



RESEARCH ARTICLE

RISK FACTORS ASSOCIATED WITH THE MOST FREQUENT COMPLICATIONS IN DIVERTICULAR DISEASE AFTER ITS SURGICAL RESOLUTION AT THE NAVAL GENERAL HOSPITAL OF HIGH SPECIALTY

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ARTICLE INFO

Article History:

Received 28th November, 2016
Received in revised form
05th December, 2016
Accepted 05th January, 2017
Published online 28th February, 2017

Keywords:

Diverticular disease,
Obesity,
Complicated diverticular disease,
Diverticulitis.

ABSTRACT

Introduction: Complications due to Diverticular Disease (ED) have a prevalence of 25%. Its clinical presentation may be in abscesses, stenosis, fistulas, bleeding and perforation that will merit urgent or elective surgical treatment. The risk factors associated before and after surgical resolution have not yet been well determined.

Objective: To identify the risk factors associated with the most frequent complications of ED that occur in patients of the Hospital General de Naval de Alta Especialidad (HOSGENAES) and the type of surgical treatment most used for resolution.

Material and Methods: We carried out an analytical, descriptive, prospective and cross-sectional study, including 56 patients with complicated ED diagnosis and who required surgical treatment in an elective or urgent manner. Postoperative evolution was evaluated and possible associated risk factors were determined. Data collection was performed using a precoded sheet and statistical analysis was performed with SPSS v 23.

Results: A total of 56 patients with ED complications were analyzed, where it was observed that the risk factors that are associated with a greater number of complications before and after the surgical resolution of ED are obesity (OR 2.1 IC 95 %), Presence of leukocytosis (OR 2.3% CI 95%), fever (OR 2.4% CI 95%) and abdominal pain (OR 3.2% CI 95%).

INTRODUCTION

Diverticular disease (ED) of the colon is a major cause of hospital admissions and a major contributor to health care costs in industrialized countries, although most patients with acute diverticulitis can be treated with medical treatment, approximately 15% will require Surgery in the United States, ED is the main surgical indication for elective colonic surgery, in our country there are no statistical data to indicate if this pathology is the main indication for colon surgery (Everhart and Ruhl, 2009; Hughes, 1969).

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Definitions

- Diverticulum: a sac-like protrusion of the colon wall.
- Diverticulosis: is limited to describe the presence of diverticula in the colon.
- Acute diverticulitis: defined as inflammation, it is generally considered to be due to microperforations of a diverticulum.
- Complicated diverticulitis: is defined as diverticulitis with one of the following associated complications: obstruction, abscess, fistula or perforation.
- Uncomplicated Diverticular Disease (ED): defined as diverticulitis with no associated complications.
- Diverticular bleeding: characterized by painless hematochezia due to segmental weakness of the rectal vessels associated with a diverticulum.

- Diverticular disease (ED) is defined as clinically symptomatic diverticulosis due to diverticular hemorrhage, simple or complicated diverticulitis, segmental colitis associated with diverticula, and uncomplicated diverticular disease.

Epidemiology

The prevalence of diverticulosis is age dependent, ranging from less than 20% at 40 years to 60% at 60 years, this will vary according to the geographical area studied, industrialized nations have rates of 5 to 45% Depending on the diagnostic method and age, approximately 95% of patients with diverticula present them in the sigmoid colon, of which 24% involve this segment of the colon but are in other parts of the colon, in 7% of patients With diverticula present throughout the colon, and in 4% of the diverticula are limited to a proximal segment of the sigmoid colon (Shahedi *et al.*, 2013). In our country, the National Institute of Nutrition "Salvador Zubirán" reported a prevalence of 4.1% in radiological studies and 1.9% in autopsies, which contrasts with what was reported in the Spanish Hospital of Mexico of 9.2% in radiological studies. The same authors cite that in a study of the Hospital Juárez of the city of Mexico, in 2,286 autopsies a case of diverticular disease of the colon was not found. These studies are over 40 years old. We do not have information on the frequency of colon ED in the rest of the Mexican Republic (Luis and Guindic, 2016).

Complicated diverticulitis

This is present in 25% in patients with diverticulosis will develop it, although the majority of the patients respond to the medical treatment, approximately 4 to 15% of the patients will require surgery, the incidence increases with the age, reason why The mean age at presentation is at age 63, approximately 16% will present patients younger than 45 years, the incidence is increased, in the United States there is an increase in the income of acute diverticulitis in 26% of 1998 to 2005 (Nguyen *et al.*, 2011) the largest increase was in patients aged 18 to 44 years in 82%, so that elective surgeries were increased by 29% in the same age range, ED bleeding occurs in 5% to 15% and is massive in one third of patients but most often spontaneously remit (Fang *et al.*, 2008). The associated risk factors for developing ED are a low-fiber diet as it has been shown that fiber can reduce the incidence of symptomatic diverticular disease by decreasing intestinal inflammation and altering the intestinal microbiota (Aldoori *et al.*, 1995), consumption of red meat And a diet high in fat increases the risk (Crowe *et al.*, 2011). Physical activity is demonstrating that it decreases the risk of presenting ED, so that in patients with obesity increases the risk of diverticulitis and diverticular bleeding (Strate *et al.*, 2012; Rodríguez-wong *et al.*, 2015; Hjern *et al.*, 2011) among other factors, smoking increases the risk of developing perforated diverticulitis and abscess formation (Hjern *et al.*, 2011), several medications Are associated with NSAIDs and opioids (Nagata *et al.*, 2012), vitamin D elevation has recently been shown to increase risk, such as impaired motility and changes in colon elastin.

Clinical manifestations

The clinical presentation of acute diverticulitis depends on the severity of the underlying inflammatory process and the

presence of associated complications; abdominal pain is the most common symptom; therefore, it occurs in the lower left quadrant due to the involvement of the sigmoid colon Pain is usually constant and present several days before the presentation, approximately 50% of patients have had one or more previous episodes of similar pain, leukocytosis may be present or not, since in 45% the white blood cell count is Normal as well as fever and other symptoms such as nausea and vomiting in case of colon obstruction (Jacobs, 2007).

Complications complicated with complicated diverticular enfemedit

Complications due to acute diverticulitis approximately 25% of patients have been associated with acute or chronic complications. Abscesses occur in 17% of patients these are due to micro perforations of the diverticulum that are contained by mesentery. Obstruction is due to recurrent episodes of acute diverticulitis, which results in decreased relative light due to per colonic inflammation or compression of an abscess, however, obstruction of the colon is rare in the acute phase and is usually associated with Development of a stenosis due to chronic inflammation (Bahadursingh *et al.*, 2003). The fistula is formed by the continuous inflammation of the diverticula that can result in the formation of a fistula in the colon towards the adjacent viscera, the fistula that more commonly implies is with the bladder followed with the vaginal but the patients must have the antecedent of Hysterectomy (Bahadursingh *et al.*, 2003; Zapata-González *et al.*, 2015). Perforation with generalized peritonitis may result from rupture of the diverticular abscess in the peritoneal cavity or free rupture of an inflamed diverticulum with fecal contamination of the peritoneum, although only 1 to 2% of patients present perforation with purulent or fecal peritonitis. Mortality rates approach 20%, here the abdomen is distended there is rigidity, rebound and intestinal noises are absent (Peter, 2014; Cirocchi *et al.*, 2014). Diverticular bleeding of the colon is the most common cause of hematochezia, accounting for 30-50% of cases of massive bleeding in which most of the time it spontaneously remits (Gayer *et al.*, 2006).

Diagnosis

The gold standard for diagnosis and to evaluate the treatment that will be applied to the patient is CT, and the suggestive findings is the presence of localized intestinal thickening of the wall greater than 4 mm, an increase in soft tissue density Within the peri-colonic fat secondary to inflammation of the colon, and the presence of diverticula in the colon, the sensitivity and specificity for the diagnosis of tomography for acute diverticulitis are 94 and 99% respectively, which will be evaluated by a classification Of Hinchey. Complications of diverticulitis can be visualized in the same way by abdominal CT, abscesses are identified as collections of fluid surrounded by an area with inflammatory changes, for patients with intestinal obstruction there is the presence of dilatation of bowel loops with levels Hydro aerosols in the vicinity of a zone of peri-colonic inflammation, collections of extra-colonic air within organs other than the intestine and abdominal wall are indicative of a fistula, in patients with peritonitis, free air can be seen With abdominal CT scan (Destigter and Keating, 2009; Tappouni *et al.*, 2015; Snyder, 2004; Goh *et al.*, 2007).

Surgical management of ED

Indications for surgery, as most patients are treated medications, surgery is only indicated when the ED is either non-susceptible or resistant to medical treatment.

The indication for emergency surgery is:

- When there is frank piercing, it is a life-threatening condition that forces surgery.
- Failure to medical treatment, when patients who deteriorate or do not improve after three to five days of antibiotics.
- Obstruction, patients presenting with colonic obstruction secondary to acute diverticulitis.
- Abscesses due to non-surgical intervention.
- Indication of elective surgery
- Fistula secondary to acute diverticulitis.
- Chronic diverticulitis.
- Asymptomatic but high risk patients: those who had a previous episode of complicated diverticulitis and those who are immunosuppressed.

Indication of elective surgery for patients who presented with a picture of complicated diverticulitis such as abscesses that were treated with antibiotics or percutaneous drainage. There are studies that demonstrate that these patients are at greater risk of developing complications or dying from a recurrent attack and therefore would benefit from early elective surgery and for immunosuppressed patients most surgeons offer elective surgery after a frame Diverticulitis, since elective surgery is associated with lower mortality rates compared to emergency surgery (Sartelli *et al.*, 2016; Horesh *et al.*, 2016).

Election of a surgical technique

This will depend on the hemodynamic stability of the patient, the degree of fecal contamination and the experience of the surgeon. The main goal of surgery is to eliminate the segment of colon that is affected and the secondary object of surgery is to restore intestinal continuity without it is possible. Hemodynamically unstable patients, these patients sometimes can not tolerate a resection of the affected colon and the reconstruction, so they should be performed laparotomy to control the damage with limited resection of the affected colon with or without reconstruction, or a laparoscopic lavage and Drainage without resection of the colon can be performed quickly. Hemodynamically stable patients, patients undergoing emergency surgery who are stable and who are submitted to elective surgery, should be able to tolerate a definitive resection of the involved colon segment. The choice of reconstruction techniques depends to a great extent on the degree of peritoneal contamination as assessed by the Hinchey classification system, (Vergara-Fernández *et al.*, 2006) Hinchey III-IV diffuse contamination in this type of patients is contraindicated a primary anastomosis, the preferred treatment is the Hartmann procedure with terminal colostomy (Banerjee *et al.*, 2005). The Hinchey I-II localized contamination is characterized by one or more peri- colonic abscesses, in the mesentery, or in the pelvis, so that this type of patients can tolerate a preoperative intestinal preparation, therefore if the affected colon segment can be resected with a primary anastomosis with or without protective ileostomy which is later

easier to repair (Constantinides *et al.*, 2006; Abbas, 2007; Gooszen *et al.*, 2001; Reyes-Espejel *et al.*, 2015). Elective surgery should be performed after 6 weeks of acute diverticulitis once the infection and inflammation have disappeared (Meyer and Sadiq, 2015).

Surgical techniques

Procedures at one time. Here what is done is resection of the colon affected with primary anastomosis is performed normally during elective surgery or during emergency surgery in patients with Hinchey I - II. Primary anastomosis is contraindicated in patients with Hinchey III-IV and relatively contraindicated for patients with important medical comorbidities, poor nutritional status, and immunosuppressed patients. The considerations that must have that the bowel is well vascularized, not edematous, and the anastomosis must be free of tension, the distal margin is typically placed in the upper third of the rectum where the tapeworms converge and the proximal margin where the colon does not present Edema, the entire colon does not have to be resected if diverticula are present in the rest of the colon since the descending and transverse colon rarely causes symptoms.

Two-step procedure: It is used primarily for patients with Hinchey III or IV and for those with Hinchey I or II who have diverticulitis with contamination or inflammation of surrounding tissues or other risk factors for anastomotic leakage, the Hartmann procedure is the most commonly performed and preferred two-step procedure for patients with Hinchey III or IV.

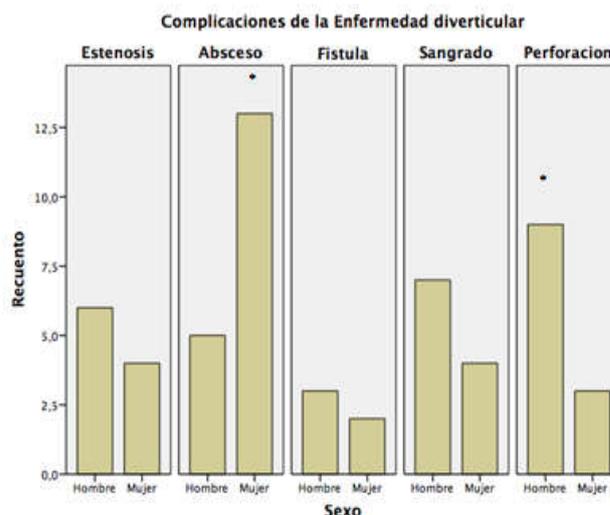
This procedure consists of resection of the diseased colon segment, creation of the colostomy and closure of the distal stump, followed by closure of the colostomy and intestinal continuity at three months later, this operation is technically more difficult as it is associated At high mortality and morbidity rates, that closure only in about 50 to 60% of patients after a Hartmann procedure. Resection of the colon with primary anastomosis and a protective ostomy is another approach of two-stage surgery where the affected colon segment is resected, with a primary anastomosis protected with a proximal stoma in the first surgery and stoma closure in The second surgery, this type of procedure is performed in patients with Hinchey I or II when there are no contraindications to primary anastomosis, this type of procedure the stoma is easier to close from a colostomy, although this procedure is not performed in patients with Hinchey III or IV have been tried in several patients with good results there are several randomized studies comparing the Hartman procedure and the anastomosis with protection stoma, where there are fewer complications, in the stoma reversal.^{34,35.}

The laparoscopic lavage was introduced to avoid laparotomy surgery and thus to put the patient in conditions to avoid a colostomy, this type of procedure is performed in patients with a Hinchey III or IV, but this procedure has to be performed by an experienced surgeon (Myers *et al.*, 2008; Parisi *et al.*, 2016; Gervaz *et al.*, 2016; Franklin *et al.*, 2008; Bugiantella *et al.*, 2015). Material and Methods: We carried out an analytical, descriptive, prospective and cross-sectional study, including 56 patients with complicated ED diagnosis and who required surgical treatment in an elective or urgent manner. Postoperative evolution was evaluated and possible associated risk factors were determined. The data collection was performed using a precoded sheet and the statistical analysis

was performed with SPSS v 23. The normality of the quantitative and qualitative variables was analyzed by the Kolmogorov-Smirnov and Shapiro-Wills statistics, respectively. Central tendency measures were used for quantitative variables. The analysis of the risk factors was determined using contingency tables where Chi square was obtained with a significance lower than 0.05. The association between the qualitative variables was determined by the Spearman correlation coefficient.

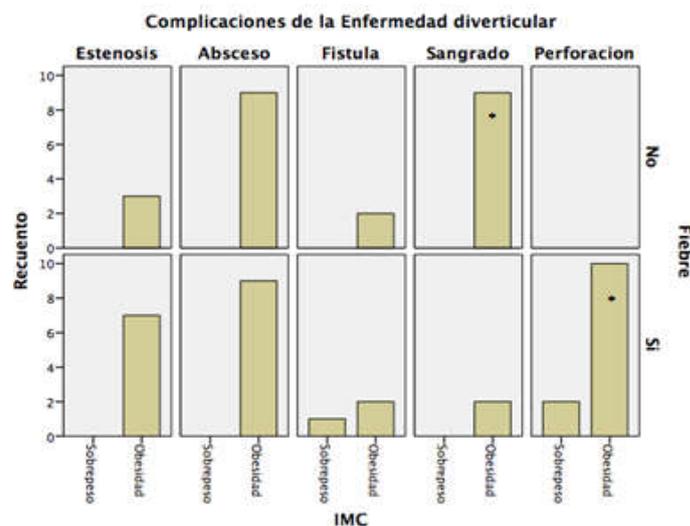
RESULTS

During the time the study was carried out, a total of 56 patients had ED complications, with a mean age of 62 +/- 16 years, of which the predominant sex was male 53% (n = 56) (Figure 1), were also divided by their BMI having obesity from BMI greater than 30 taking 94.6% (53) (n = 56) and overweight BMI greater than 25-30, presenting a 5.4% (3) (N = 56), the clinical picture for the emergency room was the classic triad for this pathology presented fever (58.9%) and 41.1% did not present (Graph 2), for abdominal pain predominating in the fossa Left iliaca presented 78.5% (44) and 21.4% (22) did not present this symptom (Graph 3), the other that was taken into account was the leukocytosis presented by 73.2% (41) and 26.8% (15) (Figure 4). All of these patients underwent CT for their diagnosis on admission to the emergency room and were classified according to the Hinchey scale of I - IV. Hinchey type I (17) in 30.4% of the patients presented the most frequent stage of the disease in our population, of which 3% of patients were given medical management with 3% of the generation of metronidazole, with 26.8% (15). In addition, they deserved surgical treatment, since they did not respond to the treatment, persisting with systemic inflammatory response data, and surgical resolution for these was for a patient Hartman procedure and another patient was submitted to resection and primary anastomosis, for those who presented a Hinchey type II (5) 8.9% of the same form was given medical treatment responding adequately 4 patients, and only 1 patient required surgical treatment by Which was performed resection with primary anastomosis and ileostomy protection. For Hinchey type III (7) a 12.5% treatment was performed in this group was surgical so that 5 patients underwent Hartman procedure and 2 patients underwent resection plus primary anastomosis and ileostomy protection. For Hinchey type IV (15) a 26.8% also the surgical treatment was surgical and the type of surgery that was performed to 12 patients was Hartman procedure and the 3 patients were done resection with primary anastomosis the conditions of the patient allowed to perform this procedure. Finally, patients with low GI bleeding were of one (12) 21.4% of whom bleeding spontaneously referred in 9 patients and only 3 required surgical intervention 3, and surgical resolution was of the Hartman procedure in 2 And in one patient resection and primary anastomosis were performed Table 1. The complications presented by the ED in order of frequency were the following ones, being the most frequent abscess in 32.1% (18), perforation and bleeding both in 21.4% (12), continuing with the stenosis in 17.9% (10); finally, the fistula was 7.1% (4), of which 3 were colo-vesical, 2 were male and 1 female, and 1 of them were colo-vaginal, having as a history of total abdominal hysterectomy.



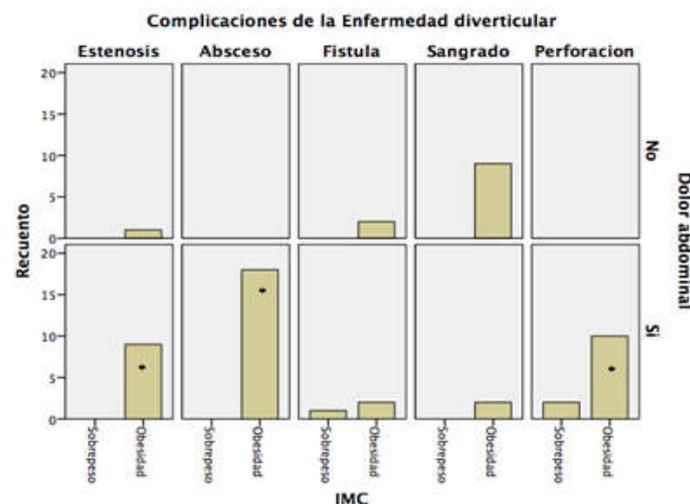
Note: * p <0.05 Chi squared.

Graph 1. Complications of diverticular disease in relation to sex



Note: * p <0.05 Chi squared.

Graph 2. Complications of Diverticular Disease in relation to obesity and the presence or absence of fever



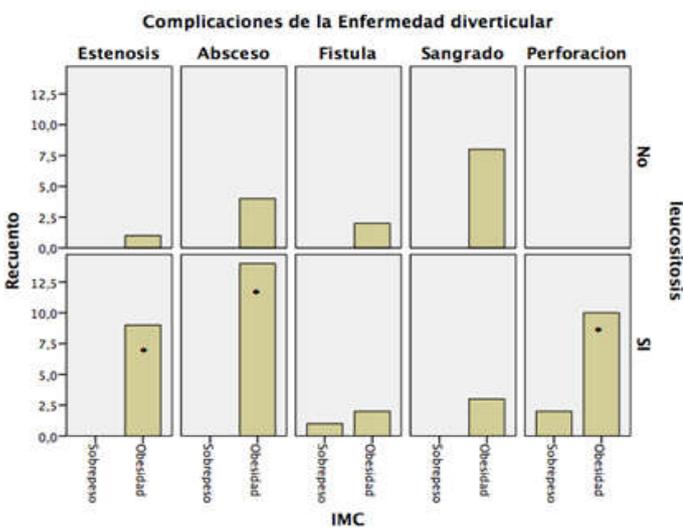
Note: * p <0.05 Chi squared.

Graph 3. Complications of Diverticular Disease in relation to obesity, whether or not there is abdominal pain

Table 1. Complications of Diverticular Disease in relation to the procedure performed for its resolution and type of Diverticular Disease

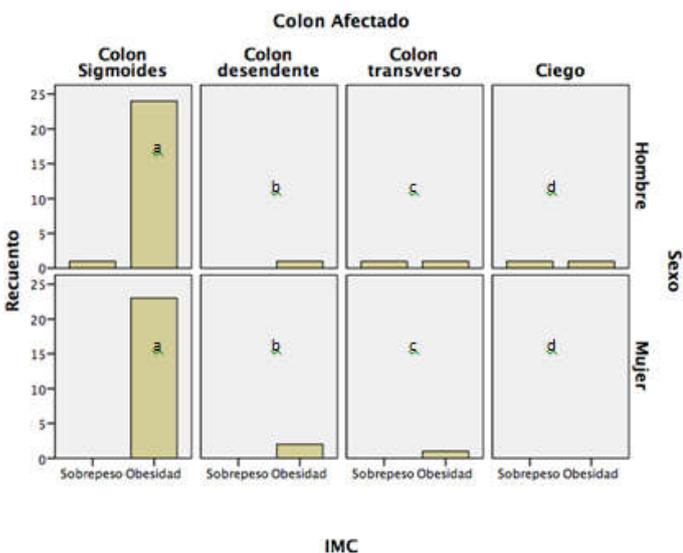
Classification of Hinchey	Performed procedure	Complications of Diverticular Disease					Total
		Stenosis	Abscess	Fistula	Bleeding	Drilling	
Kind 1 P<0.05	No Surgery	1 (50%)	14 (100%)	0 (0%)			15 (88.2%) ^a
	Hartman	1 (50%)	0 (0%)	0 (0%)			1 (5.9%) ^b
	Reconnection	0 (0%)	0 (0%)	1 (100%)			1 (5.9%) ^b
	Total	2 (100%)	14 (100%)	1 (100%)			17 (100%)
Kind 2 p>0.05	No Surgery		2 (100%)	1 (100%)	1 (100%)	0 (0%)	4 (80%)
	Reconnection and ileostomy protection		0 (0%)	0 (0%)	0 (0%)	1 (100%)	1 (20%)
	Total		2 (100%)	1 (100%)	1 (100%)	1 (100%)	5 (100%)
Kind 3 p<0.05	Hartman	3 (100%)	0 (0%)	2 (100%)			5 (71.4%) ^a
	Reconnection	0 (0%)	2 (100%)	0 (0%)			2 (28.6%) ^b
	Total	3 (100%)	2 (100%)	2 (100%)			7 (100%)
Kind 4 p>0.05	Hartman	4 (100%)				8 (72.7%)	12 (80%)
	Reconnection	0 (0%)				3 (27.3%)	3 (20%)
	Total	4 (100%)				11 (100%)	15 (100%)

Note: p <0.05 Chi square where a> b.



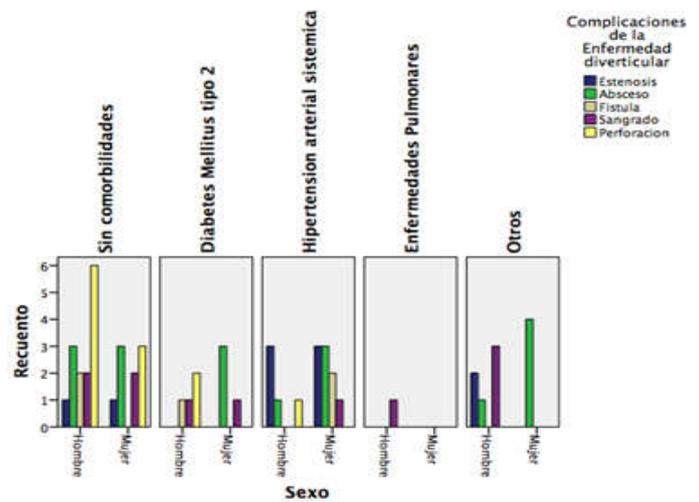
Note: * p <0.05 Chi squared.

Graph 4. Complications of Diverticular Disease in relation to obesity, whether or not leukocytosis



Note: Group Man a> b, c, d with a p <0.05 Chi squared. Female group a> b, c, d with a p <0.05 Chi squared. Male vs. Female p> 0.05.

Graph 5. Site of affection of the Diverticular Disease in relation to the sex and obesity



Graph 6. Comorbidities of Diverticular Disease in relation to sex and type of complication of Diverticular Disease

Of the involvement in the colon portion were the following being the area most affected the sigmoid colon in 85.7%, (48), following the descending and transverse colon for both in 5.4% (3), finally the blind in a 3.6% (2) Graph 5. Patient comorbidities were the most frequent systemic arterial hypertension in 25% (14), continuing with type 2 diabetes mellitus in 14.3% (8). Other comorbidities were renal, rheumatologic alterations and combination of the aforementioned was 17.9% (10), lung diseases in 1.8% (1), and finally in 41.1% (23) did not present any comorbidities at the time of diagnosis.

DISCUSSION

In this study, a mean of 62 years was obtained with respect to the age of presentation of the complications due to ED, since the age of presentation had no variations in presentation with studies performed in the United States the age of was 63 years and that This is increased with age, in a study carried out at the Hospital Juarez de México, the presentation of the disease was at age 54, where we can determine that this will vary depending on the population being studied. In our study, patients presenting with ED complications were abscess, perforation, bleeding, stenosis and fistula, where all had BMI

obesity greater than 30 kg / m² and overweight BMI of 25-30 kg / m². Obesity with complications of ED in the study discussed earlier that was performed at the Juárez Hospital in Mexico conducted by Ulises Rodriguez Wong titled "Obesity and ED of complicated colon", its study results were studied 114 patients where 88 Hinchey I (21.6%), 24 Hinchey II (27.3%), 27 Hinchey III (30.7%) and 18 Hinchey IV (20.4%) had a body mass index between 25 and 40 kg / m² of these patients.) Where they found significant statistical data, which showed that the BMI greater than 25 kg / m² as a risk factor for complicated diverticular disease showed a odds ratio of 3.4884 (95% confidence interval, 1.27-9.55) with z value of 2.44 (p = 0.014); in our study, 17 presented Hinchey I (30.4%), 5 Hinchey II (8.9%), 7 Hinchey III (12.8%), 15 Hinchey IV (26.8%), having similarities in the most frequent presentation for both Hinchey type I and IV, this article mentions studies conducted where several authors relate obesity and overweight with complicated diverticular disease in most are retrospective studies where they determine that obesity and overweight patients are at increased risk of recurrent diverticulitis, perforation and bleeding, in our study the complications presented by our population were abscess, Perforation, bleeding, stenosis and fistula, where they are related to obesity and overweight where our population with diverticulosis and these have obesity or sobrepeso are at risk of presenting the mentioned complications, although the exact pathophysiology is unknown, where in its Article published by Strate mentions the biological mechanisms by which obesity increases the risk of complications. However, obesity is linked to several plausibly factors that are believed to contribute to complications, adipose tissue secretes a number of known cytokines to participate in local inflammation and generalized therefore, obesity can increase or precipitate the inflammatory process in diverticulitis. In addition, recent reports indicate that intestinal microbes differ between individual disorders in obese and thin people the intestinal microflora are also postulated to play a role in the development of diverticulitis. Although the exact nature of these alterations is unknown, obesity may influence the Diverticular bleeding through the pathways that affect vascular integrity; finally, obesity may contribute to the development of diverticulosis

From the clinical picture presented in our study by the classical triad, abdominal pain in the left iliac fossa is the common symptom, fever and leukocytosis is present in 45%, according to the clinical guidelines for the diagnosis and treatment of ED published in The journal of gastroenterology of 2016 in Mexico in our population abdominal pain in the left iliac fossa was the most common symptom, followed by leukocytosis and fever, which are related to these guidelines. The type of surgery most performed in our hospital is the Hartmann procedure which was determined by the patient's conditions and the surgeon's criteria, the stage within the Hinchey classification in our population was type I and IV, according to The latest review by Watler concludes that all patients with Hinchey III and IV should be treated with surgery in hemodynamically stable patients with primary anastomosis with or without fecal derivation on the Hartman procedure, and those with the latter with the latter, and Patients presenting a Hinchey I or II where medical treatment is not satisfactory the treatment will be surgical, elective surgery is performed according to the patient's related factors and conditions; Laparoscopy should be favored over laparotomy in terms of

short-term results, although no long-term benefits have been reported where our hospital facility is not performed due to lack of training and experience of the surgeon.

Conclusion

The complications of ED most frequently presented in this study were abscess, perforation, bleeding, stenosis and fistula. The most frequent Hinchey stage was I and IV, so the most frequent surgical resolution was the procedure of Still the surgeries continue to be done via laparotomy, so it is necessary to train general or colorectal surgeons to be able to perform this type of surgery by minimally invasion in order to reduce the recovery time of our patients and their complications. Also we must make aware in our population about all the complications that can have for obesity or overweight that are multiple and complicated diverticular disease is one of them.

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