ORIGINAL ARTICLE: Clinical Endoscopy

Position change during colonoscope withdrawal increases polyp and adenoma detection in the right but not in the left side of the colon: results of a randomized controlled trial

Alex J. Ball, MB, ChB (Hons), Shawinder S. Johal, PhD, Stuart A. Riley, MD

Sheffield, United Kingdom

Background: It has been suggested that changing patient position during colonoscope withdrawal increases adenoma detection. The results of previous studies have been conflicting.

Objective: To evaluate whether routine position change during colonoscope withdrawal improves polyp detection.

Design: Randomized, 2-way, crossover study.

Setting: Teaching hospital.

Patients: A total of 130 patients attending for diagnostic colonoscopy.

Interventions: Patients undergoing colonoscopy had each colon segment examined twice: the right side of the colon (cecum to hepatic flexure) in the supine and left lateral position and the left side of the colon (splenic flexure and descending colon) in the supine and right lateral position. The transverse colon was examined twice in the supine position.

Main Outcome Measurements: The primary outcome measure was the polyp detection rate ($\geq$1 polyp) per colon segment. Secondary outcome measures included the number and proportion of patients with $\geq$1 adenoma in each segment and adequacy of luminal distension (1 = total collapse and 5 = no collapse).

Results: Examination of the right side of the colon in the left lateral position significantly improved polyp detection (26.2% vs 17.7%; $P = .01$) and luminal distension (mean = 4.0 vs 3.5; $P < .0001$). Position change did not improve polyp detection in the left side of the colon (5.4% vs 4.6%; $P = .99$). There was no significant correlation between luminal distension and polyp detection in the right side of the colon ($r = .03$).

Limitations: Single center and open study design.

Conclusion: Examining the right side of the colon in the left lateral position increased polyp detection compared with examination in the supine position. Polyp detection in the left side of the colon was similar in the right lateral and supine positions. (Clinical trial registration number: NCT01554098.) (Gastrointest Endosc 2015;82:488-94.)

Abbreviation: CRC, colorectal cancer.

DISCLOSURE: *All authors disclosed no financial relationships relevant to this article.*

0016-5107/$36.00
http://dx.doi.org/10.1016/j.gie.2015.01.035

Received September 23, 2014. Accepted January 11, 2015.

Current affiliations: Department of Gastroenterology, Northern General Hospital, Sheffield Teaching Hospitals, Sheffield, S5 7AU, United Kingdom.

Reprint requests: Dr Alex Ball, Department of Gastroenterology, Northern General Hospital, Sheffield Teaching Hospitals, Sheffield, S5 7AU, United Kingdom.

Colorectal cancer (CRC) is one of the commonest causes of cancer-related death in Western countries.[1] A number of studies have shown that CRC-associated mortality is significantly reduced by the colonoscopic removal of polyps.[2,3] However, not all polyps are identified during colonoscopy, and miss rates of 17% to 28% have been reported.[4-7] This is important because the risk of interval CRC after colonoscopy is inversely associated with the adenoma detection rate of the colonoscopist.[8,9]

The factors that determine polyp detection are complex, but colonoscope withdrawal time, inspection behind colon folds, adequate luminal distension, and cleaning of residual debris have been highlighted as important determinants.[10,11] In addition, it has been suggested that

changing the position of the patient during colonoscope withdrawal may improve polyp detection.

Traditionally, after insertion of the colonoscope, the instrument was most often withdrawn and the colon examined with patients in a single position (usually left lateral or supine). However, positioning patients such that the colon segment being examined is uppermost in the abdomen (right side of the colon in the left lateral position, the transverse while supine and the splenic flexure and descending colon in the right lateral position) improves luminal distension and may increase polyp detection. The merits of this strategy have been assessed in several recent studies, but the results are conflicting.[12-15]

East et al[13] were the first to report that position change improved polyp detection but the benefit was only apparent in the transverse colon. Similar results were reported by Köksal et al,[14] but the largest and most recent study has reported negative results.[15] Given these conflicting results, we have re-examined the benefits of position change during colonoscope withdrawal.

METHODS

Patients aged 40 to 80 years presenting for a diagnostic colonoscopy at the Northern General Hospital, Sheffield, between March 2012 and February 2014 were invited to participate. Patients with limited mobility, those who had previously undergone colon surgery, or those known to have colitis or a polyposis syndrome were excluded. Patients with a permanent pacemaker also were excluded, because this would preclude the use of the Scopeguide (Olympus, Tokyo, Japan). All patients gave written informed consent, and the study was approved by the local National Health Service Research Ethics Committee and registered on clinicaltrials.gov (NCT01554098).

Colonoscopy examination

All patients underwent bowel preparation with 4 L of polyethylene glycol solution. Examinations were performed by 4 experienced colonoscopists by using variable stiffness colonoscopes (CF-Q260; Olympus, Tokyo, Japan).

In order to standardize the beginning and end of each colon segment, two pinch biopsies were taken at the sigmoid-descending junction, the splenic flexure, and the hepatic flexure, thereby defining the left side of the colon (splenic flexure and descending colon but not including the sigmoid colon), the transverse colon, and the right side of the colon (cecum, ascending colon, and hepatic flexure) (Fig. 1). The location of the pinch biopsies was determined by the endoscopic appearances and the configuration of the colonoscope on the Scopeguide imager.

During colonoscope insertion, endoscopists were instructed to change the patient position as required. All polyps seen on insertion were removed or marked for later removal. These polyps were not included in the analysis. Patients in whom colonoscope insertion took longer than 20 minutes were excluded before randomization.

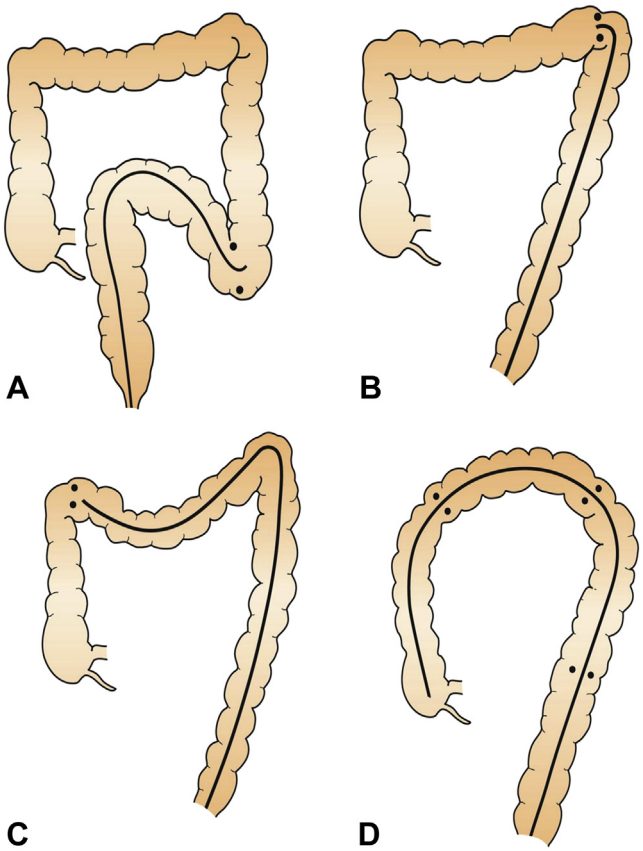

Figure 1. Characteristic configuration of the Scopeguide image (*solid line*) during insertion (**A, B,** and **C**) facilitated placement of pairs of mucosal pinch biopsies to define colon segments during colonoscope withdrawal (**D**).

During colonoscope withdrawal, each colon segment was examined twice. After cecal intubation, patients were randomized, in a 1:1 ratio, to undergo colonoscopic withdrawal in either the supine position followed by position change or vice versa. The position change was left lateral position for examination of the right side of the colon and right lateral position for examination of the left side of the colon. The transverse colon was examined twice in the supine position to assess the incremental benefit of a repeat examination in the same position. The order in which segments were to be examined was generated by www.random.org, stored in an opaque sealed envelope, and revealed only after cecal intubation.

Unless contraindicated, patients were given 20 mg hyoscine butylbromide intravenously after cecal intubation, and further doses were administered at the discretion of the endoscopist. Each colon segment was examined for a minimum of 2 minutes, during which attempts were made to maximize mucosal visualization by insufflating air, cleansing, and inspection behind mucosal folds. After the first inspection, the colonoscope was reinserted, and

the same segment was examined in the alternative position. Polyps were removed only during or after the second examination, and a third insertion was attempted if polyps remained unidentified.

Patient demographics and procedural characteristics were recorded, and bowel preparation was graded on the Boston Bowel Preparation Scale. The size, morphology (Paris classification), location, and histology of colon polyps were noted. Comparisons were made according to the number and proportion of polyps (adenomas and serrated lesions) and adenomas in colon segments proximal to the sigmoid-descending junction. Colonoscopy examinations were recorded by using a digital encoder.

Study investigators unaware of the randomization sequence graded luminal distension by using the digital recordings. Luminal distension was graded in each colon segment and in both positions on a 5-point scale from 1 = total collapse to 5 = widely distended and no distal collapse.[12] Ratings represented an overall score during the whole of the withdrawal period. Ratings of 4 + 5 were considered adequate, ratings of 3 were considered borderline, and ratings of 1 + 2 were considered inadequate. The proportions of patients with luminal distension scores of ≥4 in each position were compared.

Study endpoints

The primary outcome measure was the polyp detection rate (≥1 polyp) per colon segment. Secondary outcome measures included the number of polyps and adenomas detected and luminal distension. A post hoc analysis assessed the resulting change in surveillance interval based on the British Society of Gastroenterology guidelines.[16]

Statistical analysis

With a power of 80% and a 2-sided significance level of 5%, 130 patients were required to demonstrate a 50% increase in the detection of ≥1 polyp, from an estimated baseline polyp frequency of 10%, in each colon segment.

Differences in the proportion of patients with ≥1 polyp in the right and left sides of the colon were compared by using the Prescott test.[17] An inherent bias associated with the use of a cross-over study is the carry-over effect. With regard to the present study, the findings from the first withdrawal would have pre-alerted the endoscopist to findings during the second withdrawal. Bias due to the carry-over effect was minimized by the use of a 2-way, rather than 1-way, design and the randomization process that balanced this effect between groups. We used the Prescott test to compare differences in proportions, which, unlike the McNemar test, takes account of the period effect.[18] This refers to the superior outcomes that may occur during the second period. The McNemar test was used, however, to assess whether a second examination of the transverse colon significantly increased the proportion of patients with ≥1 polyp or adenoma because the repeat examination occurred in the same patient position.

Luminal distension ratings and the number of polyps detected after each withdrawal strategy were compared by using the Wilcoxson signed rank test, and the agreement between observers was assessed by using a weighted kappa. Correlations between luminal distension and the number of polyps detected in each segment were assessed by using the Spearman rho and interpreted as follows: strong >0.8, moderate 0.5 to 0.8, weak 0.2 to 0.5, and no/negligible 0 to 0.2.

RESULTS

A total of 198 patients were screened for study inclusion. A total of 67 were excluded, most commonly because of patient preference and insertion time >20 minutes. One patient was withdrawn because of difficulty with reinsertion in the right side of the colon, leaving 130 patients for analysis (Fig. 2). The procedural characteristics and medication use did not significantly differ between the study groups, although more men and fewer patients referred for investigation of anemia were randomized to an initial examination with position change (Table 1).

During insertion of the colonoscope, polyps were found in 23 of 130 patients (17.7%) and 18 (13.8%) had adenomas. The mean (standard deviation [SD]) and size range of these polyps was 7 mm (8), 2 to 45 mm. These polyps were excluded from the subsequent analysis.

The overall number of patients with ≥1 polyp in the right, transverse, and left sides of the colon was higher during colonoscope withdrawal with position change than in the supine position (47/130 [36.2%] vs 38/130 [29.2%], odds ratio [OR] 1.4; $P = .04$). However, the difference in adenoma detection was not significant (39/130 [30%] vs 33/130 [25.4%], OR 1.3; $P = .11$). The number of polyps per patient was also greater with position changes (mean [SD] = 0.54 [0.8] vs 0.45 [0.8]; $P = .02$), as was the number of adenomas, but the latter did not reach statistical significance (mean [SD] = 0.44 [0.8] vs 0.38 [0.7]; $P = .11$).

Examining the right side of the colon with the patient in the left lateral rather than supine position significantly increased the proportion of patients with ≥1 polyp and ≥1 adenoma (34/130 [26.2%] vs 23/130 [17.7%], OR 1.6; $P = .009$ and 30/130 [23.1%] vs 21/130 [16.2%], OR 1.6; $P = .025$, respectively). The number of polyps and adenomas per patient in the right side of the colon also was greater during withdrawal in the left lateral position (mean [SD] = 0.24 [0.6] vs 0.32 [0.6]; $P = .008$ and 0.22 [0.6] vs 0.29 [0.6]; $P = .02$, respectively).

Examining the left side of the colon with the patient in the right lateral position did not significantly increase the proportion of patients with ≥1 polyp and ≥1 adenoma compared with the supine position (7/130 [5.4%] vs 6/130 [4.6%], OR 1.2; $P = .99$ and 4/130 [3.1] vs 4/130 [3.1], OR 1.0; $P = .66$, respectively). Furthermore, there

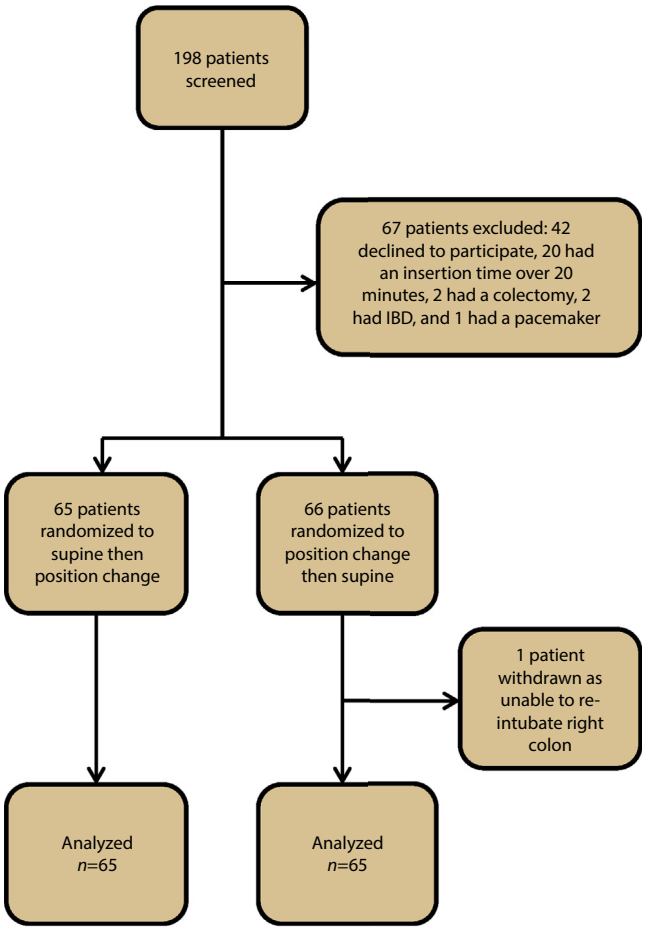

Figure 2. Patient flow diagram. *IBD,* inflammatory bowel disease.

TABLE 1. Patient and procedural characteristics and medication use

	Withdrawal order		
	Position change then supine	Supine then position change	*P* value
Polyps identified during colonoscope insertion, no. (%)	11 (16.9)	12 (18.4)	.81
Cecal intubation time, mean (± SD), min	11.5 (3.5)	11.7 (4.1)	.72
Hyoscine butylbromide used, no. (%)	64 (98.4)	65 (100)	1.00
Bowel cleanliness rating, mean (± SD)	5.6 (1.1)	5.8 (1.1)	.42
Intravenous sedation or analgesia used, no. (%)	15 (23.1)	12 (18.5)	.51
Entonox used, no. (%)	50 (77.9)	51 (78.4)	.83
Procedural indication, no. (%)			
Change in bowel habit	34 (52.3)	32 (49.2)	.86
Anemia	7 (10.8)	18 (27.7)	.02
Polyp surveillance	10 (15.4)	6 (9.2)	.42
Rectal bleeding	9 (13.8)	6 (9.2)	.58
Family history	2 (3.1)	3 (4.6)	1.00
Abdominal pain	3 (4.6)	0 (0)	.24

SD, Standard deviation.

was no significant increase in the number of polyps and adenomas per patient in the descending colon (mean [SD] = 0.05 [0.3] vs 0.05 [0.2]; P = .65 and 0.03 [0.2] vs 0.03 [0.2]; P =1.00, respectively).

There were no significant differences in the proportion of patients with ≥1 polyp or ≥1 adenoma during the first and second withdrawal through the transverse colon in the supine position (14 [10.8%] vs 16 [12.3%], OR 1.2; P = .69 and 12 [9.2] vs 14 [10.8], OR 1.2; P = .69) or the number of polyps and adenomas per patient (mean [SD] 0.12 [0.4] vs 0.15 [0.4]; P = .21 and 0.11 [0.4] vs 0.12 [0.4]; P = .79, respectively).

The mean (range) size of polyps found during colonoscope withdrawal was 3 mm (1-8 mm). There was 1 polyp >5 mm that was found in the ascending colon in the left lateral but not in the supine position (8 mm). Polyps were predominantly sessile (Is) morphology (81%), with the remainder being Paris IIa (18%) and Isp (1%).

An increase in luminal distension was seen in the right side of the colon in the left lateral position and in the left side of the colon in the right lateral position (Table 2). Luminal distension was more likely to be rated as adequate (ratings of 4 and 5) by using the position change strategy in the right (76% vs 46%; P < .0001) and left sides of the colon (92% vs 58%; P < .0001). Fewer patients had luminal distension rated as inadequate (ratings of 1 and 2) during colonoscope withdrawal in the right lateral position in the left side of the colon (6% vs 0%; P = .007), and there was a similar trend in the left lateral position in the right side of the colon (5% vs 1%; P = .06). There was substantial agreement between the luminal distension ratings of the colonoscopists (weighted kappa = 0.70).[19]

There were no significant correlations between luminal distension and the number of polyps in the right side of the colon (r = .03; P = .69), the transverse colon (r = -.05; P = .47) or the left side of the colon (r= -.05; P = .54).

Using the position change strategy rather the supine withdrawal position would have resulted in a change to the recommended surveillance interval in 10 patients. In 4 patients who would not have undergone a further examination, a 5-year surveillance examination would have been recommended. In 3 patients, earlier surveillance examinations would have been recommended (2 patients having a 3-year rather than 5-year surveillance examination and 1 patient having a 1-year rather than 3-year surveillance examination). Two patients would be having a later examination (5 years instead of 3 years), and surveillance would not have been indicated in one patient for whom a 5-year surveillance examination was recommended.

TABLE 2. Luminal distension in the right, transverse, and left sides of the colon

Colon segment	Luminal distension scores with each withdrawal strategy mean (SD)		*P* value
Right side of colon	Supine 3.5 (0.8)	Left lateral 4.0 (0.7)	< .0001
Transverse colon	1st withdrawal 4.0 (0.8)	2nd withdrawal 4.1 (0.7)	.06
Left side of colon	Supine 3.6 (0.8)	Right lateral 4.4 (0.6)	< .0001

Luminal distension scores (1 = collapsed, 5 = maximal distension).
SD, Standard deviation.

DISCUSSION

Modifying a patient's position is accompanied by the intra-abdominal movement of the colon and the intraluminal movement of fluid and gas. Radiologists have used these changes to optimize views during barium examinations for decades, and it has been suggested that adjusting the patient position, to bring colon segments uppermost within the abdomen, improves luminal distension and therefore lesion detection during colonoscope withdrawal.

However, practice among endoscopists varies, with some colonoscopists examining the colon with the patient in one fixed position (often left lateral or supine) whereas others use position change routinely during colonoscope withdrawal.[20] These differences may relate to the inconvenience associated with moving patients or uncertainty regarding its benefit. However, studies have repeatedly found that examining the transverse colon with the patient in the supine position increases polyp detection.[13,14] We therefore chose to compare withdrawal through the right side of the colon in the left lateral position, through the transverse colon in the supine position, and the left side of the colon in the right lateral position, with withdrawal through the whole colon in the supine position.

In the present study, examining the right side of the colon with the patient in the left lateral position increased polyp and adenoma detection. Data regarding the optimal position to examine the right side of the colon were hitherto lacking. Strategies to improve polyp detection in the right side of the colon may be of particular value, given that colonoscopy is reported to offer less protection against right-sided CRC.[3,21] There was no significant correlation between luminal distension and polyp detection, which is perhaps unsurprising because improved visualization does not guarantee identification of additional polyps, and many polyps are visible regardless of luminal distension. It also should be stressed that although East et al[13] reported a positive correlation between luminal distension and polyp detection, the strength of this correlation may be considered negligible ($r = .11$; $P < .01$). Despite the lack of correlations between luminal distension and polyp detection, we believe that adequate luminal distension aids in the detection of polyps and should be a goal of colonoscope withdrawal. Furthermore, despite the benefits associated with the use of the left lateral position in the right side of the colon, alternative positions should be considered whenever views remain suboptimal. The cecum, for example, may be situated medially, and in such patients the right lateral position may be advantageous.

In the present study, a second examination of the transverse colon did not significantly increase the detection of adenomas or polyps. This may suggest that there is little benefit to a second examination in the same patient position, particularly when there are adequate views during the initial examination.

We found no increase in polyp or adenoma detection by examining the left side of the colon (splenic flexure and descending colon) with the patient in the right lateral rather than the supine position. East et al[13] reported that examining patients in the right lateral rather than left lateral position increased polyp (16% vs 25%; $P = .05$) but not adenoma detection (12% vs 15%; $P = .64$), whereas Köksal et al[14] found no differences in adenoma and polyp detection. The lack of difference in polyp detection in the left side of the colon may well relate to the low prevalence of polyps within this colon segment.

The methodology used in the present study was quite different from that used by Köksal et al[14] and Ou et al,[15] and this limits the extent to which these studies may be directly compared. Köksal et al[14] also used a 2-way crossover design whereby colon segments were initially examined in the left lateral position followed by position change or vice versa. Unlike the present study, however, the position change strategy in the left side of the colon included both the supine and right lateral positions. Furthermore, the study compared adenoma detection during withdrawal in the left lateral position alone versus adenoma detection in the left lateral position and position change combined. This is an important methodologic difference because studies of back-to-back colonoscopies have consistently reported that a repeat examination, regardless of patient position, leads to an increase in polyp detection.[4-7] It is therefore uncertain whether the additional polyps detected by Köksal et al[14] occurred as a consequence of the repeat examinations or the change in patient position. Furthermore, they failed to take account of the period effect whereby the findings of the first withdrawal may pre-alert endoscopists to the same findings during the second examination.[17]

Ou et al,[15] on the other hand, used a parallel group design that compared prescribed position change against usual practice and reported no overall differences in adenoma (40.7% vs 37.9%; $P = .28$) or polyp detection (58.2% vs 56.5%; $P = .93$). It should be noted, however, that approximately half of the patients randomized to usual practice had the right side of the colon examined

in the left lateral position and about half the patients had the transverse colon examined in the supine position, thereby minimizing the possible benefit of position change.

In the present study, luminal distension in the supine position was rated adequate in approximately half of the withdrawals in the right and left sides of the colon. On the assumption that the increase in polyp detection was a consequence of improved luminal distension, this would suggest that the supine position is frequently an adequate strategy. Furthermore, although position change increases the probability of adequate distension, ratings were less than adequate in 24%. This may be a consequence of the colon muscle tone, which is not always overcome by hyoscine butylbromide administration, or variations in colon anatomy. In these circumstances colonoscopists should take additional time and care to maximize mucosal visualization.

It should be noted that the additional polyps and adenomas detected after position change were mostly diminutive and therefore of debatable clinical significance. Regardless of size, however, the adenoma detection rate is a well-established measure of colonoscopy quality because it inversely associates with post-colonoscopy cancer risk. Furthermore, the increase in adenoma detection would have translated into a change in management with regard to the number and timing of surveillance examinations. The small size of the additional polyps detected may simply reflect the typical size distribution of colon polyps, and it is likely that a larger study would be required to determine whether position change also increases detection of larger polyps during colonoscope withdrawal.

As with most studies of colonoscopy technique, an open study design was used, which is susceptible to unintentional researcher bias. This study may be criticized for excluding the polyps found during colonoscope insertion, although we believe this makes for a fairer and more appropriate comparison of an intervention performed during colonoscope withdrawal. We also believe that polyps seen during colonoscope insertion are more likely to be larger and in easy-to-see places and therefore easily detectable with either withdrawal strategy. A further limitation relates to patient positioning during colonoscope insertion, which was not standardized. Colonoscopists used position change as required to facilitate colonoscope insertion, which may have caused bias, although the number of polyps found during insertion was similar with each strategy.

The study was undertaken by 4 operators and performed on patients undergoing colonoscopy for assessment of symptoms and those attending for polyp surveillance. The study did not include patients attending for bowel cancer screening. Despite this selection bias, we believe the results remain generalizable because the size and location of polyps were reflective of the wider population. A further strength of the present study related to the use of marker biopsies to define the start and end point of each examination, which avoided researcher bias with regard to designating the position of polyps, particularly those near flexures.

Although we planned initially to compare polyp detection in different patient positions while the colonoscope was withdrawn through the sigmoid colon, some patients had discomfort during reintubation and were therefore not examined twice. In addition, some polyps were identified in areas of the sigmoid colon that were considered easy to miss during a second examination and consequently were removed during the first withdrawal. Data regarding the sigmoid colon were therefore not appropriate for analysis because of the biases introduced. The only study to compare withdrawal positions in the sigmoid colon was performed by Köksal et al,[14] who reported that examination of the sigmoid colon in the supine, right lateral, and left lateral positions increased polyp detection compared with the left lateral position. As noted, it is not possible to state whether this increase was related to the repeat examination or the change in position. The variation in sigmoid colon anatomy is such that the ideal position may vary between patients, and, at present, we suggest that colonoscopists use position change in the sigmoid colon if luminal distension is poor, and views are suboptimal.

In summary, we have shown that examining the right side of the colon with the patient in the left lateral position during colonoscope withdrawal is associated with increased luminal distension and greater polyp and adenoma detection. This is complementary to previous studies that report that the optimal position to examine the transverse colon is the supine position. Position change appears to be less important in the left side of the colon, but we advocate its use when views are suboptimal. Position change during colonoscope withdrawal should be recommended as routine in endoscopic practice.

REFERENCES

1. Cancer Incidence and Mortality in the United Kingdom, 2008-2010. Office for National Statistics 2012. Available at: http://www.ons.gov.uk/ons/rel/cancer-unit/cancer-incidence-and-mortality/2008-2010/stb-cancer-incidence-and-mortality-in-the-united-kindom–2008-2010.html. Accessed July 2014.
2. Brenner H, Chang-Claude J, Seiler CM, et al. Protection from colorectal cancer after colonoscopy: a population-based, case-control study. Ann Intern Med 2011;154:22-30.
3. Baxter NN, Goldwasser MA, Paszat LF, et al. Association of colonoscopy and death from colorectal cancer. Ann Intern Med 2009;150:1-8.
4. Rex DK, Cutler CS, Lemmel GT, et al. Colonoscopic miss rates of adenomas determined by back-to-back colonoscopies. Gastroenterology 1997;112:24-8.
5. Ahn SB, Han DS, Bae JH, et al. The miss rate for colorectal adenoma determined by quality-adjusted, back-to-back colonoscopies. Gut Liver 2012;6:64-70.
6. Heresbach D, Barrioz T, Lapalus MG, et al. Miss rate for colorectal neoplastic polyps: a prospective multicenter study of back-to-back video colonoscopies. Endoscopy 2008;40:284-90.

7. van Rijn JC, Reitsma JB, Stoker J, et al. Polyp miss rate determined by tandem colonoscopy: a systematic review. Am J Gastroenterol 2006;101:343-50.
8. Kaminski MF, Regula J, Kraszewska E, et al. Quality indicators for colonoscopy and the risk of interval cancer. N Engl J Med 2010;362:1795-803.
9. Corley DA, Jensen CD, Marks AR, et al. Adenoma detection rate and risk of colorectal cancer and death. N Engl J Med 2014;370:1298-306.
10. Lee RH, Tang RS, Muthusamy VR, et al. Quality of colonoscopy withdrawal technique and variability in adenoma detection rates (with videos). Gastrointest Endosc 2011;74:128-34.
11. Rex DK. Colonoscopic withdrawal technique is associated with adenoma miss rates. Gastrointest Endosc 2000;51:33-6.
12. East JE, Suzuki N, Arebi N, et al. Position changes improve visibility during colonoscope withdrawal: a randomized, blinded, crossover trial. Gastrointest Endosc 2007;65:263-9.
13. East JE, Bassett P, Arebi N, et al. Dynamic patient position changes during colonoscope withdrawal increase adenoma detection: a randomized, crossover trial. Gastrointest Endosc 2011;73:456-63.
14. Köksal A, Kalkan IH, Torun S, et al. A simple method to improve adenoma detection rate during colonoscopy: altering patient position. Can J Gastroenterol 2013;27:509-12.
15. Ou G, Kim E, Lakzadeh P, et al. A randomized controlled trial assessing the effect of prescribed patient position changes during colonoscope withdrawal on adenoma detection. Gastrointest Endosc 2014;80:277-83.
16. Cairns SR, Scholefield JH, Steele RJ, et al. Guidelines for colorectal cancer screening and surveillance in moderate and high risk groups (update from 2002). Gut 2010;59:666-89.
17. Prescott J. The comparison of success rates in cross-over trials in the presence of an order effect. J R Stat Soc 1981;30:9-15.
18. Senn S. Cross-over trials in clinical research, 2nd ed. Chichester: John Wiley and Sons; 2002.
19. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159-74.
20. Ball A, Campbell J, Riley S. Position change during colonoscope withdrawal: Is it worth the effort? Gastrointest Endosc 2014;80:914-5.
21. Brenner H, Hoffmeister M, Arndt V, et al. Protection from right- and left-sided colorectal neoplasms after colonoscopy: population-based study. J Natl Cancer Inst 2010;102:89-95.