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Colorectal adenomatous and serrated polyps in rural South Australia: who, why, what and where?

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Abstract

Backgrounds: The adenoma-carcinoma and serrated pathways offer a window of opportunity for the removal of pre-malignant polyps and prevention of colorectal cancer (CRC) through the use of colonoscopy. The aim of this study was to investigate variation in polyp incidence in different age groups, gender and indications for undertaking colonoscopy. We also address histological types of polyps found and where in the bowel they are located.
Methods: This study is based on the colonoscopy data collected prospectively over a one-year period in multiple South Australian rural centres, 24 general surgeons contributed to this study. All histopathology results were subsequently entered into the dataset.
Results: A total of 3497 colonoscopies were performed, with a total of 2221 adenomatous and serrated polyps removed. Both serrated and adenomatous polyps were more common in the distal colon. Patients of male gender, aged 70 years and over and with an indication of polyp surveillance had higher adenoma and serrated polyp detection rates (ADR and SPDR). Patients aged 40–49 years old who underwent colonoscopy for positive faecal occult blood had an ADR and SPDR of 25.0% and 6.3%, respectively.
Conclusions: This study has shown variation in ADR and SPDR depending on age, gender and indication for colonoscopy. This variation will help further develop key performance indicators in colonoscopy. The high ADR and SPDR in patients aged 40–49 years old whom underwent colonoscopy for positive faecal occult blood may support lowering the age of commencement of CRC screening in Australia.

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Introduction

Colorectal cancer (CRC) is the second highest cause of cancer related death in Australia.[1] Approximately two-third of CRC arises from conventional adenomas, however, the serrated pathway is also a significant cause of CRC.[2]

The adenoma-carcinoma and serrated pathways offer a window of opportunity for the removal of pre-malignant polyps and prevention of CRC through the use of colonoscopy. This has led to increasing emphasis on high quality colonoscopy to ensure the detection and removal of adenomatous (AP) and serrated polyps (SP).

The World Health Organization (WHO) Classification of Tumours of the Digestive System was published in July 2019 and provided an update of the nomenclature used for colorectal neoplasms.[3] Conventional adenoma precursors include tubular, tubulovillous and villous adenoma. Differentiating between the conventional adenoma is dependent on the composition of villous architecture seen (over 80% for villous adenoma and between 25% and 80% for tubulovillous).[3] It is not clear whether the presence of villous histology increases risk of metachronous neoplasm or CRC,[1,4,5] however it is less common for villous histology to be present without other high risk features such as large diameter and high grade dysplasia.[6]

Over the past two decades, there has been increasing research into the importance of the serrated pathway which is implicated in approximately 30% of CRC.[1] SP are characterized by the serrated architecture of the epithelium and include hyperplastic polyps (HP), sessile serrated lesions (SSL), SSL with dysplasia and traditional serrated lesions (TSA).[3] In order to diagnose a SSL, the most recent WHO classification only requires a single abnormal crypt compared to previous classifications which required two or three adjacent crypts to be abnormal.[3] This will ultimately lead to more HP being now reclassified as SSL. Risk of malignancy seems to be greater for proximal polyps, polyps over 10 mm in diameter, presence of dysplasia and for TSA.[5]

There are numerous indications for colonoscopy including screening, polyp surveillance and for investigation/diagnosis of cause of symptoms such as bleeding per rectum or change of bowel habit. Some studies have reported variation in adenoma detection rate (ADR) depending on the indication for colonoscopy.[7,8] However, a recently published meta-analysis only showed an increased ADR for colonoscopies indicated for faecal occult blood.[9] A variation in ADR depending on indication has implications for performance measurement of colonoscopists as ADR is therefore influenced by the casemix of patients.

Large polyps confer an increased risk of metachronous CRC, especially those over 20 mm.[1,4] Increased number of adenomatous polyps is associated with metachronous CRC.[1] When both AP and SP are found the risk is additive and further increased when advanced features are present (e.g., degree of dysplasia and large size).[1,4,5]

Studies have shown that colonoscopy performed in rural areas is safe and effective, meeting key performance indicators (KPI).[10,11] This study is based on the data collected prospectively over a one-year period in multiple South Australian rural centres. We investigate variation in polyp incidence in different age groups, gender and indications for undertaking colonoscopy. We also address histological types of polyps found and where in the bowel they are located. Variation may impact CRC screening practices and assist in developing appropriate key performance indicators in colonoscopy for ADR and serrated polyp detection rate (SPDR).

Methods

Mount Gambier and Districts Health Service, Millicent and District Hospital and Health Service, Naracoorte Health Service, Port Lincoln Health Service, Port Augusta Hospital, Whyalla Hospital and Riverland General Hospital are regional hospitals located in South Australia. Twenty-four general surgeons and 12 surgical registrars who perform endoscopic procedures in these seven hospitals were approached and agreed to participate in this study. There are other rural and regional hospitals in South Australia that perform colonoscopy who were not approached to participate.

Prospective data collection occurred over a 12-months period (13/7/2020–12/7/2021) and included colonoscopy procedures performed in the participating hospitals by both consultant general surgeons and registrars under supervision. Not all participating general surgeons at the time of data collection had certification through the Gastroenterological Society of Australia for colonoscopy (20 general surgeons performed colonoscopy – 14 had certification throughout whole of the study period, 3 gained certification during the study period and 3 did not have certification). This cohort includes patients with previous colorectal resection, under the age of 50 or with inflammatory bowel disease.

Data were collected by the colonoscopists into a paper-based data sheet at the time of the procedure for each individual patient. Data collected included the patients' medical record number, indication for procedure and whether polypectomy performed. Colonoscopists were able to document multiple indications for a single procedure. Patient demographics were collected and entered into the dataset.

All histopathology specimens were sent to SA Pathology (SA Pathology, Adelaide, SA, Australia). for processing and reporting, SA Pathology is the statewide pathology provider for the public health sector in South Australia. Histopathology specimens were all reported on by consultant specialist pathologists. All histopathology results from polypectomies were entered into the dataset once they became available. The location of the polyp was taken from the 'request form information' provided to the pathology provider and the size of the polyp was taken from measurements of the specimen by SA Pathology. Histological subtype and degree of dysplasia were recorded from the pathology report.

The location of the polyp was then further classified into proximal, transverse and distal colon. Proximal colon included the caecum and ascending colon, transverse included the hepatic flexure, transverse colon and splenic flexure and the distal colon included descending, sigmoid and rectum.

Data was collated by the principal investigators for statistical analysis and interpretation.

Advanced adenoma (AA) included those with a villous component, diameter of over 10 mm and/or the presence of high grade dysplasia. A clinically significant serrated lesion (CSSL) was

defined as having one of the following features: HP with a diameter of over 10 mm, all SSL and all TSA. An advanced serrated lesion (ASL) refers to a SSL over 10 mm in diameter and/or with associated dysplasia or TSA of any size. This is the same classification used by the Cancer Council Australia Clinical Practice Guidelines for Surveillance Colonoscopy.[1]

Adenomatous polyp per colonoscopy and serrated polyp per colonoscopy were calculated as the total number of polyps detected for every 100 colonoscopies. Adenoma detection rate (ADR) and serrated polyp detection rate (SPDR) is defined as the proportion of colonoscopies at which one or more histologically confirmed AP or CSSL were removed respectively.

Ethical approval for this research project and publication of results was obtained through the Central Adelaide Local Health Network Human Research Ethics Committee and the Rural Support Service, South Australia Health (Approval Number 17688).

Statistical analysis was done using Microsoft Excel (Microsoft, Redmond, Washington, USA). Confidence intervals (CI) for proportions were calculated using Wilson's score interval and statistical significance was accepted with a *P*-value smaller than 0.05. Multivariate logistic regression analysis was undertaken for adenoma and serrated polyp detection and included patient demographic data and indication for colonoscopy. Results from multivariate logistic regression analyses were presented as odds ratios (OR) and CI.

Results

A total of 4622 patient encounters were entered into the dataset during the 12-months audit period, including patients who underwent colonoscopies, gastroscopies and flexible sigmoidoscopies. There were 3497 colonoscopies performed, complete to caecum in 96.1% [95.4, 96.7] and inadequate bowel preparation in 6.0% [5.2, 6.8] (Table S1). Mean patient age was 60.8 years, 53% of patients were male. Polypectomy was performed in 36.5% [34.9, 38.1] of colonoscopies, with an overall ADR of 25.6% [24.2, 27.1]. A total of 2221 SP and AP were found (Tables 1 and 2).

A total of 1570 AP were found, the most common histological subtype was tubular adenoma (85.5%) the rarest being villous adenoma (0.9%). The majority of AP exhibited low grade dysplasia (98.2%) and 20.5% were over 10 mm in diameter. A larger number of AP were located in the distal colon compared to the proximal and transverse colon – this included all histological subtypes, degrees of dysplasia and size. A total of 431 AA were found (27.5% of the total number of AP). AA were more common in the distal colon (52.9% versus 14.2% in transverse colon and 32.9% in proximal colon).

A higher rate of AP were found upon colonoscopy with increasing age, with the 70 and over age group having an ADR of 34.7% and multivariate analysis confirming an OR of 1.88 (95% CI 1.43–2.46). The ADR and SPDR for the 40–49 year olds was lower than in all other age groups, although did not reach significance with multivariate analysis. Males had higher ADR and SPDR rate than females (OR 1.96, 95% CI 1.67–2.30 and OR 1.06, 95% CI 0.76–1.48 respectively). Indications of faecal occult blood (OR 1.93, 95% CI 1.57–2.37) and polyp surveillance (OR 2.09, 95% CI 1.66–2.63) were associated with higher rates of AP compared to other indications (Table 3).

A total of 651 SP were found, with a total of 226 CSSL and 50 ASL. SSL was the histological subtype in 29.0% of serrated polyps, with only 3.2% of these showing evidence of dysplasia. The rarest subtype of SP was TSA, with only seven found in total. 6.6% of HP were greater than 10 mm in size and 13.2% were found proximal to the descending colon. SSL, CSSL and ASL were more common in the distal colon compared to the proximal colon (Table 2). Similar to AP, there was an increase in CSSL found in patients with advanced age and in males. Polyp surveillance was associated with higher SPDR compared to other indications (Table 3) and was the only factor associated with CSSL detection that reached significance upon multivariate analysis (OR 2.18, 95% CI 1.38–3.43).

There were a total of 162 colonoscopies where there was a total of three or more AP found, 16 colonoscopies were there was three or more CSSL and 61 where both an AP and CSSL was found. Patients who had multiple AP or both an AP and SP found were more likely to be older in age (70–79 years of age OR 1.75, 95% CI 1.20–2.54) and have an indication of polyp surveillance (OR 2.54, 95% CI 1.88–3.43) (Table 4).

Table 1 Distribution of all adenomatous polyps found during colonoscopy.

	Total number of polyps (*n*)	Proximal colon[†] (*n*)	Transverse colon[†] (*n*)	Distal colon[†] (*n*)
Histological classification				
Tubular adenoma	1342	500	258	584
Tubulovillous adenoma	214	73	22	119
Villous adenoma	14	3	4	7
Degree of dysplasia				
Low grade	1541	574	280	687
High grade	29	2	4	23
Size[‡]				
Less than 10 mm diameter	1248	470	235	543
10 mm of greater diameter	322	106	49	167
Advanced adenoma[§]	431	142	61	228

[†]Proximal colon includes the caecum and ascending colon, transverse includes the hepatic flexure, transverse colon and splenic flexure and the distal colon includes descending, sigmoid and rectum.

[‡]Size of polyp determined by measurement of pathology.

[§]Advanced adenoma includes all adenomatous polyps with a villous component, diameter of over 10 mm and/or the presence of high grade dysplasia.

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Table 2 Distribution of all serrated polyps found during colonoscopy.

	Total number of polyps	Proximal colon[†]	Transverse colon[†]	Distal colon[†]
Histological classification				
Hyperplastic – all (*n*)	455	24	36	395
Hyperplastic over 10 mm (*n*)	30	3	4	23
Sessile serrated lesion without dysplasia (*n*)	183	36	50	97
Sessile serrated lesion with dysplasia (*n*)	6	0	3	3
Traditional serrated adenoma (*n*)	7	1	0	6
Clinically significant serrated lesion (*n*)[‡]	226	40	57	129
Advanced serrated lesion (*n*)[§]	50	10	18	22

[†]Proximal colon includes the caecum and ascending colon, transverse includes the hepatic flexure, transverse colon and splenic flexure and the distal colon includes descending, sigmoid and rectum.

[‡]Clinically significant serrated lesion has one of the following features: Hyperplastic polyp with a diameter of over 10 mm, all sessile serrated lesions and all traditional serrated adenoma.

[§]An advanced serrated lesion refers to a sessile serrated lesion over 10 mm in diameter and/or with associated dysplasia or traditional serrated lesion of any size.

Table 3 Rates of adenomatous polyps and clinically significant serrated lesions with different demographic groups and indications for colonoscopy.

	Number of colonoscopies (*n*)		Adenomatous polyp found *n/polyp per colonoscopy rate*[‡] (%)/*detection rate*[§] (%)		Clinically significant serrated lesion found[†] *n/polyp per colonoscopy rate*[‡] (%)/*detection rate*[§] (%)		
Age (years)							
40–49	337	51	15.1 [11.7, 19.4][‖]	13.1 [9.9, 17]	15	4.5 [2.7, 7.2]	3.6 [2.1, 6.1]
50–59	759	321	42.3 [38.8, 45.8]	25.2 [22.2, 28.4]	46	6.1 [4.6, 8.0]	4.2 [3.2, 5.9]
60–69	1023	522	51.0 [48.0, 54.1]	27.7 [25.0, 30.5]	89	8.7 [7.1, 10.6]	4.5 [3.4, 6.0]
70 and over	1002	636	63.5 [60.4, 66.5]	34.7 [32.5, 38.4]	73	7.3 [5.8, 9.1]	5.4 [4.2, 7.1]
Gender							
Male	1791	1059	59.1 [56.8, 61.4]	32.3 [30.1, 34.5]	129	7.2 [6.1, 8.5]	4.6 [3.7, 5.7]
Female	1607	508	31.6 [29.4, 33.9]	19.5 [19.8, 23.8]	109	6.8 [5.6, 8.1]	4.1 [3.6, 5.7]
Indication[¶]							
Faecal occult blood	939	581	61.9 [58.7, 64.9]	34.8 [31.8, 37.9]	54	5.8 [4.3, 7.2]	4.3 [3.1, 5.8]
Bleeding per rectum	784	224	28.6 [25.5, 31.8]	19.0 [16.3, 21.8]	46	5.9 [4.4, 7.7]	4.3 [3.1, 6.0]
Polyp surveillance	558	428	76.7 [73.0, 80.0]	37.5 [33.5, 41.5]	76	13.6 [11.0, 16.7]	7.3 [5.5, 9.8]
Change in bowel habit	505	152	30.1 [26.3, 34.2]	17.2 [15.8, 22.7]	22	4.4 [2.9, 6.5]	3.4 [2.1, 5.3]
Family history[††]	374	115	30.7 [26.3, 35.6]	20.9 [17.0, 25.3]	16	4.3 [2.7, 6.8]	2.9 [1.7, 3.5]
Anaemia	172	63	36.6 [29.8, 44.0]	20.9 [15.5, 27.6]	8	4.7 [2.3, 8.9]	4.7 [2.3, 8.9]
Iron deficiency	164	53	32.3 [25.6, 39.8]	17.7 [12.6, 24.2]	2	1.2 [0.3, 2.9]	1.2 [0.3, 2.9]

[†]Clinically significant serrated lesion has one of the following features: Hyperplastic polyp with a diameter of over 10 mm, all sessile serrated lesions and all traditional serrated adenoma.

[‡]Polyp per colonoscopy was calculated by total number of polyps removed divided by total number of colonoscopies undertaken.

[§]Adenoma detection rate and serrated polyp detection rate defined as the proportion of colonoscopies at which one or more histologically confirmed adenomatous polyp or clinically significant serrated lesions were removed respectively.

[‖]Wilson's score interval used to calculate 95% confidence interval.

[¶]Multiple indications can be recorded for the same patient undergoing colonoscopy.

[††]At least one first degree relative diagnosed under the age of 55, two second degree relatives or suspected/confirmed familial colorectal cancer syndrome.

Discussion

There has been discussion to commence CRC screening at the age of 40 years in Australia due to the reported increased incidence of CRC in the younger population.[12,13] The results from this study show that patients aged 40–49 had lower adenoma detection rate (ADR) and serrated polyp detection rate (SPDR, 13.1% and 3.6%) compared to other age groups. However, other Australian studies have reported higher rates of adenomatous (AP) and serrated polyps (SP) in younger patients and especially in females.[12,14] Patients aged 40–49 years old who underwent colonoscopy for positive faecal occult blood had a higher ADR and SPDR of 25.0% and 6.3% respectively when compared to other indications for colonoscopy in this age group (Table S2). This may support reducing the age of commencement of CRC screening given the significant findings in patients with faecal occult blood aged 40 to 49 years of age.

There is still controversy over what represents a clinically significant serrated lesion (CSSL), with variation between inclusion criteria of colonoscopy surveillance clinical guidelines and certification criteria for colonoscopy.[1,4,5,15] Table 5 shows the variation (1.1%–9.3%) in reported SPDR of our study cohort depending on different guideline criteria used. This variation of inclusion criteria used makes comparison between different studies difficult depending on which guideline was used.

Studies have reported different results with regards to association of gender and sessile serrated lesions.[10,16,17] Our study showed an

Table 4 Comparison of demographic data of patients with multiple adenomatous polyps and both adenomatous and serrated polyps found upon colonoscopy.

	All colonoscopies	Adenomatous polyp: 1 in total found	Adenomatous polyp: 3 or more found	Adenomatous and serrated polyp[†]
Number of colonoscopies (*n*)	3497	529	162	61
Age (years)				
Mean	60.8	63.8	66.3	65.5
Median	62	65	68	68
Gender % [95% CI]				
Male	52.6 [51.1, 54.4]	59.9	72.2	59.0
Female	47.4 [45.8, 49.1]	40.1	27.8	41.0
Indication % [95% CI][‡,§]				
Faecal occult blood	26.8 [25.4, 28.3]	35.9	34.6	29.5
Bleeding per rectum	22.4 [21.0, 23.8]	18.9	11.1	24.6
Polyp surveillance	15.9 [14.7, 17.1]	20.0	33.3	31.1
Change in bowel habit	14.4 [13.3, 15.6]	10.2	9.3	11.5
Family history[‖]	10.0 [9.1, 11.0]	10.2	6.2	4.9
Anaemia	4.9 [4.2, 5.7]	4.5	5.6	3.3
Iron deficiency	4.6 [4.0, 5.4]	3.6	4.9	1.6

Abbreviation: CI, confidence interval.

[†]Includes clinically significant serrated lesions: Hyperplastic polyp with a diameter of over 10 mm, all sessile serrated lesions and all traditional serrated adenoma.

[‡]Wilson's score interval used to calculate 95% confidence interval.

[§]Multiple indications can be recorded for the same patient undergoing colonoscopy.

[‖]At least one first degree relative diagnosed under the age of 55, two second degree relatives or suspected/confirmed familial colorectal cancer syndrome.

increased CSSL in male patients (4.6% versus 4.1%), although the difference did not reach significance. Other Australian studies, on the other hand, have shown increased rates in female patients.[13,14,18] Despite having lower rates of CSSL, women may have higher rates of CSSL that then develop dysplasia and carcinoma.[19] Results for AP detection were also higher in males, this is consistent with previous studies.[20]

The CSSL and AP rates varied depending on the indication for colonoscopy, which has not been reported by others.[9] There is increasing emphasis on the identification of AP and even more so SP during colonoscopy as a quality indicator. Our study supports the notion that patient demographics and the indication for procedure need to be considered when determining key performance indicators as they appear to affect SPDR and ADR achieved.

Studies investigating the anatomic distribution of colonic polyps have shown the majority of AP being located in the left colon.[21] Our findings confirm the AP distribution reported by others. A number of studies have shown the majority of SP to be located in the right colon.[14,16] this observation has been implicated in the development right sided colon cancer.[16] We found the majority of CSSL to be located in the distal colon (56.3%). The variation of inclusion criteria between studies and the recent changes in classification of SP however makes comparison between studies difficult. Further research needs to be undertaken to further delineate which features of SP increases the risk of metachronous CRC.

There have been multiple studies investigating the variation in pathologist reporting of AP and SP and the impact on colonoscopists ADR and SPDR.[16,17,22] This appears to be of even more relevance for SPDR. Studies have reported a 24-fold variation in pathologist reporting of SP, probably further exacerbated by the changes in World Health Organization classification of *SP*.[22] With increasing focus on the detection and removal of SP and the serrated pathway as a cause of CRC, there needs to be increased efforts to ensure that not only variation in SPDR amongst colonoscopists is reduced but also variation in reporting of these lesions amongst pathologists needs to be reduced.

This study included patients whom underwent colonoscopy for all indications (e.g., inflammatory bowel disease and repeat excision of a known lesion). This may reduce comparability with other studies depending on the indications for colonoscopy of their

Table 5 Serrated polyp detection rates using different inclusion and exclusion criteria according to a number of clinical guidelines on polyp surveillance and re-certification guidelines.

	Serrated polyp detection rate (%)
Cancer Council Australia – Clinical practice guidelines for surveillance colonoscopy[†]	4.3
Gastroenterological Society of Australia – Colonoscopy Certification[‡]	5.4
European Society of Gastrointestinal Endoscopy – Post-polypectomy colonoscopy surveillance[§]	1.1
British Society of Gastroenterology/Association of Coloproctology of Great Britain and Ireland/ Public Health England – Post-polypectomy and post-colorectal cancer resection surveillance guidelines[‖]	9.3

[†]Includes hyperplastic polyp with a diameter of over 10 mm, all sessile serrated lesions and all traditional serrated adenoma.

[‡]Includes all hyperplastic polyp, sessile serrated lesions and traditional serrated adenoma proximal to the sigmoid colon.

[§]Includes sessile serrated lesions without dysplasia over 10 mm in diameter, all sessile serrated lesions with dysplasia and all traditional serrate adenomas.

[‖]Includes all hyperplastic polyps, sessile serrated lesions and traditional serrated adenoma. Excludes all hyperplastic polyps located in the rectum less than 5 mm in diameter.

patient cohort. The definition used for family history as an indication for colonoscopy in this study has been abbreviated from the risk categories outlined in the Cancer Council Australia Clinical Practice Guidelines for Surveillance Colonoscopy.[1] The definition used in this study included at least one first degree relative diagnosed under the age of 55 years, two second degree relatives or suspected/confirmed familial CRC syndrome. The Cancer Council Australia Clinical Practice Guidelines for Surveillance Colonoscopy divide patients into risk categories, with patients in risk category 2 or 3 recommended to undergo colonoscopy as a screening investigation. Therefore, the definition used in this study is not identical to that specified in the Cancer Council Australia guidelines and is a limitation of this study.

Our study included results from colonoscopies undertaken by consultant general surgeons with and without certification through the Gastroenterological Society of Australia and registrars at variable levels of seniority. All procedures performed by registrars were directly supervised by a consultant. Given the variable experience and training of colonoscopists participating in this study, this may have a potential impact on the quality of colonoscopy undertaken.

There has been increasing emphasis on appropriate colonoscopy polyp surveillance intervals and undertaking colonoscopy for surveillance in patients with a family history of CRC, however, this was not the primary focus of this study.[1] Therefore, it is not clear what proportion of patients undergoing surveillance colonoscopy in this study was at an appropriate interval and how this affected ADR and SPDR – a further study should be undertaken to investigate this.

This study has shown variation in ADR and SPDR depending on age, gender and indication for colonoscopy – answering the 'who' and 'why' for colorectal polyps found during colonoscopy in the rural South Australian population. This variation will help further develop key performance indicators in colonoscopy. The prevalence of AP and SP histological subtypes and location within the bowel were described – answering the 'what' and 'where'. The high ADR and SPDR in patients aged 40–49 years old whom underwent colonoscopy for positive faecal occult blood may support lowering the age of commencement of CRC screening in Australia.

Author contributions

Matthew M. Watson: Conceptualization; data curation; formal analysis; methodology; writing – original draft; writing – review and editing. **South Australian Rural Surgical Research Group:** Data curation; project administration. **Dianne C. Watson:** Data curation; project administration. **Guy J. Maddern:** Conceptualization; methodology; supervision; writing – review and editing. **Matthias W. Wichmann:** Conceptualization; methodology; supervision; writing – original draft; writing – review and editing.

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Conflict of interest

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1. Completion rate, bowel preparation adequacy and withdrawal time for all colonoscopies.
Table S2. Comparison of 40 to 49 year olds and 50 to 59 year olds undergoing colonoscopy.