

Factors associated with abdominal discomfort during colonoscopy: a prospective analysis

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Objectives Colonoscopy can be uncomfortable. To increase safety, there is a trend, in the UK, towards reduced sedative use. We aimed to determine factors predictive of discomfort during colonoscopy.

Methods Prospectively recruited patients were asked to grade anticipated discomfort on a Numeric Rating Scale ranging from 0 to 10. Discomfort scores were recorded every 2 min during the procedure and during peaks of discomfort. An overall discomfort score was recorded.

Results One hundred and nine patients [44 male, 65 female; median 61.5 (21–80) years] were recruited. One hundred and three procedures were completed. Forty-five patients received midazolam [median 2 (1.5–5) mg]. Mean overall Numeric Rating Scale score was 4.7 (men 4.0; women 5.2; $P < 0.01$) and median peak score 7. Discomfort was usually greatest at the beginning of the procedure, while in the sigmoid colon. Discomfort scores were higher in patients with irritable bowel syndrome ($P = 0.03$); diverticular disease ($P < 0.01$); midazolam ($P = 0.02$), buscopan ($P < 0.001$) or nitrous oxide ($P < 0.001$) use; endoscope tracker use ($P = 0.01$); incomplete procedures ($P < 0.001$) or a preceding gastroscopy ($P = 0.02$), but were not correlated with discomfort during venous cannulation or digital rectal examination. Multivariate analysis showed that female sex, high anxiety,

anticipation of high discomfort, longer intubation time and higher endoscopist's grade of procedural difficulty were independent factors significantly related to overall discomfort scores. Recollected discomfort scores 2–3 months later were lower ($P < 0.01$). Low-dose midazolam had no appreciable amnesic effect.

Conclusion Factors indicative of difficult colonoscopy, and preceding gastroscopy, are associated with greater discomfort, as are the presence of female sex, irritable bowel, anxiety and anticipated discomfort. Low-dose midazolam neither relieves discomfort nor makes patients forget it. Selected patients may benefit from increased analgesia. *Eur J Gastroenterol Hepatol* 21:1076–1082 © 2009 Wolters Kluwer Health | Lippincott Williams & Wilkins.

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Introduction

Colonoscopy is a standard diagnostic tool for the investigation and surveillance of diseases affecting the colon. Colonoscopy can be an uncomfortable procedure and to relieve discomfort, sedation, opiate analgesia and anaesthetic agents are often used [1]. To increase safety, there is a trend towards lower levels of sedation and analgesia use during colonoscopy. In many endoscopy units, including our own, unsedated colonoscopy with or without use of inhaled nitrous oxide (entonox) is common practice and opiates are rarely used. Previous reports have indicated that unsedated colonoscopy is usually well tolerated, with only 5% reporting it to be very uncomfortable, 45% moderately uncomfortable and 50%

not uncomfortable when questioned 14 days after the procedure [2].

Various factors, including female sex, less-experienced colonoscopists, poor quality of bowel preparation, lower body mass index of the patient and increased age of the patient have been associated with reduced completion rate or increased caecal intubation time [3,4]. Recently, Park *et al.* [5] have reported on factors affecting abdominal pain during colonoscopy in patients undergoing colonoscopy with high-level sedation. They found that female sex, younger age (< 40 years), lower body mass index, technically difficult insertion and history of gynaeco-pelvic surgery in women were independent factors significantly related to patient discomfort during colonoscopy.

Here, we aim to determine factors associated with higher levels of patient discomfort during colonoscopy performed without, or with low-dose, midazolam sedation. This will

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allow identification of patients who are more likely to find colonoscopy uncomfortable, to allow targeted use of sedatives and analgesia.

Methods

From March to July 2007, all outpatients attending for colonoscopic examinations performed by four endoscopists in a single centre were entered into the study. All colonoscopists were practicing independently (previously having performed between 500 and more than 5000 colonoscopies). All outpatients who agreed to enter into the study were included. Patients with earlier colonic resection were excluded, as were patients with significant cognitive, hearing or visual impairment. All patients had taken Klean-Prep (norgine, Uxbridge, Middlesex, UK) (median four sachets) before attending for the procedure. Demographic data [patient sex, age, body mass index, details of previous abdominal surgery, colonoscopy indication, diagnosis of irritable bowel syndrome (using Rome III criteria [6]) and number of previous colonoscopies] were recorded.

Patients were familiarized with a numerical scale for rating levels of abdominal discomfort (0 indicating no discomfort and 10 indicating severe discomfort). When they fully understood the scale, patients were told that, when prompted throughout the procedure, they should give a score from 0 to 10 (Numeric Rating Scale; NRS) for their current level of abdominal discomfort.

Before the procedure, patients were asked to grade (0–10) their current level of abdominal discomfort, their anticipated level of discomfort during the procedure, the level of discomfort during cannulation in the antecubital fossa with a 22-gauge needle and the level of discomfort during digital rectal examination.

On initiation of the procedure, patients were asked to grade the discomfort caused by colonoscope insertion through the anal canal, and were then asked to grade their level of discomfort every 2 min during the test. Any peaks of discomfort occurring in between the 2-min intervals were also graded on the NRS. Patients were asked to grade discomfort on colonoscope tip retroflexion in the rectum and, immediately on completion, patients were asked to give an overall discomfort grade for the entire procedure.

Time to completion of insertion was noted, as was overall time for the procedure. The endoscopist was asked to grade the difficulty of the procedure from 0 (simple) to 10 (very difficult) on a numeric scale. Details on medications given during the procedure (midazolam, buscopan and inhaled nitrous oxide gas) were recorded along with whether a Scope Guide (Olympus, Watford, UK) had been used. Immediately before departure from

the endoscopy department, after full recovery from the procedure and any sedative drugs given, patients completed a Hospital Anxiety and Depression (HAD) scale, and gave a further score from 0 to 10 on the NRS for their recollected overall abdominal discomfort level during the procedure. The HAD scale is a well-validated self-screening questionnaire for anxiety and depression that consists of seven questions for anxiety and seven for depression [7,8]. Each question stem scores 0–3, such that final scores for both anxiety and depression range from 0 to 21. A score of less than 7 is normal, between 8 and 10 is borderline abnormal and 11 or more is abnormal.

Between 2 and 3 months after the procedure, all patients were contacted by letter, with some supplementary telephone calls, and asked to give a grade on the same NRS for their recollection of their overall abdominal discomfort experienced during the procedure, and a grade for their recollection of the highest peak of discomfort during the procedure.

Data were analysed using SPSS v14.0 (SPSS Inc., Chicago, Illinois, USA). The overall discomfort scores given at the end of the procedures had a normal distribution, and therefore parametric analyses were used for this data set. Comparison of means was therefore performed using the Student's *t*-test. The peak discomfort scores given during the procedures were skewed to the right, so that nonparametric analyses, including Mann–Whitney *U* and Kruskal–Wallis tests, were used for this data set. Multivariate analyses were performed using a linear regression model.

Results

One hundred and thirteen patients were invited to be included in the study, of which four refused to participate. One hundred and nine patients [44 male, 65 female; median age 61.5 (21–80) years] were therefore recruited. Seventy-two (66%) patients had the colonoscopy as a diagnostic test (39 change in bowel habit, 12 rectal bleeding, 17 anaemia and four abdominal pain) and 37 (34%) as a surveillance procedure (26 for previous polyps, eight for family history of colorectal cancer and three for inflammatory bowel disease). Seventeen (16%) patients had an earlier diagnosis of irritable bowel syndrome and 39 (36%) had previously undergone colonoscopy [median 2 (1–5) times]. Thirty-five (32%) patients had had previous abdominal surgery (15 hysterectomies, 14 appendectomies, seven cholecystectomies, five hernia repairs, one partial gastrectomy and one Nissen fundoplication). Median body mass index was 27 (21–41) for the males and 26 (19–41) for the females. Twenty-five (23%) patients scored 11 of 21 or more for anxiety and six (6%) 11 of 21 or more for depression, on the HAD scale.

One hundred and three (95%) procedures were completed to caecal pole or terminal ileum. Twelve (11%) patients had poor bowel preparation with significant faecal residue. Forty-five (41%) patients were administered midazolam [median 2 (1.5–5) mg], 35 (32%) received buscopan [median 20 (20–40) mg] and 88 (81%) patients used nitrous oxide gas. Eleven patients did not receive either midazolam or nitrous oxide. A Scope Guide was used in 56 (51%) of the procedures. Moderate or severe diverticular disease was noted in 28 (26%) examinations (and a few diverticulae were noted in a further 10) and significant mucosal inflammation was found in six (6%) examinations (with minor areas of inflammation found in a further five). Polyps were found in 38 (35%) examinations and colorectal cancer in two (2%). Bowel preparation was recorded as excellent in 31 (28%), adequate in 55 (50%), fair in 11 (10%) and poor in 12 (11%). The endoscopist graded the technical difficulty of the procedure from 0 to 10 on an NRS, with median score 5 (range 1–10). The median time to proximal point of insertion was 10.2 (3.5–32.2) min. The median procedure duration was 18.6 (10.4–38.1) min. Eighteen (17%) patients underwent dual procedures and, in each case, gastroscopy preceded colonoscopy.

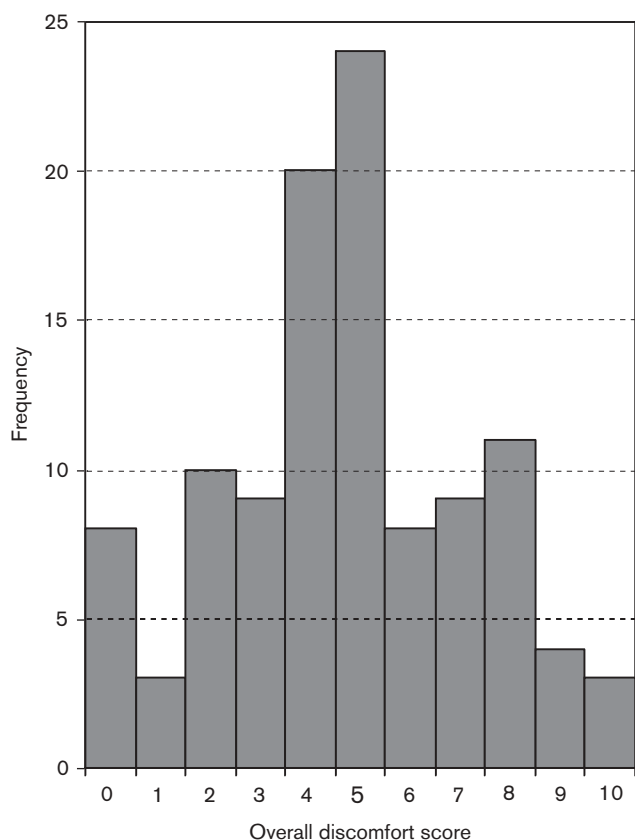
The overall abdominal discomfort scores on the NRS (0–10) given at the end of the procedures are shown in Fig. 1, and have mean overall discomfort score 4.7 (SD 2.5) and median 5 (range 0–10). Men had significantly lower overall discomfort scores than women (mean 4.0 vs. 5.2; $P < 0.01$).

The peak discomfort scores given during each procedure are shown in Fig. 2, and have mean peak discomfort score 6.9 (SD 2.5) and median 7 (range 0–10). Men had significantly lower peak discomfort scores than women (median 7 vs. 8; $P < 0.05$).

The mean of all the discomfort scores given at 2-min intervals (not including the scores given during peaks of discomfort in between the 2-min intervals) during the procedure was analysed for each patient (Fig. 3). The mean of these scores was 3.7 (significantly lower than the mean overall score given by the patients at the end of their procedures: 4.7, $P < 0.01$).

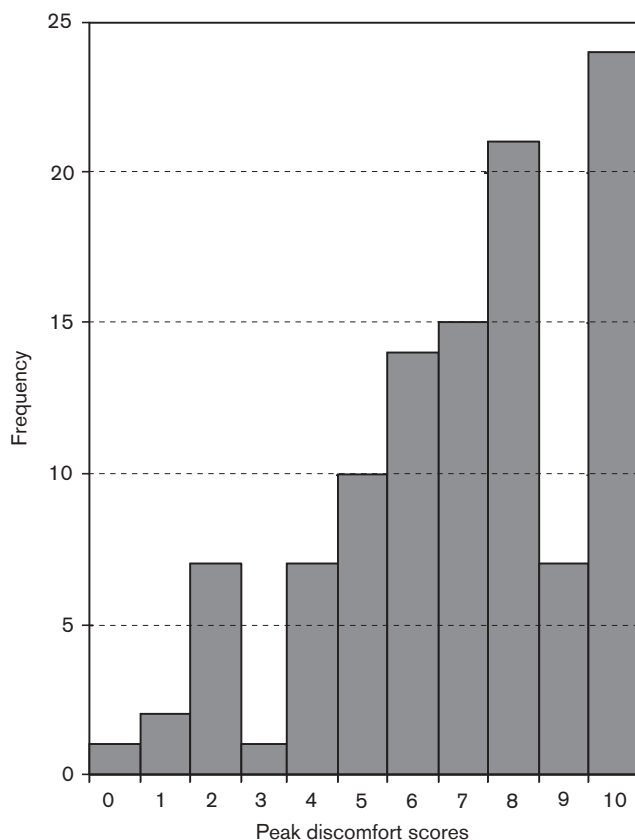
The median discomfort scores given every 2 min throughout the procedure are shown in Fig. 4. This shows that

Fig. 1



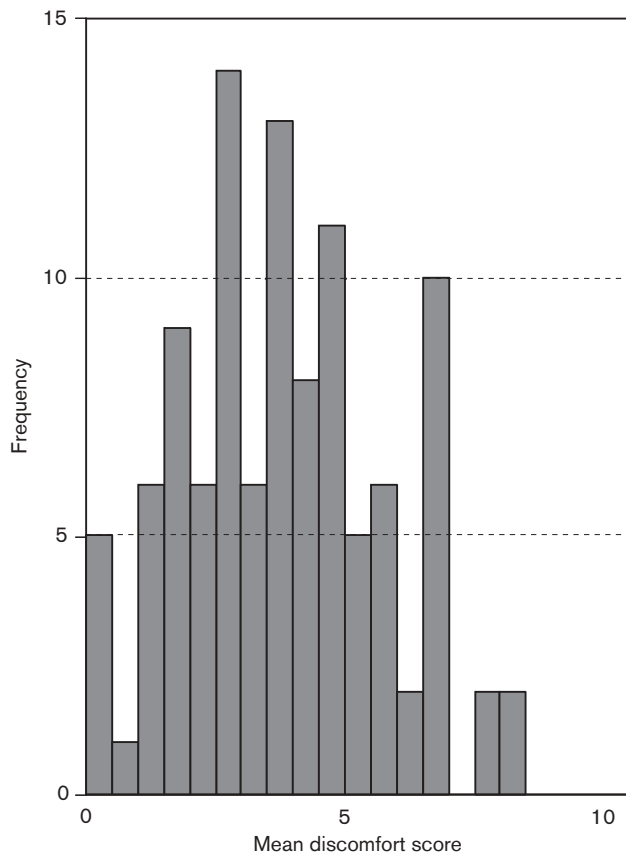
The overall discomfort scores (Numeric Rating Scale – 0: no discomfort and 10: severe discomfort) for the procedure given by patients immediately after completion of colonoscopy [mean score 4.7].

Fig. 2



The peak (maximum) discomfort score (0: no discomfort and 10: severe discomfort) given by patients during colonoscopy [median score 7].

Fig. 3



Mean discomfort scores: patients gave discomfort scores every 2 min (Numeric Rating Scale – 0: no discomfort and 10: severe discomfort). The mean of each individual patient's scores given during the procedure is shown. The mean of these mean scores for the whole group is 3.7.

discomfort is most often experienced early in the procedure. This discomfort is most often a result of negotiating the sigmoid colon. The later stages of colonoscopy (typically extubation) are more comfortable.

As shown in Table 1, discomfort scores were higher in those with irritable bowel syndrome ($P=0.03$), anxiety score on the HAD scale of 11 of 21 or more ($P < 0.001$); where indication for colonoscopy was abdominal pain ($P=0.02$); moderate–severe diverticular disease was diagnosed ($P < 0.01$); earlier hysterectomy had been carried out ($P < 0.05$); midazolam ($P=0.02$), buscopan ($P < 0.001$) or entonox ($P < 0.001$) was used; the endoscope tracker was used ($P=0.01$); insertion did not reach the caecum ($P < 0.001$) or where gastroscopy preceded colonoscopy ($P=0.02$). There was no significant difference in completion (caecal intubation) rate, endoscopist's grading of technical difficulty of the procedures or discomfort scores between endoscopists.

Multivariate linear regression analysis showed that female sex, anxiety score more than 11 of 15, anticipation of high discomfort, use of buscopan and nitrous oxide, longer intubation time and higher endoscopist's grade of procedure difficulty were independent factors significantly ($P < 0.05$) related to the patient's overall discomfort score given after colonoscopy.

Overall discomfort levels reported immediately on completion of the procedure were almost identical to those given after a recovery period of 1 h (overall mean score 4.74 vs. 4.70 after 1 h). Recollected overall discomfort scores 2–3 months after procedure were significantly lower than the originals (mean reduction 0.7; $P < 0.01$, Table 2). No significant reduction was seen in the recollected peak discomfort scores after 2–3 months.

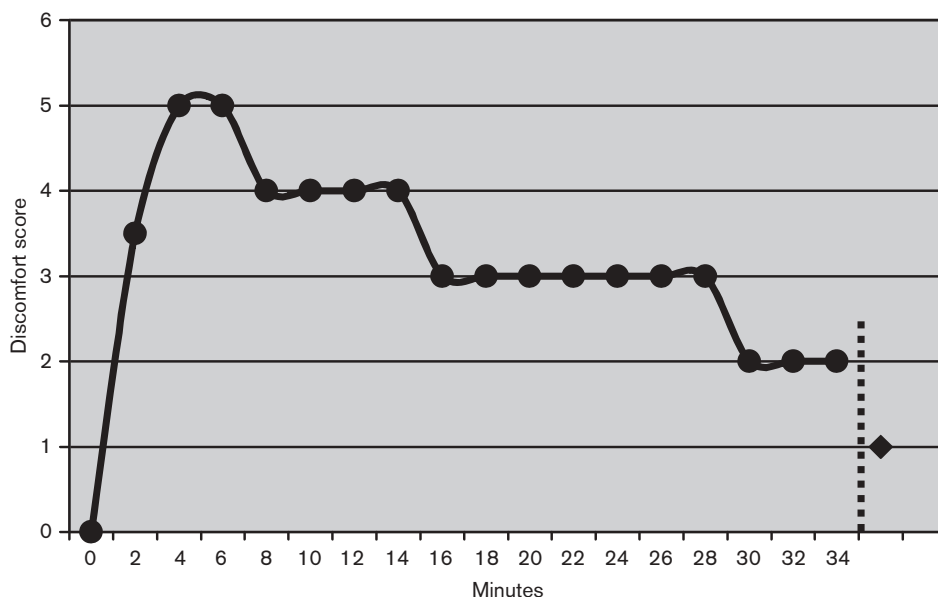
The use of midazolam did not result in any further lowering of recollected discomfort scores (Table 2). Only three patients could not remember the procedure well enough to give a discomfort score after 2–3 months. Two of these patients had been given midazolam (2 and 2.5 mg) and one had not received midazolam.

Discussion

This is the first study to determine patient levels of abdominal discomfort before, during and after colonoscopy in a cohort of patients in which no, or minimal, sedation was used. In our department, colonoscopy is performed with no sedation, or low-dose midazolam, according to patient preference. Opiates are only very rarely used but inhaled nitrous oxide gas is routinely offered for analgesia [9]. In previous studies of discomfort during sedation-free colonoscopy, discomfort scores were performed after the procedure [2,10,11]. Discomfort scores given after colonoscopy may not accurately reflect discomfort perceived during the procedure [12]. Indeed, here we have found that the overall discomfort score reported by patients at the end of the procedure is higher than the mean of the scores reported at regular intervals during the procedure.

No standard format for quantifying discomfort during endoscopic procedures has been presented in the literature. There are several studies that have used sampling of pairs of pain ratings from the same patient during various procedures to evaluate scale sensitivity [13–15]. It has been suggested that, for use during endoscopy, a 100 mm visual analogue scale is more sensitive than a 4-point NRS (no discomfort, mild, moderate or severe discomfort), except in cases where patients frequently reported no discomfort [15]. However, the reliability of a visual analogue scale where patients are potentially distracted during colonoscopy (such as through discomfort or during self-administration of nitrous oxide gas) or after administration of midazolam

Fig. 4



Discomfort during the procedure; discomfort scores were taken every 2 min during colonoscopy. The median of these scores at 2-min intervals for completed procedures is shown. The median time to completion was 18.6 min. Only four procedures went beyond 34 min. The median discomfort score given at the end of the procedures was 1 (represented by ♦).

Table 1 Factors associated with abdominal discomfort during colonoscopy

Factor under analysis (number) (Total N=109)	Mean overall score with factor	Mean overall score without factor	Median peak score with factor	Median peak score without factor
Male (n=44) [vs. female (n=65)]	4.0**	5.2	7*	8
Indication				
Diarrhoea (n=39)	4.6	4.8	7	7
Bleeding (n=12)	3.9	4.9	8	7
Anaemia (n=17)	5.3	4.7	7	7
Abdominal pain (n=4)	7.5*	4.6	8.5	7
Surveillance (n=37)	4.7	4.7	7	7
Prior abdominal surgery				
Hysterectomy (n=15/65)	5.7	4.5	8*	7
Other surgery (n=27/94)	4.6	4.8	7	7
Prior colonoscopy (n=39)	4.9	4.7	7	7
Anxiety score ≥ 11/21 (n=25)	6.5***	4.2	9**	7
Depression Score ≥ 11/21 (n=6)	4.7	6.0	8.5	7
Prior diagnosis of IBS (n=17)	5.9*	4.5	7	7
Midazolam used (n=45)	5.2	4.4	8*	7
Buscopan used (n=35)	6.0***	4.1	8**	7
Nitrous oxide used (n=88)	5.2***	2.5	8*	5
Moderate-severe diverticulosis (n=28)	5.8**	4.3	8**	7
Moderate-severe inflammation (n=6)	6.0	4.6	8	7
Poor bowel preparation (n=12)	5.5	4.6	8	7
Incomplete exam (n=6)	8.2***	4.5	10**	7
Tracker use (n=56)	5.3*	4.1	7.5	7
Preceding Gastroscopy (n=18)	6.0*	4.5	8	7

Analysis of factors affecting abdominal discomfort levels (overall and peak) scored on a Numeric Rating Scale (0–10) during colonoscopy.

*P<0.05.

**P<0.01.

***P<0.001.

is not known. During the study presented here, we familiarized patients with a 10-point visual analogue scale [ranging from 0 (no discomfort) to 10 (severe

Table 2 Recollection of discomfort reduces with time

	Score during procedure	Recollected score after 2–3 months
Mean overall score		
All (N=109)	4.7	4.0**
Midazolam group (n=45)	5.2	4.3*
Unsedated group (n=64)	4.4	3.8*
Median peak score		
All (N=109)	7	7
Midazolam group (n=45)	8	8
Unsedated group (n=64)	7	7

Comparing the levels of abdominal discomfort (overall and peak) scored on a Numeric Rating Scale (0–10) at the time of colonoscopy with the recollected scores 2–3 months after the procedure. Mean overall discomfort scores compared using paired samples *t*-test and peak discomfort scores analysed using Wilcoxon's signed ranks test.

Recollection of the overall discomfort level is significantly less than that given at the time of the procedure. Analysis of covariance shows that midazolam use does not affect the recollected overall discomfort score after 2–3 months. Recollection of peak discomfort levels did not reduce with time.

*P<0.05.

**P<0.01.

discomfort)], but then used a corresponding 10-point verbal NRS to collect the data. We used this method, because, in preliminary studies, we found that patients found it difficult to hold both paper and pencil during colonoscopy (especially if using nitrous oxide), but could always give a verbal rating when prompted. We felt that initial familiarization with a visual scale improved understanding and reproducibility of results.

We were surprised by the relatively high levels of discomfort reported during this study. There are three possible explanations for this. First, patients were asked

to rate discomfort levels during the procedure, which is likely to lead to higher reported levels of discomfort than if discomfort levels were taken only after the procedure had finished. Second, we analysed abdominal 'discomfort' rather than 'pain'. It would be of interest to repeat the study using a 10-point NRS from 0 indicating no pain to 10 indicating severe pain. Finally, scores given on the NRS may be less accurate than those given on a more cumbersome visual analogue scale [15].

In keeping with previous reports, we have found that factors indicative of difficult colonoscopy are associated with higher levels of discomfort [10,16]. Such factors include prolonged intubation time, the endoscopist grading the procedure as difficult, caecal intubation not being achieved and the presence of diverticular disease. In this study, the use of buscopan and the endoscope tracker were also associated with increased discomfort during the procedure. These factors may both be related to the difficulty of the procedure as, in our department, buscopan is often used to relieve colonic spasm during a difficult intubation and the tracker is often used to aid resolution of loops during a difficult intubation. Use of nitrous oxide gas was strongly associated with discomfort during the procedure. In our department, it is routine practice to offer this to patients experiencing discomfort during colonoscopy.

Patient factors predictive of discomfort during colonoscopy include female sex, earlier hysterectomy, a diagnosis of irritable bowel syndrome, abdominal pain as the indication for the procedure, high anxiety and the anticipation of discomfort during the test. Female sex and prior hysterectomy have previously been reported as being associated with increased discomfort during colonoscopy [10,17]. This is likely to relate to the deeper pelvis of females that may predispose to sigmoid loop formation [18]. Recently, higher patient anxiety levels have been associated with higher pain scores in open access colonoscopy where sedatives are used [19]. The anticipation of discomfort during colonoscopy has not previously been reported as a factor associated with increased discomfort, although the anticipation of pain (from rectal balloon insufflation) is associated with different brain activation patterns on functional MRI scanning during somatic pain stimulation (immersion of foot into ice water) in patients with irritable bowel syndrome compared with healthy controls [20]. Anxiety and the anticipation of discomfort, are easily determined, and could alert the endoscopist to offer short acting analgesia or sedatives for the procedure. Indeed short-acting opiates, including fentanyl and remifentanyl, which offer less respiratory depression and faster recovery times than longer acting opiates such as pethidine, have recently been shown to be safe and effective at relieving pain during colonoscopy [21,22]. We have also demonstrated that the greatest levels of

discomfort typically occur within the first few minutes of colonoscopy. This finding reinforces the need to determine which patients would benefit from short-acting analgesia use given at the start of the procedure.

The cause of visceral pain during colonoscopy is mainly because of stretch of mesenteric attachments, but with a component owing to the pressure of air distension [23,24]. We have demonstrated that preceding gastroscopy worsens colonoscopy discomfort. The reason for this increased discomfort is uncertain, but may result from increased luminal distension because of air insufflation at gastroscopy. A prospective randomized trial to determine whether colonoscopy is better tolerated when gastroscopy is performed immediately before or immediately after the procedure is required.

An important determinant of pain is an individual's perception of pain, or 'pain threshold' [25]. We used discomfort elicited by standardized venous cannulation and discomfort elicited by digital rectal examination as markers of an individual's pain threshold. Although we found that the degree of discomfort elicited by these two factors were strongly correlated ($P < 0.001$), neither correlated with overall or peak discomfort scores during colonoscopy. However, it may be that, as in irritable bowel syndrome, patients with visceral hypersensitivity have an increased tendency to report abdominal pain resulting from luminal distension, rather than have an increased neurosensory sensitivity [26].

We have found that low-dose midazolam [median 2 mg (range 1.5–5)] neither relieves discomfort nor makes patients forget it. Indeed, the use of midazolam was associated with heightened peaks of pain during colonoscopy, although there is selection bias in that it is likely that anxious patients, or those who anticipated discomfort, would be administered midazolam. Midazolam may be given during colonoscopy with the intention of inducing anterograde amnesia. Our study shows that amnesia is only very rarely induced by the low doses of midazolam used. This is in keeping with a previous study, in which midazolam was used immediately before general anaesthesia, where anterograde amnesia occurred in a dose-responsive manner, with a significant amnesic effect only being apparent at doses of 5–10 mg [27].

In summary, we have found that factors associated with a technically difficult procedure are associated with discomfort during colonoscopy. Preceding gastroscopy increases discomfort at colonoscopy such that, in dual procedures, it may be prudent to perform colonoscopy first. Patient factors independently associated with discomfort during colonoscopy are female sex, high anxiety and anticipation of discomfort. These factors are easily determined and therefore we suggest that

selected patients with a combination of these factors may benefit from analgesic, with or without sedative, use during colonoscopy.

Acknowledgement

Conflicts of interest: none declared.

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