Double contrast barium enema and colorectal carcinoma: sensitivity and potential role in screening

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SUMMARY
To establish the sensitivity of double contrast barium enema (DCBE) for detection of colorectal carcinoma in a tertiary referral centre and consider its possible role as a suitable imaging method in screening for this disease.
A total of 160 patients with a histopathologically proven diagnosis of colorectal carcinoma over a two year period were reviewed. Subsequently 112 of the 160 patients were identified as having undergone DCBE, the results of which were analysed to determine its sensitivity for detecting colorectal carcinoma.
Colorectal carcinoma was missed in 4 of the 112 barium enemas performed. This corresponds to a sensitivity of 96.5% with a false negative rate of 3.5%. The Dukes Classification in these 4 cases showed that Dukes stage B, C and D were missed, with tumours located in the right and the sigmoid colon. The mean delay to operation in these four cases was 6 weeks.

Our study correlates with previous studies showing a false negative rate for DCBE of 3.5%. Colonoscopy also fails to detect small numbers of tumours with false negative rates reported as high as 10%. We suggest that double contrast barium enema should be effective as a screening method in any future colorectal cancer screening program.

INTRODUCTION
Colorectal cancer is the second most common malignancy in the United Kingdom with 28,000 new cases each year. There are 600 new cases and 480 deaths per annum in Northern Ireland. We wished to examine the sensitivity of double contrast barium enema (DCBE) for the detection of colorectal carcinoma in a tertiary referral centre and consider its possible role as an imaging method in screening for this disease.

MATERIALS AND METHODS
All histopathologically proven cases of colorectal carcinoma in the Royal Victoria Hospital within a two-year period were reviewed. A total of 160 patients were found to have colorectal carcinoma over this 2 year period. Subsequently 112 of the 160 patients were identified as having undergone barium enema examinations. The remaining 48 patients with colorectal carcinoma were excluded from the study as they had the diagnosis established by means other than barium enema.

The examinations were performed using a standard double contrast technique, following colonic preparation with 10 mg sodium picosulphate (Picolax, Nordic) at 8 am and 6 pm on the day before the examination, and a clear fluid diet. Hyoscine bromide or glucagon was not used routinely.

RESULTS
Colorectal carcinoma was not identified in 4 of the 112 barium enemas performed (Table I). This corresponds to a sensitivity of 96.5% with a false negative rate of 3.5%. The age range of patients with unidentified tumours was 59 to 78 years, with an average age of 68 years.

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TABLE I

Undiagnosed colorectal carcinomas following DCBE

| Age   | Site                | Duke's Stage | Delay to Operation | Diverticulosis Present? | Faecal Residue Present? |
|-------|---------------------|--------------|--------------------|-------------------------|-------------------------|
| Missed Tumour 1 | 73 yrs | Caecum | D                  | 10 Days             | No                      | Yes                     |
| Missed Tumour 2 | 69 yrs | Sigmoid | D                  | 9 Weeks             | Yes                     | Yes                     |
| Missed Tumour 3 | 59 yrs | Recto-sigmoid | C               | 9 Weeks             | Yes                     | No                      |
| Missed Tumour 4 | 63 yrs | Recto-sigmoid | B               | 8 weeks             | No                      | No                      |

One malignancy was missed in the caecum. In this case, marked right-sided faecal residue had been noted in the caecum and although no gross abnormality was noted on the report, a CT scan of abdomen was recommended to evaluate the region further. This malignancy was subsequently staged as a Dukes stage D carcinoma and the delay to operation following the barium enema was 10 days.

The three remaining unidentified malignancies were in the sigmoid colon or at the rectosigmoid junction. The unidentified sigmoid lesion measured 3 cm and involved the full circumference of the sigmoid colon. This patient was staged, subsequently, as a Dukes D colorectal cancer. It was visible on retrospective reanalysis of the barium enema films (Figs. 1). The delay to operation was 9 weeks.

The 2 remaining unidentified lesions were polyps at the recto-sigmoid junction, one measuring 1.3 cm and the other 2.5 cm. The delay to operation was again between 8 and 9 weeks. Neither of these 2 polyps could be identified on retrospective viewing of the films.

DISCUSSION

Screening for colorectal carcinoma has not yet received widespread acceptance; however, there
is indirect evidence that screening for this disease between the ages of 50 and 75 years could reduce the chance of developing or dying from colorectal carcinoma by 10 to 75%, depending on which screening tests are used and how often they are done.\(^1\) The increased reduction in mortality is more likely to occur if the entire colon is visualised, with less reliance on faecal occult blood tests and flexible sigmoidoscopy. We would propose that if the entire colon is to be visualised, then DCBE should be considered as an appropriate imaging method for screening.

Colonoscopy, although having the advantage of biopsy and resection of lesions, also fails to detect a small number of colonic carcinomas, with a false negative rate reported as high as 10%.\(^2\) Furthermore, it is not always possible to negotiate a tortuous colon and reach the caecum. There is also a small risk of perforation during colonoscopy. This has been estimated at 1 in every 1000 diagnostic procedures, with a higher rate if polypectomy is performed. The estimated perforation rate during a DCBE is 1 in 25,000 examinations.\(^3\) Expense, a critical consideration with a large screening programme, is another factor favouring barium enema, with projected costs showing DCBE to be less than half that of colonoscopy. A disadvantage of DCBE is radiation dose, which is estimated at 7mSv.\(^4\)

We have demonstrated that the DCBE, as performed at our institution, has a sensitivity of 96.5% and a false negative rate of 3.5% for the detection of colorectal carcinoma in a symptomatic population. Histopathology was used as the gold standard. This false negative rate compares well with previous studies reported in the literature. Johnson et al.\(^5\) report a false negative rate of 4.7% using DCBE and Beggs et al.\(^6\) a false negative rate of 8.6%. These were both retrospective studies. A prospective study by Fork et al.\(^7\) to assess the accuracy of DCBE in the diagnosis of colorectal carcinoma identified a 99.3% accuracy in a patient cohort followed-up for four years. We do accept that the nature of our study, as with similar retrospective studies, has an element of selection bias, due to the fact that some patients with normal barium enemas during the study period may not have undergone further evaluation and may have eventually been diagnosed at another centre.

Our study looked at the detection of colorectal carcinoma in a symptomatic population, however there is an additional issue to be addressed when considering screening in an asymptomatic population. Although the detection of early colorectal cancers is important, the detection of adenomatous polyps is also required, as it is now accepted that these are the precursors of colorectal carcinomas. Studies have shown that colonoscopy may be superior to DCBE in the detection of polyps, with DCBE having an estimated sensitivity of 75-90% for adenomas greater than 1 cm in size, as opposed to colonoscopy with an estimated sensitivity of approximately 90%.\(^3\) Polyps less than 1 cm in size have a low risk of malignant potential (less than 1%) and therefore if proposed screening with DCBE was performed every 5 years, then there is a reasonable window for subsequent detection without detrimentally affecting patient outcome. For the polyps greater than 1 cm in size a trade off must be made between the apparent greater sensitivity of colonoscopy and the increased risks and costs associated with this procedure.

The reasons for failing to identify adenomas or early carcinomas on barium enema examination are either due to perceptive errors by the radiologist and/or due to technical inadequacies of the examination. Both these factors were present in our series with suboptimal bowel preparation being a factor in two of the cases. Other technical considerations include incomplete air distension, insufficient tube angulation and overexposed films.\(^8\) Concomitant diverticulosis was also present in two of the cases increasing the likelihood of a perceptive error. These may also occur due to missing the lesion in the barium pool, or missing the lesion en face or in overlapping loops.\(^9\) Radiographic findings in overlooked colorectal carcinomas include subtle changes in normal colon architecture.\(^8\) These include concave or irregular mucosal barium margins, convergence of inter-haustral folds, flat or missing haustra, reduced caecal volume and the presence of locally fixed debris like lesions.

**CONCLUSION**

Both the colonoscopic and DCBE methods of visualising the colon are in worldwide usage. Both are well-validated techniques, and each has their proponents. Colonoscopy offers the advantage of direct visualisation, biopsy and excision of lesions. It has however, a recognised technical failure rate, which may not be insignificant, can be technically challenging, and has a small risk of associated morbidity.
The double contrast barium enema is a safe, inexpensive alternative. Failure to visualise the entire colon is rare, and the DCBE has the added advantage of producing a standardised film series, which can be retrospectively scrutinised, as in our series. This advantage has implications for clinical audit, and quality assurance in a screening program.

We conclude that the DCBE, with its widespread availability, relative inexpense and high sensitivity, should merit serious consideration as an appropriate imaging method for colonic evaluation in a future colorectal screening program.

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