RESEARCH

Findings on interval colonoscopies: an auditable performance indicator for colonoscopy quality?

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ABSTRACT

Objective An important marker of colonoscopy quality is detection of pathology and incidence of missed pathology. Back-to-back colonoscopies cannot ethically be performed for quality assurance alone yet may be required for clinical reasons. This study aims to investigate the incidence of new findings in colonoscopies repeated within a 12 month period and considers the role of such an analysis in the assessment of colonoscopy quality.

Design All colonoscopies performed over a 3-year period at an endoscopy training unit were studied. Colonoscopies repeated within a 12-month period were analysed.

Results 5747 colonoscopies were performed over the study period. 137 repeat colonoscopies were included with median interval from initial colonoscopy of 174 days. 19 (14%) repeat colonoscopies yielded new findings including one cancer, 234 days following a normal colonoscopy. Additional polyps were identified in 13 colonoscopies indicating a missed polyp rate of 9%. In these, a median number of two polyps per colonoscopy with median size 5.5 mm were found. There was no morbidity associated with repeat colonoscopy in this series. New findings on repeat colonoscopy appeared more likely following initial colonoscopy by non-consultant non-training grade endoscopists (23% vs 11%, $p=0.09$) yet small numbers involved preclude meaningful comparison.

Conclusions Analysis of clinically indicated repeat colonoscopies and rate of detection of new pathology may offer utility in colonoscopy quality assurance and would offer a direct assessment of the most important aspect of colonoscopy quality.

INTRODUCTION

Colonoscopy is the gold standard diagnostic investigation for patients with lower gastrointestinal symptoms or an

increased risk of colorectal cancer (CRC), yet is associated with a moderate risk of missed adenomas and cancers.¹⁻⁴ A missed cancer may result in a significant delay to diagnosis and a worse prognosis.⁵ In recognition of this, recent decades have seen a determined drive to improve the training and quality of colonoscopy. Audit of colonoscopists and endoscopy units is now undertaken to ensure high colonoscopy quality. In the UK, audit criteria includes adenoma detection rate (ADR), quality of bowel preparation and caecal intubation rate (box 1).

However, ADR acts only as a surrogate for missed pathology while auditing incidence of postcolonoscopy CRC may be complicated by the incidence of 'de novo' lesions. Back-to-back or interval colonoscopy studies offer a more accurate measure of missed pathology yet such studies cannot ethically be performed within a clinical setting for quality assurance alone. Cost implications and the risk of complications would also prohibit regular back-to-back colonoscopy studies. However, repeat colonoscopies are required in some clinical situations including the need to undertake therapeutic procedures (eg, endoscopic mucosal resection in the absence of anticoagulation), short-interval inflammatory bowel disease (IBD) or polyp surveillance, or following equivocal biopsies on initial colonoscopy. Analysis of such repeated procedures may offer some utility in assessing incidence of missed pathology.

The study aims to investigate the incidence of new findings on all repeat colonoscopies within a 12-month period and considers the value of auditing interval colonoscopies in assessing colonoscopy quality.

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Box 1 British Society of Gastroenterology quality indicators for colonoscopy and flexible sigmoidoscopy

Quality indicators

90% unadjusted completion rate for colonoscopy
 Adenoma detection rate >10% for colonoscopy and flexible sigmoidoscopy
 Polyp recovery >90%
 Good quality bowel prep >90%
 Diagnostic colorectal biopsies for persistent diarrhoea (100%)

METHODOLOGY

Study sample

A retrospective cohort study was performed at two endoscopy units within a single National Health Service (NHS) trust. All patients undergoing colonoscopy over the period 2008–2010 were identified from SQL scope endoscopy reporting database (Unisoft Medical Systems, Middlesex, UK). All patients undergoing colonoscopy for any indication were included in the initial data set. Inpatient and outpatient procedures were included, while patients from the bowel cancer screening programme were also included. Duplicate entries were assessed to identify patients undergoing repeat colonoscopy within any 12-month period. All patients with two or more colonoscopies within a 12-month period were included. Repeat colonoscopy following an initial 'incomplete' colonoscopy or following inadequate bowel preparation as recorded on SQL scope were excluded. No further exclusion criteria were applied.

Data collection

Data was collected from the electronic SQL scope database, pathology reports and multidisciplinary team (MDT) reports and used to populate a Microsoft Excel (Microsoft, Seattle, USA) study database. Data collected for included records (initial and repeat colonoscopy) included: demographics, indication, colonoscopist grade and specialty, and presence of anticoagulation or other factors relevant to repeat colonoscopy.

Outcomes

The primary outcome of interest was incidence of repeat colonoscopy and incidence of missed cancer. Secondary outcomes were incidence of missed polyps and other colonic pathology. Data were stored in and analysed using Microsoft Excel (Microsoft, Seattle, USA).

Approval and data storage

The study was registered with the local NHS trust research and audit department. Regional ethics committee approval was not deemed necessary. All data were kept anonymised-linked and stored within a password-protected database.

Colonoscopy details and metadata

All procedures were carried out by or under the supervision of a Joint Advisory Group on Endoscopy (JAG) certified colonoscopist. During the study period, high definition endoscopy systems and carbon dioxide insufflation were not used and insertion and whole procedure or withdrawal times were not recorded.

RESULTS

A total of 5747 colonoscopies across the trust were performed over the 3-year study period. 193 (3%) colonoscopies were identified as repeated procedures within ≤ 12 months. Of these 56 repeated colonoscopies were excluded due to an initial incomplete procedure (inadequate bowel preparation $n=52$, patient discomfort $n=4$). One hundred and thirty-seven repeat colonoscopies were included for analysis, with median age in this cohort of 68 (range 23–89) years and 74 (54%) men. The median interval from initial to repeat colonoscopy was 174 (48–214) days.

Colonoscopy indication and findings

Indications for initial and repeat colonoscopy are listed in [table 1](#).

Findings on initial and repeated colonoscopy in the cohort were compared ([table 2](#)). Of note, of the total of 137 repeated procedures, 49 were normal while polyps were found in 66 (48%) and cancer in 2 patients. When compared with the previous findings, 19 (14%) of the repeat colonoscopies yielded new findings. These included additional polyps ($n=13$), diverticular disease ($n=3$), colitis ($n=1$), Crohn's disease ($n=1$) and a new cancer ($n=1$). The new finding of a cancer was found 234 days following a normal colonoscopy. The indication in this case was persistent symptoms and one malignant villous tumour (35 mm) in the proximal transverse colon was identified. Endoscopic mucosal resection (EMR) was performed and after resection histology showed a staging of T2N0M0. The second cancer on repeat colonoscopy was found in the area of an 'equivocal biopsy' on the initial colonoscopy and so is not considered a 'missed cancer'.

All repeat colonoscopies reporting polyps were analysed. The polyp detection rate on initial colonoscopy was 50% ($n=69$) and on repeat colonoscopy 49% ($n=67$). In four patients, polyps were not found on initial colonoscopy but were reported on repeat colonoscopy. Of these, one underwent repeat colonoscopy for IBD surveillance, while the other three had

Table 1 Indications for colonoscopy

Indication	All patients	Included patients Initial colonoscopy	Included patients Repeat colonoscopy
Change in bowel habit	1478 (26%)	23 (17%)	9 (7%)
Rectal bleeding	1095 (19%)	12 (9%)	3 (2%)
Anaemia	1026 (18%)	18 (13%)	6 (4%)
Abdominal pain	770 (13%)	8 (6%)	5 (4%)
Previous history/recent diagnosis of CRC	629 (11%)	10 (7%)	0
Polyp surveillance or requirement for polypectomy	556 (10%)	42 (31%)	85 (62%)
Constipation	352 (6%)	0	0
Bowel cancer screening patient	347 (6%)	4 (3%)	0
Inflammatory bowel disease surveillance	346 (6%)	14 (10%)	13 (9%)
Family history of colorectal cancer	199 (3%)	2 (1%)	0
Abnormality on previous imaging investigations	64 (1%)	4 (3%)	14 (10%)
Bleeding postpolypectomy	0	0	2 (1%)

Sum of percentage values exceeds 100 as multiple indications were present for some colonoscopies.
CRC, colorectal cancer.

persisting or new symptoms. A further nine patients who had polyps diagnosed on initial colonoscopy were found to have additional new polyps on repeat colonoscopy. The indication for these patients included polyp surveillance (n=8), and requirement for EMR (n=1). The additional polyp detection rate was therefore 9% (13 patients out of 137) at median interval to repeat colonoscopy of 174 days. A total number of 26 new polyps were reported on repeat colonoscopy in these 13 patients, with a median number of 2 new polyps. Median polyp size was 5.5 mm with five polyps ≥ 10 mm. Of the polyps 12 were reported as sessile and 3 pedunculated with a further 11 not classified on the endoscopy report. Analysis of polyp site revealed that new polyps were most commonly found in the sigmoid (n=7, 27%) and transverse colon (n=7, 27%). Overall new polyp detection appeared slightly higher in the right colon,

with 62% (n=16) of the 26 new polyps found proximal to the splenic flexure (table 3). Given the small numbers, comparative statistics were not applied.

Grade and specialty of colonoscopist

The majority of initial colonoscopies were performed by consultants (59%), while a slightly greater proportion of the repeat procedures were performed by a consultant (66%) (table 4). Of note, initial colonoscopy performed by non-consultant, non-training grades appeared more likely to yield new findings on repeat colonoscopy compared with those by consultant and trainee grades, although small numbers precluded statistical comparison (table 5) (23% vs 11%).

Finally all colonoscopists were considered as medical (including trainees, GPs and nurse specialists) or surgical endoscopists (surgical associate specialists and consultants). Of the 137 initial colonoscopies, 101 (74%) were performed by medical endoscopists. Of those initial colonoscopies yielding new findings on repeat a similar proportion (79%) was carried out by medical endoscopists. Gastroenterology consultants performed 54 (39%) of the initial colonoscopies, with 8 (15%) yielding new findings on repeat. Colorectal

Table 2 Findings on initial and repeat colonoscopy in included patients

Finding	Initial colonoscopy	Repeat colonoscopy	New findings on repeat colonoscopy
Polyp/s	69	67	13
Normal	52	49	—
Inflammatory bowel disease	10	12	2
Equivocal lesion	4	1	0
Diverticular disease	3	6	3
Cancer	1	2	1
Incomplete bowel preparation	0	1	—

Multiple findings may be present in each colonoscopy, hence sum of findings exceeds number of colonoscopies.

Table 3 Site of new polyps found on repeat colonoscopy

Site	Number
Sigmoid	7
Transverse	7
Ascending	5
Caecum	4
Rectum	2
Descending	1

Table 4 Grade of colonoscopist at initial and repeat colonoscopy

Grade	Initial	Repeat
Consultant	81 (59%)	90 (66%)
Trainee	30 (22%)	29 (21%)
Associate specialist	9 (7%)	5 (4%)
GP	12 (9%)	8 (6%)
Nurse specialist	5 (4%)	5 (4%)

consultants performed 27 (20%) of the initial colonoscopies, with 2 (7%) yielding new results on repeat. Given the small numbers of patients involved and lack of colonoscopy meta-data to match patients, comparative statistics have not been applied.

Comparison against existing quality indicators

The 137 initial colonoscopies in the included sample were assessed against existing quality indicators. The study exclusion criteria excluded instances of incomplete colonoscopy or poor bowel preparation as described above and so the 137 included colonoscopies were all completed with the ileocaecal valve with good bowel preparation. Polyp detection rate was 50% (n=69, not exclusive to adenomas) and recovery of excised polyps was 97% (105 polyps recovered from 108 excised). Meanwhile, of those with persistent diarrhoea (n=15), all 15 (100%) had colorectal biopsy series taken.

Performance against other quality indicators for all colonoscopies performed within the unit in 2013 is available in the online supplementary table S1.

DISCUSSION

A moderate number of colonoscopies in our trust is repeated each year for valid clinical reasons (n=137). Analysis of repeated colonoscopies reveals a significant number of procedures with new findings (n=19), which likely represents previously missed pathology, and includes a missed polyp rate of 9% and the finding of a single new cancer. We propose that the analysis of repeat colonoscopies should be considered as an additional indicator of colonoscopy quality.

Table 5 Comparison of grade of colonoscopist and incidence of 'missed pathology' at initial colonoscopy

Grade	Initial colonoscopy with 'missed' pathology
Consultant	10 (12%)
Trainee	3 (10%)
Associate specialist	2 (22%)
GP	3 (25%)
Nurse specialist	1 (20%)

ADR is used as an important marker of colonoscopy quality but considers how many adenomas were detected, and crucially, not how many were missed. Missed polyp or cancer rates are calculated from prospective follow-up studies and more rarely tandem or back-to-back colonoscopy studies, yet these require long follow-up periods or repeated invasive procedures which without clinical justification are ethically unacceptable. The present study presents a proof of principle that the analysis of clinically indicated repeat colonoscopies may be used as an additional means to assess colonoscopy quality.

Definition of this potential standard requires assessment of performance against existing criteria. The British Society of Gastroenterology recommend an ADR of >10%, while in the present study, polyp detection rate was 50% in the 137 initial colonoscopies. However, this includes non-adenomatous polyps and is likely further increased by sampling bias given the inclusion criteria. Meanwhile, our study demonstrates a satisfactory polyp recovery rate in these 69 patients (97%) compared with the British Society of Gastroenterology prescribed rate of >90%.

The new polyp detection rate in the repeat colonoscopies (9% in this study) likely represents missed rather than 'de novo' polyps given the short median interval of 174 days and the known natural history of polyp development.⁶ Studies employing back-to-back colonoscopies or comparison with resected specimens report adenoma miss rates of 24–26%.^{1 7 8} In our study the high polyp rate in the initial colonoscopies (due to sampling bias) likely reduces the overall polyp miss rate, while it is probable that an improvement over time in training and equipment alongside a greater focus on polyp detection has contributed to the observed improvement. Meanwhile, the present suggests a greater polyp miss rate in the right colon as has been reported previously, although the small numbers preclude statistical comparison. Nevertheless, additional vigilance is advised when progressing beyond the splenic flexure.

Of course the most damaging of missed pathology is that of CRC. In this series, a new cancer was found on repeat colonoscopy performed for persisting symptoms at an interval of 234 days. Although the cancer here likely represents a missed cancer, rapidly progressive CRC is known to occur, perhaps due to differing gene expression and molecular characteristics,⁹ and this concept supports the possibility of an 'early' post-colonoscopy CRC after a truly normal colonoscopy. The finding of one post-colonoscopy colorectal cancer (PCCRC) here (0.7%) represents a significantly lower rate than in prospective observational studies, yet without longer and more comprehensive follow-up, real comparisons cannot be drawn.

We considered some factors that may contribute to missed pathology. Repeat colonoscopy after initial colonoscopy performed by non-consultant non-training

grade endoscopists (eg, GP, associate specialist or nurse specialist) appeared more likely to yield new findings (23% vs 11%). However the study is not adequately powered for this outcome and without data on grade of endoscopist for all colonoscopies over the study period and further matching, comparative statistics should not be applied. Nevertheless it is important to emphasise the importance of appropriate training, accreditation and audit of all practitioners undertaking endoscopy.

The major limitation of this study is that data on colonoscopy finding and colonoscopists is limited to those patients undergoing repeat colonoscopy. As a result, data on quality criteria and colonoscopy meta-data for all colonoscopies over the study period are not available. Furthermore, the methods will not identify patients who have undergone repeat colonoscopy in a different unit, or who have been diagnosed with pathology by alternate means (eg, emergency surgery or radiological investigations). However, more recent audit data (online supplementary table S1) indicates a high performance at the unit against which to consider the results of this study. Additional data (eg, colonoscopist experience, use of sedation and analgesia and procedure time) considered alongside comprehensive prospective follow-up to identify all cases of PCCRC would further define the value of missed pathology on repeated colonoscopies in assessing individual or unit colonoscopy quality.

CONCLUSIONS

This study analyses findings from clinically indicated colonoscopies and reveals a missed pathology rate of 9%, including one cancer. Analysis of clinically indicated repeat colonoscopies and rate of detection of new pathology may offer utility in colonoscopy quality assurance and would offer a direct assessment of the most important aspect of colonoscopy quality. A multicentre study comparing the rate of missed pathology on repeat colonoscopies with performance against existing quality criteria and the rate of prospectively assessed postcolonoscopy CRC will confirm the role of this new criterion and define an appropriate standard.

What is already known in this topic?

- ▶ Colonoscopy is associated with a moderate risk of missed adenomas and cancers.
- ▶ A number of performance indicators for colonoscopy quality exist, yet do not directly measure the incidence of missed pathology.

What this paper adds

- ▶ This paper measures the incidence of new pathology in patients undergoing a repeat colonoscopy within 12 months.
- ▶ We propose adopting such an analysis as an additional indicator of colonoscopy quality.

How it might impact on clinical practice in a foreseeable future

- ▶ Regular audit of findings on clinically indicated repeat colonoscopies could be introduced as an additional performance indicator for colonoscopy quality.
- ▶ Such an indicator may more accurately predict overall incidence of missed pathology compared to existing surrogate markers such as adenoma detection rate.

Contributors MA: project conception, data collection and analysis; PGV-S: project conception, data collection and analysis, manuscript preparation; KS: manuscript preparation; PR: data collection and analysis; AG: project conception, manuscript preparation.

Competing interests None.

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