

Demographic and clinical data were noted and collected. Details included age and gender, number of clinical episodes, comorbidity, duration of symptoms, Hinchey class, surgical procedure, duration of intervention, rate of intestinal conversion, length of stay, and operative morbidity and mortality. Duration of symptoms was divided as shorter or longer than 24 hours. Peritoneal contamination was defined as the presence of fever (temperature higher than 38°C), leucocytosis (13,000 WBC/mm³), abdominal defence, and radiologic (computed tomography [CT] or ultrasound [US]) findings of peritoneal effusion. Hinchey II patients with extended pelvic peritoneal contamination (pelvipерitonitis) and pericolic tissue contamination (localized peritonitis) were considered separately. Patients with diffuse peritonitis (Hinchey classes 3 and 4) were subdivided according to the Mannheim Peritonitis Index (MPI) into scores higher and lower than 18. Preoperative intestinal cleaning was not performed. Operative options were one- and two-stage procedures. The surgical access was in all cases through a total median incision. Inferior mesenteric artery dissection (IMAD) was always associated with PA. Resections were not extended to extracolonic organs. Mechanical T-T apposition of intestinal stumps, hydropneumatic insufflations test, and omentoplasty were performed for primary and secondary anastomoses. Ghost ileostomy was always associated with PA. Intraoperative colonic lavage, peritoneal washing, and abdominal drainage were performed on all patients.

Analysis

Statsoft 2003 (Tulsa, Oklahoma, USA) was used to perform statistical analysis. Fisher, Mann Whitney, and Kruskal Wallis tests were used to perform univariate

analysis. For multivariate analysis, the Cox regression model was used to identify independent prognostic factors. Differences with P values less than 0.05 were considered statistically significant.

Results

POPULATION

This study is based on 118 patients who underwent emergency surgery for non-haemorrhagic complicated sigmoid diverticulitis. Demographic and clinical data are listed in Table I. The mean age was 64.3 years (range 43 to 81). Women slightly outnumbered men by a ratio of 1.2:1 (64 versus 54). Ninety-nine patients (83.4%) had experienced previous diverticulitic attacks. Surgery for peritonitis was indicated for 102 patients (86.4%) and for intestinal obstruction in the remainder. The most frequent cause of peritonitis was free intestinal perforation (75%), followed by covered penetration and flemmonous diffusion. The distribution of Hinchey classes 1, 2, 3, and 4 was 16 (13.5%), 38 (32.2%), 38 (32.2%), and 26 (22.1%), respectively. Symptoms lasted more than 24 hours in 68 patients (58%). The MPI score was above 18 in 63 patients (53%). The mean length of hospital stay was 13 days (range 9 to 26).

SURGICAL PROCEDURES

Operative options, including one- and two-stage procedures, are listed in Table II. Primary resection was performed in 113 patients (95.8%), associated with HP in 85 (72.1%) and PA in 28 (23.7%). Simple colostomy was performed on five patients (4.2%). PA was performed on all patients classified as Hinchey class 1. HP was the most frequent operation for patients in Hinchey class 2 (68.4%) and for those in Hinchey classes 3 and

TABLE IV - *Univariate analysis of morbidity risk factors.*

	Morbidity	No morbidity	P
Median age (y)	66.2 ± 9.1	63.1 ± 10.7	0.111
Age > 70 years	20/44 (45.5%)	24/74 (32.4%)	0.018
Gender (N - F)	27-17	37-37	0.313
Episode (1 st - 2 nd - 3 rd)	5-35-4	14-46-14	0.139
WBC (x10 ³ /ml)	13.0 ± 2.1	13.5 ± 3.1	0.631
Comorbidity	21/44 (47.7%)	30/74 (40.54%)	0.353
ASA score (I-II-III)	23-13-8	44-28-8	0.507
Surgical indication			
Peritonitis	43	59	0.006
Occlusion	1	15	
Peritonitis			
No	1	15	< 0.001
Abscess	2	9	
Local	4	24	
Diffuse	17	20	
Fecal	20	6	
Hinchey class			
1-2	7 (15.9%)	47 (63.5%)	< 0.001
2 with pelviperitonitis	4 (15.4%)	22 (84.6%)	
3-4	37 (84.1%)	27 (36.5%)	
Delay > 24 h	35/44 (79.5%)	33/74 (44.6%)	< 0.001
MPI (Pts)	24.5 ± 5.4	14.1 ± 8.3	< 0.001
MPI > 18 Pts	42/44 (95.4%)	21/74 (28.4%)	< 0.001
Blood loss (ml)	201.1 ± 81.0	185.8 ± 64.9	0.263
Blood transfusion (012 U)	39-4-1	65-6-3	0.864
Duration of operation (min)	110.2 ± 18.7	107.7 ± 17.6	0.522
Length of stay (d)	16.5 ± 4.2	11.4 ± 1.5	< 0.001

4 (92.2%). Intestinal continuity was restored in 93% of multistage procedures.

MORBIDITY

Complications were observed in 44 patients (37.3%); the reoperation rate was 34%. The morbidity rate in the pelviperitonitis group was 15.4%, corresponding to four patients (Table III). Intra-abdominal infection (abscess or peritonitis) was the most common complication and required surgical treatment in 76% of cases. Leakage of anastomosis occurred in 2.3% of patients with PA. No complication was observed after intestinal reconstitution in patients undergoing HP.

MORTALITY

The overall operative mortality rate was 9.3% (11 patients; Table III). Abdominal sepsis and cardiac failure were the most common causes of fatalities.

Univariate and multivariate analyses indicated age greater than 70 years, diffuse peritonitis, MPI above 18, and symptoms lasting longer than 24 hours as independent

risk factors for morbidity and mortality (Tables IV, V, and VI).

Discussion

The incidence of diverticular disease of the sigmoid colon steadily increases with age and is now the most common digestive disease in the geriatric population.²⁻⁸ Uncomplicated diverticular disease, even if asymptomatic, may lead to severe complications. The natural history of complicated diverticular disease includes various clinical manifestations, from a medically controlled disease to generalised peritonitis requiring immediate surgery. Fifty percent of patients with repeated attacks of diverticulitis who require hospitalisation will undergo surgery.⁶ Technical improvements in radiology afford earlier diagnosis of complicated diverticulitis. Earlier diagnosis and standardised therapeutic protocols have improved prognosis. Contrasted computed tomography is, at present, paramount in emergency diagnosis.^{3,8,25,26} The local and

TABLE V - Univariate analysis of mortality risk factors.

	Morbidity	No morbidity	P
Median age (y)	69.7 ± 8.2	63.7 ± 10.3	0.060
Age > 70 years	8/11 (72.7%)	40/107 (37.4%)	0.048
Gender (M - F)	2-9	52-55	0.107
Episode (1 st - 2 nd - 3 rd)	1-8-2	18-73-16	0.467
WBC (x10 ³ /ml)	12.4 ± 2.1	13.4 ± 2.7	0.444
Comorbidity	6/11 (18.2%)	45/107 (42.1%)	0.133
ASA score (I-II-III)	5-2-4	62-33-12	0.065
Surgical indication			
Peritonitis	11	91	0.359
Occlusion	0	16	
Peritonitis			
No	0	16	0.052
Abscess	0	11	
Local	1	27	
Purulent diffuse	6	31	
Fecal	4	22	
Hinchey class			
1-2	1 (9.1%)	53 (49.5%)	< 0.024
2 with pelviperitonitis	1 (19%)	25 (96.1%)	
3-4	10 (80.9%)	54 (50.5%)	
Delay > 24 h	11/11 (100%)	57/107 (53.3%)	< 0.007
MPI (pts)	26.4±4.2	17.1 ± 8.8	< 0.001
MPI > 18 Pts	11/11 (100%)	52/107 (48.6%)	< 0.003
Blood loss, ml	204 ± 137	198 ± 62	0.470
Blood transfusion (0-1-2 U)	8-2-1	96-8-3	0.328
Duration of operation (min)	110.0 ± 18.4	108.5 ± 18.1	0.856

TABLE VI - Multivariate analysis of morbidity and mortality risk factors.

Morbidity		Mortality	
Parameter	Odds ratio	Parameter	Odds ratio
Age > 70 years	4.704	Age > 70 yr	4.225
MPI > 18 Pts	23.188	MPI > 18	> 10
Delay > 24 h	4.250	Delay > 24 h	> 10
Diffuse peritonitis (Hinchey III-IV)	11.435	Diffuse Peritonitis (Hinchey III-IV)	7.555

general sepsis associated with diverticulitis and the contaminant properties of colon surgery are considered responsible for the high postoperative morbidity of emergency surgery for diverticulitis.^{27,28} In our series, abdominal infections, organ failure, and intestinal bleeding were the most common factors and were responsible for an overall morbidity rate of 37.3%. Adequate timing of anastomosis has been reported as paramount in reducing the percentage of anastomotic leak.^{6,21,27,29} The incidence of anastomotic leak was 2.3%, which agrees with ranges reported by other authors.

The overall mortality rates after colorectal surgery for complicated diverticulitis range from 1% to 3% in elective surgery and 12% to 36% in emergency surgery.^{12,15,16,27-33} The mortality rate in our series was 9.3%. Sepsis and organ failure were the most frequent causes of death, which agrees with reports of other authors. We confirmed that age older than 70 years is the main risk factor for morbidity and mortality. The number of colon resections in elderly patients increases steadily as the population ages.³⁴ Old age represents an intrinsic risk factor in almost all pathologies because functional reserve

and compliance decrease severely in these patients^{27,28}. Our results have not confirmed comorbidity as a negative prognostic factor. Recent progress in anaesthesiology and intensive care has improved the management of comorbidities by balancing organ insufficiencies, which may reduce their negative influence on prognosis³⁵. The incidences of morbidity and mortality in our series were significantly greater in patients who were admitted to surgery more than 24 hours after the onset of symptoms. An earlier timing of surgery has been shown to improve the prognosis of patients with complicated diverticulitis, particularly those with peritonitis^{15,22}. Delaying treatment promotes a prolonged action of septic focus that leads to a breakdown of functional reserves and compensation mechanisms. MPI is a system for the clinical evaluation of patients with peritonitis but, because of different critical points proposed by different authors, there is no agreement about the crucial score separating good and poor prognoses^{15,22,23,33,36}. An MPI score above 18 in our series related to significantly higher rates of postoperative morbidity and mortality.

Emergency surgical treatment for diverticulitis, apart from MPI, is based on guidelines from the American Society of Colon and Rectal Surgeons.^{10,11} The first task of surgery should be to attempt a primary resection of the diseased colon. This attitude is supported by poor results of simple intestinal deriving, leaving the inflammatory site in situ^{15-18,27,29-31,37}. The primary resection of the diseased colon associated with either HP or PA, in our experience, was possible in 95.8% of the patients. Our policy, in cases of HP, is to confine colon mobilisation to the sigmoid tract. This enables a safe, tension-free colostomy, and extraperitoneal septic diffusion triggered by more extended colonic mobilisation is avoided. PA was regularly associated with IMAD in our series. This procedure ensures both the preservation of an effective vascularisation of anastomotic stumps and the certain removal of the complete sigmoid colon and avoids the risk of recurrence at the anastomotic site, which ranges from 3% to 36%^{32,38-40}. Recurrent diverticulitis develops in patients in whom the sigmoid colon was used as the distal margin of anastomosis. Cause of incomplete resection of the sigmoid colon probably is failure to precisely recognise the colorectal junction, hindered by fusion and retraction phenomena secondary to the inflammation. The identification of superior rectal pedicle by the downward dissection of the IMAD dissection leads to the precise individuation of the colorectal junction and to the complete resection of the sigmoid colon. No recurrence has been observed in patients in our series.

Although there is general agreement about the use of PA in patients in Hinchey classes 1 and 2, using the same procedure in classes 3 and 4 is controversial. Generalised peritonitis has long been considered an absolute contraindication^{11,16,27,29,30,41-43}. PA with protective colostomy has been proposed for patients with diffuse peri-

toneal contamination because of the high morbidity and risks of permanent colostomy associated with HP.^{13,14,33} However, although no prospective comparative trials have been performed, we agree that avoidance of discomfort related to colostomy, technical difficulties, and complications related to its closure do not reasonably justify exposing patients to the danger of anastomotic leakage^{15,19,20}. Moreover, the high mortality and morbidity rates that are reported to follow HP might be not exclusively attributed to the procedure, but, at least in part, to be the a consequence of the severity of the disease that most often represents the indication for this procedure.

The unusually high rate of HP in patients considered Hinchey class 2 in our series is explained by the rate (68.4%) of pelviperitonitis diagnosed in these patients. Actually, Hinchey class 2 does not single out a well-defined pathologic stage. In particular, extended pelvic peritonitis is generally defined as a local peritonitis, which is not accurate. Colonic resection in these cases would not completely remove peritoneal contamination and renders the indication for PA questionable. Loop colostomy has been suggested as a procedure that can reduce, in these cases, the risk of PA. Loop colostomy does not completely divert enteric material and does not warrant a real full protection of the anastomosis because its rate of complications is high. HP for patients in our series with extended pelviperitonitis was safe and effective and afforded acceptable morbidity and mortality rates (Table IV). A ghost ileostomy was associated in 31.4% of Hinchey class 2 patients who underwent PA⁴⁴. We recommend this procedure because it combines all the advantages of a disposable ileostomy without its complications. Intraoperative colonic lavage was performed on all patients in our series, whether or not primary anastomoses were programmed. We agree that colonic lavage should be given to patients who undergo a multistage procedure because it improves the maturation of the stump by reducing early contamination of the stoma wound and minimising tension on anchoring sutures⁴⁵.

Conclusion

We confirmed that age older than 70 years, symptoms lasting longer than 24 hours, MPI above 18, and diffuse peritonitis are significant predictors in the surgical treatment of complicated diverticulitis. PA, although confirmed as the adequate treatment for patients with disease considered as Hinchey class 1, was not used for those in Hinchey classes 3 and 4, all of whom underwent HP. Two-thirds of patients classified as Hinchey class 2 were treated with HP. Underlying this approach is the frequency of extended pelvic peritonitis. A clear-cut distinction between localised peritonitis and pelviperitonitis is necessary to better determine the surgical treatment for each condition.

Riassunto

OBIETTIVO: Scopo del nostro studio è stato quello di identificare i fattori di rischio di morbidità e mortalità postoperatorie in pazienti sottoposti ad intervento chirurgico di urgenza per diverticolite complicata del sigma. Ulteriore obiettivo è stato quello di definire l'adeguato approccio chirurgico per questi pazienti.

PAZIENTI E METODO: Sono stati analizzati retrospettivamente i dati relativi a 118 pazienti sottoposti ad intervento chirurgico di urgenza per diverticolite complicata del sigma. Gli interventi chirurgici eseguiti hanno compreso resezioni con anastomosi primaria (AP), procedure di Hartmann (PH) e colostomie. Tutte le complicanze osservate sono state registrate ed i potenziali fattori di rischio analizzati.

RISULTATI: Le indicazioni all'intervento chirurgico d'urgenza sono risultate la peritonite in 102 casi e l'occlusione intestinale nei restanti 16. La mortalità e morbidità generali sono risultate del 9.3% e 37.3%, rispettivamente. La resezione primaria del colon diverticolitico è stata possibile in 113 pazienti (95.8%), mentre nei restanti casi si è proceduto a colostomia. L'età maggiore di 70 anni, la presenza di peritonite generalizzata e la durata dei sintomi superiore a 24 ore sono risultati fattori di rischio indipendenti di morbidità e mortalità.

DISCUSSIONE: I nostri risultati hanno confermato che l'età maggiore di 70 anni, la peritonite diffusa ed il ritardo nel trattamento chirurgico rappresentano in questi pazienti, dei fattori di rischio indipendenti per morbidità e mortalità diversamente dalla comorbidità che non ha mostrato lo stesso valore predittivo. In accordo a quanto suggerito dalle linee guida generali, il primo obiettivo degli interventi chirurgici eseguiti è stato quello di tentare la resezione primaria del tratto di colon infiammato (95.8% of our patients). L'inusuale elevato numero di PH eseguite nei nostri pazienti in classe 2 di Hinchey, è riconducibile al frequente rilievo di pelvipertonite (68.4%) osservato in questi casi. La peritonite pelvica, difatti, definita come una reazione localizzata, può talvolta risultare estesa. In questi casi, la resezione colica non rimuove completamente l'area contaminata e l'esecuzione di una anastomosi può risultare rischiosa.

CONCLUSIONI: Il trattamento chirurgico in urgenza della diverticolite complicata è caratterizzato da elevate ratei di morbidità e mortalità. L'età maggiore di 70 anni, la durata dei sintomi superiore a 24 ore e la peritonite diffusa rappresentano fattori predittivi negativi. La precoce rimozione del focolaio settico resta l'obiettivo irrinunciabile di questa chirurgia. L'anastomosi primaria è raccomandata esclusivamente nei casi in cui la sepsi sia stata completamente rimossa.

References

1) West AB: *Diverticulosis coli: Update on a "Western" disease*. Adv Anat Pathol, 2005; 12(2):74-80.

2) Stollman N, Raskin JB: *Diverticular disease of the colon*. Lancet 2004; 21; 363(9409):631-39. Review.

3) Floch MH, Bina I: *The natural history of diverticulitis: Fact and theory*. J Clin Gastroenterol, 2004; 38(5S):2-7.

4) Colecchia A, Sandri L, Capodicasa S, Vestito A, Gazzella G, Staniscia T, Roda E, Festi D: *Diverticular disease of the colon: New perspectives in symptom development and treatment*. World J Gastroenterol, 2003; 9(7):1385-389. Review

5) Beitz JM: *Diverticulosis and diverticulitis: spectrum of a modern malady*. J Wound Ostomy Continence Nurs, 2004; 31(2):75-82. Review.

6) Simpson J, Scholefield JH, Spiller RC: *Pathogenesis of colonic diverticula*. Br J Surg, 2002; 89(5):546-54. Review.

7) West AB, Losada M: *The pathology of diverticulosis coli*. J Clin Gastroenterol, 2004; 38(5 Suppl): S11-6.

8) Stollman NH, Raskin JB: *Diagnosis and management of diverticular disease of the colon in adults*. Ad Hoc Practice Parameters. Committee of the American College of Gastroenterology. Am J Gastroenterol, 1999; 94(11):3110-121.

9) Tonelli F, Di Carlo V, Liscia G, Serventi A: *La malattia diverticolare del colon: Quando e come trattarla*. Ann Ital Chir, 2009; 80:3-8

10) Rafferty J, Shellito P, Hyman NH, Buie WD: *Standard Committee of the American Society of Colon and Rectal Surgeons: Practice parameters for sigmoid diverticulitis*. Dis Colon Rectum, 2006; 49:939-44.

11) Wong WD, Wexner SD, Lowry A, Vernava A 3rd, Burnstein M, Denstman F, Fazio V, Kerner B, Moore R, Oliver G, Peters W, Ross T, Senatore P, Simmang C: *Practice parameters for the treatment of sigmoid diverticulitis-supporting documentation. The Standards Task Force. The American Society of Colon and Rectal Surgeons*. Dis Colon Rectum, 2000; 43(3):289-87.

12) Janes S, Meagher A, Frizelle FA: *Elective surgery after acute diverticulitis*. Br J Surg, 2005; 92(2):133-42. Review.

13) Shilling MK, Maurer CA, Kollmar O, Buchler MW: *Primary vs secondary anastomosis after sigmoid colon resection for perforated diverticulitis (Hinchey stage III and IV)*. Dis Colon Rectum, 2001; 44(5):699-703.

14) Salem L, Flum DR: *Primary anastomosis or Hartmann's procedure for patients with diverticular peritonitis? A systematic review*. Dis Colon Rectum, 2004; 47(11):1953-964. Review.

15) Zeitoun G, Laurent A, Rouffet F, Hay J, Fingerhut A, Paquet J, Peillon C, Research TF: *Multicentre, randomized clinical trial of primary versus secondary sigmoid resection in generalized peritonitis*. Br J Surg, 2000; 87:1366-374.

16) Chandra V, Nelson H, Larson DR, Harrington JR: *Impact of primary resection on the outcome of patients with perforated diverticulitis*. Arch Surg, 2004; 139(11):1221-224.

17) Greif JM, McSherry CK: *Surgical treatment of perforated diverticulitis of the sigmoid colon*. Dis Colon Rectum. 1980; 23(7):483-87. Review.

18) Underwood JW, Marks CG: *The septic complications of sigmoid diverticular disease*. Br J Surg, 1984; 71(3):209-11.

19) Nespoli A, Ravizzini C, Trivella M, Segala M: *The choice of*

- surgical procedure for peritonitis due to colonic perforation.* Arch Surg, 1993; 128(7):814-18.
- 20) Wedell J, Banzhaf G, Chaoul R, Fischer R, Reichman J: *Surgical management of complicated colonic diverticulitis.* Br J Surg 1997; 84(3):380-83.
- 21) Alves A, Panis Y, Mathieu P, Manton G, Kwiatkowski F, Slim K: *Association Francaise de Chirurgie. Postoperative mortality and morbidity in French patients undergoing colorectal surgery: Results of a prospective multicenter study.* Arch Surg, 2005; 140(3):278-83.
- 22) Pisanu A, Cois A, Uccheddu A: *Surgical treatment of perforated diverticular disease: Evaluation of factors predicting prognosis in the elderly.* Int Surg, 2004; 89:35-38.
- 23) Billing A, Frohlich D, Schildberg FW: *Prediction of outcome using the Mannheim Peritonitis Index in 2003 patients. Peritonitis Study Group.* Br J Surg, 1994; 81:209-13.
- 24) Makela JT, Kiviniemi H, Laitinen S: *Prognostic factor of perforated sigmoid diverticulitis in the elderly.* Dig Surg, 2005; 22:100-6.
- 25) Labs JD, Sarr MG, Fishman EK, Siegelman SS, Cameron JL: *Complications of acute diverticulitis of the colon: Improved early diagnosis with computerized tomography.* Am J Surg, 1988; 155(2):331-6.
- 26) Morris J, Stellato TA, Lieberman J, Haaga JR: *The utility of computed tomography in colonic diverticulitis.* Ann Surg, 1986; 204(2):128-32.
- 27) Letwin ER: *Diverticulitis of the colon. Clinical review of acute presentations and management.* Am J Surg, 1982; 143(5):579-81.
- 28) Pessaux P, Muscari F, Ouellet JF, Msika S, Hay JM, Millat B, Fingerhut A, Flamant Y: *Risk factors for mortality and morbidity after elective sigmoid resection for diverticulitis: Prospective multicenter multivariate analysis of 582 patients.* World J Surg, 2004; 28(1):92-6.
- 29) Rodkey GV, Welch CE: *Changing patterns in the surgical treatment of diverticular disease.* Ann Surg, 1984; 200(4):466-78.
- 30) Peoples JB, Vilck DR, Maguire JP, Elliott DW: *Reassessment of primary resection of the perforated segment for severe colonic diverticulitis.* Am J Surg, 1990; 159(3):291-93; discussion 294.
- 31) Schwesinger WH, Page CP, Gaskill HV 3rd, Steward RM, Chopra S, Strodel WE, Sirinek KR: *Operative management of diverticular emergencies: strategies and outcomes.* Arch Surg, 2000; 135(5):558-62.
- 32) Benn PL, Wolff BG, Ilstrup DM: *Level of anastomosis and recurrent colonic diverticulitis.* Am J Surg, 1986; 151(2):269-71.
- 33) Gooszen AW, Tollenaar RA, Geelkerken RH, Smeets HJ, Bemelman WA, Van Schaardenburgh P, Gooszen HG: *Prospective study of primary anastomosis following sigmoid resection for suspected acute complicated diverticular disease.* Br J Surg, 2001; 88(5):693-7.
- 34) Spivak H, Vande Maele D, Friedman I: *Colorectal surgery in octogenarians.* J Am Coll Surg, 1996; 183:46-50.
- 35) Kehlet H, Wilmore DW: *Multimodal strategies to improve surgical outcome.* Am J Surg 2002; 13(6):630-41. Review
- 36) Blair NP, Germann E: *Surgical management of acute sigmoid diverticulitis.* Am J Surg, 2002; 183(5):525-28.
- 37) Belmonte C, Klas JV, Perez JJ, Wong WD, Rothenberger DA, Goldberg SM, Madoff RD: *The Hartmann procedure. First choice or last resort in diverticular disease?* Arch Surg, 1996; 131(6):612-15; discussion 616-271.
- 38) Salem L, Veenstra DL, Sullivan SD, Flum DR: *The timing of elective colectomy in diverticulitis: A decision analysis.* J Am Coll Surg, 2004; 199(6):904-12.
- 39) Thorn M, Graf W, Stefansson T, Pahlman L: *Clinical and functional results after elective colonic resection in 75 consecutive patients with diverticular disease.* Am J Surg, 2002; 183(1):7-11.
- 40) Tocchi A, Mazzoni G, Fornasari V, Miccini M, Daddi G, Tagliacozzo S: *Preservation of the inferior mesenteric artery in colorectal resection for complicated diverticular disease.* Am J Surg, 2001; 182(2):162-67.
- 41) Gallinara LS, Forte A, D'Urso A, Bezzi C, Lorenzotti A, Palumbo P, Bezzi M: *Indicazioni e trattamento chirurgico delle diverticoliti acute complicate.* Ann Ital Chir, 2001; 72:431-36.
- 42) Celi S, Parisi A, Maccarone P, Alberti A, Littori F, Dattola M, Basile M: *Il trattamento chirurgico della diverticolite acuta del colon. Esperienza personale.* Ann Ital Chir, 2001; 72:437-42.
- 43) Cennamo A, Tolomeo R, Falsetto A, Polito A, Di Giacomo G, De Pascale V: *Una complicanza della diverticolite acuta: La fistola colo-vescicale (Caso Clinico).* Ann Ital Chir, 2002; 73:311-16.
- 44) Miccini M, Amore Borapasta S, Gregori M, Barillari P, Tocchi A: *Ghost ileostomy: Real and potential advantages.* Am J Surg, 2010; 200(4):55-7.
- 45) Murray JJ, Schoetz DJ Jr, Collier JA, Roberts PL, Veidenheimer MC: *Intraoperative colonic lavage and primary anastomosis in nonelective colon resection.* Dis Colon Rectum, 1991; 34:527-31.