Original research

Dedicated service for Barrett's oesophagus surveillance endoscopy yields higher dysplasia detection and guideline adherence in a non-tertiary setting in the UK: a 5-year comparative cohort study

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ABSTRACT

Objective Barrett's oesophagus (BO) endoscopic surveillance is performed to varying quality, dedicated services may offer improved outcomes. This study compares a dedicated BO service to standard care, specifically dysplasia detection rate (DDR), guideline adherence and use of advanced imaging modalities in a non-tertiary setting.

Design/method 5-year retrospective comparative cohort study comparing a dedicated BO endoscopy service with surveillance performed on non-dedicated slots at a non-tertiary centre in the UK. All adult patients undergoing BO surveillance between 1 March 2016 and 1 March 2021 were reviewed and those who underwent endoscopy on a dedicated BO service run by endoscopists with training in BO was compared with patients receiving their BO surveillance on any other endoscopy list. Endoscopy reports, histology results and clinic letters were reviewed for DDR and British society of gastroenterology guideline adherence.

Results 921 BO procedures were included (678 patients). 574 (62%) endoscopies were on a dedicated BO list vs 348 (38%) on non-dedicated. DDR was significantly higher in the dedicated cohort 6.3% (36/568) vs 2.7% (9/337) (p=0.014). Significance was sustained when cases with indefinite for dysplasia were excluded: 4.9% 27/533 vs 0.9% 3/329 (p=0.002). Guideline adherence was significantly better on the dedicated endoscopy lists.

Factors associated with dysplasia detection in regression analysis included visible lesion

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Barrett's oesophagus endoscopic surveillance is performed to varying quality with longer segments routinely underbiopsied by endoscopists and guideline adherence often incomplete.
⇒ Oesophageal inspection times and optical enhancement have been shown to improve outcomes and studies involving tertiary referral centres have shown dedicated services can significantly improve dysplasia detection.
⇒ Dedicated Barrett's services are being developed in many UK trusts; however, no published studies in a purely non-tertiary setting have shown significant improvement in dysplasia detection.

WHAT THIS STUDY ADDS

⇒ This is the first comparative cohort study in a purely non-tertiary environment to show a significant improvement in dysplasia detection with a dedicated Barrett's service.
⇒ This study showed a dedicated Barrett's service had improved adherence to British Society of Gastroenterology guidelines across all measures compared with standard care.
⇒ The improvements in dysplasia detection were not necessarily down to the use of optical enhancement or acetic acid, but guideline adherence, especially more consistent Seattle protocol biopsies and targeted biopsies, improved outcomes.

⇒ This is valuable as most routine surveillance is performed in the non-tertiary environment and supports the development of specific Barrett's lists performed by endoscopists trained in surveillance technique and lesion recognition on a wider scale.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Improving the training of those involved in Barrett's endoscopy, and accreditation as per the model of bowel cancer screening, may help improve dysplasia detection.
⇒ Barrett's surveillance endoscopy could be organised on specific endoscopy slots with specifically trained endoscopists and with an appropriate procedure time to improve the quality and consistency of performance.
⇒ This study shows when there is improved guideline adherence more dysplasia is detected and does not necessarily need new equipment to achieve this.

documentation (p=0.036), use of targeted biopsies (p=<0.001), number of biopsies obtained (p≤0.001).

Conclusions A dedicated Barrett's service showed higher DDR and guideline adherence than standard care and may be beneficial pending randomised trial data.

INTRODUCTION

Barrett's oesophagus (BO) is a precursor lesion of oesophageal adenocarcinoma (OAC). It affects approximately 2% of the population in the UK and carries a per annum risk of progression to cancer of 0.33%.[1 2] Most patients with BO will not progress to OAC but some, due to a combination of demographic, genetic and environmental factors, may develop dysplastic BO (DBO) progressing to adenocarcinoma. Endoscopic treatments are widely available to treat DBO hence a key to prevention of OAC is detection at the dysplastic, or early neoplastic phase.

The British Society of Gastroenterology (BSG) and National Institute of Clinical Excellence have produced guidelines advising on endoscopic surveillance for BO to detect dysplasia, including the use of Seattle protocol biopsies—four quadrant biopsies at each 2 cm interval in the affected oesophagus—and targeting of visible lesions.[3 4] Image enhancement techniques are also widely available, which change the optical assessment of the image during endoscopy and can enhance areas of abnormal surface features or vasculature.[5 6] Dilute acetic acid causes a reversible surface change to the mucosa named acetowhitening and in the presence of dysplasia or neoplasia there is early loss of the acetowhitening allowing for targeted biopsies of these areas.[7] Both of these techniques have shown improvements in lesion recognition by expert and non-expert endoscopists in the research environment.[8]

Studies show that guideline adherence to the Seattle protocol can be beneficial to patients[9] but is inconsistently performed, with endoscopists routinely underbiopsying longer segments.[10] Northern Ireland data suggest dysplasia is frequently missed with rates of OAC cases having been missed at a prior endoscopy of 12.7%,[11] and in a US meta-analysis this was higher at 25%.[12]

In the UK, the majority of Barrett's surveillance endoscopy occurs ad hoc, with procedures interspersed with other endoscopic procedures such as colonoscopy and performed by clinicians who do not have specific detailed training in BO endoscopy or who perform low annual numbers. One proposal to address this is to develop a dedicated team of endoscopists with training in lesion recognition to perform BO surveillance on specific lists, as is the case for colorectal cancer screening. Dedicated BO services have been shown by Ooi *et al* to improve dysplasia detection in a mixed tertiary and non-tertiary study and other cohort studies show improved adherence to BSG surveillance guidelines.[13 14] Here, we present findings of a 5-year experience of a dedicated BO endoscopy service in a non-tertiary setting.

Objectives

- To compare dysplasia detection rate (DDR) for Barrett's surveillance endoscopy performed on a dedicated Barrett's endoscopy service by trained individuals versus routine clinical care in the same hospital.
- To compare adherence to the BSG guidelines for Barrett's endoscopic surveillance.
- To review other factors which may have improved dysplasia detection, namely use of image enhancement or dye spray and the use of targeted biopsies.

METHODS

Study design and setting

Using a prospectively maintained database, we examined 5 years of outcomes of Barrett's surveillance endoscopy of prevalent cases by a dedicated endoscopy service at a UK non-tertiary teaching hospital compared with routine care.

At this centre a dedicated endoscopy service has been performed by three clinicians: two gastroenterology higher specialty trainee clinical research fellows and one consultant gastroenterologist all of whom had training in BO and legion recognition and were performing high volumes of BO surveillance (>100 cases/year). Each BO endoscopic procedure was scheduled for 1.5 units (30 min) on a ring-fenced Barrett's list, with prior BO segments >10 cm given 2 units (40+ min). Hence, each list may consist of up to seven procedures depending on the lengths of BO.

In the comparison group, patients had their endoscopy performed on any list performed by an endoscopist trained and experienced in upper gastrointestinal (UGI) endoscopy. These clinicians had no expressed interest or specific training in Barrett's surveillance endoscopy beyond their initial UGI endoscopy training and experience, reflecting the current UK standard

practice of surveillance care. Cases were scheduled for 1.5 units and 2 units for long segments as above but could be scheduled on lists with any mixture of other cases.

For both groups, the indication for endoscopy was routine Barrett's surveillance and cases were of prevalent Barrett's. Barrett's surveillance cases were scheduled, usually from their prior surveillance endoscopy, onto endoscopy lists by a booking team separate from the endoscopists. All the same equipment was available for use by the endoscopists, use of acetic acid, narrow band imaging (NBI) or other modalities were at the discretion of the individual endoscopist.

The index surveillance endoscopy was the outcome, no future follow-up was performed in this study.

Participants

Inclusion criteria

- All adults >18 years of age.
- Prevalent cases of BO without prior known dysplasia.

Exclusion criteria

- Cases were not included in the data set if Barrett's had been found as an incidental finding (incident cases) or they had presented for endoscopy for an alternative reason but had a background of BO.
- Patients returning for a follow-up of prior dysplasia were excluded.

Variables

Demographic data were obtained for all participants including, age, sex, comorbidities and maximal length of Barrett's segment as per the Prague classification.

Data were obtained on endoscopy outcomes as per the BSG reporting guidelines, use of imaging modalities and histology results. Results were obtained from the index endoscopy alone, so dysplasia detection was determined by the histology results of the index endoscopy.

Bias

With a retrospective design, there is the risk of sampling bias, to mitigate this all patients who had BO documented anywhere in their endoscopy report were screened for inclusion via endoscopy reporting software Endosoft. An audit tool (Excel) was devised to standardise measurements recorded by research team members from the electronic patient records. Missing data were assessed and variables with <10% missing data were analysed with expectation maximisation to look for randomness, and if not likely missed at random, multiple imputation was performed to populate the missing values. To mitigate selection bias, patients who had prior dysplasia were excluded from the analysis.

Study size

Study period was chosen as it was deemed 5 years would allow for significant numbers of dysplasia to be detected.

Statistical analysis

Categorical variables are described as proportions and continuous variables are described as median with IQRs or mean with SD. There were missing data for variables of:

- Number of comorbidities.
- Prague C length.
- Prague M length.
- Number of total biopsies from report/histology.
- Number of biopsies/2 cm segment.

The missing data were analysed with expectation maximisation showing they likely not to have occurred at random (Little's Missing Completely at Random (MCAR) test χ^2 86.633 Dif 25, sig. $p \leq 0.001$) hence multiple imputation using 10 iterations was used to populate the missing values for these variables. All statistical analyses presented use the pooled multiple imputation dataset.

Analyses were performed by using the χ^2 test for categorical variables and independent t-test for continuous variables. Binary logistic regression was used to look for factors significant to dysplasia detection. A two-tailed $p<0.05$ was used to determine statistical significance. Statistical analysis was performed on IBM SPSS V.29.

RESULTS

A total of 921 BO surveillance procedures were included performed on 678 patents. Of these 574 (62%) were performed on a dedicated BO list vs 348 (38%) on the non-dedicated lists. Patient characteristics and demographics are outlined in table 1.

Dysplasia detection

Overall dysplasia detection in the dedicated group was 6.3% (36/568) vs 2.7% (9/337) in the non-dedicated group ($p=0.014$) (16 cases had no biopsies obtained). When indefinite for dysplasia (IDD) cases were excluded, DDR was 4.9% (27/553) dedicated vs 0.9% (3/329) non-dedicated ($p=0.002$).

Adherence to the BSG guidelines

Outcomes for adherence to the BSG minimum data set are outlined in table 2. Adherence to the BSG guidelines was significantly better in the dedicated service.

Further data relating to other endoscopy outcomes for each group are outlined in table 3.

Factors influencing dysplasia detection

Using binary logistic regression, factors associated overall with dysplasia detection included use of targeted biopsies (OR 4.6 95% CI 1.89 to 11.28, $p \leq 0.001$), number of biopsies taken ($p=0.001$), and

Table 1 Patient demographics and information regarding length of Barrett's segment for each cohort

	Dedicated N=574 endoscopies	Non-dedicated n=348 endoscopies	Significance (independent t-test for continuous, χ^2 for categorical)
Age (years)	Mean 64.3 (SD 10.6) Range (25–90) Median: 66, IQR 14	Mean: 64.8 (SD 10.3) 66, IQR 14, (32–91)	0.541 (95% CI −0.858 to 1.94, p=0.448)
Sex (%)	Male sex n=415 (72%)	Male sex n=239 (69%)	p=0.240
Prague length M— Median, (IQR) (range)	Median 3 cm (IQR 4) (range 0–17 cm)	Median 3 cm (IQR 3) (range 0–15 cm)	−0.7402 (95% CI −1.14 to −0.337, p≤0.001)
No of comorbidities	Median=1 (IQR 2) 0–160 (28%) 1–2=302 (53%) 3–4=99 (17%) 5+=11 (2%)	Median=1 (IQR 2) 0–109 (31%) 1–2=160 (47%) 3–4=60 (18%) 5+=12 (4%)	0.28 (95% CI −0.152 to 0.207, p=0.760)
Sedation	198/574 (34.5%) given sedation Midazolam 198/574 (34.5%) 0.5 mg—1/574 (0.2%) 1.0 mg—11/574 (2%) 1.5 mg—18/574 (3%) 2 mg—152/574 (27%) 3 mg—13/574 (2.3%) 4 mg—3/574 (0.5%) Median dose 2 mg Fentanyl 33/574 (5.7%) Dose 50 µg—32/574 (5.6%) 100 µg—1/574 (0.2%)	122/347 (35%) Given sedation Midazolam given=122/348 (35%) 0.5 mg—1/122 (0.3%) 1.0 mg—17/348 (4.9%) 1.5 mg—3/348 (1%) 2 mg—96/348 (28%) 3 mg—2/348 (0.6%) 4 mg—3/348 (1%) Median dose—2 mg Fentanyl given=16/348 (4.6%) Dose 50 µg—10/348 2.9% 75 µg—2/348 (0.6%) 100 µg (1.1%) Median dose 50 µg	
Sedation and dysplasia detection % of cases given sedation	13/36 were sedated	3/9 were sedated	p=0.876
Mean no of total biopsies Biopsies per 2 cm segment	8.31 (mean total) (SD 5.9) Median 6 (IQR 7) Mean 3.9 (SD 1.7)	6 (mean total) (SD 4.6) Median 5 (IQR 5) 3.28/2 cms (mean) (SD 1.8)	► 2.369 (95% CI −3.1 to −1.638, p≤0.001) ► 0.654 (95% CI −0.984 to −0.414, p≤0.001)
DDR Type of dysplasia/neoplasia where found	6.3% (36/568) Indef=n=15 (3%) LGD=n= 18 (3%) HGD=n = 4 (1%) OAC=n= 5 (1%)	2.7% (9/337) Indef=7 (2%) LGD=1 (0.3%) OAC=n=2 (0.6%)	p=0.014
Yield for visible lesions (including early loss of whitening with acetic acid)	28/36	4/9	p=0.48

DDR, dysplasia detection rate; HGD, high-grade dysplasia; IDD, indefinite for dysplasia; LGD, low-grade dysplasia; M, maximal Prague length; OAC, oesophageal adenocarcinoma.

Table 2 Table outlining the adherence to the BSG minimum dataset for reporting of Barrett's surveillance endoscopies

BSG standard	Dedicated	Non-dedicated	P value (χ^2)
Prague classification documented	98% (563/574)	88% (307/347)	≤0.001
Barrett's Islands described	66% (378/574)	10% (35/348)	≤0.001
Hiatus hernia delineated	85% (488/574)	56% (196/348)	≤0.001
Presence or absence of visible lesions documented	87% (498/574)	24% (82/348)	≤0.001
If present, visible lesions described with Paris classification	20% (45/220)	0% (0/126)	≤0.001
Seattle protocol adherence	80% (446/558)	29% (96/329)	≤0.001

BSG, British Society of Gastroenterology.

Table 3 A table outlining endoscopist and technique factors between the dedicated and non-dedicated cohort

Variable	Dedicated list	Non-dedicated list	Significance (χ^2)
Performed by-endoscopist background	Clinical fellow 98% (565/574) Nurse endo 0.2% (1/574) Consultant gastroenterology 1% (7/574)	Nurse endo 50% (174/348) Consultant gastroenterology 47% (163/348) Trainee gastro 0.2% (1/348) Surgical consultant 3% 11/348	N/A
Use of NBI	93% (534/574)	18.7% (65/348)	p≤0.001
Use of acetic acid	27% (156/574)	2% (7/348)	p≤0.001
Targeted biopsies obtained	58% (327/569)	37% (129/346)	p≤0.001

NBI, narrow band imaging.

whether visible lesions were commented on (OR 3.37 95%CI 1.08 to 10.53, p=0.36). Use of acetic acid, NBI and Seattle protocol adherence did not meet statistical significance. The analysis is summarised in table 4.

Dysplasia was detected at an endoscopy when targeted biopsies obtained in 38/45 (84%) endoscopies; 7/45 cases of dysplasia were detected on Seattle protocol alone and hence reinforces the importance of Seattle protocol for hard to detect flat dysplasia.

Comparing Seattle protocol adherence across specialty groups, clinical fellows had the most consistent adherence at 80% (439/549). The least consistently performing groups were the nurse endoscopists at 21% (29/136) and surgical consultants 11% (1/9). Gastroenterology consultants achieved 45% (72/159) adherence.

DISCUSSION

The key finding from this study was the significant difference in dysplasia detection, with significantly more dysplasia found by the dedicated endoscopy service in this non-tertiary setting. Further to this, the study demonstrated a significantly enhanced adherence to the BSG quality standard of care from the BSG guideline 2013 minimum dataset for reporting.[3] The DDRs were lower than those previously published by Ooi *et al*, of 18% vs 8%, however, their data included tertiary referral centre data which is likely to include a saturated population.[13] A systematic review and meta-analysis showed a pooled neoplasia detection rate (NDR, comprising high-grade dysplasia (HGD) and OAC) of 5% (95% CI 3.4% to 7.1%, I^2=97%) in 10 studies consisting of 4 studies in expert centres and 6 in community centres.[15] Their pooled expanded NDR including low-grade dysplasia (LGD) was 14.4% (95% CI 11.2% to 18.3%, I^2=98%). This reflects higher DDRs than we have found in the dedicated service in our study, though we excluded new referrals and patients referred for other aetiologies hence were focused on prevalent cases, known to have lower dysplasia rates. However, one of the key findings from that systematic review is that with every increase of 1% NDR there was a reduction of 3.5% in postendoscopy BO neoplasia. This highlights the importance of optimising BO surveillance practices; a dedicated service may be beneficial and is feasible in the non-tertiary environment.

There is controversy over using LGD and IDD as outcomes for dysplasia detection, given the interobserver variability in reporting these cases histopathologically[16 17]; however, a recent meta-analysis reported an incidence rate of progression from IDD of 11.4 cases per 100 person years to LGD, 1.5 to HGD and 0.6 to EAC.[18] The Benign Barrett's Oesophagus Taskforce consensus refers to IDD as an interim diagnosis[19]—either it will regress or has prevalent neoplasia within it, hence we felt it to be an important inclusion, and this is consistent with the prior study by Ooi *et al*.

Table 4 Outcomes of binary logistic regression analysis looking at factors associated with dysplasia detection

Variable	OR	95% CI	Significance
NBI use	1.34	0.412 to 4.35	0.627
Acetic acid use	1.16	0.549 to 2.45	0.697
Prague documented	0.350	0.099 to 1.239	0.104
Visible lesions commented	3.372	1.08 to 10.53	**0.036**
Seattle protocol adherence	0.752	0.287 to 1.969	0.562
Targeted biopsies obtained	4.471	1.86 to 10.75	**<0.001**
No of biopsies/2 cm	0.917	0.759 to 1.109	0.373
No of biopsies (total)	1.097	1.042 to 1.1.54	**<0.001**

χ2(12, N=922)=59.532, p≤0.001, Hosmer Lemeshow test p=0.324, and percentage accuracy in classification=95%
Values in bold denote statistical significance.
NBI, narrow band imaging.

Furthermore, all biopsies with suspected dysplasia in the study were reviewed by two histopathologists as per BSG guidelines and when we excluded IDD cases, there remained a statistically significant DDR between the groups.

Increasingly lesion recognition is an important factor in dysplasia detection and one of the benefits of a dedicated service is the clinicians involved gain more experience of visualising Barrett's mucosa as they perform a greater volume of surveillance. In this study we were not able to show a clear link between dysplasia detection and acetic acid or optical enhancement (NBI) and in other studies dysplasia is found more commonly on Seattle protocol biopsies, even in expert centres,[20] so the improved adherence to biopsy protocols is encouraging. Technologies such as artificial intelligence may help improve lesion recognition and are currently undergoing validation trials.[21 22]

In the UK, a colonoscopy workforce has been segregated for bowel cancer screening; these endoscopists receive a specific additional training pathway beyond basic diagnostic training, are audited for their key performance indicators such as the adenoma detection rate and must go through an accreditation process.[23] The endoscopists performing the routine care for the non-dedicated arm of this study were very experienced, consultant gastroenterologists, surgeons and clinical endoscopists, however, this study speaks to the specific challenge of identifying Barrett's lesions. A similar accreditation and training process could be established for BO surveillance which focusses on lesion recognition and training in guideline adherence and dysplasia detection.

A key metric not well documented at present is the oesophageal inspection time. Longer oesophageal inspection time has been shown to increase lesion detection and the advice from the UGI endoscopy quality standards is 1 min per centimetre of BO Prague length.[24 25] Our median BO lengths were 3–4 cm which is manageable perhaps within routine scheduling, but longer lengths may need further allotted time to perform adequate withdrawal assessment. Future work could involve standardising reporting of oesophageal withdrawal times for BO cases, to correlate DDR with this metric in a non-tertiary setting. Risk-scoring systems might help streamline surveillance to reduce the workload and allow for more time for oesophageal inspection, and have been devised using BO patient demographics and clinical metrics,[26] however, are not yet robust for clinical use. Biochemical marker risk stratification using minimally invasive investigations, such as breath tests and non-endoscopic oesophageal sampling methods such as Cytosponge, might be able to assist with streamlining surveillance.[27–29]

Limitations

This study was undertaken at a single site, with a small number of practitioners performing the dedicated endoscopy service; however, we feel this better reflects what may occur in the non-tertiary environment where the bulk of BO surveillance occurs in the UK. A prospective database was used but data were obtained retrospectively, and this may be susceptible to bias from missing data, however, we addressed this with multiple imputation. There were differences in the clinical background of the clinicians involved in each service and it was not possible to quantify prior experience of all the endoscopists involved. It is a non-randomised design, future studies should use a randomised design, this is important to avoid scheduling bias as those with longer segments may have been deliberately assigned on referral to the dedicated service.

CONCLUSIONS

This study has shown that dedicated Barrett's endoscopy services show significantly higher dysplasia detection in a non-tertiary settling. The reasons for this are likely to be multifactorial from procedure time to technical skill to biopsy protocol adherence. A randomised controlled trial comparing BO endoscopy and clinic services to standard care should be performed, and further work to look at clinician behaviour may be beneficial to explore barriers to guideline adherence when performing surveillance for Barrett's.

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Contributors Conception and design: ER, JB, SH, JM, NP and YA devised the concept of the study. Analysis and interpretation of the data: ER, HY, IR, SMHN, MK, IE and MA performed the screening and data collection, ER performed the statistical analysis of the data with input from JB, YA, JM, SH and NP. Drafting of the article: ER produced the initial draft of the manuscript. Critical revision of the article for important intellectual content and final approval of the article: all authors contributed to and revised the final version of the manuscript. YA is the guarantor for the overall content and accepts full responsibility for the work.

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Patient consent for publication Not applicable.

Ethics approval As this study incorporates elements of clinical audit and service evaluation, it falls under the UK health service governance standards no ethical approval was required. The study was registered with the hospital audit department (local reference number: 5329) and data were managed in accordance with Caldicott principles to protect patient confidentiality.

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