ORIGINAL ARTICLE

Value of routine stool testing for pathogenic bacteria in the evaluation of symptomatic patients with ileal pouches

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Abstract

Background: In symptomatic patients with an ileal pouch, stool studies are often sent to diagnose enteric pathogens. Aim of this study is to find the value of routine stool studies in the evaluation of symptomatic patients and the clinical implications of such pathogens in patients with ileal pouches.

Methods: Consecutive ileal pouch-anal anastomosis (IPAA) patients who had stool tests out of a 2283-case registry from 2002 to 2015 were included in the study. Patients with positive stool cultures were compared with controls (symptomatic without positive stool culture) in a 1:4 ratio. Response to antibiotic therapy, recurrence rate and rate of hospitalization at 1 and 3 months were assessed.

Results: A total of 643 (28%) had stool cultures done and only 1.7% (11/643) were found to be positive for stool cultures. *Campylobacter* spp. (45%) was the most common pathogen followed by *Aeromonas* spp. (36%). Non-smokers and patients without any antibiotic use in the last 3 months were found to have higher prevalence of positive stool cultures than controls ($p < 0.001$ and $p = 0.023$). Patients with pathogenic bacteria were found to have a higher risk of acute kidney injury (27.3% vs 4.5%, $p = 0.049$), hospitalization within 3 months of initial stool testing (36.4% vs 6.8%, $p = 0.009$) and mortality (18.2% vs 0%, $p = 0.040$). However, there were no statistically significant differences in the clinical outcomes in patients with positive stool cultures who received pathogen-directed therapy.

Conclusions: We found that the yield of stool tests for bacterial pathogens in symptomatic pouch patients was extremely low and the treatment of detected pathogens had a minimum impact on the disease course of pouchitis. The clinical utility of routine stool culture in those patients warrants further study.

Key words: pouchitis, ileal pouch, enteric pathogens, stool culture

Introduction

Approximately 30% of the patients with ulcerative colitis (UC) would eventually require surgical intervention after 15 years of the disease [1]. Restorative proctocolectomy with ileal pouch-anal anastomosis (IPAA) has become the surgical treatment of choice for the majority of the patients with refractory UC, colitis-associated dysplasia or familial adenomatous polyposis (FAP) [2]. Pouchitis is the most common complication, which is almost exclusive in UC patients with IPAA as compared to FAP counterparts, with a reported cumulative prevalence ranging from 23% to 46%, and an annual incidence up to 40% [3,4]. Symptomatic patients can present with increase in stool frequency, urgency, incontinence, abdominal, rectal or pelvic pain. However, these symptoms were nonspecific and can be a presentation of other inflammatory or non-inflammatory disorders of the pouch [5]. The diagnosis of pouchitis is based on a combined clinical, endoscopic, radiographic and histologic assessment.

Dysbiosis and dysregulated mucosal immune response are believed to play a key role in the development of 'conventional' or idiopathic' pouchitis [6]. In some patients, ileal pouch inflammation may be caused by specific pathogens, including *Clostridium difficile* (*C. difficile*) [7] and cytomegalovirus (CMV) [8], resulting in failure to respond to standard antibiotic therapy. In a study by Shen *et al.*, 18.3% of symptomatic patients with an ileal pouch were found to be positive for *Clostridium difficile* infection (CDI) [9].

Previous studies have shown an increased risk of occurrence and exacerbation of Inflammatory Bowel Disease (IBD) following gastrointestinal (GI) infection with enteropathogenic bacteria [10,11]. There are case reports of *Campylobacter jejuni* infection (CJI) in pouch patients presenting with high fever and dehydration [12] or mimicking Crohn's disease (CD) [13]. However, the association between enteric pathogenic bacteria and disease activity of the pouch is not well established. Nonetheless, stool testing for enteric pathogens is often performed in symptomatic patients. The aim of this study was to assess the value of routine stool testing in symptomatic patients with ileal pouches.

Patients and methods

After obtaining approval from Cleveland Clinic Institutional Review Board, we reviewed all of the pouchitis patients who were regularly followed in the Center for Ileal Pouch Disorders between 2002 and 2015. Pouchitis patients who had a stool culture done were identified from our electronic medical records using ICD-9 codes.

Inclusion and exclusion criteria

Pouch patients with symptoms of pouchitis and stool tests positive for *Campylobacter*, *Aeromonas*, *Escherichia coli 0157:H7*, *Salmonella* or *Shigella* were identified and included in the study. Any patient with concomitant CDI was excluded from the study. All the cases were compared with age-matched controls (pouch patients with no previous history of infection with pathogenic bacteria or *C. difficile*) in a 1:4 ratio. Both in-patients and out-patients were included.

Laboratory testing for pathogenic bacteria

The diagnosis of pathogenic bacteria infection was made by positive stool culture except for CJI, which was confirmed by the presence of positive enzyme immunoassay as part of a stool culture panel in patients with symptoms suggestive of pouchitis (increased bowel frequency, bleeding, urgency, abdominal cramping and tenderness). Enzyme immunoassay has been shown to be more sensitive and accurate in diagnosing CJI than the traditional culture methods [14].

Clinical variables

Retrospective chart review was performed by one investigator (A.S.) to extract relevant data and demographic information, including age, gender, body mass index (BMI), smoking history, travel history, chronic medical issues, clinical symptoms, risk factors for enteric pathogens and antibiotics used to treat them. Pouch-related variables were also collected including indication of pouch surgery, duration of disease, type of pouch, history of pouchitis, past or current immunosuppressants (azathioprine, 6-mercaptopurine, methotrexate and anti-tumor necrosis factor or anti-integrin agents) and antibiotic use in the last 3 months or at the time of colectomy.

In addition, we recorded information regarding pouchitis-related hospital admissions, sepsis, acute kidney injury (AKI), re-admission within 3 months after treatment, pouch failure (defined by the need for pouch revision or excision and permanent ileostomy) or death. The diagnosis of pouchitis was made on the basis of a triad of compatible symptoms, endoscopic and histologic findings. A pre- and post-treatment modified Pouch Disease Activity Index (mPDAI) was also calculated, with a score ≥ 5 suggestive of diagnosis of pouchitis [15].

Outcome measurements

The primary outcome measures of the study were pouchitis-related Emergency Room visits, hospitalization, sepsis, re-admission within 3 months, surgery or death. The secondary objective was to identify risk factors for such pathogens in pouch patients.

Statistical analysis

Descriptive statistics were computed for all variables. These included mean and standard deviations or medians and interquartile ranges (IQR) for continuous variables, and frequencies for categorical variables. Univariate analysis was performed to assess differences between subjects with and without pathogenic bacteria. Analysis of variance (ANOVA) or the non-parametric Kruskal-Wallis tests were used for continuous and ordinal variables and Pearson's chi-square tests or Fisher's exact tests were used for categorical factors. A multivariate analysis was not done due to the small numbers in the study group. All analyses were done using SAS (version 9.4, The SAS Institute, Cary, NC) and $p < 0.05$ was considered statistically significant.

Ethical considerations

Data were collected using electronic medical record without any direct contact with the patients for the purpose of study. The need for informed consent was waived and the study was approved by the Cleveland Clinic Institutional Review Board.

Results

There are a total of 2283 with ileal pouches in our data registry. Patients who were tested for stool pathogens were included in the study.

Frequency of detection of stool pathogens

A total of 643 (28%) patients with symptoms suggestive of pouchitis from the whole database had stool cultures. In our clinical

practice, patients with an increased bowel frequency or change in stool consistency for more than 2–3 days despite anti-diarrheal agents underwent the stool tests for *C. difficile*. Whether other stool pathogens were tested was at the discretion of the treating physician. There were 11 patients (1.7%) with positive stool cultures. *Campylobacter* spp. (45.5%) was the most common pathogen followed by *Aeromonas* spp. (36.4%), *Escherichia* (9.1%) and *Salmonella* (9.1%) (Figure 1). These patients were included in the study group. The control group comprised 44 age-matched pouchitis patients who tested negative for pathogenic bacteria on stool testing. These were selected in a random manner from the remaining 632 pouch patients who had negative stool cultures. Stool specimens of all patients in the study and control groups were negative for *C. difficile*.

Comparison of demographic and clinical variables

Comparison of demographic and clinical characteristics of patients with and without pathogenic bacteria is given in Table 1. Out of 11 patients with pathogenic bacteria, four patients had acute pouchitis, three had chronic pouchitis, one patient had CD of the pouch and three patients had mechanical etiology of the pouchitis. In the control group ($n = 44$), 3 patients had acute pouchitis, 23 had chronic pouchitis, 2 patients had CD of the pouch, 1 patient had cuffitis, 1 had irritable pouch syndrome and 14 patients had various mechanical etiologies of the pouchitis. In univariate analysis, non-smokers ($p < 0.001$) and patients without any antibiotic use in the last 3 months ($p = 0.023$) were found to have higher prevalence of positive stool cultures, but there were no significant differences between the study and the control group in terms of history of diabetes or chronic kidney disease, type of IPAA surgery performed, the use of proton pump inhibitors, histamine-2 blockers, immunosuppressants or antibiotics at the time of colectomy. Patients with positive stool testing tended to be more often females (7/11), those with a history of UC (10/11), two-stage J-pouch surgery (10/11) and the use of immunosuppressive medications (8/9), but the difference between the two groups did not reach statistical significance.

Comparison of laboratory and Modified Pouch Disease Activity Index (mPDAI))

There was no statistically significant difference in white blood cells, immunoglobulin G level, fever, stool frequency and rectal bleeding between pre and post treatment in the study group.
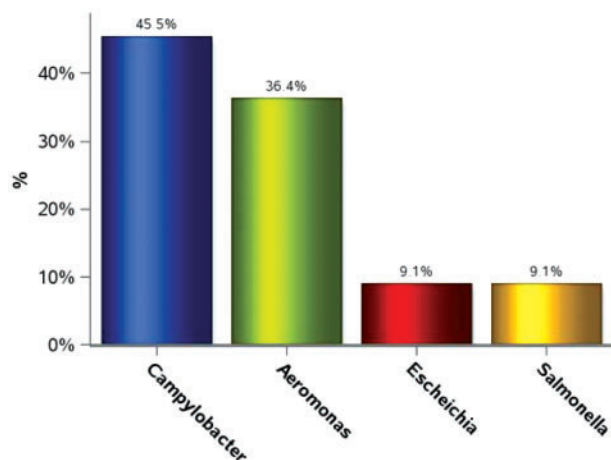

Figure 1. Bacterial infection in pouchitis.

Subjects with pathogenic bacteria were less likely to have granularity (0% vs 61.5%, $p = 0.008$) and ulceration (33.3% vs 92.3%, $p = 0.017$) prior to the antibiotic treatment and were less likely to have ulceration (20% vs 87.5%, $p = 0.032$) after the treatment. Before treatment with antibiotics, the mPDAI in the study and control groups were 7 and 4 and post treatment were 5 and 2, but there was no statistically significant difference, with p-values of 0.25 and 0.84, respectively. This was due to the small number of the study group ($n = 11$) and most of the patients did not have pouchoscopy either before or after the treatment in both groups (Table 2 and Table 3).

Clinical course of enteric pathogen infection and impact of treatment

The difference in the clinical course of patients with and without pathogenic bacteria are summarized in Table 4. The duration of antibiotic use was significantly shorter in patients in the study group (9.9 ± 9.2 days) than controls (45.1 ± 53.4 days) ($p = 0.039$). When compared with the control group, patients with pathogenic bacteria were found to have a higher risk of AKI (27.3% vs 4.5%, $p = .049$), hospitalization within 3 months (36.4% vs 6.8%, $p = 0.009$) and mortality (18.2% vs 0%, $p = 0.040$). Of two patients who died in the study group, one patient had concomitant pneumonia and myelodysplastic syndrome and the other patient had vancomycin-resistant bacteremia (VRE). It was difficult to determine whether they had died of pouchitis-related complications.

Only 7 out of 11 with positive stool testing were assessed for treatment success, as 2 died and 2 patients were lost to follow-up. Five out of seven patients (71%) were symptom-free at 1 month after treatment in the study group, but four out of the five (80%) had recurrence of symptoms. Of 44 patients in the control group, 26 (59%) were treated with antibiotics and 8 (18%) were treated with corticosteroids. Eradication of symptoms could not be assessed in the control group due to lack of culture positivity and variable treatment therapies. Repeat antibiotic therapy was required in 10/15 (66.7%) of patients in the control group as compared to 4/11 (36.4%) in the study group ($p < 0.001$). There was no difference in duration of repeat antibiotics (4.7 % vs 50.8 days, $p = 0.17$), hospitalization (54.5% vs 27.3%, $p = 0.085$), sepsis (18.2% vs 4.5%, $p = 0.17$), intensive care unit (ICU) admissions (9.1% vs 0%, $p = 0.20$), length of stay (8% vs 3%, $p = 0.058$) or repeat pouch surgery (36.4% vs 19%, $p = 0.22$) in the study and control groups.

Discussion

Infections with pathogenic bacteria are commonly seen in inflammatory bowel disease patients [11,16–18]. Besides CDI, the association of enteric pathogens with pouchitis is not well established in pouch patients. The present study attempted to assess the risk factors and effects on clinical outcomes of pathogenic bacteria in patients with IPAA and to find the value of routine stool testing in the evaluation of symptomatic patients. Pathogenic bacteria were found only in 1.7% (11/643) of the patients with pouchitis symptoms. *Campylobacter* spp. (45.5%) was the most common pathogen followed by *Aeromonas* spp. (36.4%), *Escherichia* (9.1%) and *Salmonella* (9.1%). These pathogens were more common in non-smokers and patients without any antibiotic use in the last 3 months. When compared to the controls, patients in the study group had a higher frequency of AKI and hospitalization within 3 months of initial stool

Table 1. Demographics and baseline characteristics

Factor	No pathogenic bacteria (N = 44)		Pathogenic bacteria (N = 11)		P-value
	No.	Statistics	No.	Statistics	
Age at diagnosis, years	34	25.1 ± 11.8	8	34.0 ± 9.3	0.054
Male gender, *n* (%)	44	25 (56.8)	11	4 (36.4)	0.22
Race, *n* (%)	44		11		0.43
Caucasian		40 (90.9)		10 (90.9)	
African-American		0 (0.0)		1 (9.1)	
Hispanic		3 (6.8)		0 (0.0)	
Other		1 (2.3)		0 (0.0)	
Body mass index, kg/m^2	44	25.0 ± 5.2	10	24.2 ± 9.4	0.73
Smoking, *n* (%)	44		11		**<0.001**
Current		18 (40.9)		1 (9.1)	
Ex-smoker		26 (59.1)		1 (9.1)	
Never		0 (0.0)		9 (81.8)	
Alcohol use	44		11		0.24
Current		12 (27.3)		3 (27.3)	
Ex-alcoholic		32 (72.7)		7 (63.6)	
Never		0 (0.0)		1 (9.1)	
Travel out of USA in last 6 months	44	0 (0.0)	11	0 (0.0)	–
Family history of IBD, *n* (%)	44	14 (31.8)	11	2 (18.2)	0.37
Diabetes, *n* (%)	44	4 (9.1)	11	1 (9.1)	0.99
Chronic kidney disease, *n* (%)	44	1 (2.3)	11	1 (9.1)	0.36
History of malignancy, *n* (%)	44	6 (13.6)	11	3 (27.3)	0.27
History of autoimmune process, *n* (%)	44	6 (13.6)	11	0 (0.0)	0.33
Baseline disease type, *n* (%)	44		44		0.36
Ulcerative colitis		43 (97.7)		10 (90.9)	
Familial adenomatous polyposis		1 (2.3)		1 (9.1)	
History of pouchitis, *n* (%)	44	37 (84.1)	11	7 (63.6)	0.13
Age at IPAA, years	43	33.3 ± 13.9	10	40.9 ± 13.6	0.12
Disease duration at IPAA, months	33	85.9 ± 83.2	8	113.4 ± 87.0	0.41
IPAA stages, *n* (%)	44		11		0.54
1		1 (2.3)		0 (0.0)	
2		32 (72.7)		10 (90.9)	
3		11 (25.0)		1 (9.1)	
Type of pouch, *n* (%)	44		11		0.50
J		42 (95.5)		10 (90.9)	
K		1 (2.3)		1 (9.1)	
S		1 (2.3)		0 (0.0)	
Tachycardia, *n* (%)	42	6 (14.3)	11	3 (27.3)	0.51
Prior immunosuppressant, *n* (%)	42	39 (92.9)	9	8 (88.9)	0.55
Current immunosuppressant, *n* (%)	44	17 (38.6)	11	4 (36.4)	0.89
Proton pump inhibitor, *n* (%)	44	8 (18.2)	11	5 (45.5)	0.057
H2 blockers, *n* (%)	44	2 (4.5)	11	1 (9.1)	0.50
Antibiotics in last 3 months, *n* (%)	44	32 (72.7)	11	4 (36.4)	**0.023**
Antibiotics prior to colectomy, *n* (%)	43	2 (4.7)	11	3 (27.3)	0.091

IBD, inflammatory bowel disease; IPAA, ileal pouch-anal anastomosis.

testing but the two groups did not differ significantly in other clinical outcomes.

Pouch flora in general is susceptible to dietary variations, antibiotics, stress and travel, and this is reflected by changes in the flora composition and changes in pH. This may promote the multiplication of potential pathogenic bacteria. It has been hypothesized that a low number of pathogens do not damage the host but, when the number increases, they can cause pouchitis. Chronic inflammation results in continuous epithelial cell death, providing extra nutrients for the pathogens [19–21]. Previous studies have shown that disruption of the intestinal barrier and intestinal permeability can be caused by pathogenic bacteria [22,23], leading to an increased translocation of intestinal microflora, which may act as stimuli for inflammation in a susceptible host [23–25]. Typically, symptomatic patients with

ileal pouch present with increase in bowel frequency, bleeding, urgency, abdominal cramping and tenderness, but they can have atypical presentations of high fever and dehydration [12] or mimicking CD on histology [13]. Stool tests are often sent to diagnose such pathogens but the validity of stool testing and implications of such infections in ileal pouch patients are largely unknown.

In our study, the rate of culture-positive pathogenic bacteria found was only 1.7% (11/643). We believe low culture positivity was mainly due to several reasons: stool cultures were done only in 28% of the patients with symptoms of pouchitis; the accuracy of laboratory tests was suboptimal; the timely processing of stool specimens may not be achieved in all patients; and the majority of the patients with pouchitis symptoms are treated empirically with antibiotics, which also eradicate enteric

Table 2. Pre-culture laboratory data and Modified Pouch Disease Activity Index (mPDAI)

Factor	No pathogenic bacteria (N = 44)		Pathogenic bacteria (N = 11)		p-value
	No.	Statistics	No.	Statistics	
White blood cell, × 10^9/L	40	8.3 ± 3.4	11	7.9 ± 5.0	0.77
Hemoglobin, g/dL	40	13.0 ± 2.1	11	11.7 ± 2.0	0.075
Albumin, g/dL	41	5.2 ± 0.66	11	4.0 ± 0.82	0.57
IgG level, mg/dL	26	293.8 ± 93.9	4	281.9 ± 82.6	0.81
Stool frequency, n (%)	42		11		–
2		42 (100.0)		11 (100.0)	
Rectal bleeding, n (%)	38	14 (36.8)	11	2 (18.2)	0.25
Fecal urgency/abdominal cramps, n (%)	41		11		0.42
0		0 (0.0)		1 (9.1)	
1		9 (22.0)		0 (0.0)	
2		32 (78.0)		10 (90.9)	
Fever (>100F), n (%)	41	5 (12.2)	11	2 (18.2)	0.61
Edema, n (%)	14	10 (71.4)	6	3 (50.0)	0.61
Granularity, n (%)	13	8 (61.5)	6	0 (0.0)	**0.018**
Friability, n (%)	14	10 (71.4)	6	3 (50.0)	0.61
Loss of vascular pattern, n (%)	11	5 (45.5)	6	3 (50.0)	0.99
Mucus exudates, n (%)	11	6 (54.5)	6	1 (16.7)	0.30
Ulceration, n (%)	13	12 (92.3)	6	2 (33.3)	**0.017**
Polymorphic infiltration, n (%)	17		4		0.95
1		13 (76.5)		3 (75.0)	
2		4 (23.5)		1 (25.0)	
Ulceration per low-power field, n (%)	13		5		0.99
0		2 (15.4)		0 (0.0)	
1		9 (69.2)		5 (100.0)	
2		2 (15.4)		0 (0.0)	
mPDAI, n (%)	7		4		0.25
7		1 (14.3)		1 (25.0)	
8		1 (14.3)		1 (25.0)	
9		1 (14.3)		1 (25.0)	
10		1 (14.3)		1 (25.0)	
12		2 (28.6)		0 (0.0)	
13		1 (14.3)		0 (0.0)	

pathogens, or this could just could be an epiphenomenon. In a study by Arora *et al*., the prevalence of *Campylobacter* in UC patients at our institution was found to be 2.3% (21/918) [10]. *Campylobacter* being most common pathogen in our study population could be from an epiphenomenon or from background high *Campylobacter* rates in UC patients at our institution. Gosselink *et al.* showed a significantly increased number of enteric pathogens such as *Clostridium perfringens* and hemolytic strains of *E. coli* during pouchitis episodes and treatment with ciprofloxacin resulted in complete eradication of these pathogens, reduction in mPDAI and restoration of normal pouch flora [26]. Our findings showed that there was no major change in the clinical course or the management of pouchitis in study patients after pathogen-directed antibiotic therapy, as compared to the controls, suggesting stool testing is of minimum diagnostic value and should not be done on a routine basis. In pouchitis patients with systemic symptoms (fever, tachycardia), high leukocyte count or sepsis, stool studies should be considered along with pouch biopsy to rule out CMV and other possible etiologies. We herein propose an algorithm for the laboratory evaluation in enteric pathogens for symptomatic pouch patients (Figure 2).

We found positive stool testing to be more prevalent in females, which is contrary to previous studies on *C. difficile*, in which male gender has been reported to be an independent risk factor for *C. difficile* infection of the ileal pouch [9,27]. Although a greater proportion of patients with enteric pathogens tended to be females, the difference was not statistically significant. Nonsmokers were found to have a higher prevalence of positive stool cultures in our study, which is in concordance with the findings of Merrett *et al.*, in which smokers were found to have significantly fewer episodes of pouchitis compared with nonsmokers [28]. In a recent study, Joelsson *et al.* found smoking not to have a preventive effect on pouchitis [29]. This remains to be further explored.

This study has some limitations. Our findings were based only on a cohort of 11 patients, which may limit the value of the findings. However, balanced against this is the fact that infection with enteric pathogens is uncommon in ileal pouches and the cohort presented is thus far the largest to date. Our study population was being followed-up at a tertiary referral IBD center; this might have introduced a referral bias. We only recorded the pouch-related hospitalization at our institution and could have missed interim events at the other hospitals. As this a retrospective study, we were unable to record information regarding dietary risk factors. We used the recent endoscopic examination before and after the treatment of pathogenic bacteria to calculate the mPDAI score—this might have resulted in bias, given the fluctuating nature of the disease course with changes in the disease severity between endoscopic examinations. However, the time delay between endoscopic

Table 3. Post-culture laboratory data and Modified Pouch Disease Activity Index(mPDAI)

Factor	No pathogenic bacteria (N = 44)		Pathogenic bacteria (N = 11)		p-value
	No.	Statistics	No.	Statistics	
White blood cell, $\times 10^9$/L	4	6.8 ± 4.0	4	7.0 ± 4.6	0.94
Hemoglobin, g/dL	4	13.1 ± 1.8	4	12.2 ± 2.3	0.56
Albumin, g/dL	4	4.0 ± 0.65	3	4.0 ± 0.42	0.97
Stool frequency, n (%)	12		8		0.41
0		1 (8.3)		0 (0.0)	
2		11 (91.7)		8 (100.0)	
Rectal bleeding, n (%)	11	3 (27.3)	8	0 (0.0)	0.23
Fecal urgency/abdominal cramps, n (%)	11		8		0.53
0		0 (0.0)		1 (12.5)	
1		5 (45.5)		1 (12.5)	
2		6 (54.5)		6 (75.0)	
Fever (>100 F), n (%)	8	0 (0.0)	8	1 (12.5)	0.99
Edema, n (%)	7	5 (71.4)	5	1 (20.0)	0.24
Granularity, n (%)	7	3 (42.9)	5	0 (0.0)	0.20
Friability, n (%)	7	4 (57.1)	5	2 (40.0)	0.99
Loss of vascular pattern, n (%)	6	1 (16.7)	5	1 (20.0)	0.99
Mucus exudates, n (%)	5	3 (60.0)	5	1 (20.0)	0.52
Ulceration, n (%)	8	7 (87.5)	5	1 (20.0)	**0.032**
Polymorphic infiltration, n (%)	8		2		0.33
1		5 (62.5)		2 (100.0)	
2		3 (37.5)		0 (0.0)	
Ulceration per low-power field, n (%)	5		2		0.67
0		2 (40.0)		0 (0.0)	
1		2 (40.0)		2 (100.0)	
2		1 (20.0)		0 (0.0)	
mPDAI, n (%)	5		2		0.84
5		2 (40.0)		0 (0.0)	
6		0 (0.0)		1 (50.0)	
9		1 (20.0)		1 (50.0)	
10		1 (20.0)		0 (0.0)	
13		1 (20.0)		0 (0.0)	

Table 4. Clinical outcomes

Outcome	No pathogenic bacteria (N = 44)		Pathogenic bacteria (N = 11)		p-value
	No.	Statistics	No.	Statistics	
Duration of antibiotics, days	25	45.1 ± 53.4	11	9.9 ± 9.2	**0.039**
Eradicated/symptom-free at 1 month, n (%)	–	–	7	5 (71.4)	–
Follow-up stool culture, n (%)	7	2 (28.6)	11	5 (45.5)	0.64
Recurrence of symptoms, n (%)	23	21 (91.3)	5	4 (80.0)	0.46
Repeat antibiotics, n (%)	15	10 (66.7)	11	4 (36.4)	**<0.001**
Repeat steroid treatment, n (%)	15	2 (13.3)	11	0 (0.0)	0.49
Duration of treatment, days	13	50.8 ± 96.9	9	4.7 ± 6.1	0.17
Hospitalization, n (%)	44	12 (27.3)	11	6 (54.5)	0.085
Sepsis, n (%)	44	2 (4.5)	11	2 (18.2)	0.17
Acute kidney injury, n (%)	44	2 (4.5)	11	3 (27.3)	**0.049**
Intensive care unit, n (%)	44	0 (0.0)	11	1 (9.1)	0.20
Length of stay, days	44	3.0 ± 3.3	11	8.0 ± 16.4	0.058
Hospitalization within 3 months, n (%)	44	3 (6.8)	11	4 (36.4)	**0.009**
Repeat pouch surgery/diversion, n (%)	42	8 (19.0)	11	4 (36.4)	0.22
Status, n (%)	42		11		**0.040**
Alive		42 (100.0)		9 (81.8)	
Deceased		0 (0.0)		2 (18.2)	

examinations and the evaluation status for enteric pathogens was short, thus minimizing the effect of this measurement bias.

In conclusion, the yield of stool culture for pathogens in symptomatic pouch patients was extremely low and, when compared with the controls, the treatment of detected pathogens had a minimum impact on the disease course of pouchitis. The clinical utility of routine stool culture in those patients warrants further study.
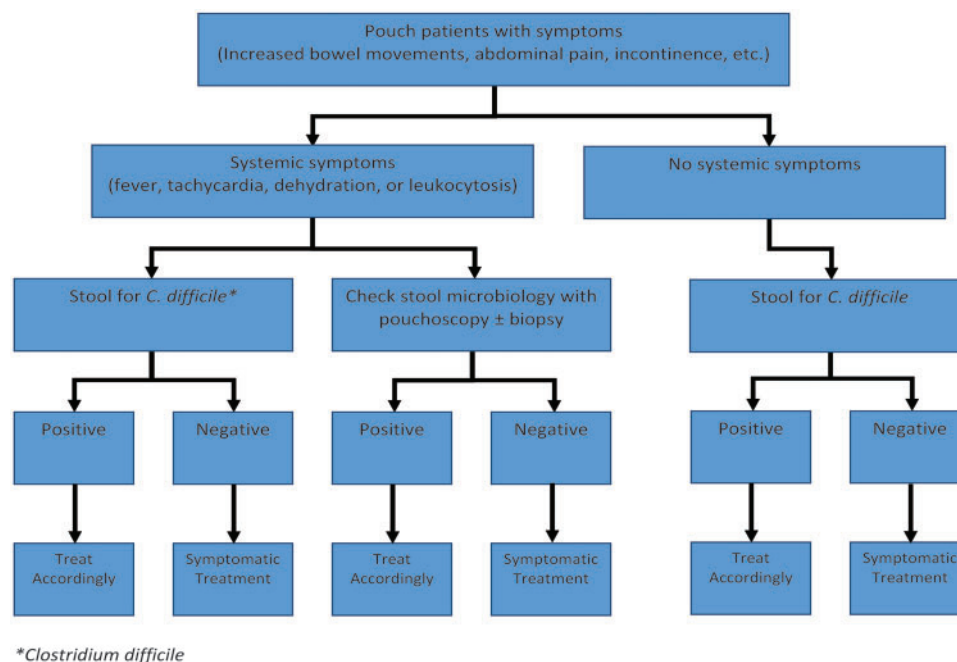
Figure 2. Proposed laboratory evaluation of pouch patients with symptoms.

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