those doctors who took the time and trouble to complete the questionnaire, especially those who wrote to amplify their opinions.

- 1 Ketley D, Woods KL. Impact of clinical trials on clinical practice: example of thrombolysis for acute myocardial infarction. *Lancet* 1993;342:891-4.
- 2 Collins R, Julian D. British Heart Foundation surveys (1987 and 1989) of United Kingdom treatment policies for acute myocardial infarction. *Br Heart J* 1991;66:250-5.
- 3 GREAT Group. Feasibility, safety, and efficacy of domiciliary thrombolysis by general practitioners. *BMJ* 1992;305:548-53.
- 4 Gruppo Italiano per lo studio della streptochinasi nell' infarto miocardico (GISSI). Effectiveness of intravenous thrombolytic treatment in acute myocardial infarction. *Lancet* 1986;i:397-401.
- 5 Second international study of infarct survival collaborative group. Randomised trial of intravenous streptokinase, oral aspirin, both, or neither among 17187 cases of suspected acute myocardial infarction. ISIS-2. *Lancet* 1988;ii:349-60.
- 6 AIMS trial study group. Effect of intravenous APSAC on mortality after acute myocardial infarction: preliminary report of a placebo-controlled clinical trial. *Lancet* 1988;i:545-9.
- 7 Wilcox RG, von der Lippe G, Olsson CG, Jensen G, Skene AM, Hampton JR. Trial of tissue plasminogen activator for mortality reduction in acute myocardial infarction. Anglo-Scandinavian study of early thrombolysis (ASSET). *Lancet* 1988;ii:525-30.
- 8 The European Myocardial Infarction Project Group. Prehospital thrombolytic therapy in patients with suspected acute myocardial infarction. *N Engl J Med* 1993;329:383-9.

- 9 Rawles J, on behalf of the GREAT Group. Halving of 1-year mortality from acute myocardial infarction by domiciliary thrombolysis in the Grampian region early anistreplase trial (GREAT). *J Am Coll Cardiol* 1994;23:1-5.
- 10 Liddell R, Grant J, Rawles J. The management of suspected myocardial infarction by Scottish general practitioners with access to community hospital beds. *Br J Gen Pract* 1990;40:318-22.
- 11 Gordon I. Streptokinase used in general practice. *J R Coll Gen Pract* 1989;39:49-51.
- 12 Birkhead JS. Time delays in provision of thrombolytic treatment in six district hospitals. *BMJ* 1992;305:445-8.
- 13 Gray D, Keating NA, Murdock J, Hampton JR. Impact of hospital thrombolysis policy on out-of-hospital response to suspected myocardial infarction. *Lancet* 1993;341:654-7.
- 14 Rule S, Brooksby P, Sanderson J. Use of thrombolysis for acute myocardial infarction by general practitioners. *Postgrad Med J* 1993;69:190-3.
- 15 Gemmill JD, Lifson WK, Rae AP, Hillis WS, Dunn FG. Assessment by general practitioners of suitability of thrombolysis in patients with suspected acute myocardial infarction. *Br Heart J* 1993;70:503-6.
- 16 McCrea WA, Saltissi S. Electrocardiogram interpretation in general practice: relevance to prehospital thrombolysis. *Br Heart J* 1993;70:219-25.
- 17 British Cardiac Society, the Cardiology Committee of the Royal College of Physicians, and the Trafford Centre for Medical Research, University of Sussex. Seventh survey of staffing of cardiology in the United Kingdom 1991. *Br Heart J* 1992;68:621-9.
- 18 Weston CFM, Penny WJ, Julian DG, on behalf of the British Heart Foundation Working Group. Guidelines for the early management of patients with myocardial infarction. *BMJ* 1994;308:767-71.

(Accepted 8 June 1994)

Cancer Prevention in Primary Care

Screening for colorectal cancer

Joan Austoker

This is the ninth in a series of articles looking at how cancer can be prevented in general practice

In the United Kingdom there are almost 31 000 new cases of colorectal cancer each year and nearly 20 000 deaths. It is the second most common cause of all deaths from cancer in the United Kingdom. The efficacy of screening with faecal occult blood tests to detect and treat tumours at an early stage, and thereby to reduce mortality, is currently being assessed in several randomised controlled trials. In general, faecal occult blood tests have a low sensitivity and only moderate levels of uptake among the population invited for screening. Until the studies in Denmark, Sweden, and Nottingham report their findings, there is no case for providing such screening routinely to an asymptomatic population. Detecting and removing premalignant adenomas by flexible sigmoidoscopy could be more effective than detecting early localised, asymptomatic cancers in reducing deaths from colorectal cancer. It is estimated that screening people at about the age of 60 by a single flexible sigmoidoscopy examination with appropriate colonoscopic surveillance could prevent 5500 cases of colorectal cancer and 3500 deaths in the United Kingdom each year. A randomised controlled trial to confirm these observations should be seen as a priority.

Colorectal cancer: current facts

In the United Kingdom in 1988 there were almost 31 000 new cases of large bowel cancer, 19 336 in the colon and 11 636 in the rectum. Figure 1 shows the general distribution of cancers of the large bowel. Tumours in the sigmoid colon, rectosigmoid junction, and the rectum account for nearly 70% of all cases.

In all parts of the large bowel by far the most common histology is adenocarcinoma (90-94% of cases), and a substantial proportion of colorectal cancers may arise from adenomatous polyps.

Colorectal cancer is the second most common cause of all deaths from cancer in the United Kingdom (12% of all deaths from cancer), accounting for 19 625 deaths in 1992. Most deaths from colorectal cancer (93%) occur in people over 55 (fig 2). Death rates have fallen

FIG 1—Distribution of cases of cancer by site in large bowel¹

since 1921. Rates are continuing downwards except for colon cancer in men, in whom rates have increased slightly over the past few decades.

Colorectal cancer has a fairly poor prognosis, with a relative survival rate at five years of 37%. Because nearly half of all patients present late there has been little improvement in survival rates in recent decades, despite the introduction of new surgical techniques

FIG 2—Number of deaths from large bowel cancer in the United Kingdom, 1992

Cancer Research Campaign Primary Care Education Research Group, Department of Public Health and Primary Care, University of Oxford, Oxford OX2 6PE
Joan Austoker, director

BMJ 1994;309:382-6

and adjuvant chemotherapy, although there is now accumulating evidence that adjuvant chemotherapy is beginning to have an effect. Early stage cancers (Dukes's stage A) have survival rates of around 80% (fig 3). There is some evidence that patients treated in centres specialising in the management of colorectal cancer fare better.

FIG 3—Age adjusted survival rates five years after curative resection of colorectal cancer according to stage of disease (Dukes's stage A, B, or C) at diagnosis in 1977-81¹

The development of colorectal cancer is thought to be a multistep process involving both genetic and environmental factors. The large international variation in the incidence of this disease and the significant time trends since the beginning of this century suggest that lifestyle factors play an important part in the aetiology of this disease, the most important being diet.² The evidence so far suggests that a healthy, well balanced diet rich in fruit and vegetables, starch, and fibre (especially vegetable fibre) and low in fat and alcohol may offer some protection from large bowel cancer.

High risk groups

Most (85-90%) colorectal cancers are sporadic and not thought to be due to hereditary factors. Family studies have shown that the risk of colorectal cancer in a first degree relative of an affected person is two to three times the risk in the general population. Increased risk to relatives is also associated with early age of onset in the affected person. In addition, several conditions are associated with an increased susceptibility for colorectal cancer. Several dominantly inherited syndromes are associated with colorectal cancer. Familial adenomatous polyposis is characterised by the presence of thousands of benign tumours (polyps) lining the entire large intestine. It accounts for about 1% of cases of colorectal cancer in the Western world, and the gene responsible has recently been identified on chromosome 5. Hereditary non-polyposis colorectal cancer is another dominantly inherited syndrome associated with a high risk of colorectal malignancy, including site specific colon cancer (type a) and a family syndrome that is associated with an increased risk of endometrial, ovarian, genitourinary, and other extracolonic cancers in addition to an increased risk of colon cancer (type b). Kindreds of families with hereditary non-polyposis colorectal cancer are commonly defined as those in which at least three relatives in two generations have colorectal cancer, with one of the relatives having cancer diagnosed under the age of 50. Recently a gene has been isolated which predisposes to colorectal cancer and probably other cancers in the type b syndrome. This gene, hMSH2, is one of a family of DNA repair genes. Other members of the gene family will soon be isolated, and these may also play a part in inherited predisposition.

Other diseases carrying an increased risk of colon

cancer include longstanding ulcerative colitis and, to a lesser extent, Crohn's disease. Finally, patients who have had colon cancer in the past are at higher risk of developing additional colorectal tumours.

Prospects for screening

Screening is attractive because of the great difference in prognosis between early (Dukes's stage A) stages of disease and later stages in which infiltration through the bowel wall has already occurred. Early diagnosis would significantly improve survival rates as many cases are diagnosed at a late stage when curative treatment is not possible. In addition, there is much evidence supporting the fact that large polypoid adenomas of the colon and rectum are in many cases precursors of malignant change. Their identification and removal might reduce the subsequent incidence of invasive cancers, as well as eventually reducing mortality.

Most colorectal cancers arise in people who have no known predisposing risk factors. In the future, most of those at high risk may be identified by genetic markers. Selective screening of high risk groups is, however, unlikely to have a major impact on the overall incidence or mortality from this disease. Some of the genetic markers for inherited cancer syndromes are also found in sporadic cases—and adenomas—so in the long term future prescreening by genetic markers might be feasible for the general population.

Colorectal cancer screening tests

Three principal tests have been used to screen for colorectal neoplasia: digital rectal examination, sigmoidoscopy, and screening for faecal occult blood. The American Cancer Society recommends an annual digital rectal examination for people over 40, an annual faecal occult blood test for people over 50, and sigmoidoscopy (preferably flexible) every 3-5 years in people over 50. In the United Kingdom the need to monitor and advise high risk groups is well recognised, but until screening has been shown conclusively to reduce mortality from colorectal cancer and the benefits and risks have been carefully evaluated, screening cannot be recommended on a population basis.

Digital rectal examination

Digital rectal examination is easy to perform, but it is of limited value for screening as only a small proportion of colorectal tumours are within the range of an examining finger.

Faecal occult blood tests

Faecal occult blood tests are mainly aimed at the detection of early asymptomatic cancers and are based on the assumption that such cancers bleed, and the small amounts of blood lost in the stool may be detected chemically or immunologically. Several tests for faecal occult blood have been developed. In some test kits—for example, Haemoccult—the person being screened places a small stool sample on a guaiac impregnated card and sends it off to be tested; in others—for example, Coloscreen—the person performs and interprets the test themselves by observing a change in colour.

Box 1 shows some of the advantages and disadvantages of faecal occult blood tests. They provide a cheap and easy method of screening with reasonable but not high levels of acceptability to the population (see below). The main disadvantages are (a) their low sensitivity (about 40% of cancers and 80% of adenomas

Box 1—Faecal occult blood tests as screening procedure

- Quick, easy, and comparatively cheap to perform
- Has reasonable but not high levels of acceptability to the general population
- Has comparatively low sensitivity
- Sensitivity can be improved by rehydrating the stool sample but at the expense of greatly reducing the specificity
- Poor marker for colorectal neoplasia: most cancers and polyps will be missed:
 - Most adenomas do not bleed
 - Not all tumours bleed
 - Less sensitive for upper than lower gastrointestinal lesions
 - Less sensitive for rectal lesions than upper left side lesions
 - Only a small sample of faeces is tested, and blood may not be evenly distributed throughout the stool
- Many lesions bleed only at a late stage in their natural history
- Has been shown in one study to reduce mortality from colorectal cancer with annual screening but with high rate of false positive results, which means that the degree of intervention is high
- Screening every two years has not, at present, been shown to lead to a reduction in mortality
- Newer immunochemical tests seem to combine higher sensitivity with reasonable specificity and warrant testing in randomised controlled trials

may be missed by a single screen with standard guaiac slide tests), and (b) the late stage in the natural history at which lesions bleed, leading to a short lead time and a requirement for frequent testing.

Faecal occult blood tests can detect blood from any part of the bowel, but because haemoglobin is degraded as it passes through the gastrointestinal tract they are less sensitive for upper gastrointestinal lesions than for lower lesions. They are also less sensitive for rectal lesions than for higher left sided lesions, possibly because there has been less opportunity for blood to be diffused widely through the whole stool. Only a small sample of faeces is taken at any one time, so if blood is not evenly distributed throughout the stool, then none may be included in the sample. Blood loss from colorectal cancers is not constant but intermittent, and therefore the usual, if arbitrary, recommendation is that three to six successive stool specimens should be tested.

The sensitivity of tests is also inversely related to the dryness of the stool sample when tested, and some authorities recommend rehydration. Although this improves sensitivity, it results in many false positive results. In a study in Minnesota rehydration led to a fourfold increase in the number of positive test results and the number of diagnostic procedures involving

colonoscopy. Red meat and vegetables containing peroxidase, such as tomatoes, may give false positive results in tests, and therefore dietary restriction for three days before the test is sometimes recommended. Faecal occult blood tests for use in screening need to balance their level of sensitivity for detection of haemoglobin against the requirement to keep false positive results as low as possible. Immunochemical methods of detecting occult blood seem to combine high sensitivity with reasonable specificity and may be worth testing in randomised controlled studies in the future.

Several large randomised trials, including one in Nottingham, are currently investigating the effectiveness of population screening by faecal occult blood tests in reducing incidence and mortality and also the accuracy of the test and its acceptability to the general population. The available evidence so far indicates that screening can meet the initial requirements for success—namely, an increased prevalence of cancer and adenomas at the first screen, a shift towards earlier stage at diagnosis, and some evidence that survival of subjects with cancers detected at screening is greater than that of a control population. But these are insufficient proof in themselves that screening saves lives. A reduction in the mortality from colorectal cancer in the whole target population, or a reduction in incidence of invasive cancer in the case of screening for premalignant adenomas, is the only valid way of proving the benefit of screening. Recent results from the randomised trial in Minnesota of faecal occult blood testing reported a 33% reduction in mortality from colorectal cancer for an annually screened population, but there was no significant reduction in mortality for those screened every two years. The rate of false positive results was, however, high during the study (38% of those screened annually and 28% of those screened every two years had at least one colonoscopy), making this a highly invasive intervention. False positive test results can result in considerable anxiety and greatly increase workload and costs. The large number of colonoscopies carried out in the Minnesota study make it difficult to determine whether the reduction in mortality can be attributed to faecal occult blood testing or to the use of colonoscopy. Because of the many anomalous findings in this trial, conclusions about the value of faecal occult blood tests cannot be drawn at least until the current studies in Denmark, Sweden, and Nottingham report their findings.

Box 2—Sigmoidoscopy as screening procedure

- Most adenomas will never develop into cancer
- Comparatively expensive to perform and invasive
- Bowel preparation is required
- Acceptability to the general population needs to be determined
- Screening and treatment can in most cases be performed simultaneously
- Over 60% of all colorectal cancers occur within reach of the flexible sigmoidoscope
- Has a high sensitivity and specificity
- Some cancers may be missed:
 - Some are difficult to detect, particularly "flat" adenomas or those in folds at junctions
 - Some cancers may not have an adenoma phase
 - Some cancers may pass rapidly through the adenoma phase and be missed by infrequent or one off sigmoidoscopy
- Most cases of cancer in the ascending colon will be missed as they do not have adenomas in the rectum or sigmoid colon
- Selective follow up of high risk distal adenomas could enable the prevention of some proximal colon cancers
- Could result in significant reductions in incidence of and mortality from colorectal cancer and requires testing in randomised controlled trials

Sigmoidoscopy

Whereas faecal occult blood tests aim at detecting early asymptomatic cancers, most distal colorectal cancers arise as benign adenomas with a slow transition time to malignancy of 10-35 years. Because of this long natural history prevention of progression to cancer by the detection and removal of premalignant adenomas may be a more effective method for reducing deaths from colorectal cancer than the detection of early, localised asymptomatic cancers.

Box 2 shows some of the advantages and disadvantages of sigmoidoscopy. It is a more expensive and invasive initial test than faecal occult blood tests, but it has two distinct advantages.

(1) It is highly sensitive for lesions as small as 5 mm, so neoplasia is detectable at an early stage.

(2) Lesions can be removed endoscopically at the time of screening in most cases, so the screening procedure can be both diagnostic and therapeutic.

The flexible sigmoidoscope (65 cm) is now recommended for screening rather than the rigid sigmoidoscope. It is preferred by patients and may be passed higher into the colon than the rigid sigmoidoscope.

The instrument may be passed to at least the junction of the sigmoid and descending colon, below which over 60% of colorectal cancers are located (fig 1). Bowel preparation is required, but the actual examination takes only four to eight minutes, depending on the need to undertake biopsy or polypectomy.

EVIDENCE FAVOURING THE USE OF SIGMOIDOSCOPY AS A SCREENING TEST

A good deal of evidence exists to support the belief that infrequent sigmoidoscopy may be an effective screening test.

- A case-control study of rigid sigmoidoscopy found that only 9% of those who died from colorectal cancer compared with 24% of the controls had undergone screening sigmoidoscopy, representing a 70% reduction in risk of death among those who had undergone the procedure. Those who had had a proctosigmoidoscopy 9-10 years previously were at the same low risk of dying from distal colorectal cancer as those who had had an examination within four years of diagnosis, providing evidence that sigmoidoscopy confers protection for at least 10 years. The study concluded that a screening programme using flexible sigmoidoscopy could lead to a reduction of at least 30% in mortality from colorectal cancer.
- Another smaller case-control study found a reduction in mortality of 80% after screening, mostly by flexible sigmoidoscopy
- A retrospective analysis at St Mark's Hospital, London, showed that polypectomy after rigid sigmoidoscopy up to 30 years previously resulted in a lower than expected incidence of rectal cancer, preventing at least 85% of rectal cancers from developing. From this it can be concluded that if all adenomas detected at sigmoidoscopy are completely removed the risk of rectal cancer is rendered low for many years thereafter.
- An observational study in the United States showed that colonoscopic polypectomy resulted in reduction in risk of colorectal cancer of between 76% and 90%.

CANCER IN THE PROXIMAL COLON

Cancer in the proximal colon cannot be detected directly by sigmoidoscopy. However, the presence of adenomas in the distal colon is considered to be a marker for increased risk of lesions in the proximal colon. About 30% of those with proximal colon cancers will have an index lesion within the reach of the flexible sigmoidoscope.

Not all people with distal adenomas are at an increased risk of developing proximal colon cancer (table). In a cohort of patients followed up at St Mark's Hospital after removal of adenomas from the rectum and distal sigmoid colon, those with only low risk distal

Features of distal adenomas as markers of high or low risk of developing proximal colon cancer^{3,4}

	High risk†	Low risk
No of adenomas	≥ 3	< 3
No of hyperplastic adenomas in the sigmoid colon	≥ 5	< 5*
Size (cm)	≥ 1	< 1
Histology	Tubulovillous or villous	Tubular
Dysplasia	Severe or malignant	Mildly or moderately dysplastic

*Or multiple hyperplastic adenomas in rectum.

†Any of the following.

adenomas were not at increased risk of developing colon cancer long term, while those with high risk distal adenomas were at a fourfold increased risk. Ninety per cent of the colon cancers which developed during follow up occurred in this high risk group, which comprises about 3-5% of the population. Selected colonoscopy of those with high risk distal adenomas detected at screening should thus enable the prevention of at least some proximal colon cancers.

THE NEED FOR RANDOMISED CONTROLLED TRIAL OF FLEXIBLE SIGMOIDOSCOPY

The Imperial Cancer Research Fund has made a strong case for a randomised controlled trial of flexible sigmoidoscopy (box 3). It has been proposed that screening by a single flexible sigmoidoscopy towards the end of the sixth decade, with appropriate colonoscopic surveillance for those found to have high risk adenomas (3-5%) could, if applied nationally, prevent about 5500 cases of colorectal cancer and 3500 deaths in the United Kingdom each year. A single screening examination, such as that proposed, with selective follow up for those at high risk, could be cost effective and acceptable to those who are screened as they will not be required to undergo regular rescreening. Until such a randomised controlled trial is undertaken the efficacy of flexible sigmoidoscopy in reducing the incidence of and mortality from colorectal cancer will remain unproved.

Uptake and acceptability of colorectal cancer screening tests

A major determinant of the success of any screening programme is its acceptance by the target population.

ACCEPTABILITY OF FAECAL OCCULT BLOOD TESTS

Widely divergent participation rates have been reported for faecal occult blood tests in different studies, ranging from 8% to 80%. In the United Kingdom compliance with conventional tests such as Haemoccult is about 55% in the general population. Although the unpleasant aspects of performing faecal occult blood tests have often been blamed for non-compliance, negative attitudes towards the test only partly explain non-compliance. Other factors such as education, awareness of the disease, peer pressure, and perceived vulnerability all play a more important part in determining whether a person complies with the test. Those who accept screening have been found to have more positive attitudes to the implications of the test, to treatment, and to the value of screening in general and to be more optimistic about their health than those who do not. The experience of a close friend or relative with bowel cancer has been found to be associated with an increased likelihood of compliance. The "lack of perceived need in the asymptomatic individual," the belief that doing the test would induce anxiety, and perceptions of the severity of colorectal cancer negatively influence compliance.

Two studies that compared different methods of invitation for a Haemoccult test found that acceptance was greatest (57%) among people offered the test

Box 3—Case for randomised controlled trial of single sigmoidoscopy examination at age 55-64^{1,3}

- Case-control studies and retrospective analyses have suggested that sigmoidoscopy followed by polypectomy when appropriate could lead to substantial reductions in incidence of and mortality from rectal and distal colon cancers
- A single sigmoidoscopy towards the end of the sixth decade should identify most people with distal adenomas likely to develop into cancer:
More than 90% of cases are diagnosed after the age of 55
The prevalence of distal adenomas as determined by flexible sigmoidoscopy increases strikingly with age, plateauing at about 9% before the age of 60
- The optimal age for such screening needs to be determined
- Colonoscopic surveillance restricted to the 3-5% of the population with high risk distal adenomas could result in a 25% reduction in mortality in those with proximal colon cancers
- A randomised controlled trial to confirm the above observations should be seen as a priority

during a consultation with their general practitioner, but it was only 38-40% when the test was sent by post. Inclusion of an educational leaflet has been found to make no difference. Acceptance of a posted Haemoccult test in the Nottingham study 53% with a slight variation with age and sex (greatest among men aged 55-69 and women 50-69), but rates of 65% have been found in Scandinavian countries.

Various strategies to improve compliance have been assessed in general practice. The traditional Haemoccult test involves the patient in manipulating faeces. A number of alternative tests have been developed to try to make the procedure more acceptable. A trial comparing compliance with two of these new "magic toilet paper" tests with that of Haemoccult found that self-administered tests do not overcome the problem of poor compliance (uptake rates: Haemoccult 49.1%, Coloscreen 50.6%, Early Detector 52.1%). There were, however, appreciable differences between the tests in the proportion of patients finding them "messy" or "disgusting" (Haemoccult 72%, Coloscreen 48%, Early Detector 55.4%). Non-compliers were significantly more likely to find the test disgusting. In general, colorectal screening was as acceptable to those who experienced false positive results as to those with negative results. The great majority of both groups reported the screening to have been worthwhile, were not less willing to participate in other medical screening tests, and generally approved of the principle of screening.

A randomised controlled trial testing patient compliance with screening for colorectal cancer in association with general practice health checks found that overall compliance with testing for faecal occult blood was not significantly increased by associating it with a health check. However compliance was higher when the testing kit was enclosed with the health check invitation than when it was offered at the health check.

ACCEPTABILITY OF SIGMOIDOSCOPY

An acceptance rate of 70% for the procedure has been achieved in two published screening studies and recently in a large general practice screening study in the United Kingdom. In another randomised study in the United Kingdom comparing faecal occult blood testing and faecal occult blood testing with sigmoidoscopy, uptake for sigmoidoscopy has been low. The overall acceptability of sigmoidoscopy to the general asymptomatic population is a key issue which the proposed randomised trial would be in a good position to address.

Conclusion

Colorectal cancer is an important cause of premature mortality in the United Kingdom. Epidemiological studies are gradually getting closer to defining factors which promote or inhibit the development of this disease. Molecular geneticists have made important progress in identifying several different genes that are implicated in the initiation of both sporadic and hereditary colorectal cancers and the progression from premalignant adenomatous polyp to malignant tumour. Ultimately, this will lead to new methods of detecting and treating the disease. More recently, the identification and mapping of genes responsible for inherited predisposition to colorectal cancer (perhaps 5% to 10% of all cases) will facilitate the diagnosis and counselling of patients at high risk.

The efficacy of screening with faecal occult blood tests to detect tumours at an earlier, more treatable stage is currently being assessed in several studies. Until the current studies report their findings, there is no case for providing such screening routinely to an asymptomatic population. Detection and removal of

pre-malignant adenomas by flexible sigmoidoscopy could be a more effective method of reducing deaths from colorectal cancer than the detection of early, localised, asymptomatic cancers. It is estimated that screening before the end of the sixth decade by a single flexible sigmoidoscopy examination with appropriate colonoscopic surveillance could prevent 5500 colorectal cancer cases and 3500 deaths in the United Kingdom each year. A randomised controlled trial to evaluate the efficacy of flexible sigmoidoscopy screening in reducing the incidence of and mortality from colorectal cancer should be seen as a priority.

I thank Professor Jocelyn Chamberlain and Dr Jack Cuzick for constructive comments on drafts of this article.

- 1 Cancer Research Campaign. Cancer of the large bowel. Factsheet 18. London: CRC, 1993.
- 2 Austoker J. Diet and cancer. *BMJ* 1994;308:1610-4.
- 3 Atkin WS, Cuzick J, Northover JMA, Whymer DK. Prevention of colorectal cancer by once-only sigmoidoscopy. *Lancet* 1993;341:736-40.
- 4 Imperial Cancer Research Fund. Protocol for randomised controlled trial to evaluate a "once-only" flexible sigmoidoscopy screen for prevention of bowel cancer (1993). J Cuzick, personal communication.

Selected additional references

- Ahlquist DA, Wieand HS, Moertel CG, McGill DB, Loprinzi CL, O'Connell MJ, *et al.* Accuracy of fecal occult blood screening for colorectal neoplasia. *JAMA* 1993;269:1262-7.
- Atkin WS, Morson BC, Cuzick J. Long-term risk of colorectal cancer after excision of rectosigmoid adenomas. *N Engl J Med* 1992;326:658-62.
- Blalock SJ, DeVellis B, Sandler RS. Participation in fecal occult blood screening: a critical review. *Prev Med* 1987;16:9-18.
- Box V, Nichols S, Lallemand RC, Pearson P, Vakili PA. Haemoccult compliance rates and reasons for non-compliance. *Public Health* 1984;98:16-25.
- Chamberlain J. Is screening for colorectal cancer worthwhile? *Br J Cancer* 1990;62:1-3.
- Eddy DM. Screening for colorectal cancer. *Ann Intern Med* 1990;113:373-84.
- Farrands PA, Hardcastle JD, Chamberlain J, Moss S. Factors affecting compliance with screening for colorectal cancer. *Community Medicine* 1984;6:12.
- Hardcastle JD, Chamberlain J, Sheffield J, Balfour TW, Armitage NC, Thomas WM, *et al.* Randomised controlled trial of faecal occult blood screening for colorectal cancer. Results of the first 107 349 subjects. *Lancet* 1989;ii:1160-4.
- Hardcastle J. Randomised control trial of faecal occult blood screening for colorectal cancer: results of the first 144 103 patients. *Eur J Cancer Prev* 1991;1:21.
- Hobbs FDR, Cherry RC, Fielding JW, Pike L, Holder R. Acceptability of opportunistic screening for occult gastrointestinal blood loss. *BMJ* 1992;304:483-6.
- Hunter W, Farmer A, Mant D, Verne J, Northover J, Fitzpatrick R. The effect of self-administered faecal occult blood tests on compliance with screening for colorectal cancer: results of a survey of those invited. *Fam Pract* 1991;8:367-72.
- Kinsella AR. *Colorectal cancer. A scientific perspective.* Cambridge: Cambridge University Press, 1993.
- Kronborg O, Fenger C, Olsen J, Beck K, Sondergaard O. Repeated screening for colorectal cancer with fecal occult blood test. *Scand J Gastroenterol* 1989;24:599-606.
- Levin B. Screening sigmoidoscopy for colorectal cancer. *N Engl J Med* 1992;326:700-2.
- Mandel JS, Bond JH, Church TR, Snover DC, Bradley GM, Schuman LM, *et al.* Reducing mortality from colorectal cancer by screening for fecal occult blood. *N Engl J Med* 1993;328:1365-71.
- Mant D, Fitzpatrick R, Hogg A, Fuller A, Farmer A, Verne J, *et al.* Experiences of patients with false positive results from colorectal cancer screening. *Br J Gen Pract* 1990;40:423-5.
- Mant D, Fuller A, Northover J, Astrop P, Chivers A, Crockett A, *et al.* Patient compliance with colorectal cancer screening in general practice. *Br J Gen Pract* 1992;42:18-20.
- Neugut AI, Pita S. Role of sigmoidoscopy in screening for colorectal cancer: a critical review. *Gastroenterology* 1988;95:492-9.
- Newcomb PA, Norfleet RG, Storer BE, Surawicz TS, Marcus PM. Screening sigmoidoscopy and colorectal cancer. *J Natl Cancer Inst* 1992;84:1572-5.
- Selby JV, Friedman GD, Quesenberry CP, Weiss NS. A case-control study of screening sigmoidoscopy and mortality from colorectal cancer. *N Engl J Med* 1992;326:653-7.
- Selby JV. Screening sigmoidoscopy for colorectal cancer. *Lancet* 1993;341:728-9.
- Silman A, Mitchell P. Attitudes of non-participants in an occupation based programme of screening for colorectal cancer. *Community Medicine* 1984;6:8-11.
- Thomas W, Hardcastle J. An update on the Nottingham trial of faecal occult blood testing for colorectal carcinoma. In: Miller A, Chamberlain J, Day N, eds. *Cancer screening.* Cambridge: Cambridge University Press, 1991:106-15.
- Verne J, Kettner J, Mant D, Farmer A, Mortensen N, Northover J. Self-administered faecal occult blood tests do not increase compliance with screening for colorectal cancer: results of a randomised controlled trial. *Eur J Cancer Prev* 1993;2:301-5.
- Winawer SJ, Schottenfeld D, Flehinger BJ. Colorectal cancer screening. *J Natl Cancer Inst* 1991;82:243-53.
- Ponder B. *Genetic testing for cancer risk. C&C scientific yearbook 1994-5.* London: Cancer Research Campaign, 1994.
- Winawer SJ. Colorectal cancer screening comes of age. *N Engl J Med* 1993;328:1416-7.
- Winawer SJ, Zauber AG, Nah Ho M, O'Brien MJ, Gottlieb LS, Sternberg SS, *et al.* Prevention of colorectal cancer by colonoscopic polypectomy. *N Engl J Med* 1993;329:1977-81.

A complete list of references is available from the author.