RESEARCH

Colonic lesion characterisation skills among UK endoscopists and the impact of a brief training intervention

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ABSTRACT

Objective To assess UK gastroenterology registrars' and consultants' competence in in vivo characterisation of polyps, plus the impact of a dedicated colonic lesion characterisation training intervention.

Design Prospective evaluation of a computer-based colonic lesion training module.

Setting Three UK general hospitals.

Patients High-quality endoscopic images obtained during colonoscopy in a previous study.

Interventions 30 min computer-based training module covering in vivo characterisation of colonic lesions viewed under white light, chromoendoscopy and magnification chromoendoscopy.

Main outcome measures Accuracy of characterisation of colonic lesions (hyperplastic vs adenoma vs cancer) before and after training and differences between groups (bowel cancer screening (BCS) nurses vs gastroenterology trainees vs consultant gastroenterologists).

Results Mean accuracy pretraining was 61.1%, 67.6% and 60.0% for the trainee, consultant and nurse groups respectively with no significant difference between the groups. Mean accuracy post-training improved significantly to 71.2%, 72.6% and 67.2% for the trainee, consultant and nurse groups ($p < 0.001$ vs pretraining) with no significant difference between the three groups. Mean sensitivity and specificity improved significantly for the 15 participants overall.

Conclusions The baseline level of colonic lesion characterisation skills is limited for gastroenterology consultants and trainees and does not differ from that of non-endoscopist BCS nurses. Accuracy of lesion characterisation can be modestly improved with a brief computer-based training intervention. Lesion characterisation should become a standard part of training in colonoscopy, and should be learnt

alongside technical skills for endoscope handling and therapeutic procedures.

INTRODUCTION

Accurate characterisation of colonic lesions is required for their optimal management during colonoscopy. Benign adenomatous polyps should be endoscopically resected, but lesions demonstrating endoscopic features suggestive of deep submucosal invasion should be tattooed, biopsied and referred for surgical resection. Distal hyperplastic polyps have negligible malignant potential and therefore can in theory be safely left in situ. However, the practice of most colonoscopists at present is to remove all polyps. Many recent studies have focused purely on distinguishing between small adenomatous and hyperplastic polyps.^{1–6} However, identifying endoscopic features of malignant polyps is also a key skill for colonoscopists.

Data from the UK national colonoscopy audit suggest that approximately half a million colonoscopies are performed in the UK each year.⁷ During the course of their career, most endoscopists who perform regular colonoscopy will perform several thousand colonoscopies, and therefore encounter and manage several thousand colonic lesions.

In the UK, completion rates, sedation levels and safety of colonoscopy are assessed as a routine part of training,⁸ monitored and enforced by the Joint advisory Group (JAG) for gastrointestinal endoscopy. More recently, the Direct Observation of Polypectomy Skills (DOPyS) has been introduced, which assesses skills in polypectomy.⁹ Currently,

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neither the JAG assessment process nor the 2010 gastroenterology higher specialist training curriculum includes any formal training in the skills of colonic lesion characterisation.¹⁰

We aimed to assess UK gastroenterology registrars' and consultants' competence in in vivo characterisation of polyps, plus the impact of a dedicated colonic lesion characterisation training intervention.

METHODS

This study was a prospective evaluation of a computer-based training module. The study received no specific grant from any funding agency in the public, commercial or not-for-profit sectors. An existing image library of 37 colonic lesions developed as part of a previous study¹¹ was used. All patients from whom images were obtained provided informed consent. As this study was an evaluation of an educational intervention, no formal ethical approval was sought.

The 37 lesions consisted of 13 hyperplastic polyps, 15 adenomatous polyps and 9 submucosally invasive cancers. High-quality images of each lesion viewed in three modalities were used: white light (WL), 0.2% indigo carmine (IC) and 0.2% indigo carmine with magnification (MIC), giving 111 images in total. IC is a widely available chromoendoscopy dye which can be used with any endoscopy platform. Images were incorporated into a Powerpoint presentation (Microsoft, UK) displaying one image per screen, with the three images of each lesion presented sequentially (WL-IC-MIC)—see [figure 1](#).

Participants were divided into four groups:-

- ▶ Five general consultant gastroenterologists without any special interest in in vivo diagnosis (*consultants*—median 2500, range 1500–5000 colonoscopies performed). Bowel cancer screening colonoscopists were not included.
- ▶ Five gastroenterology trainees StR3–StR7 (*trainees*—median 280, range 5–1000 colonoscopies performed)
- ▶ Five bowel cancer screening programme specialist nurses (*nurses*—not performing endoscopy)
- ▶ A UK based and Japanese expert endoscopists who both used in vivo diagnostic techniques on a regular basis in their daily practice (*experts*).

Participants were tested separately, and the same images were used for each participant. Participants were asked to classify the lesion displayed in each image as either a hyperplastic polyp, adenomatous polyp or invasive cancer, selecting one of these three options. No feedback was given and participants were unaware of the proportion of each type of lesion used in the study. Following this first testing phase, all participants in the trainee, consultant and nurse groups participated in a 30 min computer-based training module delivered by an experienced endoscopy research fellow. This included information on the principles of in vivo characterisation using WL,

chromoendoscopy and magnification endoscopy, lesion morphology using the Paris classification¹² and Kudo's pit patterns.^{13–15} The training modules incorporated several example images demonstrating pit patterns and lesion morphology. None of the test images were used in the training module. Participants in these three groups then repeated the testing phase in an identical manner. The overall time taken to complete test training and repeat test was 60–90 min per participant.

Statistical analysis

Participant classification of each lesion was compared with the formal histopathological diagnosis as established by an experienced specialist gastrointestinal histopathologist. Mean accuracy rates, sensitivity and specificity for neoplasia for each group of participants were calculated, with 95% CIs. For comparison of accuracy between groups, before and after training, one-way analysis of variance with post-hoc Tukey's test was used. For comparison of each group's accuracy, sensitivity and specificity before and after training, McNemar's test was used. The results of this study are considered experimental hypothesis-generating data, and hence no correction for multiple comparisons was made. A p value of <0.05 was considered statistically significant.

RESULTS

Accuracy pretraining

Prior to undergoing the training module, the mean overall accuracy was 61.1% for the trainee group, compared with 67.6% for the consultant group and 60.0% for the nurse group. The mean score for the two experts was 89.6%. Mean scores following the training module were 71.2% for the trainee group, 72.6% for the consultant group and 67.2% for the nurse group—see [table 1](#).

Comparison between groups prior to training showed that accuracy of lesion characterisation did not differ significantly between the consultant, trainee and nurse groups. The two experts performed significantly better than each of the other three groups.

Accuracy post-training

Following the training module, there was a significant improvement in the mean accuracy for all 15 participants. Subgroup analysis showed that significant improvement occurred in all three groups—see [table 1](#). The performance of the two experts remained significantly better than all three groups post-training (p<0.02 for all three comparisons).

Sensitivity and specificity

Mean sensitivity for neoplastic histology for the 15 participants improved significantly from 68.3% to 73.2%—see [table 2](#). When analysed by participant group, the increase in mean sensitivity post-training

Figure 1 Example images from image library of colonic lesions viewed with white light (WL), chromoendoscopy and magnifying chromoendoscopy. (A) Hyperplastic polyp, WL; (B) adenoma, WL; (C) invasive cancer, WL; (D) hyperplastic polyp, indigo carmine (IC), (E) adenoma, IC; (F) invasive cancer, IC, (G) hyperplastic polyp, MIC; (H) adenoma, MIC; (I) invasive cancer, MIC.

was limited to the nurse group, not reaching statistical significance for the consultant or trainee groups.

Mean specificity for all participants increased significantly from 52.8% to 64.7%—see [table 3](#). Analysis by group showed increased mean specificity in all three groups post-training, but the increase only reached statistical significance in the trainee group.

Performance by modality

Performance was also analysed by modality pretraining and post-training. For consultants and trainees, no significant difference in overall accuracy was found between WL, IC and MIC assessments either pretraining or post-training.

In the nurse group, pretraining accuracy was significantly higher for both IC and MIC assessments

Table 1 Overall accuracy pretraining and post-training

	Accuracy pretraining correct/total, % (95% CI)	p Value—comparison between groups	Accuracy post-training correct/total, % (95% CI)	p Value—comparison between groups	p Value—pretraining vs post-training change
All subjects (excluding experts)	1047/1665 62.9% (60% to 66%)		1170/1665 70% (67% to 74%)		<0.001
Consultant	375/555 68% (61% to 74%)	0.170*	403/555 73% (67% to 79%)	0.920*	<0.001
Trainee	339/555 61% (54% to 68%)	0.982†	395/555 71% (68% to 74%)	0.519†	0.037
Nurses	333/555 60% (56% to 64%)	0.092‡	372/555 67% (56% to 78%)	0.320‡	0.005
Experts	199/222 90% (85% to 93%)	<0.001§		<0.02§	

*Consultant versus trainee comparison.

†Trainee versus nurses.

‡Consultant versus nurse.

§Expert versus all three groups.

Table 2 Sensitivity for neoplasia pretraining and post-training

	Sensitivity pretraining correct/total, % (95% CI)	Sensitivity post-training correct/total, % (95% CI)	p Value
All subjects	738/1080 68% (63% to 73%)	791/1080 73% (70% to 76%)	0.002
Consultant	257/360 71% (59% to 84%)	271/360 75% (66% to 85%)	0.151
Trainee	245/360 68% (57% to 79%)	262/360 73% (68% to 78%)	0.100
Nurses	236/360 66% (54% to 77%)	258/360 72% (66% to 77%)	0.047

p Values comparing pretraining and post-training performance using McNemar's test.

compared with WL ($p=0.021$ and $p=0.016$ respectively). Post-training, no significant differences in accuracy were found between assessments made with the three modalities.

Interobserver agreement

Prior to training, mean κ values for interobserver agreement were 'poor' for the trainee (0.35) and nurse (0.39) groups and 'fair' for the consultant group (0.43). Mean κ values significantly increased following training for the consultant group ($p=0.002$) and trainee group ($p=0.027$) but not for the nurse group ($p=0.193$). Post-training levels of agreement were 'fair' for the nurse group (0.46) and consultant group (0.55) and 'good' for the trainee group (0.60).

DISCUSSION

In recent years, there has been a drive to improve the quality of colonoscopy in the UK, both in terms of the quality of patient experience and the main outcome measures such as caecal intubation and adenoma detection.^{7 16} Improved caecal intubation rates, bowel preparation and withdrawal techniques are known to improve colonic lesion detection.^{17–19} A less studied area is the quality of colonic lesion

interpretation and subsequent management of these lesions. Potential precursors of cancer such as adenomatous polyps and proximal serrated polyps should be removed. Distal hyperplastic polyps have negligible malignant potential, and a future paradigm may be that these can be left in situ if identified with high confidence.²⁰ Identification of invasive cancers is important as inappropriate attempts at endoscopic resection can compromise patient care.

This picture-based study examined colonic lesion characterisation skills in three groups of endoscopists (trainees, consultants and experts) plus UK bowel cancer screening nurses who do not perform any endoscopic procedures.

The results of this study demonstrate that the baseline level of lesion characterisation skills is limited for gastroenterology consultants and trainees.

Prior to the training intervention, there were no significant differences in accuracy between consultant, trainee and nurse groups. Post-training again, there was no difference in overall accuracy between the three non-expert groups. This is despite the consultant group having many years and several thousand procedures greater experience in colonoscopy and in vivo interpretation of hundreds and thousands of colonic lesions in real-life clinical practice. The results of this study suggest that there is room for improvement in lesion characterisation among both trainees and experienced consultants, with neither group performing any better than a group of non-endoscopist nurses. The two expert endoscopists who used in vivo diagnostic techniques such as IC chromoendoscopy frequently in their usual practice showed significantly higher accuracy levels than each of the other three groups. This is unsurprising and simply validates the assessment tool. These results would suggest that lesion characterisation skills are not simply obtained through routine colonoscopy experience. They appear to be specific skills which can be learnt through focused education and training.

Following the brief training intervention delivered to the three non-expert groups, the mean accuracy of the 15 subjects combined improved significantly, but the magnitude of the increase in accuracy was small. However, this does demonstrate that even a brief intervention can improve diagnostic accuracy. Subgroup analysis showed that a significant gain in mean accuracy was seen in all three groups, when the performance of the five participants in each groups was analysed together. However, improvement was not seen for every individual participant. Significant improvement in interobserver agreement was also seen in the consultant and registrar groups following the training intervention.

When sensitivity and specificity for neoplasia were assessed, there was a significant improvement for the 15 subjects analysed as a whole. However, when analysed by group, the improvement in sensitivity was

Table 3 Specificity pretraining and post-training

	Specificity pretraining correct/total, % (95% CI)	Specificity post-training correct/total, % (95% CI)	p Value
All subjects	309/585 53% (42% to 63%)	379/585 65% (55% to 74%)	<0.001
Consultant	118/195 61% (34% to 87%)	132/195 68% (54% to 82%)	0.161
Trainee	94/195 48% (23% to 73%)	133/195 68% (58% to 78%)	<0.001
Nurses	97/195 50% (28% to 71%)	114/195 58% (23% to 94%)	0.064

p Values comparing pretraining and post-training performance using McNemar's test.

only significant in the nurse group and improvement in specificity was only significant in the trainee group. Specificity in the trainee and nurse groups was lower pretraining than the consultant group, which may be explained by these groups being more risk averse and concerned about undercalling a potential neoplastic lesion. Consultants, by the nature of their job, are key decision makers and are more used to making risk judgements on a regular basis. It is also notable that post-training CIs were much narrower for sensitivity than for specificity, indicating greater variability between subjects in their ability to accurately characterise non-neoplastic lesions.

Overall the gains in accuracy seen following training were modest (from a mean of 63% to 70% for the 15 subjects overall). Previous similar studies have shown greater improvements in accuracy using a similar brief training intervention. Raghavendra *et al*²¹ demonstrated an improvement in accuracy from 47.6% to 90.8% in distinguishing hyperplastic and adenomatous polyps viewed with narrow-band imaging (NBI) following a 20 min training session. Ignjatovic *et al*²² performed a similar computer-based training study and showed improvement in differentiation between hyperplastic and adenomatous polyps viewed with NBI. A similar study to ours showed limited improvements with training in interpreting WL and chromoendoscopy images of hyperplastic and adenomatous polyps.¹¹ However, improvements in accuracy in interpreting NBI images were greater. Our study does differ from those described above in that three categories of colonic lesions were included (hyperplastic polyps, adenomatous polyps and early invasive cancers), rather than two (hyperplastic and adenomatous polyps) and hence the chances of a correct result from a 'guess' would be lower. We also used three different modalities (WL, IC, MIC) which may have added complexity and require a longer learning period. The difference in results may indicate that it is easier to learn interpretation of NBI rather than traditional chromoendoscopy but this remains to be proven.

Following training, the overall accuracy of the three non-expert groups fell well short of that achieved by experts. It is likely that to become highly proficient in in vivo characterisation requires learning through studying images and incorporation of advanced imaging and chromoendoscopy techniques into an endoscopists' regular daily practice over a prolonged period of time. Mentoring and teaching during real-life cases is also likely to be an important part of the learning process.

If in vivo diagnosis is to become a part of routine clinical care, then training programmes will need to be developed and robust methods for assessing competence established. This study would suggest that training is more complex than a simple brief intervention, and does not support the findings of earlier studies suggesting that in vivo diagnosis can be learnt in as

little as 20 min.^{21 22} This would be in keeping with the results seen in community-based in vivo characterisation studies where the results were suboptimal.^{2 23–25}

This study had some limitations: picture-based studies do not always reflect real life in vivo interpretation of lesions and the spectrum of lesions included a far higher proportion of early cancers than would be encountered in everyday practice.

In summary, our study showed gains in diagnostic accuracy of lesions viewed following a brief training intervention. Before and after training, there was no difference in mean accuracy between consultants, registrars and nurses; however, two expert endoscopists had significantly greater accuracy in lesion characterisation.

At present, even basic in vivo diagnostic skills and lesion characterisation do not feature in the curriculum for higher specialist trainees in gastroenterology in the UK. Given the advances in this field over the past few years, there is a strong case for lesion characterisation to become a standard part of training in colonoscopy, which should be learnt alongside technical skills for endoscope handling and therapeutic procedures and formally evaluated through DOPyS or other forms of competency assessment.

Key messages

What is already known on this topic?

- ▶ Accurate assessment of colonic lesions helps guide management during colonoscopy.
- ▶ Colonic lesion characterisation is not formally assessed as part of UK colonoscopy training.

What this study adds?

- ▶ Baseline colonic lesions characterisation skills do not differ between consultant gastroenterologists, gastroenterology trainees and non-endoscopist BCS specialist nurses.
- ▶ Characterisation skills can be modestly improved by a brief computer-based training intervention.

How might it impact on clinical practice in the foreseeable future?

- ▶ Lesion assessment and characterisation should be incorporated into colonoscopy training in the UK and formally assessed.

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