



# Can endoscopic follow-up after acute diverticulitis be rationalised?

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## Abstract

**Background** Acute diverticulitis (AD) is a common cause of presentation to emergency surgical services. Follow-up with endoluminal investigation to exclude colorectal cancer (CRC) remains controversial. Guidelines are increasingly moving to a more restrictive follow-up based on severity of disease and age. The purpose of this observational study was to assess the prevalence of CRC in AD patients and the impact of follow-up on endoscopy services.

**Methods** Patients admitted with a diagnosis of AD over a 2-year period were reviewed. The proportion of patients undergoing endoscopic follow-up and the CRC detection rate were recorded. The potential impact of a more conservative approach to follow-up was evaluated.

**Results** There were 484 patients with AD presenting 546 times (M:F = 198:286; median age = 63 years). 80% of admissions were aged 50 or older. There were 43 emergency interventions in 39 patients (10 percutaneous drain; 33 surgery). The remainder were managed conservatively. 28 patients (5.1%) underwent colonic resection with cancer found in one specimen (3.6%). 287 patients underwent endoluminal follow-up with cancer diagnosed in 3 cases (1.0%). There was no significant difference in the prevalence of CRC between patients requiring emergency surgery and those managed conservatively, or between patients with complicated versus uncomplicated diverticulitis.

**Conclusion** CRC masquerading as acute diverticulitis is rare. The incidence of neoplasia both at endoscopic follow-up and in patients requiring emergency intervention is low. Conservative follow-up strategies appear safe, but their effectiveness in reducing the burden on endoscopy services may be limited by current age-based recommendations. Restricting follow-up to those with complicated AD would reduce the number of patients requiring endoluminal investigation by 70%.

**Keywords** Diverticulitis · Endoscopy · Colorectal cancer

Acute diverticulitis (AD) is a common complication of colonic diverticulosis accounting for over 125,000 admissions in England per year [1]. The incidence of AD and the rate of hospital admission are increasing in western countries [2, 3].

Historically, the diagnosis of AD was often made clinically, without the use of cross-sectional imaging. Recognising that colorectal cancer (CRC) could present with similar signs and symptoms, endoscopic evaluation of the colon became routine once the acute attack had resolved. The Royal College of Surgeons commissioning guide for colonic diverticular disease, sponsored by the Association of Coloproctology of Great Britain and Ireland (ACPGBI) was originally published in 2014 and reviewed in 2017. This recommended that all patients require investigation of the colonic lumen by either endoscopy, barium enema or CT colonography following an episode of AD [4].

The increasing use of contrast enhanced computed tomography (CT) over the last 10 years, both to confirm the diagnosis and to assess severity, has enabled the diagnosis of AD to be made with greater sensitivity and specificity [5]. As such, CT imaging is now recommended for all suspected

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*What does this paper add to the literature?* This paper provides data showing that colon cancer is extremely rare in the majority of patients with acute diverticulitis. The data illustrates the burden that follow-up places on endoscopy services and we discuss how this may be addressed.

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cases of acute diverticulitis presenting to secondary care [6]. This has led to a desire to reserve endoscopic follow-up for those with high-risk features at presentation or where a greater incidence of suspicion for CRC exists.

The appeal of a more selective approach is not only in avoiding unnecessary invasive investigations but also in reducing the burden on endoscopy services and associated financial costs. The COVID-19 pandemic has drawn significant attention to the low yield obtained from current colorectal cancer pathways [7]. Furthermore, colonoscopy is often more challenging in patients with significant diverticular disease and may be associated with greater discomfort and lower completion rates [8].

Contemporary meta-analyses have estimated the incidence of CRC at 6.1–10.8% in patients presenting with ‘complicated’ AD i.e., abscess or perforation. However, a much lower incidence of between 0.5 and 1.2% has been observed in patients with uncomplicated AD, similar to that of asymptomatic controls [9–11].

This had led to changes in the guidance from many specialist bodies. The European and American surgical societies released evidence-based guidelines in 2019, as have the World Society of Emergency Surgery in 2020. These recommend against routine colonic evaluation after successfully treated uncomplicated acute diverticulitis, unless high-risk features are present [12, 13]. The ACPGBI consensus guidelines for emergency colorectal surgery published in 2021 now only advise routine endoscopic follow-up for patients with complicated AD or other risk factors for malignancy. These include concerning features on imaging, rectal bleeding and notably, age over 50 years [6]. This is due to a perceived age-related increase in colonic neoplasia amongst patients with diverticular disease, although this has not uniformly been demonstrated in the literature [14]. With the incidence of AD rising amongst younger patients [15, 16], it is unclear what the practical application of this guidance will be in the UK. Furthermore, everyday practice may vary from guidelines due to individual patient factors. The purpose of this study was to:

- Determine the proportion of patients presenting with AD that undergo endoscopic follow-up.
- Assess the prevalence of CRC in patients with AD.
- Investigate the impact of follow-up on endoscopy services.

## Methods

Local research and development approval was sought prior to commencing the study. Patient consent and ethical approval were not required in line with the requirements laid out by the Health Research Authority. Patients admitted as

an emergency with a diagnosis of AD between 1st January 2018 and 31st December 2019 were identified from hospital coding systems. These were then manually screened according to the following criteria developed in line with the NICE guidance regarding diagnosis and investigation of acute diverticulitis [17].

### Inclusion criteria

- CT scan reported as showing AD  
*OR*
- Clinical diagnosis of AD in addition to a rise in either serum C-reactive protein (CRP) or white cell count (WCC).

### Exclusion criteria

- Patients presenting with haematochezia in the absence of other features of AD (i.e. diverticular bleeding).
- Patients presenting with diverticular stricture without acute diverticulitis.
- Diagnosis of CRC made during index admission.

Demographic and clinical data were retrieved from centrally held electronic hospital record systems. These were cross referenced with data extracted from patient endoscopy and histopathology reports. Patient age, sex, length of stay and modified Hinchey classification as described by Sartelli [18] were recorded. Radiological or surgical intervention, endoluminal follow-up and time to endoluminal investigation were noted. Patients with histologically reported colorectal cancer or advanced polyp were identified. We planned to exclude individuals from the analysis who were missing data for these prespecified variables, however, this was not required for any of the patients in our study.

The primary outcome of the study was the proportion of patients with CRC based on Hinchey classification. Secondary outcomes were the proportion of patients undergoing endoluminal follow-up and the number of patients for whom follow-up was not indicated based on current recommendations.

Statistical analysis was performed using GraphPad Prism. Categorical data were analysed using Fisher’s exact test with unpaired *t* test used for continuous data. All *P* values are presented as two-tailed with *P* < 0.05 considered statistically significant.

## Results

Eight hundred and fifteen emergency admissions were identified with a diagnosis of diverticular disease through the coding system over the study period. Six patients had a CT

**Table 1** Patient characteristics

	<i>N</i>	%
Total admissions	546	–
Total patients	484	100
Patients with $\geq 2$ admissions	48	9.9
Mean length of stay (days; $n = 546$ )	4.2	(Range 0–50)
CT scan ( $n = 484$ )		
Yes	417	86.2
No	67	13.8
Distribution ( $n = 417$ )		
Caecum/ascending	19	4.6
Transverse	6	1.4
Descending/sigmoid	391	93.8
Hinchey classification* ( $n = 417$ )		
0	272	65.2
1a	61	14.6
1b	21	5.0
2a	22	5.3
2b	23	5.5
3	7	1.7
4	11	2.6

\*Modified Hinchey Classification as described by Sartelli et al. [18]

scan that was highly suggestive of CRC on index admission and were excluded. A further 231 had diagnoses other than AD or did not meet the prespecified inclusion criteria. After the removal of duplicates, 484 patients with AD comprised the final study population, presenting 546 times over 2 years. The majority were female (M:F=198:286) with a median age of 63 years (range 19–93). Eighty per cent of admissions were aged 50 or older. Forty eight patients had more than one admission across the 2-year period, constituting 62 (11.4%) of the total admissions. Thirteen percent of patients had a history of diverticular disease. The mean serum C-reactive protein and white cell count on admission were 103 mg/L and  $12.57 \times 10^9/L$ , respectively. Details of the study population are given in Table 1.

Four hundred and fifty seven out of 546 admissions (83.7%) resulted in a CT scan. The majority of these showed ‘uncomplicated’ diverticulitis (65% Hinchey 0). Most cases were managed conservatively with only 8% patients requiring emergency intervention. Two patients from the study population underwent elective resection, one for colovesical fistula and one because of inconclusive luminal follow-up investigation. The first patient did not have a CT on their index admission but developed a colovesical fistula prior to endoscopy, confirmed on a follow-up scan. The other patient was Hinchey 0 on index admission. Both pathology specimens confirmed diverticulitis. Two patients initially presenting with Hinchey 2 disease subsequently developed Hinchey 4 diverticulitis and required resectional surgery.

**Table 2** Intervention details

	<i>N</i>	%
Interventions ( $n = 484$ )		
Percutaneous drain	10	2.1
Emergency surgery	33	6.8
Open	24	5.0
Laparoscopic	8	1.7
Laparoscopic converted	1	0.2
Procedure		
Hartmann’s procedure	22	4.5
Hartmann’s + additional resection	2	0.4
Hartmann’s + repair of colovesical fistula	1	0.2
Right colectomy	1	0.2
Lavage only	5	1.0
Diagnostic laparoscopy	2	0.4
Elective surgery	2	0.4
Emergency histology		
Benign	24	85.7
Tubular adenoma/LGD	1	3.6
Adenocarcinoma (T3N1bM1c R0)	1	3.6
Elective histology		
Benign	2	7.1

Further information regarding the intervention and follow-up results are presented in Tables 2 and 3.

In total, four cancers were diagnosed in the 484 patients in this cohort (0.83%, median age 66, range 51–87). Three of these were found at endoscopic follow-up. One patient clinically diagnosed with AD, re-presented shortly after discharge with large bowel obstruction and underwent resection. Within this group, the median interval from discharge to diagnosis of CRC was 34 days (range 3–58). There was no statistically significant difference in the incidence of CRC detected at endoscopy (1.05%, 95%CI 0.21 to 3.18%) when compared with resected specimens (3.57%, 95%CI < 0.01 to 19.20%;  $P = 0.313$ ). Similarly, no difference was found in the proportion of CRC detected following uncomplicated (0.37%, 95%CI < 0.01 to 2.27%) versus complicated AD (0.69%, 95%CI < 0.01 to 4.19%;  $P = 1.00$ ). Only one of 272 patients in our series with Hinchey 0 AD was found to have colon cancer at endoscopy. A summary of outcomes according to Hinchey classification at index presentation is presented in Table 4.

The unadjusted luminal follow-up rate in our study was 59%. When adjusted for endoscopy within the previous 2 years the follow-up rate was 64%, rising to 75% when further adjusted for resections, death, patients residing out of area and failed attendance. Only 4 of the initial follow-up studies were incomplete (2 impassable strictures, 1 tight angulation 1 unable to tolerate procedure). The median

**Table 3** Endoscopic follow up

	N	%
Previous luminal study (n = 546)	141	25.8
Within 2 years prior to admission	76	13.9
Within 5 years prior to admission	118	21.6
Luminal follow-up (62 duplicates removed n = 484)		
Flexible sigmoidoscopy	193	40.3
Colonoscopy	93	19.4
CT colonography	1	0.2
Patients not undergoing follow-up		
Patient declined	44	9.1
Out of area	2	0.4
Other <sup>a</sup>	148	30.6
Mean interval discharge-endoscopy (days, n = 281)	78.5	(Range 3–357)
Luminal findings (n = 286)		
Diverticulosis only	176	61.5
Normal	20	7.0
Active diverticulitis/colitis	23	8.0
Ulcerative colitis	1	0.3
Benign stricture	3	1.0
Haemorrhoids/other benign findings	7	2.4
Incomplete examination	5	1.7
Polyps	46	16.1
Tubular adenoma	16	
Tubulovillous adenoma	4	
Serrated	9	
Hyperplastic	5	
Inflammatory	4	
Leiomyoma	1	
Spindle cell	1	
Total LGD	10	3.5
Total HGD	0	0
Adenocarcinoma	3	1.0
CTC findings (n = 1)		
Normal	1	0.3

LGD low grade dysplasia, HGD high grade dysplasia, CTC CT colonography

<sup>a</sup>Includes patients having undergone recent luminal investigation and not fit for follow-up

**Table 4** Outcomes by group

Group <sup>a</sup>	N	Resection	Crude follow-up (%)	Adjusted FU <sup>b</sup> (%)	Cancer
Hinchey 0	272	3	174 (64)	200 (74)	1
Hinchey 1	82	3	53 (64)	64 (78)	0
Hinchey 2	45	9	20 (44)	35 (78)	1
Hinchey 3	7	4	3 (43)	7 (100)	0
Hinchey 4	11	7	2 (18)	10 (91)	0
No CT	67	2	35 (35)	45 (67)	2
Total	484	28	287 (59)	364 (75)	4

<sup>a</sup>At index admission

<sup>b</sup>Adjusted for resection, death and failed attendance

interval to follow-up was 79 days, however, 20% of patients waited more than 90 days for investigation.

Nine patients had endoscopy during their index admission. All had been admitted under the medical team with suspected colitis and a diagnosis of AD was made at the time of endoscopy. None were found to have CRC. Of the 67 patients who did not have a CT scan on admission, 19 had previous imaging or endoscopic findings of diverticular disease. A comparison of the clinical diagnosis group, complicated AD, uncomplicated AD and cancer groups is presented in Table 5.

## Discussion

This study presents data on endoscopic follow-up after AD from a high volume, 958-bed acute trust delivering emergency general surgery across two sites. Sixty per cent of patients underwent luminal follow-up in our study, with a cancer detection rate of 1.05%. The study limitations include the retrospective nature and the relatively small sample size of the surgical resection group.

The prevalence of CRC in our study, particularly amongst patients with complicated AD was lower than reported in other studies [9–11]. This may be because the group undergoing surgical resection was insufficiently powered to represent the true prevalence, as suggested by the wide confidence interval. Endoscopy results were recorded up until the 1 May 2021 in our investigation (17 months after the last admission). It is also possible that following the study patients for longer may detect additional cases of CRC manifesting in those patients who did not undergo follow-up. However, only one of the 272 patients with uncomplicated AD was found to have CRC. Although the prevalence of CRC was slightly higher in the complicated AD group, this difference was not significant, most likely due the sample size. Nevertheless, the prevalence of CRC in uncomplicated AD was below that of that of the background asymptomatic population which brings in to question the appropriateness of routine endoscopic follow-up.

**Table 5** Comparison of uncomplicated AD, complicated AD and clinical diagnosis

	H0	H1-4	No CT	Cancers
<i>N</i>	272	145	67	4
M/F	104:168	70:75	24:43	1:3
Median age	62	61	68	66 (range 51–87)
LOS	2	5	1	7 (range 1–9)
	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)
<b>Management</b>				
Conservative	271 (99.6)	109 (75.2)	65 (97.0)	4 (100)
IR drain	0 (0)	10 (6.9)	0 (0)	0 (0)
Emergency surgery	1 (0.4)	26 (17.9)	2 (3.0)	0 (0)
Elective surgery	1 (0.4)	0 (0)	1 (1.5)	0 (0)
Cancers	1 (0.4)	1 (0.7)	2 (3.0)	–

The majority of patients admitted in our series underwent a CT scan (84%). However, our study found two cancers that were subsequently diagnosed in patients who did not have cross-sectional imaging on their index admission. This serves to highlight the importance of CT scanning in the diagnostic pathway for AD. A study by Andeweg et al. examined the findings of 287 patients admitted with suspected acute left-sided colonic diverticulitis in the Netherlands. In their sample, more than 50% were found to have alternative diagnoses on CT scan with 3.8% diagnosed with colorectal malignancy [19]. Data regarding endoscopic findings for patients diagnosed with AD without cross-sectional imaging is relatively scarce. In a multicentre trial comparing antibiotic therapy for clinically diagnosed uncomplicated AD, Ridgway et al. followed up 75 of the 79 participants with endoscopy or contrast radiology. They reported diverticulosis in 80% but no cases of colorectal malignancy [20].

Previous studies have typically only included patients with CT confirmed diverticulitis [9–11, 21]. We chose to include patients without radiological confirmation to reflect genuine clinical practice and to investigate the outcomes in this group. Our study identified 2 cancers in this group meaning the prevalence of CRC in the clinically diagnosed group was 4–8 fold higher than the uncomplicated and complicated CT groups (3.0% vs. 0.37% vs 0.69%, respectively).

From our dataset it was not possible to reliably estimate the proportion of patients who were deemed unfit or unsuitable for endoscopic follow-up as this was not consistently recorded. It is notable that almost 10% of patients declined or failed to attend follow-up, suggesting that the risk of malignancy or serious pathology perceived by patients is low, or perhaps that endoscopic investigation is a sufficiently unattractive proposition as to outweigh this risk. The high frequency of colonoscopy in our series (20% of post discharge-endoscopy) is also of interest. Given that only 6% of disease was proximal to the left colon, it is perhaps

surprising that more patients were not offered a flexible sigmoidoscopy [22]. Whether this might improve acceptability and take-up of endoscopy is uncertain.

Current guidelines now advise that endoscopic follow-up can be omitted in patients who have undergone investigation within the previous 2 years [6]. In our cohort, 14% of admissions had an endoscopy performed in the preceding 2 years rising to 22% within 5 years. The number of admissions with a study in the last 2 years who went on to have further endoscopy was relatively small (20 out of 76) and several of these were inpatient procedures during admission.

One tool which may aid in more targeted investigation in the context of AD is quantitative faecal immunochemical testing (qFIT). This has been successfully used to prioritise the referral of patients with suspected CRC from primary care since 2017 [23, 24] and more recently to adapt pathways during the COVID pandemic [25]. Thresholds of between 4 and 10 µg Hb/g faeces have given acceptable sensitivity and specificity for CRC, however, a suitable cut-off for investigation is yet to be defined for patients recovering from an acute episode of diverticulitis. Given that active inflammation was noted at 8% of follow-up endoscopy in our series, a higher false negative rate might be expected in this population and the optimum timing of qFIT testing requires further research. Large scale collaborative studies such as the DAMASCUS study [26] will hopefully provide important real-world data on initial management for patients with AD, but further information is needed regarding what follow-up rates are practically achievable, the resource utilisation, acceptability and safety of current approaches.

Evidence included in current guidelines has shown either weak or more often no significant association between prevalence of colorectal cancer and age amongst patients undergoing follow-up after AD [27–29]. This was confirmed on meta-regression analysis of 31 studies totalling 50,445 patients [10]. Despite the rising incidence of AD in younger

age groups, AD remains commonest amongst patients over the age of 50, accounting for 80% of presentations in our study. With UK guidelines recommending endoscopic evaluation for all patients over 50, including those with uncomplicated AD, only a small proportion of younger patients with uncomplicated AD would not require luminal follow-up based on current guidance. This study suggests that adherence to current guidance would reduce luminal follow-up requirements by 16%. However, restricting luminal follow-up only to patients with complicated AD has potential to reduce the burden on endoscopy services by 70%.

A recent survey of UK centres reported that only 55% of units were meeting urgent cancer wait targets [30]. This study suggests that current guidelines for endoscopic follow-up after AD will have little effect to ameliorate the pressure on endoscopy services. Recent reports have also shown the considerable environmental impact of endoscopy services and we must recognise that clinical decisions regarding endoscopic investigation incur alarming energy, landfill and reprocessing costs as well as the attributable financial expenses [31–33].

Future guidance should also critically acknowledge the limitations of colonoscopy. Although false negative rates for colonoscopy are improving nationally, data published in 2019 estimates that CRC is missed in as many as 7.4% of studies [34]. Population-based studies consistently show diverticular disease as a risk factor for missed pathology at endoscopy and 3-year post-colonoscopy CRC rates may reach 11.6% amongst patients with diverticulosis [34–36].

Given that evidence for age-based risk stratification is limited, it might be time to consider whether high quality CT scanning is sufficient in patients with uncomplicated AD and whether UK guidelines should align more with those of other advisory bodies.

## Conclusion

Colon cancer is an uncommon but important finding amongst patients presenting to secondary care with AD. Current guidelines continue to place significant demand on endoscopy services with stratification by age as well as radiological findings. Limiting luminal investigation to patients presenting with complicated AD (Hinchey 1–4) appears safe and would reduce endoscopic follow-up demands by 70%. Further evaluation is required to implement new technologies such as qFIT but robust pathways with regular audit of performance may help to improve the resource utility and cost-effectiveness of investigation following acute diverticulitis.

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## Declarations

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