

Research Article

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Early Elective Versus Delayed Elective Laparoscopic Sigmoidectomy Following the Acute Episodes of Sigmoid Diverticulitis: A Prospective Study

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Abstract

Objectives: we are aiming to investigate and compare the outcome of early elective surgery for sigmoid diverticulitis directly after improving the acute attacks versus delayed elective interventions.

Methods: Our study included 47 patients of sigmoid diverticulosis. Patients were divided into 2 groups; group A (25 patients) who underwent surgery in the same hospital admission of the acute attack after controlling the manifestation of the acute inflammation within one week of admission, and group B (22 patients) who underwent surgery 4-6 weeks after subsidence of the acute attacks during the inflammation-free interval. We had collected and recorded patients' data during and after a surgical procedure, then data were statistically analyzed.

Results: No significant differences between group A and B regarding the mean operative time (p-value 0.067). However, the mean amount of the intra-operative bleeding and the rate of Hartman's procedure were significantly higher in the early elective group (p-value 0.034 versus 0.021). About the conversion rate and the mean postoperative ICU as well as hospital stay days, there were no significant variances between the two groups.

Conclusion: Medically and financially, the early elective operations for patients following the clinical recovery of the AD attacks are preferred than the delayed elective surgeries.

Keywords: Elective Surgery; Laparoscopic Sigmoidectomy; Sigmoid Diverticulitis

Introduction

Acute Diverticulitis (AD) of the sigmoid colon becomes a fairly common medical problem with a rising incidence; this may be attributed to lifestyle subjects and changes in dietary habits [1]. The clinical picture of AD varies from mild inflammation to a free colonic perforation and septic peritonitis [2,3]. In AD; conservative management is the treatment of the first choice for mild or phlegmonous inflammation. On the other hand, surgery is a ministry for a complicated AD with colonic perforation and septic peritonitis [4].

The growing incidence of the AD and its probably life-threatening complications make it an important issue in clinical practice [5]. Treatment of sigmoid diverticular disease underwent

a frequent updating in the last decades and many recommendations were established in this field [6]. Surgery is the main strategy for the management of sigmoid diverticular disease. However, one of the principal challenges in surgery lies in deciding the optimal time in which patients would benefit from an elective operation [7]. The outcome and quality of life (QoL), as well as financial issues after an attack of the AD, may be determined by the rate of recurrence and the persistence of symptoms [8,9]. Following the first attack of the AD, the recurrence rate after conservative management without surgery is around 40 to 50 % [10,11]. Currently, there are two options have been in concurrent practice in various hospitals regarding the timing of surgery after the clinical improvement of AD: (i) the delayed elective operation, in which the surgery is performed 4-6 weeks after an acute attack during the inflammation-free interval [12], and (ii) the early elective operation, in which the surgery takes place in the same hospital admission directly after conservative management of the

AD attack in the hope of decreasing any adhesion resulting from the acute inflammation [13]. This second choice was adjusted from the practice in the management of acute cholecystitis [14]. We are aiming to contribute by the present study, to provide an ideal management and proper decision-making for every patient with the diverticular disease.

Patients and method

This study was completed at the General Surgery department, Banha University Hospital in Egypt and King Saud Hospital in Saudi Arabia from May 2016 until December 2018. The study includes 47 consecutive patients who came to our hospital recently treated or having an attack of sigmoid Acute Uncomplicated Diverticulitis (AUD). In both hospitals, the study protocol was approved by the Ethical Committee. An informed consent was obtained from each patient for participation in the study. Patients were informed in details about the advantages and disadvantages of both management plans. The management plans were followed in both hospitals.

We had 2 varieties of patients in this study. The first category of patients had been admitted to the hospital through the emergency department for the treatment of an acute attack of sigmoid AD. Patients who were in need of surgery and signed the consent, considered for early surgical intervention in group A during the same hospital admission after improving the manifestations of the acute episode. The second category included two types of patients; (i) patients from the first category who refused early intervention and preferred delayed surgery and (ii) patients who had been referred to our hospitals to be evaluated for possible operative treatment after a recent improvement of an acute attack of the AD. At the time of hospitalization, patients did not have any manifestations of the AD. If surgery was indicated, patients were selected in group B in our study and booked for an elective operation. Depending on the timing of surgery, patients were categorized into 2 groups: (i) group A, including 25 patients who underwent a laparoscopic sigmoid colectomy within the same hospital admission of AD after improvement of the clinical manifestation of the acute attacks and (ii) group B, including 22 patients who underwent the same type of surgery 6-12 weeks after complete improvement of acute attacks of AD. Patients were clinically evaluated through general, abdominal, and Per Rectal (PR) examinations. Laboratory tests such as Complete Blood Count (CBC), C-Reactive Protein Level (CRP) Random Blood Sugar (RBS), kidney function tests, liver function tests, serum amylase, pregnancy test for females in the childbearing period and urine as well as stool analyses. Diagnostic imaging done in the form of erect abdominal plain X-ray, Ultrasonography (US) and Computed Tomography (CT) scans with intravenous and oral contrast material. A complete colonoscopy was done after improvement of the acute attack of diverticulitis and a biopsy was taken from any ulcerating or

inflamed lesions. The diagnosis of the AD had to be confirmed by a CT scan. The diagnoses of AUD corresponds to the modified Hinchey classification 1A [15-17] and it was established in our study when there was an absence of perforation (extravasation of dye on CT), abscess, or signs of septic peritonitis

We included in our study: (i) Patients who were diagnosed as having AUD and underwent a conservative management in our ED or referred to us from other hospitals after remission of AD, (ii) Age \geq 18 years, and (iii) the American Society of Anesthesiology (ASA) Score of I-III. We have excluded from the study: (a) patients who had AD and underwent surgery during the acute attack, (b) Patients undergoing planned open sigmoid resections (c) Diverticulosis accompanied by colon cancer, (d) Patients participating in other studies, (e) Patients with psychiatric illnesses, and (f) ASA score $>$ III. The use of these criteria by the hospitals for allocation of patients to both management procedures avoided reliance on the selection of patients by surgeons, who therefore stayed fair. The collected data about our patients included: (A) Demographic and clinical data comprising age, gender, BMI, ASA score, and associated co-existing diseases and (B) Important intra-operative as well as post-operative data. Data were collected at each contributing hospital and statistically analyzed.

Preoperative assessment and preparation

- **In group A**, on admission, the diagnosis of the AUD was established depending on clear medical history and laboratory as well as radiological exams, a conservative treatment followed through giving: Ciprofloxacin 200 mg IV twice daily, metronidazole 0.5 g IV, three times daily, and nutrition intake was restricted to liquid foods. As soon as the patient condition had stabilized, treatment was converted to oral medications and resumed normal oral feeding. He/she were given the right to choose one of the treatment plans.
- **In both groups**, the day before surgery, all patients received a mechanical bowel preparation either orally or with enemas to ease the colonic anastomosis. The day of surgery, intravenous antibiotic prophylaxis (Cefazoline 2 gm and metronidazole 500 mg) was given one hour before surgery.

Operative technique

All operation started through a laparoscopic approach, but when conversion to open surgery was needed, a midline exploratory incision was implemented. A sigmoid resection was done in all operations. The splenic flexure was mobilized in some cases to allow a tension-free anastomosis. During the operation, the proximal resection margin was identified for every individual patient taking into consideration that the entire diseased colonic segment was resected. On the other hand, the distal margin was constantly in the upper, intra-peritoneal part of the rectum. The main left colonic artery has been preserved as much as possible. The anastomosis tightness was evaluated visually through an air leak test through filling the pelvis with normal saline with a trans-anal air insufflation. In a few cases (one patient in each group),

a transient diverting proximal transverse colostomy was done. A suction drain inserted in all patients. The resected colonic segment was removed through a small supra-pubic incision. In some cases, when indicated, the laparoscopic approach was converted to an open laparotomy (A=2 and B=1) or to a laparoscopic-assisted Hartmann procedure (A=2).

Postoperative care

After operations, most patients shifted to the ordinary ward beds. However, some patients who were generally unstable (A=2 and B=2) shifted to ICU. Patients were managed in the PO period through the Enhanced Recovery After Surgery Protocols (ERAP). Patients stimulated for early mobilization, good observation of pulmonary function, the intravenous antibiotic was continued for 24 h after surgery, and DVT prophylactic measures were applied. On the 1st PO day, urine catheter removed, oral fluid and soft diet started, and drains were removed on the 5th PO day or when it became minimal (< 50 ml in 24 hours). Patients discharged home once they return to the normal dietary and bowel habit with a good general condition as well as reasonable laboratory tests. After the anastomosis integrity was confirmed, the diverting colostomy was closed on the 6 to 8 PO weeks by using a contrast study. The outpatient clinic follow-up continued until patients became fully improved and had no more PO morbidities.

Statistical analysis

Data presented as mean ± SD, ranges, numbers, and ratios. Results analyzed using Wilcoxon’s ranked test for unrelated data (Z-test) and Chi-square test (X² test) for numerical data. Statistical analysis conducted using the SPSS Version 21 (SPSS, Chicago IL, USA) for windows statistical package. The P-value considered as statistically significant if it was <0.05.

Results

The study included 47 patients with AUD, divided into 2 groups; 25 patients in group A and 22 patients in group B. Patients were divided according to the timing between the improvement of AD manifestations and laparoscopic sigmoidectomy. Group A, for patients who underwent surgery directly after improvement of symptoms (early elective operation) and Group B, for those who underwent sigmoidectomy 4-6 weeks after improvement of the AD symptoms (delayed elective operation). No significant differences regarding age, sex, ASA score or BMI between patients of both groups. Also, basic medical history and clinical findings were nearly comparable between both groups. However, the abdominal examination revealed a significantly higher Palpable abdominal mass within patients of group A compared with group B (p-value=0.001). Patients’ demographic data are summarized in (Table 1).

Data	Strata	Group A n=25	Group B n=22	p-value
Number (%)	47	25(53%)	22(47%)	
Age (years)		60.38±8.25(48-70)	61.41±6.92(50-69)	0.541
Sex	Males	11(44%)	20(41%)	NS
	Females	14(56%)	13(59%)	NS
BMI (kg/m ²)		29.59±3.01(28-34)	30.11±2.42(27-35)	0.626
ASA score		1.65±0.68(1-3)	1.81±0.59(1-3)	0.521
Palpable abdominal mass		9 (36%)	4(18%)	0.001
Mild bleeding per rectum, n (%)		2(8 %)	1(4.5 %)	0.091
Chronic co-existing disease*	Hypertension	10(40%)	8(36%)	NS
	Diabetes mellitus	7(28%)	5(23%)	NS
	BA	4(16%)	4(18%)	NS
	IHD	4(16%)	3(14%)	NS
	Renal impairment	2(8%)	2(9%)	NS
	Chronic liver disease	3(12%)	3(14%)	NS

Data are presented as mean ± SD & numbers; ranges & percentages are in parenthesis. BMI: Body Mass Index; ASA: American Society of Anesthesiologists; NS: Nonsignificant; BA: Bronchial asthma; IHD Ischemic Heart Disease *some cases had more than one Chronic disease.

Table 1: Patients’ demographic and preoperative clinical data.

In both groups, all patients passed the operations smoothly without any major intra-operative complications. Regarding the operative time, there was no significant difference between both groups (p-value 0.231). The mean amount of blood loss during the operation was significantly higher (p-value 0.034) among patients of the early elective group. About the technique of surgery, the rate of Hartman’s procedure was significantly higher in the early sigmoidectomy group compared with the delayed group (p-value 0.021). On the other hand, there was no significant difference between both groups about conversion rate and ICU admission days. No significant differences between both groups regarding the PO complication and the PO hospital stay days (p-value = 0.086 and 0.078 respectively) (Table 2).

Data	Strata	Group A n=25	Group B n=22	p-value
Operative time (min)		102±15.35(85-150)	97.64±10.61 (75-135)	0.231
Intra-operative blood loss		170.5±12.25(50-350)	110.5±55.61(50-250)	0.034
Technique of surgery	Started as laparoscopic-assisted sigmoid resection	25(9%)	22(100%)	
	Conversion to laparotomy	2(8%)	1(4.5%)	0.142
	Hartman’s procedure	2(8%)	0.0	0.021
	Proximal stoma	1(4%)	1(4.5%)	0.612
PO ICU admission (days)		1.27±1.5(1-5)	1.13±1.1(1-4)	0.362
PO complications*	Fever	3(12%)	2(9%)	0.254
	Ilius	1(4%)	1(4.5%)	0.094
	Bleeding	1(4%)	0.0	0.083
	Anastomotic leakage	1(4%)	0.0	0.089
	DVT	0.0	1(4.5%)	0.075
	Wound infection	2(8%)	2(9%)	0.369
	Total	8	6	0.086
PO hospital stays (days)		7.31±2.45(7-12)	6.62±3.67(6-11)	0.078

Data are presented as mean ± SD & numbers; ranges & percentages are in parenthesis. PO: postoperative.* some cases had more than one PO complication.

Table 2: Operative and postoperative data.

Discussion

The optimal management of sigmoid diverticular disease after an attack of acute inflammation stills a point of debate regarding the time and type as well as the indications of the possible surgical intervention [18]. Elective laparoscopic surgery is considered a strong therapeutic option in these situations [19]. Now, laparoscopic sigmoid resection is the optimal surgical procedure for diverticular disease [20]. Apart from situations where the emergency operation is mandatory, an elective surgical intervention is performed on patients who have one or more complications of diverticular disease, such as recurrent attacks of the AD, fistulae formation, stenosis, or sealed perforations [21]. It should be noted that the rate of recurrent AD following a conservative management of the

first attack is around 40% [18]. In a study done by Käse,r et al. [22] have found that nearly 40% of patients with AD would have chosen an earlier surgery.

About the time of elective laparoscopic surgery for sigmoid diverticulitis after subsiding of acute attacks, the most recent studies recommend a delayed elective surgery during the inflammation-free time. Several studies have found that the least safe period between the end of an acute attack and surgery is 4-6 weeks [23], and this was the interval used for patients of group B in our study. Early elective operation (group A) is an alternative to surgery in the inflammation-free time. This procedure was derived from the idea of laparoscopic cholecystectomy done in cases of acute cholecystitis. However, in the case of the AD, the operation

is performed directly after the improvement of the acute attack manifestations.

This early elective intervention was defined by Siewert et al since 1995 [24] and is feasible to be applied in all stages of diverticulitis [25-27]. It is clearly noted that, studies about the results of early elective surgery existing conflicting outcomes. Hoffmann, et al. [14] found that no significant difference in the results compared with the delayed elective surgery. At the end of their study, they advised the early elective surgery mainly because it allows a single hospital admission with a shorter hospital stay interval. On the contrary, a prospective study about the early elective surgery done by Reissfelder, et al. [13] recommended against this type of surgery because it led to markedly worse results. We are aiming from this study to offer additional results and data for further evaluation of the early elective method. The analysis of outcomes in this study, agree with the results of Hoffmann et al. and revealed that there is no significant difference between the early elective (group A) and the delayed elective sigmoidectomy (group B). No significant differences between the two groups regarding the mean operative time, conversion rate, mean PO ICU as well as the hospital stay days, or the frequency of PO complications. However, intraoperative bleeding and the rate of Hartman's procedure with a colostomy were significantly higher among patients of the early elective group; this may be attributed to the tissue fragility due to the sequelae of the recently treated acute inflammation. However, these differences did not affect the overall outcomes. In the present study, we did not record any severe complications or mortality. Also, the frequencies of PO complications were low at 4.3-13.8% in comparable studies [28]. In our study, anastomotic leak as well as PO bleeding were rare in both groups (A = 4% vs. B = 0.0%), PO paralytic ileus (A = 4% vs. B = 4.5%) and wound infection (A=0.0% vs. B=4%).

In our study, there were no recorded cases of ureteric injury; this can be considered an important success especially in the early elective procedures. There is no doubt that, ureteric injuries, in particular, occur more often due to the adhesion that leads to problematic entree to the surgical site. The idea of the early elective method is to operate when there are still very few or no any post-inflammatory adhesions. The conversion rate in both groups was (A=8 versus B=9% p = 0.269) which lie within the acceptable ranges of other comparable studies [29]. Against the study done by Perniceni. et al. [30], a conversion from laparoscopic to open procedure in our study was low and did not have any effect on the overall outcome. Consequently, an early elective sigmoidectomy was not a harmful method to the patient's life, even when the completion of the procedure through the laparoscopy was not possible. Our results go with and confirm the recommendation of the studies done by Hoffman et al. and Felix, et al [14,18]. The design of Reissfelder, et al. study [13] was comparable to ours; however, they found poorer results for the early elective procedure

according to all criteria. On the other hand, Felix, et al. study was also similar to our study in the design as well as most of the outcomes. This encourages the question as to why the early elective operation led to better outcomes in our study. Firstly, the antibiotic treatment period in the of Reissfelder, et al. [12] study in the early elective group was short in comparison to our study (5 versus 8 days respectively). Also, this may explain the low incidence of anastomotic leakage in our study. This opinion finds support in the good results observed by Hoffmann et al. and Felix et al. studies [14,18], who also detected a bigger time window of around three weeks.

The average of the operation time in Reissfelder's [12] study was 160.1 min, which is parallel to the operation times in comparable studies [25,30-33]. On the contrary, the mean operative time in our study was nearly 50% lesser than the time in the previously mentioned studies, It is well known that the short operative time in the colorectal surgery is shown to minimize the incidence of anastomotic leakage [14]. This short operation time in our study as well as in Felix et al. study, may also explain the impressive results in both studies. We agree with Felix et al. who concluded in their study that a high level of expertise leads to a shorter operation time as well as meticulous tissue handling and these things will improve the operative outcome. On the other, we agree with Felix et al. in thinking that poor surgical skills have been considered as a risk factor for bad outcomes for this operation [25,27,34]. In many countries all over the world, diverticular disease of the colon with its complications and recurrent acute attacks causes huge costs in healthcare systems. These expenses include; the direct outlays of treatment and hospitalization as well as the indirect costs of human absence from the workplace, and so on. It is very clear from our study that patient who underwent an early elective sigmoidectomy will not need to go to the hospitals again and of course, they will not be admitted many times and not takes medications for control of the acute attacks again.

We can say that any decrease in the number of attacks gives not only advantages for patients' health [34] but also declines the direct cost of treatment and the indirect costs of decreasing productivity. We think that this study is the first one to be done in our hospitals about the timing of elective surgery of diverticular disease after AD. However, we think that the limitation of our study is the small number of patients who were included in the study and we hope to arrange in the future another study containing a greater sample of patients to permit a more confident declaration as to whether or not patients of AD advantage from early elective surgery.

Conclusions

The early elective operations for patients after the recovery of of the AD attacks are effective and safe as delayed elective surgeries. In addition, it avoids a repeated hospital admission as

well as long-term medical treatment and thus saves free hospital beds and the quantitative amount of medical expenditure on this type of disease.

Declaration: The authors declare that there is no any conflict of interest.

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