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# The clinical yield of colonoscopy

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## Introduction

In the last 50 years Sir Francis Avery Jones has illuminated many fields within gastroenterology, not least the colon. The 1930s were a dark age in the investigation of the colon, little having changed since the introduction of the electric sigmoidoscope by Sir Percy Lockhart-Mummery in 1904. Fischer's double-contrast barium enema of 1923 was little heeded in this country for decades. The unexplained predilection of most colonic disease for the relatively accessible distal bowel to some extent covered up the relative inadequacy of the investigative techniques then available. As an enthusiast for upper gastrointestinal endoscopy Avery, together with Sir Alan Parks, organised the introduction of colonoscopy to St Mark's and actively supported the British pioneers of this technique.

The time-lag before the fibreoptic revolution in clinical gastroenterology reached the colon is a reflection both of anatomic and technical problems involved. In the mid-1960s gastrocameras and fibre-gastroscopes were routinely used in pioneering departments but the relatively crude angulation mechanisms of these early instruments, adequate in the stomach, made them extremely difficult to guide through the tight and unpredictable bends of the colon. One uncomfortable compromise in the quest for total colonoscopy was to have the patient swallow a guide-string, recovered at the anus and pulled tight to shorten the colon and to allow a passive fibreoptic 'colon tube' to be passed over it (Provencale and Revignas, 1969). The first purpose-built colonoscopes—more flexible than gastroscopes and with 4-way angling controls—had a working life of only 200–300 examinations, whereas 10 years later current instruments can last over 1,000 procedures and are much easier to use. The essential advance has been in the improved mechanical strength and agility facilitated by production of ever-smaller fibre-bundles which leave more room in the instrument shaft for stronger pull-wires and larger channels.

Anatomic difficulties and technical limitations have also highlighted one of the major problems of colonoscopy—how to teach it. Persuading a fibrescope to pass through the redundant and elastic folds of some colons can face the clinician with problems similar to those of the Indian rope trick. Unlike the magician, the endoscopist cannot see the unwanted loops forming in his instrument unless he uses fluoroscopy, which is inconvenient and results in a 2-dimensional image which sometimes only adds to his confusion. Textbook colonic anatomy suggests that the descending and ascending colon are fixed retroperitoneally, whereas in at least 10–20% of patients these regions prove to be mobile, resulting in weird and unpredictable loops for the endoscopist and pain for the patient. Although an understanding has gradually built up of the principles for successful colonoscopy (Hunt and Waye, 1981; Sakai, 1981; Cotton and Williams, 1983; Shinya, 1982) it remains a technique requiring a combination of manual dexterity, anatomic imagination and pertinacity which is not easy to pass on. Colon models are of some help but can only crudely represent the amazing variability of the bowel. At present most colonoscopists are essentially self-taught at the expense of their patients.

## The logistics of colonoscopy

Bowel preparation is unfortunately a very individual matter. What is acceptable to one patient distresses another: a regime which clears one colon fails completely in the next. There may be no such thing as the 'ideal bowel preparation' and certainly present alternatives all have problems (Teague and Manning, 1977; Cotton and Williams, 1983). The ideal regime should be able to be sent by post to the patient's home, be pleasant-tasting, taken by mouth shortly before the procedure so as to avoid the indignity of enemas, and never cause cramping pains, nausea or fluid-balance problems. The best-buy compromise for colonoscopy results in a fluid residue which can be easily aspirated by the endoscopist,

whereas the radiologist and surgeon both prefer a dry colon.

The use or non-use of sedation is also an individualistic matter depending partly on the endoscopist's skill and technical ability but also on anatomic and psychological considerations. For the reasons described above the ease of colonoscopy is unpredictable before the procedure, even if barium enema films are available. Short colons on short mesenteries can cause pain when only slightly stretched, whereas long colons on long mesenteries may tolerate loops very well. Fixation from previous pelvic surgery or inflammation will sometimes, but not always, result in pain and difficulty. The pain of colonoscopy, being visceral, can be intense and of an unpleasant quality similar to colic or labour pain. A combination of sedative and opiate analgesia (usually diazepam 5–10 mg i.v. and pethidine 50–75 mg i.v.) provides adequate threshold of tolerance for the 10–15 minutes of insertion. After sedation however, the patient cannot drive and must be escorted home, which makes colonoscopy a more major procedure. Many stoical or motivated patients can manage without sedation but for a first examination it may be better to assume that sedation will be required. Very short-lived sedatives or long-acting antagonists to existing medications could have an important role in facilitating the wider use of colonoscopy.

Over-sedation, suppressing the patient's ability to complain and allowing heavy-handed technique, received a bad press in the early days of colonoscopy and was blamed for a number of bowel perforations. In practice, the amount of sedation normally used does not stop the patient complaining vigorously when appropriate, the complications originally encountered mostly being due to the over-stiff and poorly-angling instruments then available as well as to clumsy technique in using them. Any invasive procedure can be expected to have complications however, and colonoscopy is no exception. Nonetheless, the perforation rate during colonoscopy must be much lower than that reported in existing reports based on pioneering experience (Rogers *et al.*, 1975; Fruhmorgan and Demling, 1979; Macrae, Tan and Williams, 1983) and probably approaches 1 in 2–3,000 colonoscopies. Therapeutic procedures involving electro-surgical currents, injection techniques or use of lasers will obviously carry additional hazard, perhaps 10-fold that of a diagnostic examination. Compared to the very low complication rate of barium enema these figures are significant and should not be forgotten by the clinician requesting colonoscopy. On the other hand, for a procedure which may often avoid surgery the risks are acceptable overall, especially since many endoscopic 'perforations' can be managed conservatively and the commonest complication is bleeding after polypectomy, also managed expectantly or with blood transfusion in the majority of cases (Macrae *et al.*, 1983).

The technical variability of colonoscopy is to some extent reflected in the time taken for the procedure, usually about 30 min but as little as 10 mins or as much as 40–50 min in some cases. Not infrequently technical difficulty means that the procedure is painful or stressful to the instrument rather than prolonged in time. The difficulty is concentrated at two anatomic points, the sigmoid-descending junction and the splenic flexure, and in each case reflects the tendency of the instrument to loop and stretch the sigmoid colon when the tip is being coaxed around a hairpin bend. More flexible instruments pass relatively easily around in the distal colon but are difficult to control when attempting total colonoscopy. The correct combination of torque-stability and flexibility characteristics has been worked out by the manufacturers empirically. The variability in colon dimensions and character in different patients makes it improbable that a single instrument can have 'ideal' properties and probably a well-equipped endoscopist should have at least two colonoscopes, one longer and stiffer and the other shorter, thin and floppy for passage through fixed or strictured distal colon. Since in many patients the suspected pathology is likely to be in the distal colon a case can be made for preferentially using very flexible short or intermediate length instruments for routine colonoscopy, aiming to make a rapid and socially-acceptable examination at least to the splenic flexure. Current philosophy, based on an ideal which may not be widely achieved, considers anything less than total colonoscopy as a poor compromise. This review is reasonable for experts and special centres but does not reflect the normal clinical situation. A single quick fibreoptic examination, often after only a disposable enema, would at least be a great improvement on the previous diagnostic methods of rigid proctosigmoidoscopy and 'standard' or single-contrast barium enema, both very uncomfortable and relatively inaccurate techniques.

## 'Diagnostic laparotomy' from within

Previous to colonoscopy further investigation of any patient having a suspicious or uncertain finding on barium enema was liable to be at laparotomy. Not infrequently, as in the case of a patient with a deformity or mass associated with diverticular disease, the surgeon would be uncertain of his findings on palpation alone and local resection would be undertaken 'for safety's sake' in spite of the risks involved. The endoscopist should have 90–95% success rate (Williams, 1981a) in reaching and passing

the problem area (with a thin instrument if necessary) and his mucosal view, backed by the pathologist's opinion on biopsy or cytology, should be extremely accurate. Lesions can be missed at colonoscopy (Laufer, Smith and Mullens, 1976; Williams, Macrae and Bartram, 1982) but errors should be rare if the endoscopists is warned to scrutinise a particular area. Only if the abnormality is sub-mucosal or if the instrument tip is unable to pass the area or to manoeuvre fully (because of fixation) is there any serious risk of misassessment. Tight strictures present the prime example of this problem but a proper view can also be difficult around some acute bends or in the cavernous proximal colon, when looping of the instrument in the distal colon results in pull-wire friction and difficulty in steering. Another source of inaccuracy is the endoscopist's difficulty in localisation within the amorphous length of the colon. It is not difficult to mistake the proximal sigmoid colon for the splenic flexure or the hepatic flexure for the caecum. At worst this may result in lesions being missed altogether but the endoscopist can also give misleading localisation to the surgeon.

In spite of these limitations colonoscopy has proved sufficiently accurate to make diagnostic laparotomy for colonic disease a thing of the past. Countless patients with polyps, strictures, diverticular disease and suspicious deformity of the colon on X-ray have been saved surgery by satisfactory results at colonoscopy. It seems inconceivable now that laparotomy should have been the normal procedure for definitive diagnosis of terminal ileal or caecal Crohn's disease, for fear of mistakenly treating tuberculosis by corticosteroids. There are circumstances when barium enema appearances, as of a constricting carcinoma with 'apple-core' deformity, are sufficient alone to indicate surgery. Even then it is often wise to perform check colonoscopy, perhaps on the pre-operative day, for X-ray appearances can be misleading, large stalked polyps can mimic cancer or the presence of very numerous associated polyps may indicate more extensive resection. The high morbidity and mortality of colonic operations in the elderly makes referral for colonoscopy absolutely indicated if there is the slightest doubt.

**Bleeding—mild, moderate and severe**

Although 95% of ano-rectal bleeding is recognized as being due to simple causes such as haemorrhoids and fissure (Williams and Thomson, 1977) clinicians are correctly trained to investigate further those patients in whom bleeding is darker, mixed into the stool, seen to be 'coming from above' on proctosigmoidoscopy or which persists after treatment of the local condition. One of the most impressive original demonstrations of the clinical yield of colonoscopy was the finding of disease missed on barium enema in 30–55% of patients subsequently referred on for colonoscopy (Teague *et al.*, 1978; Swarbrick *et al.*, 1979). This yield was artificially high due to superselection of problem patients by the referring clinician but did show the advantage of the endoscopist's colour view of blood compared with the problems for the radiologist of interpretation in black and white. Especially in the tortuosity of the sigmoid colon it is easy for the radiologist to miss or mis-assess irregularities or filling defects which stand out like beacons to the endoscopist because of their reddened or bleeding surface. Polyps provide the majority (18–20%) of such missed lesions but cancers (5–10%) and various forms of inflammatory bowel disease another 10–15%, most of the remaining undiagnosed patients being presumed to have intermittent ano-rectal causes for their bleeding.

Flat lesions such as mild colitis, 'solitary ulcer syndrome' of the rectum and haemangiomas are for practical purposes invisible to the barium radiologist. The endoscopist is in danger, if anything, of over-diagnosing. This is particularly easy for possible vascular lesions such as angiodysplasias since prominent or confluent normal vessels can be mistaken as being abnormal. The diagnosis of angiodysplasia, presenting clinically as either profuse or occult bleeding in the over-50s, has become fashionable due to the combined effects of zealous angiography and colonoscopy. From an endoscopist's point of view, it appears to be a relatively uncommon cause of bleeding, the diagnosis of angiodysplasia being made in only 30 patients of over 1,000 in our series having total colonoscopy because of bleeding, (Danesh, Zambartas and Williams, 1984). When seen endoscopically it is very easy to electrocoagulate, photocoagulate or inject the surface of angiodysplasias or localised haemangiomas, although several sessions may be necessary for complete destruction and re-epithelisation of larger lesions (Rogers, 1980). Only a few patients with confluent or very numerous lesions need operative treatment. Since in so many patients endoscopy is at the same time diagnostic and therapeutic and since a negative barium enema cannot exclude pathology, colonoscopy is becoming recognized as the first-line investigation of choice in patients with colorectal bleeding or unexplained anaemia.

Massive bleeding, fortunately a relatively uncommon problem, is poorly investigated by barium enema except for the accurate demonstration of the extent of any diverticular disease. Colonoscopy is feasible (but difficult) either in the acute stage when fresh bleeding makes the colon self-cleaning, or immediately after the bleeding has stopped. Per-oral bowel preparation is needed to clean the bowel of

altered blood and enemas are avoided since they reflux blood proximally. A few studies from enthusiasts report useful diagnostic yield (Rossini and Ferrari, 1976; Forde, 1981) including some lesions such as polyp stalks or angiodysplasias where endoscopy is curative. In other patients, the endoscopist may not find the exact bleeding site but can localise sufficiently for the purposes of surgical resection. Unfortunately, diverticular disease is difficult enough to endoscope in the fully-prepared state and during bleeding is likely to defeat all but the most expert and persistent endoscopist. Angiography or isotope scintigraphy are accepted as the most effective methods for localization of massive colonic bleeding but attempted colonoscopy may have a place as an intermediate measure whilst these investigations are being organized and can sometimes be successful or therapeutic.

## A high-powered view of inflammatory bowel disease

The ability of the endoscopist to see mild colitis has been mentioned above and there have been reported cases of 'minimal change' total colitis below the threshold of diagnosis for double contrast barium enema (Elliott *et al.*, 1981). Biopsy is a integral part of the endoscopic procedure and should be performed routinely in any patient with diarrhoea, since other cases of 'microscopic colitis' have been reported where even the endoscopic view appeared normal (Kingham *et al.*, 1982). Although rectal biopsy and barium enema are still the main-stay of routine investigation of inflammatory bowel disease (Laufer, Mullens and Hamilton, 1976) this very high-resolution capability of endoscopy is of great importance for a few patients, such as those with unexplained diarrhoea and weight loss, who usually respond rapidly to appropriate medical treatment if colitis is diagnosed. Colonoscopy has been reported as successful first-line investigation of children with possible inflammatory bowel disease (Chong *et al.*, 1982). It may also be useful in defining the exact extent of colonic inflammatory disease, as in the examination of patients needing partial resection for ileo-colic Crohn's disease for instance, in whom if very extensive minor disease is shown endoscopically the surgeon may decide to perform only a limited resection with post-operative medical therapy. In many patients with colitis appropriate treatment of more severely affected areas, as demonstrated on X-ray, can be clinically very adequate. It may even be counterproductive to know from endoscopy that the proximal colon is mildly abnormal (Lux *et al.*, 1978; Gabrielsson *et al.*, 1979) in patients radiologically assessed as having distal colitis, who can be expected to respond to corticosteroid enemas, do not need oral therapy and probably do not share the long-term cancer risk of true 'total colitis' patients.

Conventional combination of rectal biopsy and X-ray in the diagnosis of inflammatory bowel disease shows the overall configuration very adequately in most patients and is superior to endoscopy in demonstrating fistulation, fissuring, stricturing or involvement of the proximal small intestine. Both Crohn's disease and tuberculosis however, frequently spare the distal colon or rectum and colonscopy will be necessary to give tissue diagnosis before starting major medication such as corticosteroids or azathioprine. To do this by laparotomy was particularly undesirable in Crohn's disease because of the risk of post-operative fistula formation, whereas the endoscopist can reach to (usually through) the ileo-caecal valve to inspect and biopsy the mucosal aspect without risk. The biopsies obtained endoscopically are small and it has taken a re-think by pathologists to learn to interpret the disease process on the basis of this apparently inadequate sampling technique. The endoscopist can help by 'targetting' his biopsies very accurately, as in the case of Crohn's disease where 25–30% of patients can be shown to have diagnostic granuloma formation if the margins of small ulcers are selected for multiple biopsies (Geboes *et al.*, 1978; Chong *et al.*, 1982). In about 80% of patients with Crohn's disease the pathologist can define the changes seen as 'highly suggestive' even if they are not diagnostic and in some of the remainder the possibility of ulcerative colitis may be ruled out on the basis of endoscopic features, such as the presence of 'aphthoid' ulcers in otherwise normal mucosa. There is however, an overlap between the endoscopic or biopsy features of the different forms of inflammatory disease, whether non-specific, infective, allergic or ischaemic and the substantial contribution of the endoscopist to differential diagnosis of these conditions must be in the context of the clinical features and the results of other investigations; i.e. the endoscopist can be wrong!

## Cancer prevention in high-risk groups

### *Extensive colitis*

The cancer risk in total patients with colitis 10–20 years after the onset of symptoms is approximately 30–40 times that of a normal person (Butt, Lennard-Jones and Ritchie, 1980; Bayless and Yardley, 1981). Those particularly at risk can usually be predicted by the histological identification of pre-cancerous dysplastic changes on mucosal biopsy. Although this phenomenon was originally described on rectal biopsy (Morson and Pang, 1967) it was soon recognized from colonoscopic surveillance that around 30% of patients with dysplastic changes in the colon show no abnormality in the rectum. Although some

severe dysplasia is polypoid and potentially visible on barium enema (Blackstone *et al.*, 1981) in many cases dysplastic mucosa is flat and in others there may be confusingly sinister-looking surface irregularity due only to post-inflammatory polyp or scar formation, with no abnormality on biopsy. Total colonoscopy every 1–2 years is now the main-stay of investigation of patients with total colitis, biopsies being taken at intervals throughout the colon (usually 10 or more biopsies in all). The use of small diameter paediatric instruments has made it possible to pass through narrowed areas of the colon, taking biopsy or cytology material in and above strictures, many of which prove to be benign. The contribution of colonoscopy in chronic colitis has been to select out the 10% of patients who need colonic resection because of severe dysplasia, to indicate the right time for surgery (sometimes 20 or 30 years after the onset of symptoms) but mainly to spare the majority of such patients from the previous policy of routine total or sub-total colectomy 10 years after onset.

*Ureterosigmoidostomy*

An analogous cancer risk of at least a 100-fold is shown to occur after 10–20 years in an even smaller group of patients in whom the ureters have been implanted into the sigmoid colon because of congenital or acquired bladder problems. The cancers occur in colonic mucosa adjacent to the ureteric stomas situated in the mid-sigmoid colon, 25–40 cm above the anus and easily accessible to limited colonoscopy. A very flexible paediatric colonoscopy proves ideal for this purpose since the sigmoid loop is usually tethered by surgical adhesions. Preliminary surveys of ureterosigmoidostomy patients have shown a 15% of incidence of snareable adenomas in relationship to the ureters, removal of which should reduce or remove the long-term cancer risk (Stewart, Macrae and Williams, 1982).

*Adenomatous polyposis and colorectal cancer families*

If the diagnosis of adenomatous polyposis is to be made before there is a significant risk of cancer, screening examinations of asymptomatic family members must start at 10–12 years of age, colectomy in those found to be affected being advised by 17–18 years of age. Limited colonoscopy or fibre-sigmoidoscopy gives a much more detailed view of the mucosa than the rigid sigmoidoscope and by using the 'dye-spray' technique resolution and biopsy of polyps even 1 mm in diameter is possible. A 25% dilution of washable blue fountain pen ink squirted onto representative areas of colonic mucosa during the procedure causes these tiny lesions to project as pink islands against a blue background. Combined with biopsy proof (since young people may have mucosal lymphoid follicles which simulate polyps) this accuracy of diagnosis or exclusion should make the present routine of annual examinations unnecessary. Fibre-sigmoidoscopy at 2–3 yearly intervals should be sufficient and the period of screening could probably be stopped at about 35 years of age, whereas current advice has been for rigid proctosigmoidoscopy every year up to 50 years of age.

A subtly different screening problems arises in colorectal cancer families where the genealogy shows a high incidence of colorectal cancer in first-degree relatives at relatively young age. These families show a raised incidence of sporadic adenomas at any point in the colon but do not have polyposis coli. Colonoscopic screening examinations are the logical choice because of the greater accuracy of colonoscopy and the opportunity of immediate destruction or ablation of any polyp found. The whole colon must be examined, probably at 2–3 yearly intervals and starting at 10 years younger than the youngest age of diagnosis of cancer in any family member (Williams, 1981b).

**The polyp problem**

The biggest single clinical contribution of colonscopy has proved to be in the management of colonic polyps. Polyps are often found by chance, whether at proctosigmoidoscopy, barium enema or colonoscopy, in patients investigated for abdominal pain, altered bowel habit or overt ano-rectal bleeding. Nonetheless, the evidence is overwhelming that adenomas are the precursor lesions for colorectal cancer, at least 5% of them already contain invasive cancer and others would presumably turn malignant if not removed (Muto, Bussey and Morson 1975; Shinya and Wolff, 1979). Before the arrival of colonoscopy, laparotomy was needed to remove polyps beyond reach of the rigid sigmoidoscope, those under 1 cm being observed by annual barium enema until there was a change of configuration or size on follow-up. This policy meant not only repeated examinations for numerous patients but also the risk of cancer forming in the interim period—which may be reflected in the 10% malignancy rate found in surgically removed polyps (Muto *et al.*, 1975) compared to 5% in endoscopic series (Gillespie *et al.*, 1979). The statistics on the incidence, development and post-polypectomy follow-up results collected during the era before colonscopy are equally certain to have been biased by inaccurate methodology (Williams *et al.*, 1982b), since they are based mainly on rigid-proctosigmoidoscopy and the single-contrast barium enema. Being relatively inaccurate techniques these will have resulted in a high probability of missing small lesions, with a subsequent falsely-raised incidence of polyps and cancers on follow-up. The whole polyp literature

must be re-written now that more accurate techniques—double-contrast barium enema and colonoscopy—are available. Modern studies also include important additional details such as age of patient, size of polyps found etc. which are not available in previous studies.

The opportunity for cancer prevention offered by removal of polyps is important, but the size of the problem is also substantial (Panish, 1979). Accurate post-mortem studies (Williams, Balasooriga and Day, 1982a) show over a third of a population over 55 years of age to have an adenoma somewhere in the colon and over 10% in the elderly to have an adenoma of a centimeter or more in diameter. Having once diagnosed a polyp its removal now presents no problem but thereafter there is an onus to provide long-term follow-up (Williams, 1983). Twenty to thirty percent of patients are found to have further adenomas and 5–7% to have carcinoma on follow-examinations in the 5–10 years after polypectomy (Kirsner *et al.*, 1960; Brahme *et al.*, 1974; Deyhle, 1980; Macrae and Williams, 1984). Because even colonoscopy will miss lesions, the first check is usually advised at one year with subsequent examinations at 2–3 yearly intervals. Studies are under way to attempt to establish which patients are at higher risk for polyp or cancer formation (Macrae and Williams, 1984), the corollary being that some patients (possibly those with a single small adenoma) may be at such low risk that no follow-up is indicated. To prove the point, follow-up of a non-polyp-bearing control group would be necessary, something which has to date only been achieved in one study (Brahme and Ekelund, 1974), too small to allow any detailed conclusions to be drawn.

The 4–5% of adenomas with invasive carcinoma and the 1% of stalked carcinomas which can be physically removed by endoscopic snare polypectomy have re-kindled the dispute as to whether 'local removal' of a malignancy is safe. Given careful histopathological assessment (Morson *et al.*, 1984) and a well or moderately-well differentiated tumour at least several millimeters clear of the resection line, the likelihood of metastases, especially resectable ones, appears to be remote. Although there is an emotionally-charged contrary view, it seems that patients are best served by not running the risk of operation if a stalked malignant polyp appears on endoscopic and pathological grounds to have been adequately resected. A longer and larger follow-up study will be needed to prove this point conclusively.

## The hare or the tortoise?

Colonoscopy could be thought to be making all the running in the modern management of colonic disease. It is certainly giving a welcome shake-up to colonic diagnosis. The accuracy of view, the biopsies, the chance to take up probes, electrodes, laser guides or balloons is invaluable in appropriate patients for clinical or research purposes. However, colonoscopy can be a difficult and traumatic technique either in patients with mobile colons which loop uncontrollably or if adhesions cause fixation. Colonoscopy requires manual skill that cannot be quickly taught; the uninitiated frequently fail to pass the sigmoid-descending junction or the splenic flexure and expose the patient to a significantly higher risk of complications than occur after barium enema. Most endoscopists feel that colonoscopy should usually be under intravenous sedation, making it a 'heavy' procedure to organise. Radiologists never sedate for barium enema, although some patients wish they would. An air contrast enema can be performed in 10–15 minutes whereas a diagnostic colonoscopy usually takes about twice as long—longer still for polypectomies. The barium enema is probably a little cheaper than colonoscopy, although there are many hidden costs in radiology and newer colonoscopes have made endoscopy very cost-effective.

Except in rarified settings or for selected indications, the double contrast barium enema remains the work horse in spite of its failings and false-positives. Gilbertsen *et al.* (1980) caused calculated offence in describing the single contrast enema as 'a good technique for diagnosing inoperable colon cancer'; the double contrast technique might be thought of as the ideal screening investigation for normal colons. Except when there is active inflammatory bowel disease it can be argued that a high probability of disease is an indication for colonoscopy (as in patients with rectal bleeding, previous cancer, polyps etc). It is unfortunate that the endoscopist cannot predict beforehand which patient will prove to be difficult to endoscope, which would make barium enema the preferred choice. It is however, possible to abandon colonoscopy, aspirating all air or reinsufflating carbon dioxide, and then to perform a satisfactory double contrast barium enema of the rest of the colon (Williams *et al.*, 1982b). The use of carbon dioxide insufflation for rapid reabsorption afterwards (Rogers 1974; Hussein, Bartram and Williams, 1984) has advantages in making the patient more comfortable after endoscopy as well as allowing endoscopy and barium enema to be combined. Whereas barium enema can follow colonoscopy the endoscopist can unfortunately not see once the colon is barium-coated, making it necessary to pre-select patients on clinical grounds when endoscopy is likely to be the first-line procedure. In a few very high-risk patients, such as those with multiple adenomas or with severe dysplasia in ulcerative colitis, it is our policy to advise both colonoscopy and then double

contrast barium enema in the same patient on the same visit.

Undoubtedly the comparative role of the endoscopist and radiologist in colonic disease will continue to change over the next decade with further improvements of radiological standards, introduction of new scanning techniques and improvements in endoscopy. An open-minded approach to the selection of the appropriate technique for the particular patient is important and means that the clinician should appreciate the rival claims so that he can make the best choice for his patient.

## Conclusions

In spite of technical difficulties, fibreoptic colonoscopy has justified its role in colorectal practice by its accuracy in diagnosis of lesions difficult or impossible to see on barium enema and by its ability to provide histological proof. Added to now routine electro-surgical therapeutic techniques the ability to introduce guide wires, probes, balloons or electrodes gives the endoscopist many advantages over the radiologist. Ideally colonoscopy and high-quality colon radiology will co-exist and complement each other closely, a few patients having a combination of both techniques in a single investigational session.

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