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ELECTIVE LAPAROSCOPIC LEFT COLECTOMY FOR DIVERTICULAR DISEASE: A MONOCENTRIC STUDY ON 205 CONSECUTIVE PATIENTS

Colectomia eletiva laparoscópica esquerda para a doença diverticular: estudo monocêntrico em 205 pacientes consecutivos

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HEADINGS – Colectomy, laparoscopic Diverticulitis.

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ABSTRACT - ***Background*** - The increased prevalence of diverticular disease has made its most appropriate management a matter of constant debate. Especially for the cases of diverticulitis, considerable progress has been made in terms of diagnosis and management. The surgical resection of the involved colon is the only means of definitely eradicate this condition and so, the elective laparoscopic colectomy has emerged as a safe and interesting choice among the options of treatment. ***Aim*** - To analyze the outcomes of the laparoscopic left colectomy for diverticular disease performed over a 17-year period at a single institution. ***Methods*** - Between April 1990 and May 2007, a total of 205 consecutive left laparoscopic colectomies were retrospectively reviewed. Data obtained included the pre-operative work-up, indications for surgery, operative results, complications and follow-up. Univariate and multivariate statistical analyzes were performed in an effort to identity risk factors for adverse outcomes in the series. ***Results*** - Indications were for non-complicated acute diverticulitis (80%), acute or chronic complicated diverticulitis (18.05%) and bleeding diverticular disease (1.95%). The conversion rate was 5.85% (12 cases). The median operative time was 180 (100-420) min with a hospital stay of 7 (5-44) days. The mean length of the resected specimen was 29.12 (+8.2) cm. Most cases (88.3%) had an unremarkable postoperative course but complications occurred in 24 (11.7%) patients. In order of frequency, these were: paralytic ileus (n=6), pelvic collections (n=4), bowel obstructions (n=4) and fistulas (n=2), among others. A re-operation was necessary in eight cases and there was one death (0.48%). Median follow-up was 26.5 (1-156) months with a satisfying result seen in 179 (87.32%) of the patients. In 18 (8.78%) cases, persistent symptoms of functional colonic disorders were noted. There were 7 (3.41%) anastomotic stenosis in witch two needed a re-operation. The recurrence rate was 1.95% (4 cases). Age and intraoperative complications were identified as risk factors for conversion. The presence of associated lesions was significantly correlated with the persistence of functional colonic symptoms during the follow-up. ***Conclusions*** - The laparoscopic left colectomy is safe and effective in comparison to all other modalities of management for diverticular disease. Precise diagnosis and respect of the current indications are essential to achieve such results.

RESUMO – ***Racional*** - O aumento da prevalência de doença diverticular tornou o seu manuseio mais adequado uma questão de debate constante. Especialmente para os casos de diverticulite, progresso considerável tem sido feito em termos de diagnóstico e tratamento. A ressecção cirúrgica do cólon envolvido é a única maneira de erradicar definitivamente essa condição e, portanto, a colectomia laparoscópica eletiva surgiu como uma opção segura e interessante entre as várias formas de tratamento. ***Objetivo*** - Analisar os resultados das colectomias laparoscópicas esquerdas para a doença diverticular realizadas durante um período de 17 anos em uma única instituição. ***Métodos*** - Entre abril de 1990 e maio de 2007, um total de 205 colectomias consecutivas esquerdas laparoscópicas foram revistas retrospectivamente. Os dados obtidos incluíram o pré-operatório, indicações para a operação, os dados cirúrgicos, complicações e seguimento. Análises estatísticas univariada e multivariada foram realizadas em um esforço para identificar os fatores de risco e efeitos adversos na série. ***Resultados*** - As indicações foram diverticulite aguda (80%) não-complicada, diverticulite aguda ou crônica complicada (18,05%) e sangramento na doença diverticular (1,95%). A taxa de conversão foi de 5,85% (12 casos). A mediana do tempo

operatório foi de 180 minutos (100-420), com internação hospitalar de 7 (5-44) dias. O comprimento médio do espécime ressecado foi 29,12 centímetros. A maioria dos casos (88,3%) teve curso pós-operatório normal, mas complicações ocorreram em 24 (11,7%) pacientes. Em ordem de frequência foram: íleo paralítico (n = 6), coleções pélvica (n = 4), obstruções intestinais (n = 4) e fístulas (n = 2), entre outros. Re-operação foi necessária em oito casos e houve um óbito (0,48%). O seguimento mediano foi de 26,5 (1-156) meses, com resultado satisfatório em 179 (87,32%) dos pacientes. Em 18 (8,78%) casos, os sintomas persistentes de distúrbios funcionais do cólon foram anotados. Houve sete (3,41%), estenoses da anastomose e em dois precisou de re-operação. A taxa de recidiva foi de 1,95% (4 casos). Idade e complicações intra-operatórias foram identificadas como fatores de risco para a conversão. A presença de lesões associadas foi significativamente correlacionada com a persistência de sintomas funcionais do cólon durante o seguimento. ***Conclusões*** - A colectomia laparoscópica esquerda é segura e eficaz em comparação com todas as outras modalidades de tratamento da doença diverticular. Diagnóstico preciso e cuidado nas indicações são essenciais para atingir bons resultados.

INTRODUCTION

The increased prevalence of diverticular disease has made its most appropriate management a matter of constant debate. Especially for the cases of diverticulitis, considerable progress has been made in terms of diagnosis and management. Accurate CT scan diagnosis and radiological interventional techniques are now largely available[2], as well as effective antimicrobial agents[10]. Finally, as the surgical resection of the involved colon is the only means of definitely eradicate this condition, the elective laparoscopic colectomy has emerged as a safe and interesting choice among the options of treatment[6,15,16].

Although recently challenged about its progressiveness[7,8], the natural history of diverticulitis is assumed to be that of recurrence over time for at least one third of the patients[3,10]. The fear of complications from this benign and prevalent disease has motivated medical and surgical societies to produce guidelines and consensus conferences on the subject[11,14]. Mortality usually comes from recurrent sepsis and/or emergency operations for complicated cases. As a result, the most offered surgical procedure is the electively performed sigmoidectomy, usually indicated for all complicated and many non-complicated cases of diverticulitis[15].

The laparoscopic approach to the left colectomy has now evolved to be safely offered to patients when performed by experienced laparoscopic surgeons. While reviewing our experience with this operation, the goals of this study were to critically analyze the current indications, technical aspects, operative outcomes and complications, as well as the long-term follow-up results.

METHODS

Population

Between April 1990 and May 2007, a total of 210 elective laparoscopic colonic resections for diverticular disease were performed at the Unit of General and Digestive Surgery at the Edouard Herriot Hospital, Lyon, France. This retrospective study included the 205 left colectomy procedures comprising 185 sigmoidectomies (90,24%) and 20 left hemicolectomies (9,76%). The three right colectomies and two total colectomies were excluded.

Patients were first referred for surgical consultation either from the gastroenterology outpatient department, the general practitioner clinics or the emergency department. Pertinent information was then collected in a comprehensive sheet including pre-operative consultations, subsequent hospitalizations and post-operative follow-up. Data were later entered into a computer database and updated every time new information was obtained. Those included the patient's previous history, mode of presentation, surgical indications, pre-operative work-up, details of the operative procedure, complications, hospital stay, mortality and follow-up results. The absence of symptoms related either to the diverticular disease or to the surgical procedure was considered as a satisfying result during the follow-up. Residual or persistent unspecific symptoms attributed to the large bowel were considered as functional colonic disorders.

Usual surgical indications were: 1) after a documented diagnosis of complicated diverticulitis either acute or chronic (abscess, perforation, fistula, stenosis); 2) after the second non-complicated acute attack of diverticulitis; 3) after the first non-complicated acute attack of diverticulitis in special situations such as the patient aged < 50 years and the immunosuppressed patient; 4) diverticular disease complicated with bleeding; 5) diverticular disease with associated lesions that necessitated surgical treatment

such as the colonic neoplasm. Although uniformly followed in our surgical unit, those indications varied along the years. After an episode of complicated diverticulitis, whether or not an invasive procedure was needed, an interval of at least 2-3 months was respected before the elective operation was scheduled.

SURGICAL TECHNIQUE

All patients had a mechanical bowel preparation with a polyethinele glycol (PEG) solution preoperatively and an antibiotic prophylaxis on anaesthetic induction. A nasogastric tube was not systematically left in place during the post-operative period.

A total laparoscopic operative technique was used in which a stapled intrabdominal anastomosis is made. The resected specimen is removed through an enlarged 12mm right lower quadrant (RLQ) trocar incision. This also permits at the same time the insertion of the anvil of the circular stapler (Ethicon Endosurgery) size 29mm into the descending colon stump. The stapler is then passed through the anus to complete the anastomosis after closing the small incision and re-establishing the pneumoperitonium. Some variations were tried at the beginning of the experience, by using this minilaparotomy either to insert a hand-port (15 cases) or to manually perform the anastomosis in a laparoscopic-assisted technique (7 cases). The procedure is performed with the surgeon standing on the right side of the patient and with the introduction of four trocars. In 158 (77,07%) cases, it was judged necessary to release the splenic flexure of the colon. In those occasions, the procedure was started with the surgeon standing between the legs of the patient and an additional 5 mm trocar was introduced. A drain was placed most of the time (96,1% of cases) and a protection colostomy was rarely necessary (three cases).

The steps of the operation were as follows: 1) release of the splenic flexure of the colon (when necessary for descending the proximal colonic stump after an adequate sigmoid resection); 2) systematic identification of the left ureter with the placement of a provisory landmark (seton); 3) medial mesocolic dissection for appropriate ligature of the left colonic vessels; 4) distal dissection and division of the rectum sufficiently below the recto-sigmoid junction; 5) liberation of the descending colon by a lateral approach; 6) exteriorization and transection of the left colon through a small RLQ incision and insertion of the stapler anvil; 7) closure of the small incision and completion of the anastomosis intrabdominally after re-establishing the pneumoperitoneum.

STATISTICAL ANALYSIS

Statistical logistic univariate and multivariate models were built trying to identify possible risk factors for adverse outcomes in the population studied. Multiple different variables were tested for its effects over the rates of post-operative complications and/or non-satisfying outcomes, conversion and post-operative colonic functional disorders. The Fisher's exact test was used for qualitative variables analysis, Student t-test for quantitative variables analysis and Mann & Whitney test for non parametric variables analysis. To build logistic multivariate analysis, only variables that were statistically significant in univariate model ($p<0.1$) were kept. In multivariate analysis a $p<0.05$ was considered statistically significant. Results for logistic multivariate model are presented as odds-ratio. All statistical analyses were done using Stata 10.0 software (StataCorp LP, College Station, TX).

RESULTS

Pre-operative

Patients were 107 (52.2%) female and 98 (47.8%) male with a median age of 60 (30-90) years. There were 46 (22.4%) patients aged < 50 years. The mean BMI was 25.3 (+ 3.5) Kg/m2 with obese patients (BMI > 30) representing 11.7% of the population studied.

Antecedents of previous abdominal surgery were noted in the majority (60%) of the patients. The most frequent previous scars founded were those of appendectomy (n= 28), other laparotomies (n=31), both appendectomy and laparotomies (n=30) and Pfannestiel (n=13). Comorbidities included diabetes in 12 (5.8%) and steroid therapy in 6 (2.9%) of subjects with 79% being ASA classification 1 or 2, 13.1% of ASA 3 and only 0.5% of ASA 4.

The median time from the onset of symptoms was 15 (1-240) months, with a median of 2 (0-12) previous acute attacks and a median of 1 (0-4) previous hospitalisations for acute attacks. The most frequent surgical indication was for non-complicated acute diverticulitis (80%), followed by acute or chronic complicated diverticulitis (18.05%) and bleeding diverticular disease (1.95%) (Table1). The complicated diverticulitis cases consisted of inflammatory stenosis (n=17), abscess (n=10), fistula (n=6) and peritonitis/ perforation (n=4).

Pre-operative studies used were contrast enema in 95.6% of cases, colonoscopy (84.8%), ultrasonography (77%) and CT scan (72.7%).

Operative

Associated lesions were present in 40 (19.51%) of patients. Those consisted of gallbladder stones (n=15); benign colonic neoplasms (n=12); hernias of the abdominal wall (n=5); adnexal masses (n=4); colon cancer (n=1); Meckel's diverticulum (n=1); renal cyst (n=1) and a cyst of the billiary tract (n=1).

TABLE 1 - Indications for surgery

	N	%
Non-complicated acute diverticulitis[#]	164	80
Complicated diverticulitis (acute or chronic)	37	18,05
Abscess (10) Peritonitis/Perforation (4) Fistula (6) Stenosis (17)		
Bleeding diverticular disease[*]	4	1,95
TOTAL	205	100

[#] Nine patients with an associated benign colonic tumor that contributed for indication

[*] One patient with an associated benign colonic tumor that contributed for indication

Intraoperative adhesions were noted in 36 (17.56%) cases.

Intraoperative complications occurred in 10 patients (4.89%) and were mainly treated by laparoscopic repair (7 cases) (Table2). The three cases that need a conversion for repair were a colonic injury, a right external iliac artery injury that occurred during the dissection of adhesions due to previous surgery, and a tear of the rectal stump bellow the anastomosis. Nevertheless, from the total of 12 conversions (5.85%), the most frequent cause was a failure of dissection due to inflammatory adhesions (9 cases).

The median operative time was 180 (100-420) minutes. The mean length of the resected specimen was 29.12cm (±8.92). The median hospital stay was 7 (5-44) days.

TABLE 2 - Intraoperative complications (n=10; 4.89%)

Complication	N	Management
Tear of the mesocolon	1	Laparoscopic repair
Colonic injury	3	Conversion for repair (1 case) Laparoscopic repair (2 cases)
Inferior mesenteric artery injury	1	Laparoscopic repair
Superficial epigastric vessels injury	1	Laparoscopic repair
Hypogastric artery injury	1	Laparoscopic repair
External iliac artery injury	1	Conversion for ligature
Left ureter injury	1	Laparoscopic repair
Tear of rectal stump below anastomosis	1	Conversion for repair
TOTAL	10	

Outcomes

The majority of patients had an unremarkable postoperative course (88.3%) with complications occurring in 24 patients (11.7%) (Table 3). A re-operation was needed to treat eight of these cases (3.9% of the population), with a laparoscopic approach being possible in three of them.

There was one death (mortality rate of 0.48%) in a patient that had septic shock on third postoperative day. An urgent laparotomy was performed that revealed no evidence of fistula at the site of the anastomosis and the patient died on fourth postoperative day in the intensive care unit. The most probable cause hypothesized for the sepsis being a generalized urinary tract infection.

TABLE 3 - Post-operative complications (n=24; 11.7%)

Type	N	Management
Paralytic ileus	6	Conservative
Pelvic collection	4	Conservative (1 case) Radiological drainage (2 case) Laparoscopic re-operation (1 case)
Fistulae	2	Open re-operation – Hartmann procedure
Obstruction due to adhesions/ bands	4	Conservative (1 case) Open re-operation (2 cases) Laparoscopic re-operation (1 case)
Missed small bowel injury	1	Laparoscopic re-operation
Missed large bowel injury	1	Open re-operation – Hartmann procedure
Abdominal wall hematoma	1	Conservative
Urinary tract infection	1	Medical
Pulmonary embolism	1	Medical
Septicemia	1	Medical (1 case)
Rectal bleeding	1	Conservative
Pancreatitis	1	Medical
TOTAL	10	

The median follow-up was 26.5 (range 1-156) months. The majority of patients (179, 87.32%) had a satisfying result (Table 4). In 18 (8.78%) cases different symptoms of functional colonic disorders could be identified that didn't need specific treatment. There were seven (3.41%) cases of anastomotic stenosis diagnosed around the second pos-operative month except for two cases manifested after six months. In five of them an endoscopic dilatation was the only necessary treatment, but in the other two cases an open re-operation for resection of the stenotic segment was required. It was also faced another two cases of non-anastomotic descending colon stenosis: one was due to an acute attack of ulcerative colitis and the other was an ischemic stenosis in a devascularized segment of the left colon. There were two cases of fecal incontinence and one case of sexual dysfunction that resolved without specific treatment.

TABLE 4 - Follow-up (median of 26.5 months)

Outcome	N (% total)
Satisfying	179 (87,32%)
Functional colonic disorders	18 (8,78%)
Anastomotic stenosis	7 (3,41%)
Non-anastomotic descending colon stenosis	2 (0,97%)
Incisional hernias	5 (2,43%)
Transient fecal incontinence	2 (0,97%)
Transient sexual dysfunction	1 (0,48%)
Recurrence	4 (1,95%)

Recurrence rate was low (1.95%) and occurred during the first eight months of follow-up. Those consisted of two cases initially operated for non-complicated diverticulitis (one re-operated), one for complicated diverticulitis and one for bleeding diverticulosis (re-operated).

Risk factors for adverse outcomes

Table 5 shows the correlations studied in univariate analysis between various possible risk factors for the adverse outcome of conversion. A significant association was found when comparing the rate of conversion for the variables age (p=0.006), intraoperative complication (p=0.016) and previous urgent invasive treatment (p=0.119). Those were further analysed in a multivariate model to more accurately verify the nature of theses associations (Table 6).

TABLE 5 - Risk factors studied in univariate analysis for conversion

Risk factors	Conversion		p-value
	Yes (n = 12)	N (n = 189)	
Age (yrs)	68 ± 10,9	58,6 ± 11,5	0.006
BMI (kg/m^2)	24,7 ± 3,3	25,4 ± 3,5	0.56
Steroid therapy	1 (9,1%)	5 (2,7%)	0.297
Previous abdominal surgery	10 (83,3%)	112 (59,6%)	0.132
Time from onset of symptoms (yrs)	34,7 ± 32,3	36,7 ± 44,7	0,57 *
Complicated diverticulitis	4 (33,3%)	33 (17,5%)	0.24
Previous acute attacks (< 2)	8 (66,7%)	114 (60,3%)	0.8
Previous urgent invasive treatments	2 (18,2%)	8 (4,4%)	0.103
Associated lesions	1 (9,1%)	39 (20,7%)	0.697
Adhesions	2 (18,2%)	34 (18,1%)	1
Intraoperative complication	3 (25%)	7 (3,7%)	0.016
Associated procedure	3 (27,3%)	63 (33,3%)	1

* Mann & Whitney

** Teste t de Student ou teste de Fisher

TABELA 6 - Fatores de risco significativo em análise multivariada

Resultados	Odds-ratio	SE	p
Morbidade pós-operatória geral (complicações e seguimento não satisfatório)			
Idade (anos)	1.029	0.0165	0.07
Duração da colectomia (min)	1.006	0.0033	0.064
Conversão			
Idade (anos)	1.091	0.0378	**0.012**
Complicação intra-operatória	18.65	17.34	**0.002**
Operação de emergência no passado	4.46	4.27	0.119
Distúrbios funcionais pós-operatórios do cólon			
Lesões associadas	3.19	1.7	**0.029**
Duração dos procedimentos associados (min)	1.0088	.006485	0.173

Similar analyses were performed for the adverse outcomes of post-operative overall morbidity and post-operative colonic functional disorders. Of those, a significant association was found between the presence of associated lesions and the rate of post-operative colonic functional disorder (p= 0.029). Other less strong associations were found between the variables age (p=0.07) and duration of the colectomy (p=0.064), and the adverse outcome named post-operative overall morbidity.

DISCUSSION

Diverticular disease is present in over 70% of the population in the eighth decade of life and its incidence increases with age. However, fewer than 10% of patients develop complications , which can be life threatening. There are few studies on the natural history of this disease[14], leading to controversies about its optimal management.

As expected, nearly all of our patients were treated for diverticulitis. As was noted by the clinical presentation (median previous attacks) in the series, there was a clear tendency to follow current indications for surgery in those cases at diagnosis. On the other hand, the wide range of variation in the number of those attacks shows that in many instances the surgical recommendation was re-assessed, with patients being individualized. Consequently, the most frequent indication was non-complicated diverticulitis. Although it is assumed that those cases don't have a persistent septic focus, nor major irreversible anatomical changes, the authors don't think that the operation could be considered as prophylactic once the symptomatic disease had been established. Regardless of the efforts to question the natural history of this disease[9], it is considered the surgical resection of the involved colon the only mean of its eradication and thus to avoid its complications.

From the technical point of view, the authors assured a tension free anastomosis by enlarging the trocar orifice at the RLQ and by mobilizing the splenic flexure which is usually done systematically, except in selected cases[6]. The distal dissection was carefully extended in order to assure the resection of the diseased colon below the rectosigmoid junction, which is shown to be associated with lower recurrence rates[1]. Laparoscopic colonic resection to remove the diseased segment of the colon but not all diverticula is the recommended procedure[2]. By reviewing the literature, laparoscopic colectomy proves to be safe comparing to open procedures in terms of morbidity and mortality[9,10,13]. The authors had a morbidity rate of 11.7%, a mortality rate of 0.48% and two anastomotic fistulae, which are comparable to the rate in the literature which ranges from 0-5.5%.

Our complication rate is consistent with other published series[4,12,16]. The majority of intraoperative injuries were vascular and bowel perforations and were managed laparoscopically in 70% of cases.

In order to identify possible risk factors for adverse

outcomes when performing this procedure, a statistical analysis was made by using univaried and multivariate methods. The conversion rate increased with age, intraoperative complications and previous invasive procedures. The increased morbidity imposed by a converted operation should be considered in that group of patients when deciding the best surgical strategy, perhaps by offering open surgery beforehand to those individuals. Furthermore, this could represent the price to pay when the surgical indication is postponed. Increasing age may lead to less precise characterization of symptoms and increased risk of previous procedures, which leads to greater morbidity.

Increased age in short and long-term adverse outcomes is emphasized by its relation (p=0.07) to the post-operative overall morbidity. For the post-operative functional disorders, the most significant factor was the presence of associated lesions, which could suggest the occurrence of undiagnosed colonic disorders related to the patient's complaints before surgery.

Stricture of the anastomosis occurred in 3.41% of our patients, which is comparable to most studies (0.5-5.9%) and can be explained by the inflammatory process[4,17] ,and the stapler size, specially if diameters less than 28 mm are used[5]. Even though sexual dysfunction is a feared complication after such operation, our series included 98 men and only one of them had to deal with this issue which was a transient problem managed conservatively.

Although subjective and difficult to measure, patient satisfaction was paramount and encouraged us greatly in offering and developing laparoscopic techniques in our department. In our opinion, this notion largely overpasses any existent objective data that we can show in favor of laparoscopy. Since the early 90's, similar to many other centers around the world, the authors have been progressively introducing this approach as the preferred technique for colonic resections in theirs unit.

CONCLUSION

Currently, after 17 years of experience, the authors feel comfortable and reassured to systematically offer laparoscopic colectomy as the procedure of choice for all cases of diverticular disease in witch a surgical solution is proposed.

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