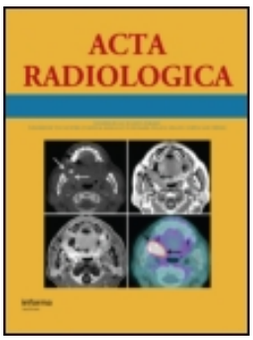

Acta Radiologica

ISSN: 0284-1851 (Print) 1600-0455 (Online) Journal homepage: http://www.tandfonline.com/loi/iard20

Diverticulitis of the sigmoid colon

T. Stefánsson, R. Nyman, S. Nilsson, A. Ekbom & L. Påhlman

To cite this article: T. Stefánsson, R. Nyman, S. Nilsson, A. Ekbom & L. Påhlman (1997) Diverticulitis of the sigmoid colon, Acta Radiologica, 38:2, 313-319

To link to this article: http://dx.doi.org/10.1080/02841859709172071

Published online: 04 Jan 2010.

Acta Radiologica 38 (1997) 313–319
Printed in Denmark · All rights reserved

ACTA RADIOLOGICA
ISSN 0284-1851

DIVERTICULITIS OF THE SIGMOID COLON

A comparison of CT, colonic enema and laparoscopy

T. STEFÁNSSON[1,2], R. NYMAN[3], S. NILSSON[3], A. EKBOM[1,2] and L. PÅHLMAN[1]

Departments of [1]Surgery, [2]Epidemiology, and [3]Diagnostic Radiology, University Hospital, Uppsala, Sweden.

Abstract

Purpose: To evaluate the use of laparoscopy, CT, colonic enema (CE), and laboratory tests (white blood cell count (WBC), sedimentation rate (SR), and C-reactive protein (CRP)) in diagnosing diverticulitis of the sigmoid colon.

Material and Methods: The diagnostic methods were prospectively evaluated in 88 patients, 30 of whom were referred for laparoscopy.

Results: Fifty-two patients were found to have sigmoid diverticulitis: 20 patients by laparoscopy, 21 by CT, and 11 by CE combined with one positive laboratory test. Laparoscopy proved to be superior to the other diagnostic methods in diagnosing diverticulitis of the sigmoid colon. CT had a high specificity (1.0; 95% CI: 0.92–1.0) but low sensitivity (0.69; 95% CI: 0.56–0.79) in detecting diverticulitis. CE had a higher sensitivity (0.82; 95% CI: 0.71–0.90) but a lower specificity (0.81; 95% CI: 0.67–0.91) than CT.

Conclusion: CT was the best method for diagnosing abdominal pathology outside the colon. CT can be recommended as the first examination in seriously ill patients where abscesses and other causes of the symptoms than diverticulitis must first be ruled out. Laparoscopy is probably the most accurate method in diagnosing diverticulitis.

Key words: Diverticulitis, CT; enema; laparoscopy; comparative investigation.

Correspondence: Tryggvi Stefánsson, Department of Surgery, Reykjavik University Teaching Hospital, IS-108 Reykjavik, Iceland.
FAX +354 5 25 12 02.

Accepted for publication 22 August 1996.

Acute abdominal pain and tenderness, particularly in the elderly, frequently proves to have diverticulitis of the sigmoid colon or malignant disease as the underlying cause (3, 5, 6, 10). Clinical examination, combined with a barium enema perhaps some weeks later, has a low specificity for a correct diagnosis of sigmoid diverticulitis (16). An early and correct diagnosis is important for patients with suspected acute diverticulitis as the optimal treatment for nonperforated diverticulitis is probably nonsurgical, especially in elderly people where an operation is associated with an increased mortality (17). Moreover, malignant diseases can mimic the symptoms of acute diverticulitis and an incorrect diagnosis of diverticulitis will thus delay the cancer diagnosis (16). Finally, there is evidence of an increased risk of left-sided colon cancer in patients with diverticulitis of the sigmoid colon, further underlining the need for a correct early diagnosis (15). Some reports advocate the use of CT as the initial examination (4, 9, 12) and others have shown good results with the colonic enema (CE) (8, 11, 14).

The aim of this study was to prospectively evaluate the use of CT, CE, laparoscopy, and laboratory tests (white blood cell count (WBC), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP)) in the diagnosis of diverticulitis in the sigmoid colon.

Material and Methods

The University Hospital in Uppsala, central Sweden, is the only emergency hospital in an area with a population of 280000. All patients with acute abdominal disease in the area would be referred to this hospital. Our study comprised a total of 88 patients: 24 men and 64 women, median age 63 years, range 29–91 years. The study period was November 1991 to April 1994. The inclusion criterion was acute lower abdominal pain with suspicion of diverticuli-

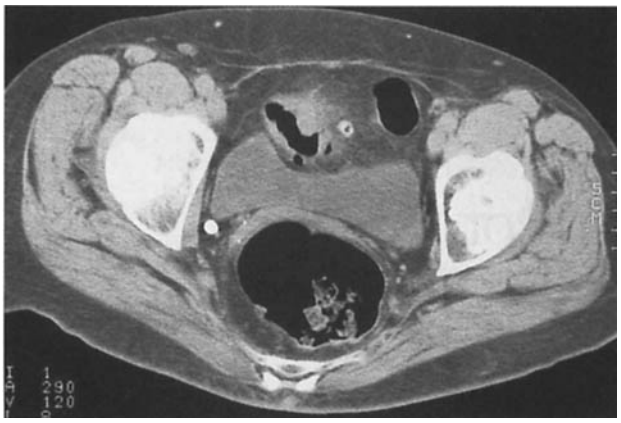

Fig. 1. Transverse CT image of the lower abdomen in a patient with sigmoid diverticulitis, demonstrating diverticulosis combined with an increased attenuation of pericolic fat.

Fig. 2. Colonic enema in a patient with sigmoid diverticulitis, demonstrating diverticulosis combined with irregularity of the bowel lumen and the mucosa.

tis. Patients subjected to acute surgery were not included.

At admittance it was noted from the patient charts whether the patient had a previous clinical diagnosis of sigmoid diverticulitis. The physical status of the patient was assessed, and blood samples drawn for analysis: WBC in 88 patients, CRP in 83, and ESR in 86. The reference intervals were: WBC 9.0×10^9; CRP 10 mg/l; ESR for women 20–40 years 16 mm, and >40 years 35 mm; and ESR for men <60 years 13 mm, and ≥60 years 24 mm. Then the appropriate treatment was initiated. Within 0–7 days (median 3 days) 84 patients were subjected first to CT and then to CE examinations; 2 patients underwent only CT; and 2 others only CE; giving a total of 88 patients. In the second half of the study period, laparoscopy was performed in a subgroup of 30 out of 46 consecutive patients, all of whom had had both CT and CE. Twelve patients refused laparoscopy and 4 were omitted due to high age or concomitant diseases. The study was approved by the Ethics Committee.

The CT examinations were performed on either a Siemens DR2 (in 57 cases) or a Siemens Somatom Plus tomograph (in 29 cases). All patients took 20 ml of Gastrografin (Schering, 370 mg I/ml) or Omnipaque (Nycomed, 350 mg I/ml) orally in 800 ml of water during a 2-h period prior to the examinations. Immediately before examination the rectum and the distal colon were insufflated with gas through a rectal tube. The patients were examined from the pubic bone to the iliac crest with 8/8-mm slices and to the diaphragm with 8/12-mm slices. The pelvic area was re-examined after i.v. administration of 100 ml of Ultravist (Schering) or Iopamiro (Bracco) (300 mg I/ml) at a rate of 3 ml/s and a delay of 40 s. The diagnostic CT criterion for diverticulitis was a change in the attenuation of the pericolic fat combined with diverticulosis. The films were interpreted separately by 2 experienced radiologists (R.N. and S.N.), blinded to the results of clinical assessment, laboratory tests, CE and laparoscopy. The diagnosis was a consensus between the 2 radiologists.

CE was given without any preparation of the bowel. The examinations were performed with a single contrast technique using barium (Mixobar Colon, Astra Tech) and filling the colon to the left flexure. The diagnostic criteria for diverticulitis on CE was a narrowing in the bowel lumen with an irregularity of the mucosa or a leakage of contrast material outside the lumen of the bowel combined with diverticulosis.

All 30 laparoscopies were performed by the same colorectal surgeon (T.S.), using a 10-mm Olympus laparoscope (0° optic or a 45° optic) through a trocar at the umbilicus. An extra trocar was placed in the right iliac fossa for a grasper or a babcock to assist in moving the bowel in order to visualize all parts of the descending and sigmoid colon. Diverticulitis was recognized by a reddened, inflamed and edematous serosa through the laparoscope, and by a thickened bowel wall identified through palpating with an instrument. These changes were often ac-

Table 1

Results in 88 patients with clinically suspected sigmoid diverticulitis: laboratory tests (88 patients); CT (86 patients); CE (86 patients); and laparoscopy (30 patients)

Diverticulitis of the sigmoid colon was revealed in		**52 patients**
based on laparoscopy in		20 patients
based on CT in		21 patients
based on CE and a positive laboratory test in		11 patients
No diverticulitis of the sigmoid colon		**36 patients**
Subjected to laparoscopy:		10 patients
small bowel ileus	2	
inflamed adhesions in the left upper quadrant	1	
salpingitis	1	
ovulation	1	
normal laparoscopy, but jejunal diverticulitis revealed on CT	1	
no explanation for the symptoms	4	
Not subjected to laparoscopy:		26 patients
no diverticulas found on CT and CE	6	
other diseases found on CT, CE, or during follow-up, to explain the symptoms	12	
no explanation discovered for the symptoms	8	

companied by inflamed adhesions to adjacent organs or to the abdominal wall.

The final diagnosis of sigmoid diverticulitis was determined by any of the 3 methods (laparoscopy, CT or CE) combined with an elevated result in one of the laboratory tests (WBC, ESR or CRP). All patients categorized as having diverticulitis were also subjected to sigmoidoscopy so as to exclude sigmoid cancer. All charts were evaluated at the end of June 1994 to discover whether any of the patients had developed malignancy or other pathology that might account for the symptoms.

The Mann-Witney U-test was used for continuous variables when the results were compared for patients with and without diverticulitis. The Chi-square test was used when the outcome was dichotomous. The probabilities are given in exact *p*-values calculated on Statistica, a statistical software package for Macintosh computers. The sensitivity of a diagnostic procedure in diagnosing sigmoid diverticulitis was calculated as the proportion of true-positive diverticulitis patients that was correctly identified by the diagnostic procedure. The specificity was the proportion of true-negative diverticulitis patients correctly identified by the diagnostic procedure (1). Confidence intervals were calculated as 95% CI on proportions (2).

Results

CT demonstrated increased attenuation of the pericolic fat in 42% (37/86) of the patients, diverticulosis in 86% (74/86), bowel wall thickening in 39% (34/86), and pericolic abscess in 7% (6/86) (Fig. 1). A combination of increased attenuation of the pericolic fat and diverticulosis was present in 41% (35/86) and they were categorized as having diverticulitis according to CT. The 2 patients who had increased attenuation of the pericolic fat but no diverticulosis were later found to have cancer of the ovary and the sigmoid colon respectively.

CE demonstrated sigmoid diverticulosis in 79% (68/86) of the patients and an irregularity of the bowel lumen and the mucosa in 62% (53/86). A combination of diverticulosis and irregularity was revealed in 57% (49/86) of the patients and they were categorized as having diverticulitis according to CE (Fig. 2).

The WBC was elevated in 69% (61/88) of the patients, CRP in 83% (69/83) and the ESR in 41% (35/86). In 85% (75/88) at least one of the laboratory test values was elevated.

Laparoscopy demonstrated signs of diverticulitis in 20 of 30 examined patients. There was one peroperative complication with perforation of the small bowel in one patient with small bowel ileus, which was treated successfully with open surgery. An uncomplicated abdominal wall hematoma was the only postoperative complication with laparoscopy.

The final diagnosis (Table 1): A total of 52/88 (59%) patients were finally categorized as having diverticulitis. The diagnosis was based on: laparoscopy in 20 patients with a follow-up of 2–16 months (median 8 months); CT in 21 patients with a follow-up of 8–28 months (median 25 months); and CE combined with one elevated laboratory test value in 11 patients with a follow-up of 14–32 months (median 29 months). There were significantly (p=0.02) fewer CT diagnoses of diverticulitis among the first 42 patients (11/41) compared to the

Table 2

Comparison of clinical parameters in 88 patients: diverticulitis and no diverticulitis

	Patients with diverticulitis, n=52	Patients without diverticulitis, n=36	*p*-value
Age (years), mean	61.6 (SD 12.8)	62.7 (SD 15.4)	0.72
Median	63	62.5	0.79
Men/women	16/36	8/28	0.19
Medical history: diverticulitis	29/52	10/36	0.0094
Medical examination			
Fever (temperature >37.5°)	45/52	25/36	0.051
Pain: left lower quadrant	50/52	32/36	0.18
Pain: right lower quadrant	8/52	3/36	0.33
Tenderness: left lower quadrant	51/52	33/36	0.16
Tenderness: right lower quadrant	5/52	3/36	0.84
Left lower quadrant mass	5/52	3/36	0.84
Rectal tenderness	26/52	11/36	0.069
Laboratory tests			
Anemia	4/52	7/36	0.098
WBC (>9×10^9/l)	44/52	19/36	0.0011
ESR elevated	23/50	12/36	0.24
CRP (≥10 mg/l)	50/52	19/31	<0.0001
Radiological examinations			
CT positive	35/51	0/35	<0.0001
Colonic enema positive	41/50	7/36	<0.0001
Colonic enema positive and one laboratory test positive	41/50	4/36	<0.0001

latter 46 patients (23/45) who were examined during the period in which we performed the laparoscopies. The final diagnosis of sigmoid diverticulitis was given to 52% (22/42) in the first group compared to 65% (30/46) in the latter group (p=0.21) and the diagnosis diverticulitis as a CE diagnosis was given to 48% (20/42) in the first group and 64% (28/44) (p=0.13) in the latter.

Of the 36 patients who were categorized as not having diverticulitis, 10 were subjected to laparoscopy and an explanation for the symptoms was then evident in 5 patients, and in an additional patient after CT. In the remaining 26 patients, diverticulitis was ruled out in 6 as no diverticulas could be found by CT or CE. Twelve patients were diagnosed as having other diseases which were a probable explanation of the symptoms. In 12 patients (4 from the first group of 10, and 8 from the remainder) no explanation for the symptoms was found. The 36 patients were followed for 2–32 months (median 25 months).

Comparison between patients with and without diverticulitis (Table 2): Among the 52 patients with sigmoid diverticulitis, a medical history of sigmoid diverticulitis was significantly more common than in the other group, and elevated rates of CRP, WBC and body temperature were significantly more frequent. No significant differences in age, gender, localization of abdominal pain, or rectal tenderness were found.

Detectability of diverticulitis (Tables 3 and 4): CT showed low sensitivity (0.69) but a significantly higher specificity (1.0), and no false-positive results. There were 16 false-negative cases of which 6 were diagnosed by laparoscopy and 10 by CE combined with an elevated laboratory test value. Of these 10 patients: 3 were operated upon later and the diagnosis of diverticulitis was verified by histology; 3 had sigmoidoscopy which revealed an edematous mucosa and segmental strictures in the sigmoid colon; and 4 had relapsing disease with typical clinical symptoms.

CE showed high sensitivity (0.82) and specificity (0.81), and the specificity increased to 0.89 if CE was combined with an elevated laboratory test value. There were 7 false-positive cases with CE and 5 of these had no signs of diverticulitis at laparoscopy. One patient had a lung cancer metastasis in the pelvis revealed on CT and verified by needle biopsy. Another had a thickened jejunal wall on CT which was confirmed at surgery to be diverticulitis of the jejunum but with no signs of sigmoid diverticulitis. There were 9 false-negative CE examinations. Four of these 9 were subjected to laparoscopy which revealed diverticulitis. In the remaining 5 the diverticulitis was diagnosed on CT.

The laboratory tests (WBC, SR, CRP) showed a

Table 3

False-positive (FP) and false-negative (FN) results of CT, and CE plus laboratory tests (WBC, CRP, ESR) after the examination of 88 patients with clinically suspected diverticulitis

	FP, n		FN, n
CT	0		16
		Diverticulosis diagnosed by laparoscopy	6
		Diverticulosis diagnosed by CE and elevated laboratory tests	10*
Colonic enema	7		9
No diverticulitis by laparoscopy	5	Diverticulitis diagnosed by laparoscopy	4
Lung cancer metastasis**	1	Diverticulitis diagnosed by CT	5
Jejunal diverticulitis***	1		
Laboratory tests	24		1
No diverticulitis by laparoscopy	5	Diverticulitis diagnosed by laparoscopy	1
No diverticulitis by CE	8		
No diverticulitis by CT or CE	11		

* 3 patients were later subjected to sigmoid resection and the diverticulitis diagnosis was verified by histology. 3 patients were subjected to sigmoidoscopy, which revealed narrowing in the bowel lumen and edema in the sigmoid mucosa, supporting the diverticulitis diagnosis. 4 patients had relapsing disease with typical symptoms of diverticulitis.

** CT diagnosis verfied by histology.

*** Diagnosed on CT, and sigmoid diverticulitis ruled out by laparotomy.

Table 4

Detecting sigmoid diverticulitis in 88 patients: sensitivity (r), specificity (s) and positive predictive value (+PV) with 95% CI for laboratory tests, CT, colonic enema, and colonic enema with 1 laboratory test positive. Reference: final diagnosis of diverticulitis

	r	95% CI	s	95% CI	+PV	95% CI
CT	0.69	0.56–0.79	1.0	0.92–1.0	1.0	0.92–1.0
CE	0.82	0.71–0.90	0.81	0.67–0.91	0.85	0.74–0.93
CE and 1 positive laboratory test	0.82	0.71–0.90	0.89	0.76–0.96	0.91	0.81–0.97
WBC, ESR and CRP	0.98	0.91–0.99	0.33	0.21–0.48	0.68	0.58–0.77

Table 5

30 patients subjected to laparoscopy: sensitivity, specificity, and positive predictive value with 95% CI for CT, CE and laboratory tests with laparoscopy as reference

	r	95% CI	s	95% CI	+PV	95% CI
CT	0.65	0.44–0.82	1.0	0.79–1.0	1.0	0.74–1.0
CE	0.80	0.60–0.93	0.50	0.22–0.78	0.76	0.56–0.90
CE and 1 positive laboratory test	0.80	0.60–0.93	0.80	0.49–0.96	0.89	0.69–0.98
WBC, ESR and CRP	0.95	0.78–0.98	0.50	0.22–0.78	0.79	0.61–0.91

high sensitivity (0.9) but a very low specificity (0.33) in detecting sigmoid diverticulitis. Of 24 patients with false-positive results, 5 were subjected to laparoscopy where there was no sign of diverticulitis. Of the rest, 8 had no diverticulosis and 11 had diverticulosis but no sign of diverticulitis on CT or CE. One patient, whose labarotory test values were not elevated, had diverticulitis (an inflammation around one diverticula) revealed on laparoscopy.

Patients subjected to laparoscopy (Tables 5 and 6): The results in the subgroup of 30 patients, who had laparoscopy, were similar to those of the whole material of 88 patients, but with greater CI (Table 5).

Of these 30 patients, 20 were found to have diverticulitis. Two of them had abscesses on CT, a finding that was indicated on laparoscopy by inflamed adhesions between the pelvic organs, closing the pelvis. Laparoscopy demonstrated liver cysts in one of 3 patients, who had liver cysts on CT. Both CT and laparoscopy showed bilateral ovarian cysts in one patient, and only CT demonstrated kidney cysts in one patient and a kidney stone on the right side in another patient.

In 5 of the 10 patients with no diverticulitis on laparoscopy, laparoscopy demonstrated other abnormal findings: 2 had small bowel ileus; one had adhe-

Table 6

Findings at laparoscopy and CT in 30 patients with clinically suspected sigmoid diverticulitis, who underwent laparoscopy

	Laparoscopy	CT
Diverticulitis of the sigmoid colon	20	13
Liver cysts	1	3
Bilateral ovarian cysts	1	1
Kidney cysts	0	1
Kidney stone	0	1
Small bowel ileus	1	0
Inflammatory adhesions in left upper quadrant of the abdomen	1	0
Salpingitis	1	0
Ovulation cyst	1	1
Thickening of the jejunal wall	0	1
Cysts in liver and both kidneys	0	1
Gallstones	0	1

sions in the left upper quadrant; one had salpingitis with adhesions; and one had ovarian cysts with signs of a recent ovulation, the only finding also demonstrated by CT. Among the 5 patients with normal laparoscopies, CT demonstrated: one patient with a thickening of the jejunal wall; one with cysts in both liver and kidneys; and one with gallstones; 2 had normal CT examinations (Table 6).

Discussion

The major strength of the present study is that almost all patients with suspected sigmoid diverticulitis were covered by the study period. The study probably ensured an increase (although insignificant) in the clinical accuracy of the diagnosis diverticulitis during the time of the study period. However, this change did not affect our results on sensitivity and specificity as we compared the diagnostic methods as paired samples but it affected the positive predictive value as it was depedent on the prevalence of the disease.

The major weakness of the study was the lack of histological proof of the correct diagnosis, which more or less depended on follow-up and exclusion of other diseases. However, inspection by laparoscopy should be reasonably reliable in detecting diverticulitis that had spread to the serosa of the sigmoid colon. The results also clearly indicated that laparoscopy was the most reliable method compared to CT and CE. The similarity in the results between the whole material and the subgroup with laparoscopy as diagnostic reference implied reasonably reliable results when only CT and/or CE were used for diagnosing diverticulitis. The long follow-up period in the CT group (≥8 months, median 25 months) and in the CE group (≥14 months, median 29 months) probably ruled out malignant disease as the cause of the symptoms.

A policy of less invasiveness favors the use of CT and CE before laparoscopy in diagnosing diverticulitis. The major advantage with CT was the lack of false-positive cases and the ability to detect the disease spreading to the outside of the colon as well as other conditions that can mimic the symptoms of diverticulitis, results similar to those found by others (4, 9, 11, 13). The sensitivity of CT was somewhat low, and lower than the result in the only other prospective study published to date (4). In this study CT had a sensitivity of 0.9 (95% CI: 0.8–1.0) and a specificity of 1.0 (95% CI: 0.9–1.0) and CE had a sensitivity of 0.8 (95% CI: 0.6–0.9) and a specificity of 1.0 (95% CI: 0.8–1.0). The high sensitivity and specificity for both methods could probably be explained by different inclusion criteria as all patients had fever (>37.3°), WBC over 10000/mm^3, and 16 out of 27 patients had abscesses. Patients with complications from sigmoid diverticulitis, such as abscess, perforation, or fistula, usually undergo emergency surgery owing to the acute abdominal symptoms. They seldom constitute a diagnostic problem and were therefore excluded from our study.

The sensitivity of CT improved over time, which can be partly explained by an increased number of patients with diverticulitis in the latter period. Another reason might be that the films were interpreted separately for each time period and that detectability of the signs of diverticulitis improved over time. If the sensitivity of the CT diagnosis of diverticulitis increased between the 2 time periods, the sensitivity of CT is probably somewhat underestimated in this study. The false-negative cases were probably due to the difficulties in detecting the early stage of diverticulitis with only minor changes in the pericolic fat, which seemed to be the most important CT sign for detecting diverticulitis (4, 9, 12). Localized thickening of the bowel wall was less reliable owing to the uneven distention of the lumen after insufflation of air, and to the remaining fecal products. With an enema of water instead of air, the same problems would probably have been encountered. However, the air insufflation was helpful in localizing the different segments of the bowel.

The major disadvantage with CE was the risk of false-positive diagnosis and its inability to reveal disease outside the mucosa of the colon. In patients with severe diverticulosis it was sometimes difficult to determine whether there were any signs of diverticulitis or not. By adding the elevated laboratory test values (WBC, SR, CRP) to the results of the CE, the number of false-positive results decreased

from 7 to 4. Laboratory results were highly sensitive to diverticulitis (r=0.96; 95% CI: 0.88–0.99) but owing to their low specificity (s=0.31; 95% CI: 0.18–0.46) they cannot be recommended as a single diagnostic method. The WBC was elevated in 81% of the patients with diverticulitis, contradicting earlier retrospective studies that showed elevated WBC in less than 50% of patients with diverticulitis (7).

Choosing the method to use as the first examination depends on the circumstances, i.e.: the availability of CT, and what other diagnoses to be ruled out. Most patients have characteristic signs and symptoms and can therefore be treated successfully with nonsurgical therapy and with no need for any urgent imaging study. CT would seem to be the easiest and most accurate method for patients in a more serious condition, where abscesses and other causes have to be ruled out. CE in combination with laboratory tests has high sensitivity and specificity in the diverticulitis diagnosis and can be used in patients with a mild form of the disease to confirm a suspected diverticulitis or to rule out strictures. In limited cases, when both CT and CE fail, laparoscopy can be justified to determine the diagnosis.

REFERENCES

1. Altman D. & Bland J.: Statistics notes. Diagnostic tests 1; sensitivity and specificity. Br. Med. J. 308 (1994), 1552.
2. Armitage P. & Berry G.: Statistical methods in medical research, p. 115. 2nd edn. Blackwell Scientific Publications 1985.
3. Brewer R., Golden G., Hitch D. et al.: Abdominal pain. An analysis of 1000 consecutive cases in a university hospital emergency room. Am. J. Surg. 131 (1976), 219.
4. Cho K. C., Morehouse H. T., Alterman D. D. et al.: Sigmoid diverticulitis, diagnostic role of CT, comparison with barium enema studies. Radiology 176 (1990), 111.
5. Darby C., Berry A. & Mortensen N.: Management variability in surgery for colorectal emergencies. Br. J. Surg. 79 (1992), 206.
6. Feny G.: Acute abdominal disease in the elderly. Experience from two series in Stockholm. Am. J. Surg. 143 (1982), 751.
7. Hackford A. W. & Veidenheimer M. C.: Diverticular disease of the colon. Current concepts and management. Surg. Clin. North Am. 65 (1985), 347.
8. Hiltunen K. M., Kolehmainen H., Vuorinen T. et al.: Early water-soluble contrast enema in the diagnosis of acute colonic diverticulitis. Int. J. Colorectal Dis. 6 (1991), 190.
9. Hulnick D. H., Megibow A. J., Balthazar E. J. et al.: Computed tomography in the evaluation of diverticulitis. Radiology 152 (1984), 491.
10. Irvin T.: Abdominal pain. A surgical audit of 1190 emergency admissions. Br. J. Surg. 76 (1989), 1121.
11. Johnson C. D., Baker M. E., Rice R. P. et al.: Diagnosis of acute colonic diverticulitis. Comparison of barium enema and CT. AJR 148 (1987), 541.
12. Labs J. D., Sarr M. G., Fishman E. K. et al.: Complications of acute diverticulitis of the colon. Improved early diagnosis with computerized tomography. Am. J. Surg. 155 (1988), 331.
13. Lieberman J. M. & Haaga J. R.: Computed tomography of diverticulitis. J. Comput. Assist. Tomogr. 7 (1983), 431.
14. Morris J., Stellato T. A., Lieberman J. et al.: The utility of computed tomography in colonic diverticulitis. Ann. Surg. 204 (1986), 128.
15. Stefánsson T., Ekbom A., Sparén P. et al.: Increased risk of left-sided colon cancer in patients with diverticular disease. Gut 34 (1993), 499.
16. Stefánsson T., Ekbom A., Sparén P. et al.: Malignancies among patients with a clinical diagnosis of diverticular disease of the colon. Eur. J. Surg. 161 (1995), 755.
17. Stefánsson T., Påhlman L., Ekbom A. et al.: Surgery in acute diverticulitis, a retrospective population based study. 130 patients operated on in the University Hospital in Uppsala, Sweden, 1969–1989. Dissertation, Uppsala University (1994).