Contents available at **PubMed**
www.clinicalandtranslationalinvestigation.com

PERMANYER

Rev Inves Clin. 2016;68:299-304 ORIGINAL ARTICLE

Advantages of Minimally Invasive Surgery for the Treatment of Colovesical Fistula

Noel Salgado-Nesme*, Omar Vergara-Fernández, Luis Alberto Espino-Urbina, Hugo Alberto Luna-Torres and Adolfo Navarro-Navarro

Division of Colon and Rectal Surgery, Department of Surgery, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico

ABSTRACT

Background: Colovesical fistulas in two-thirds of the cases are due to diverticular disease. In recent years, a minimally invasive approach has shown advantages over the traditional open approach. The goal of this study was to evaluate the surgical results and safety of the laparoscopic procedure in patients with colovesical fistula. **Material and methods**: We retrospectively evaluated 24 patients who underwent surgery for colovesical fistula in a referral center from 2005 to 2011. Patients were divided into two groups: (i) laparoscopic approach, and (ii) open approach. **Results**: The laparoscopic and open groups had similar characteristics with respect to age and gender distribution. There were a higher number of bladder repairs in the open approach group (83.3 vs. 16.6%; p = 0.01). The operative time (212 ± 74 min vs. 243 ± 69 min; p = 0.313) and intraoperative bleeding (268 ± 222 ml vs. 327 ± 169 ml; p = 0.465) were similar in both groups. The conversion rate of the laparoscopic approach to open surgery was 25%. There was no difference in morbidity (41.1 vs. 25%; p = 0.414), although the laparoscopic group had a shorter hospital stay (9 ± 4 days vs. 15 ± 11 days; p = 0.083) without statistical significance. **Conclusions**: The treatment of colovesical fistula by a laparoscopic approach is safe and is associated with less bladder repairs and a shorter hospital stay. (REV INVES CLIN. 2016;68:299-304)

Key words: Colovesical fistula. Diverticular disease. Laparoscopy.

INTRODUCTION

Colovesical fistula was described for the first time in 1888. Diverticular disease is the cause of these fistulas in two-thirds of the cases. However, they have also been described in other conditions such as colon or bladder neoplasms, radiation to the pelvis, or Crohn's disease[1,2].

The clinical diagnosis is sometimes difficult because pneumaturia and fecaluria, which are pathognomonic

Corresponding author:
*Noel Salgado-Nesme
Departamento de Cirugía, Servicio de Cirugía de Colon y Recto
Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán
Vasco de Quiroga, 15
Col. Belisario Domínguez, Sección XVI, Del. Tlalpan
C.P. 14080, Ciudad de México, México
E-mail: noelsalgadonesme@yahoo.com.mx

Received for publication: 04-10-2016
Accepted for publication: 17-10-2016

signs, are found in late stages and with a low frequency[2,3].

Acute sigmoid diverticulitis is the most common cause of fistula. The incidence of colovesical fistula in diverticular disease is 2-23%. The pathophysiologic mechanism of this condition is the direct extension of a ruptured diverticulum or erosion of a peridiverticular abscess into the bladder. There is always a risk of formation of a fistula between an inflamed diverticulum and an adjacent organ. In addition, fistulas into the cecal appendix, fallopian tubes, uterus, ureters, and skin have been described. The colovesical fistulas are the most common kind, followed by colovaginal fistula in patients who have undergone hysterectomy[4-6].

Traditionally, surgical treatments of colovesical fistulas include resection of the sigmoid colon and fistulous tract, and bladder repair[7]. With the advent of laparoscopic colon surgery, this technique has been found to offer advantages such as lower levels of surgical trauma, postoperative adhesions, pain, and ileus. However, there are few studies evaluating the outcomes of colovesical fistula surgery using a minimally invasive approach[8-12].

The aim of our study was to evaluate postoperative outcomes and length of hospital stay after a minimally invasive approach compared to open surgery in colovesical fistula repair.

MATERIAL AND METHODS

Study subjects

A review of patients who underwent surgery for colovesical fistula from 2005 to 2011 in a reference center was carried out using a prospectively collected database. The colovesical fistula was diagnosed by rectal water-soluble contrast tomography, barium enema, cystography, and/or colonoscopy. The diagnosis was confirmed through surgical findings and histopathology results in all cases. Demographic variables, operative bleeding, surgical time, morbidity, mortality, and length of hospital stay were recorded. Weight was classified according to body mass index (BMI): a BMI < 18.5 was considered malnutrition; BMI 25-30, overweight; and > 30 was defined as obesity[13]. The preoperative albumin serum levels were > or < 3 g/dl. Anemia was defined as a hemoglobin level < 12 g/dl, and diabetes was defined as a serum glucose level > 126 mg/dl[14].

Surgical procedures

The type of surgery to be performed was decided according to the surgeon's preference. All patients received mechanical bowel preparation using polyethylene glycol. Oral antibiotic prophylaxis with erythromycin and neomycin was used one day before surgery, and intravenous antibiotic prophylaxis with cefuroxime was used 30 minutes before surgery. Surgery consisted of resection of the sigmoid colon and a colorectal anastomosis by resecting the fistulous tract. Bladder integrity was assessed by a urology specialist using the methylene blue test. A urinary catheter was placed in all patients whether or not they underwent bladder repair; this catheter was held in place for 10 days after surgery. Colorectal anastomosis was performed by double stapling technique using circular staplers 31 or 29 mm. Laparoscopic procedures were performed using five trocars. In the laparoscopic approach, vascular pedicles were dissected using vascular staplers and/or vessel sealing devices. Colon resection was extended to the rectosigmoid junction. All patients underwent a hydropneumatic test to verify the integrity of the anastomosis.

Statistical analysis

Results are expressed as means with standard deviation. Fisher's exact test was used to analyze nonparametric variables, and Student's *t*-test was used to analyze quantitative variables. Statistical significance was assigned a value of $p < 0.05$. Statistical analysis was performed using the SPSS Software v16 (SPSS Inc. Chicago Illinois, USA).

RESULTS

Twenty-four patients were included, 12 in each group. The average age was 56 years in the laparoscopic and 57 years in the open group; 91% of patients were male in both groups. Comparison of other demographic variables is shown in table 1.

Regarding the surgical procedure, 10 resections with primary anastomosis (83.4%), and two Hartmann's

Table 1. Demographic variables

	Laparoscopic (n = 12)	Open (n = 12)	p
Average age (years)	56 (34-83)	57 (40-81)	NS
≤ 50 years	9 (75%)	9 (75%)	
Male gender	11 (91.6%)	11 (91.6%)	NS
Body weight			
Obesity	3 (25.0%)	2 (16.6%)	0.615
Overweight	3 (25.0%)	6 (50.0%)	0.206
Undernourished	1 (8.3%)	2 (16.6%)	0.539
Albumin			
> 3 mg/dl	9 (75%)	6 (50%)	0.206
≤ 3 mg/dl	3 (25%)	6 (50%)	
Hemoglobin			
> 12 mg/dl	10 (83.3%)	10 (83.3%)	NS
≤ 12 mg/dl	2 (16.6%)	2 (16.6%)	
Glucose			
≥ 126 mg/dl	10 (83.3%)	11 (91.6%)	0.535
< 126 mg/dl	2 (16.6%)	1 (8.3%)	

Table 2. Comparison of intraoperative variables

	Laparoscopic (n = 12)	Open (n = 12)	p
Surgery			
Sigmoidectomy+ PA	10 (83.3%)	10 (83.3%)	NS
HP	2 (16.6%)	2 (16.6%)	
Bladder repair	2 (16.6%)	10 (83.3%)	0.010
Surgical time (min)	212 ± 74.78	243 ± 69.32	0.313
Bleeding (ml)	268 ± 222	327 ± 169	0.465
Transfusion	2 (16.6%)	1 (8.3%)	0.537
Conversion	3 (25%)		

HP: Hartmann's procedure; PA: primary anastomosis.

procedures were performed in both groups. None of the patients who had undergone Hartmann's procedure underwent intestinal reconnection due to the presence of comorbidities in these patients.

Bladder repair was more frequent in patients who had undergone open surgery (83.4 vs. 16.6%; p = 0.01). The surgical time was 212 ± 74.78 min in the laparoscopic group and 243 ± 69.32 min in the open group (p = 0.313).

Intraoperative bleeding was 268 ± 222 ml and 327 ± 169 ml in the laparoscopic and open groups, respectively. Transfusion was required for two patients in the laparoscopic group (16.6%) and one patient in the open group (8.3%). There was a conversion rate of 25% (3/12) because of poor anatomical exposure in two cases and bleeding in one case. These three procedures were completed by open surgery without complications (Table 2).

There were three complications in each group (25%): one anastomosis leak and two urinary tract infections in the laparoscopic group; and one surgical wound infection, one anastomosis leak, and one lesion of the left ureter in the open group. The latter was repaired successfully during the same surgery.

The hospital stay was 9 ± 4 days in the laparoscopic group and 15 ± 11 days in the open group (p = 0.083). Morbidity and hospital stay length were not higher in patients undergoing conversion in the laparoscopic group (11 days).

No recurrences or deaths occurred in either group after a mean follow-up of 18.6 months (7-69 months).

DISCUSSION

Diverticular disease of the colon is a common condition occurring in more than one-third of the population over 45 years old. It is known that only 20% of patients will develop a diverticulitis-associated event at 10 years after diagnosis[6]. To our knowledge, this is the first report on this complication in our country and in Latin America.

Among the first series of laparoscopic treatment for diverticular disease of the colon complicated by the development of fistulas are the studies performed by Kockerling, Bouillot, and Le Moine. Kockerling, et al. included 55 patients with colovesical fistula (18.1% of 304 cases with diverticulitis undergoing laparoscopic surgery) in their case series[10]. They describe that 28.9% of cases with perforated diverticulitis, fistula, or lower gastrointestinal tract bleeding had associated morbidity, versus 14.8% in cases with only peridiverticulitis, stenosis, or undergoing repeat surgery for recurrence; the conversion rate to open surgery was 31.8 vs. 7.2% in elective cases and 18.2% in cases with peridiverticulitis, stenosis, or undergoing repeat surgery for multiple recurrences[10]. Bouillot, et al. included 154 patients (136 cases with intracorporeal anastomosis and 18 cases with manual anastomosis via mini-laparotomy) with a surgical time similar to our series (223 ± 79 min). Mortality was zero and reported morbidity was 14%, with a conversion rate of 13.9%. Unlike our study, their patients undergoing conversion had a longer hospital stay (9.3 vs. 13.0 days)[15]. Eijsbouts, et al. describe a series of 70 cases, four of which underwent surgery by laparoscopic approach and three by "facilitated" laparoscopic approach (splenic flexure and sigmoid mobilization using laparoscopic surgery and dissection of the rectosigmoid junction and the fistulous tract through a Pfannenstiel mini-laparotomy)[16].

Liberman, et al. compared 14 patients with open or laparoscopic approaches, three of whom had colovesical fistula[17]. Although no sub-analysis regarding patients with fistula was conducted, favorable findings in the minimally invasive approach, including intraoperative bleeding (171 vs. 321 ml), start of a liquid diet (2.9 vs. 6.1 days), and hospital stay (6.3 vs. 9.2 days), were observed. Additionally, savings of approximately US$ 12,000 in favor of the laparoscopic approach were found when comparing the total average hospital charges.

In 2005, Bartus, et al. described 40 patients with diverticular fistula who underwent surgery, 36 of whom had laparoscopic surgery with an average hospital stay of 6.2 days shorter when compared with our results, but with surgical times similar to those reported by us (an average of 220 vs. 212 min), and a conversion rate identical to that in our study (25%). In the study by Bartus, et al. they had no anastomotic leaks or repeat surgeries, unlike our study where there were two events[18]. The fundamental importance of that publication is that the development of fistulas secondary to diverticular disease of the colon does not contraindicate curative surgery using a minimally invasive approach.

In our study, primary anastomosis was performed in 83.4% of patients and 16.6% of patients underwent Hartmann's procedure. There is information that supports the construction of a primary anastomosis in these patients. Milesky, et al.[19] described a series of 27 patients where resection and primary anastomosis were performed in 51.8% of cases, resection and Hartmann's procedure in 11.1% of cases, and a derivative colostomy was performed in only 33.3%. The overall hospital stay for each group was 10, 33, and 57 days, respectively. Meanwhile, Walker, et al.[20] described a total of 14 patients, 85.7% of whom were treated with resection and primary anastomosis without morbidity related to dehiscence. Furthermore, there were no recurrences with this approach. Both groups recommend staging treatments for severe inflammatory processes, the presence of large abscesses, or other conditions not associated with diverticular disease (severe post-radiation damage, long-standing traumatic injury, inflammatory bowel disease, or local-regionally advanced cancers). Delaney, et al., in a series of 24 cases of colovesical fistula caused by diverticular disease, reported that 95.8% of the cases were treated by resection and primary anastomosis, with only one case derived by loop ileostomy[21]. Moreover, the conversion rate was subdivided depending on the involved or origin organ (27.4% in sigmoid vs. 15.4% in bladder, vs. 25% in our series). Similar to our findings, they reported no statistically significant differences regarding complication rates, repeat surgeries, and readmission between laparoscopic and converted cases. In a study of 31 patients, Holroyd, et al.[22]

performed sigmoidectomy and anterior resection with protective loop ileostomy in 18.1% of cases. No colorectal anastomosis was protected after the isolated sigmoidectomy.

Menenakos, et al. reported a conversion rate different to that found by us (5.5%)[23]. This is a striking finding because more extensive procedures (sigmoidectomy and extended left colectomy in 22.22%) were performed in their study. However, the authors report a recurrence rate of fistula in 5.5%, probably related to partial/segmental resections of sigmoid in 11.1%. Similarly, the conversion rates reported by Burke, et al.[24] and Royds, et al.[25] for this procedure range from 0 to 36%, similar to that reported in our series.

The morbidity rate reported in the literature ranges from 4 to 46% and mortality, from 0 to 30%[15-25]. In our series, morbidity was 25% and mortality was null.

Regarding intraoperative variables, it is important to note that in our series the surgical time was similar to that reported in the literature. Additionally, there was a trend to a lower surgical time in the laparoscopic group. This may be due to selection bias because the most complex cases were probably performed by celiotomy. Bartus, et al. reported an average surgical time of 50 minutes higher for the minimally invasive approach[18]. In a series of 42 patients, Abbass, et al. showed a trend to lower surgical time for diverticular disease complicated by colovesical fistula compared with elective resections without fistula, without reaching statistical significance (251 vs. 281 min; $p = 0.36$)[26]. In their series, bleeding (150 ml for open and laparoscopic procedure) and the need for transfusion (0% for laparoscopic and 5% for open) were similar in both groups and lower than our results (268 ml for laparoscopic vs. 327 ml for open and 16.6% for laparoscopic vs. 8.3% for open, respectively). We believe that the main difference in surgical time in our series is due to a lower percentage of bladder repairs in the laparoscopic group; such repair was performed routinely in open procedures. Despite the fact that bladder closure was performed less frequently in the laparoscopic group, morbidity was not higher. This is similar to that reported by Ferguson, et al. who did not perform bladder repair in 67%, and there were no differences in recurrence, urinomas, or vesicocutaneous fistula[27]. All of our patients remained with a urinary catheter for 10 days after surgery, and only cases in which leakage of methylene blue was evident during surgery were repaired.

The recurrence rate reported in the literature ranges from 0 to 11% (for cases secondary to diverticular disease of the colon)[18-26,28]. In our series, no patient had recurrence. Lynn, et al. reported a rate of 11%; the patients who underwent complex bladder repair showed higher recurrence rates (6 vs. 24%; $p = 0.022$)[28]. Other risk factors for recurrence include rectal and urethral diseases, presence of malignancy, and history of radiotherapy[28]. We believe that our recurrence rate was zero because all anastomoses were performed in the upper third of the rectum, there was no need to perform complex bladder repairs, and all cases were due to diverticular disease of the colon.

Oberkofler, et al. reported a closure rate of colostomy of 66% for patients with primary anastomosis and 90% for protective loop ileostomy[29]. In our series, 16.4% of patients underwent terminal colostomy, and they were not reconnected due to a high surgical risk.

Abbass, et al. reported an average BMI of 31 in a series of 42 patients[26]. In our series, 50% of patients were overweight or obese. As in their series, our patients underwent sigmoidectomy with colorectal anastomosis.

The average hospital stay reported in other series for the minimally invasive approach ranges from 6 to 12 days[18-26,28,30]. In our series, there was a trend to shorter hospital stay in the laparoscopic group (9 ± 4 days vs. 15 ± 11 days; $p = 0.083$). We believe that a statistical significance was not reached due to the small number of patients and the retrospective nature of the study. In this respect, our study shows no real advantage of the laparoscopic approach.

We found a reduced need for bladder repair in the laparoscopic approach; we believe this may be due to a selection bias in this group due to the retrospective design of the study. When performing the procedure by open surgery, we usually check the fistulous tract in the bladder wall with further debridement of nonviable tissue at the edges, and the defect is closed in two planes. When we perform the surgery by laparoscopy, we repair only the visible defects without drying the major portion of the path, which is not translated

into a greater number of urinary fistulas; we attribute this to the rapid healing of the bladder due to the lack of distention provided by the Foley catheter left for a week. On the other hand, when there was no need for bladder repair, the presence of the fistula could be questioned; however, the diagnosis of colovesical fistula was always confirmed with diagnostic studies and corroborated during surgery.

In conclusion, the treatment of colovesical fistula using the minimally invasive approach offers some advantages such as safety similar to that of the open approach, with a likely shorter hospital stay. In our study, no difference in morbidity was found among patients undergoing bladder repair. Sigmoid resection with anastomosis within the upper third of the rectum seems to offer a lower recurrence rate. We suggest conducting prospective randomized studies to consider the laparoscopic approach as standard treatment for colovesical fistula.

REFERENCES

1. Cripps WH. Passage of air and feces from the urethra. Lancet. 1888;2:619.
2. Gruner JS, Sehon JK, Jonson LW. Diagnosis and management of enterovesical fistulas in patients with Crohn's disease. Am Surg. 2002;68:714-9.
3. Garcea G, Majid I, Sutton CD, Pattenden CJ, Thomas WM. Diagnosis and management of colovesical fistulae; six-year experience of 90 consecutive cases. Colorectal Dis. 2006;8:347.
4. Najjar SF, Jamal MK, Savas JF, Miller TA. The spectrum of colovesical fistula and diagnostic paradigm. Am J Surg. 2004;188: 617-21.
5. Solkar MH, Forshaw MJ, Sankararajah D, Stewart M, Parker MC. Colovesical fistula is a surgical approach always justified? Colorectal Dis. 2005;7:467-71.
6. Melchior S, Cudovic D, Thomas C, Gillitzer R, Thüroff J. Diagnosis and surgical management of colovesical fistulas due to sigmoid diverticulitis. J Urol. 2009;182:978-82.
7. Laurent SR, Detroz B, Detry O, Degauque C, Honoré P, Meurisse M. Laparoscopic sigmoidectomy for fistulized diverticulitis. Dis Colon Rectum. 2005;48:148-52.
8. Garrard CL, Clements RH, Nanney L, Davidson JM, Richards WO. Adhesion formation is reduced after laparoscopic surgery. Surg Endosc. 1999;13:10-3.
9. Köhler L, Rixen D, Troidl H. Laparoscopic colorectal resection for diverticulitis. Int J Colorectal Dis. 1998;13:43-7.
10. Köckerling F, Schneider C, Reymond MA, et al. Laparoscopic resection of sigmoid diverticulitis. Results of a multicenter study. Laparoscopic Colorectal Surgery Study Group. Surg Endosc. 1999;13:567-71.
11. Siriser F. Laparoscopic-assisted colectomy for diverticular sigmoiditis. A single-surgeon prospective study of 65 patients. Surg Endosc. 1999;13:811-13.
12. Dwivedi A, Chahin F, Agrawal S, et al. Laparoscopic colectomy vs. open colectomy for sigmoid diverticular disease. Dis Colon Rectum. 2002;45:1309-14.
13. Salas-Salvadó J, Rubio MA, Barbany M, Moreno B; Grupo Colaborativo de la SEEDO. SEEDO 2007 Consensus for the evaluation of overweight and obesity and the establishment of therapeutic intervention criteria. Med Clin (Barc). 2007;128:184-96.
14. American Diabetes Association. Standards of medical care in diabetes 2014. Diabetes Care. 2014;37:14-80.
15. Bouillot J, Berthou J, Champault G, et al. Elective laparoscopic colonic resection for diverticular disease: results of a multicenter study in 179 patients. Surg Endosc. 2002;16:1320-3.
16. Eijsbouts QA, De Hann J, Berends F, Sietses C, Cuesta MA. Laparoscopic elective treatment of diverticular disease: a comparison between laparoscopic assisted and resection facilitated techniques. Surg Endosc. 2000;14:726-30.
17. Liberman MA, Phillips EH, Carroll BJ, Fallas M, Rosenthal R. Laparoscopic colectomy vs traditional colectomy for diverticulitis. Outcome and costs. Surg Endosc. 1996;10:15-18.
18. Bartus C, Lipof T, Sarwar S, et al. Colovesical Fistula: Not a contraindication to elective laparoscopic colectomy. Dis Colon Rectum. 2005;48:233-6.
19. Mileski WJ, Joehl RJ, Rege RV, Narhrwold DL. One-stage resection and anastomosis in the management of colovesical fistula. Am J Surg. 1987;153:75-9.
20. Walker KG, Anderson JH, Iskander N, McKee RF, Finlay IG. Colonic resection of colovesical fistulae: a 5-year follow-up. Colorectal Dis. 2002;4:270-4.
21. Pokala N, Delaney CP, Brady KN, Senagore AJ. Elective laparoscopic surgery for benign internal enteric fistula: a review of 43 cases. Surg Endosc. 2005;19:222-5.
22. Holroyd DJ, Banerjee S, Beaban M. Colovaginal and colovesical fistula: the diagnosis paradigm. Tech Coloproctol. 2012;16:119-26.
23. Menenakos E, Hahnloser D, Nassiopoulus K, Chanson C, Sinclair V, Petropoulos P. Laparoscopic surgery for fistula that complicate diverticular disease. Arch Surg. 2013;388:189-93.
24. Burke JP, Taiha S, Yii H, Coffey JC, Waldron D, Condon E. Laparoscopic-assisted sigmoid colectomy for diverticular colovesical fistula. Am Surg. 2013;79:9.
25. Royds J, O'Riordan JM, Eguare E, O'Riordan D, Neary PC. Laparoscopic surgery for complicated diverticular disease: a single center experience. Colorectal Dis. 2012;14:1248-54.
26. Abbass MA, Tsay AT, Abbas MA. Laparoscopic resection of chronic sigmoid diverticulitis with fistula. JSLS. 2013;17:636-40.
27. Ferguson GG, Lee EW, Hunt SR, Ridley CH, Brandes SB. Management of the bladder during surgical treatment of enterovesical fistula from benign bowel disease. J Am Coll Surg. 2008;207:569-72.
28. Lynn ET, Ranasinghe NE, Dallas KB, Divino CM. Management and outcomes of colovesical fistula repair. Am Surg. 2012;78:515-18.
29. Oberkofler CE, Rickenbacher A, Raptis DA, et al. A multicenter randomized clinical trial of primary anastomosis or Hartmann procedure for perforated left colonic diverticulitis with purulent or fecal peritonitis. Ann Surg. 2012;256:819-26.
30. Marney LA, Ho YH. Laparoscopic management of diverticular colovesical fistula: Experience in 15 cases and review of the literature. Int Surg. 2013;98:101-9.