15.3.1 Colonoscopy and flexible sigmoidoscopy 2734

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CONTENTS 15.3.1 Colonoscopy and flexible sigmoidoscopy 2734 James E. East and Brian P. Saunders 15.3.2 Upper gastrointestinal endoscopy 2740 James E. East and George J. Webster 15.3.3 Radiology of the gastrointestinal tract 2748 Fiachra Moloney and Michael Maher 15.3.4 Investigation of gastrointestinal function 2757 Jervoise Andreyev 15.3.1 Colonoscopy and flexible sigmoidoscopy James E. East and Brian P. Saunders ESSENTIALS Colonoscopy involves full oral bowel preparation and planned examination of the whole large bowel, while flexible sigmoidos- copy is usually performed after a phosphate enema and visualizes only the rectum and left colon. In expert hands, after appropriate explanation to the patient (which increases the chances of the pro- cedure being well tolerated), and (usually) some form of 'conscious sedation', total colonoscopy is possible in 98 to 99% of cases in the absence of obstruction, a severely ulcerated colon, or other contraindication. The indications for colonoscopy are wide and constantly ex- panding, and are likely to continue to do so until alternative less invasive techniques ('virtual colonoscopy' or genetic tests) are per- fected. Common indications include patients with or requiring (1) bleeding, anaemia, or occult blood loss; (2) chronic diarrhoea or known inflammatory bowel disease, which is accurately and easily assessed by endoscopy and biopsy; (3) polyps that can be removed endoscopically; and (4) surveillance for cancer preven- tion. Therapeutic colonoscopy now allows resection of almost all benign colonic polyps and some very early cancers as well as dila- tation of anastomotic or Crohn's disease strictures and stenting of malignant strictures. Introduction Colonoscopy involves full oral bowel preparation and planned examination of the whole large bowel, while flexible sigmoidos- copy is usually performed after a phosphate enema and visualizes only the rectum and left colon. In expert hands, after appropriate explanation to the patient (which increases the chances of the procedure being well tolerated), and (usually) some form of 'con- scious sedation', total colonoscopy is possible in 98 to 99% of cases in the absence of obstruction, a severely ulcerated colon, or other contraindication. Equipment Colonoscopes range from 60 to 70-cm flexible sigmoidoscopes or thin, very flexible paediatric instruments also used in adults with fixation or stricturing, up to 165-cm colonoscopes with dif- ferent flexibility characteristics and instrumentation channel sizes. Further technical improvements include higher resolution, zoom magnification, better control ergonomics, adjustable shaft

flexibility, image enhancement, and magnetic imaging of shaft loops without fluoroscopy. Thin ultrasound probes for use with conventional in- struments, and other more advanced technologies are available in specialist centres. A large range of accessories can be introduced through the suction/instrumentation channel of a colonoscope, including biopsy or grasping forceps; washing, spraying, or deflation tubes; cytology brushes; and injection needles. Therapeutic accessories include bi- opsy forceps, polypectomy snares and retrieval devices, cutting wires, endoscopic knives, coagulating forceps and argon plasma co- agulating catheters, laser light guides, haemostatic clip and nylon loop applicators, dilating balloons, and metal stent introducers. CO_2
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15.3.1 Colonoscopy and flexible sigmoidoscopy 2735 insufflation apparatus has become a standard of care as the gas is exhaled within 10 to 15 min and ensures that patients are not left distended and uncomfortable after the procedure. Cleaning and disinfection As for all flexible endoscopes, skilled maintenance, regular checks, and meticulous cleaning are essential. All parts, including air, water, and instrumentation channels, must be accessed during cleaning. It is not possible to sterilize a colonoscope but scrupulous mechanical cleaning and ‘high-level disinfection’ rapidly inactivate viral agents (including HIV and hepatitis B and C) and bacteria. However, myco- bacterial spores require prolonged disinfection agents and may be present in patients with HIV/AIDS, thus mandating invariably high standards of disinfection. Even with purpose-built washing ma- chines, designed to perfuse the various channels of an endoscope, it can take up to an hour to clean and disinfect an instrument, so mul- tiple colonoscopes are required to provide a routine service. Almost all accessories are now ‘single-use’ disposables but any others require equally rigorous cleaning and autoclave sterilization or high-level disinfection. Prions are not removed by ‘high-level disinfection’ and hence instruments must be quarantined when they have been used for ‘invasive’ endoscopy, including biopsy, in a patient known to have or to be at risk of variant Creutzfeldt–Jacobs disease; how- ever, ‘invasive’ procedures in a patient at risk of variant Creutzfeldt– Jacobs disease due to receipt of pooled plasma concentrates is no longer deemed to confer a high risk of endoscope contamination and standard decontamination is acceptable. Patient preparation Psychological Psychological preparation of the patient should not be forgotten, since most of those scheduled for colonoscopy are apprehensive, whether through embarrassment, expected discomfort, or fear of colorectal cancer. Explanatory literature and a friendly telephone manner at the time of booking the exam can help a great deal. Equally, a warm and reassuring atmosphere on reception, while obtaining informed consent, and also during the procedure, can help transform colonoscopy from an ordeal into a reasonable and well-tolerated experience. Bowel preparation Flexible sigmoidoscopy preparation is normally by disposable enema (hypertonic phosphate or similar) given or self-administered 30 min before the procedure. Some patients prefer to avoid the in- dignity of an enema by taking full oral preparation and this is also advisable in any patient with a colon narrowed by pronounced di- verticulosis or stricturing. Full bowel preparation is usually the most unpleasant part of col- onoscopy. Oral preparation must be preceded by dietary restric- tions, which include stopping iron or constipating agents in the preceding days and a low-fibre diet (with no nuts, mushrooms, or iron-containing red wine) for at least 24 h. Fluid overload is the commonest approach, usually achieved by ingestion of 3 to 4 litres of isotonic polyethylene glycol–electrolyte solution, which avoids electrolyte losses. Various commercial poly- ethylene glycol–electrolyte combinations exist, flavoured and pack- aged for posting. However, up to 10% of patients become nauseated, vomit, or become distended and stop drinking, which can result in poor preparation, especially in the proximal colon. A new low- volume 2-litre polyethylene glycol

preparation with ascorbic acid has recently been shown to be better tolerated and equally effective as the traditional 4-litre polyethylene glycol preparation. Purgative preparation is a very cheap and well-tolerated alterna- tive, although a few individuals can suffer cramping, incontinence, or vasovagal reaction. After the dietary restrictions previously de- scribed and senna or bisacodyl tablets on the afternoon before examination, a litre of isotonic osmotic laxative (commonly magne- sium citrate) is drunk followed by other clear fluids. Drinking con- tinues up to the time of the procedure to avoid solidification in the proximal colon, which can result in adherent residue that is difficult to flush or aspirate. Recently, the use of 'split-dose' bowel preparation has been ad- vocated in international guidelines whereby approximately half the dose of preparation is given on the day of the procedure, with the rest the day before. This consistently improves bowel preparation and is now the standard of care. If there is any possibility that the patient is obstructed, full oral preparation is contraindicated because of the possibility of per- foration; a smaller volume should be given, supplemented by en- emas. In the presence of massive bleeding it may be preferable to proceed directly to colonoscopy, relying on the purgative effect of blood rather than wasting time on preparation. Nasal-tube lavage is an alternative compromise before emergency colonoscopy (with the angiography team alerted in case adequate views prove impossible). Medication There is surprisingly wide variation around the world in attitudes to colonoscopy. In certain countries with enough anaesthetists avail- able (France, Australia), propofol anaesthesia is routinely employed. In others (Japan, China) and many institutions in Scandinavia, Germany, or northern Italy, unsedated colonoscopy is the norm. Fashions and opinions change and the trend is to some form of medication. Conscious sedation 'Conscious sedation' is offered to most patients in the United Kingdom, unless they are likely to be easy to examine (flexible sig- moidoscopy, previously easy examination, male sex, sigmoid resec- tion, or stoma) or are motivated to manage without medication in order to leave rapidly afterwards or to drive home. To generalize, women have longer colons and are more likely to suffer without sed- ation. The unpleasant gnawing quality of 'visceral pain' caused by the inevitable stretching of colon or attachments during insertion is, in a tolerant patient, quite manageable for a few spells of 20 to 30 s. The 50:50 mixture of nitrous oxide and oxygen (Entonox) has been introduced into many endoscopy units as a short-acting inhaled an- algesic to help with these short episodes of pain, especially at flexible sigmoidoscopy; however, prolonged examinations or the sensitivity of patients with irritable bowel syndrome can be much helped by a minimal dose of a sedative–analgesic combination. Combining a low dose of benzodiazepine (typically, midazolam 2–3 mg, intra- venously), with an opiate analgesic (e.g. fentanyl 25–100 μg, intra- venously) reduces discomfort and anxiety and gives the patient a well-deserved feeling of euphoria. Low-level sedation of this kind

 does not inhibit conversation or the ability to complain of pain or to change patient position when necessary. Smaller doses should be given in older or sick patients but incremental larger doses (espe- cially opiates) can be needed in apprehensive younger ones. Pulse oximetry monitoring and nasal oxygen is routine, and resuscitation equipment and reversal agents (flumazenil, naloxone) should be im- mediately accessible. Sedated patients should be accompanied home. General anaesthesia General anaesthesia is rarely needed and has the disadvantage that an unconscious patient cannot change position spontaneously, and also that removal of the warning given by pain may tend to more aggressive techniques. However, physician-administered 'propofol sedation' is increasingly advocated in the United States of America and Germany and undoubtedly, in patients with particular reasons for anaesthesia, propofol gives excellent results with rapid recovery compared to

high doses of conventional sedation. Antispasmodics Antispasmodics are decried by many on the basis that they are thought to elongate the colon and make insertion more difficult, but an atonic colon may allow more accurate steering and less need for gas distension reducing looping during insertion. Randomized trials assessing benefits of Buscopan for adenoma detection during with- drawal are conflicting but we routinely use hyoscine N-butyl bromide to speed insertion and optimize the view during examination. Antibiotics The use of antibiotic prophylaxis prior to colonoscopy or flexible sigmoidoscopy to prevent endocarditis has been abandoned in new guidelines, even for patients previously considered at high risk, for example, those with previous endocarditis, both in the United Kingdom and in the United States of America. Specific cases may still need prophylaxis, such as those with severe neutropenia. Procedures Flexible sigmoidoscopy Although rigid sigmoidoscopy (a misnomer as it usually only exam- ines the rectum) is commonly still practised in colorectal outpatient clinics, it provides only limited views in the unprepared upper rectum. Flexible sigmoidoscopy after enema bowel cleansing is the kindest and most logical means of examining proximal to the rectosigmoid junction (15 cm), whereas the distal rectum and anal canal are well, and in skilled hands often better, seen with a rigid instrument. In the presence of severe diverticular disease, it may be impossible to reach even the mid-sigmoid region without expertise and a thin endoscope. After hysterectomy, adhesions may make it uncomfortable to examine without sedation. For this reason, al- though flexible sigmoidoscopy is both better tolerated and more accurate and effective than aggressive, rigid proctosigmoidoscopy, depth of insertion should be limited to what is tolerable by the indi- vidual patient. Some endoscopists mistakenly attempt to reach the splenic flexure routinely. Without fluoroscopy or magnetic endo- scope imaging, even expert endoscopists can be completely mis- taken between the sigmoid-descending junction and the splenic flexure. At 60 cm of insertion the tip of the instrument can be any- where between the mid-sigmoid and the hepatic flexure, and there are no positive localizing landmarks. Insertion usually follows digital lubrication with jelly, the blunt tip of the instrument being inserted as the sphincters relax. Thereafter the instrument is coaxed in, as gently as possible, without haste or force, steering and corkscrewing around bends with twisting move- ments. Forceful insertion with loss of visualization, guesswork, and blind ‘push through’ are all avoided as far as possible. Any small polyps (up to 6 mm) that may be adenomas are normally snared at once, as they may be difficult to see on withdrawal (when the colon has been shortened and convoluted) or if left for subsequent col- onoscopy. Because of the remote possibility of explosive gas con- centrations after limited preparation, either repeated suction with air reinflation or use of CO_2 should precede electrosurgery; alterna- tively, ‘cold snaring’ with physical removal of the polyp can be used. The use of flexible sigmoidoscopy for colorectal cancer screen ing has increased following three recent, very large, random- ized, population-based studies in the United Kingdom, Italy, and the United States of America reporting that one-off flexible sig- moidoscopy prevents left-sided colorectal cancer and colorectal cancer-related death. This level of evidence is not yet available for colonoscopy. Total colonoscopy In expert hands, and in the absence of obstruction, a severely ulcer- ated colon, or other contraindication, total colonoscopy is possible in 98 to 99% of cases, with little sedation or suffering and virtually no complications. In less expert hands, ‘total colonoscopy’ or ‘com- pletion’ rates as low as 75% have been reported. The principal differ- ence in technique between expert and inexpert is the ability, while keeping sufficient orientation for steering purposes, to pull back and crumple the segment of colon already traversed, and simultaneously straighten the way or bend ahead. The ideal is to keep the colono- scope as straight as possible and to pleat or ‘concertina’ the colon over it, avoiding the unnecessary loops and pain caused by pushing too hard or too long. The ideal is not always immediately achievable,

so patience and determination—tempered by humanity—are essen- tial qualities for the colonoscopist (see Video 15.3.1.1). Paradoxically, a freely mobile colon, without the conventionally fixed segments in the descending and ascending parts, can be as dif- ficult to traverse as one with adhesions. This is principally because atypical loops may form, sometimes uncontrollable until the instru- ment tip eventually reaches a fixed point, which gives a ‘hold’ and allows the shaft to be straightened back. Happily, this type of long and mobile colon, although a nightmare for the endoscopist, typic- ally also has long attachments so that the patient experiences little discomfort. From the point of view of the patient, colonoscope stretch dis- comfort is felt as ‘wind pain’, rapidly relieved as soon as the causative loop can be straightened. True overdistension is easily removed by aspiration. Once the colonoscope has successfully passed into the descending colon and has been straightened back to remove sigmoid colon looping, it is likely that the rest of the insertion phase will be con- siderably easier. When the colonoscope shaft is straight, it feels re- sponsive and free, as do the angling controls: the more looped the colonoscope is, the less responsive the instrument becomes, and the

 more the patient suffers. Avoiding looping and responding to pain are the basis for successful, kind, and safe insertion. Good technique also minimizes instrument repair bills and maximizes accuracy and ease of targeting lesions, since a straight instrument handles better. This practical philosophy underlies the reason for simple but effective ‘tricks of the trade’ such as position change. It is obvious that in the left lateral position there will be pooling of any fluid in the left colon; the transverse colon will also tend to sag down and so make the splenic flexure more acute. It therefore follows that, where there is a poor view or difficulty in insertion, position change may improve matters (to supine or right lateral at the splenic, but back to left lateral again for the hepatic flexure). Adding only the simple principles of pulling back as often as possible to straighten each loop before tackling the next, avoiding overdistension to keep the bowel reasonably deflated and supple, and trying hand pressure from an assistant whenever an unavoidable loop may be accessible (sigmoid and transverse colon), the art of colonoscopy is explained. Insensitivity, impatience, or aggression results in the endoscopist being too muscular and tense to handle the shaft and controls sen- sitively, and so more likely to cause needless looping, pain, failure, and complications. CT colonography and capsule colonoscopy CT colonography (‘virtual colonoscopy’) is an alternative for in- complete colonoscopy, for those with significant comorbidities, or for patients who prefer not to have colonoscopy. The diagnostic performance appears similar to colonoscopy in meta-analysis for cancer and polyps 1 cm or larger in size, but less good for smaller polyps or flat lesions. Capsule colonoscopy, whereby a double-ended videocapsule endoscope is swallowed after bowl preparation, is another alterna- tive (PillCam COLON 2). This provides video images as the capsule tumbles through the colon and appears to have similar diagnostic performance for larger adenomas and cancers as colonoscopy, but is less good for significant sessile serrated polyps and smaller lesions. Approximately 10% of capsule examinations are unreadable due to inadequate preparation or failure of the capsule to transit the whole colon. Colonoscopy remains the criterion standard for whole-colon examination. Indications The indications for colonoscopy are wide and constantly expanding, and are likely to continue to do so until alternative, less invasive tech- niques (virtual colonoscopy or genetic tests) are perfected. Where there is a shortage of endoscopic personnel, skill, or facilities it is possible to reduce the load of total colonoscopy by cross-referring for CT imaging. It is also possible to combine CT with prior flexible sigmoidoscopy on the same visit, on the basis that limited colonos- copy covers the highest yield area, which is also the most prone to missed diagnosis or

overdiagnosis. Gastrointestinal bleeding High-yield indications include patients with bleeding, anaemia, or occult blood loss. Persistent bleeding, especially if dark or mixed in with the stool, is of sinister import, although it may be due only to local mucosal traumatization in diverticular disease. Good clinicians may select out for sigmoidoscopy patients with obvi- ously fresh bleeding on defecation or with spotting on toilet paper. However, the presence of blood in a patient aged 50 years or more (so at risk for colorectal neoplasia) is increasingly used as an ex- cuse for the reassurance of a whole-colon screening examination. Of all patients with blood loss referred for colonoscopy, around 10% will have a 'significant' lesion, either a neoplastic polyp of 1 cm diameter or greater or malignancy. Colonoscopy is considered the investigation of choice for major bleeding, being readily available and offering immediate therapy and a high degree of diagnostic ac- curacy. Angiodysplasia, small ectatic vascular lesions in the prox- imal colon of older people with bleeding or anaemia, is relatively rare but is an example of a condition easily diagnosed and treated by colonoscopy (Fig. 15.3.1.1). Diarrhoea and inflammatory diseases Chronic diarrhoea or known inflammatory disease is accurately and easily assessed by endoscopy and biopsy (Fig. 15.3.1.2). The terminal ileum can be accessed in more than 80% of cases by an experienced endoscopist. Endoscopic differential diagnosis be- tween the focal or aphthous ulcers with intervening normal mucosa in Crohn's disease and the generally reddened surface of ulcerative colitis is easy and definitive in around 90% of cases. A few remain as 'indeterminate colitis' and differential diagnosis can be more dif- ficult in severe or chronic cases. The possibility of infective colitis, including tuberculous or amoebic, must be borne in mind and extra specimens taken for microscopy and culture if in doubt. Biopsies typically show a somewhat greater extent of inflammation than is visible to the eye, and so must be taken at intervals around the colon in any patient with bowel frequency to exclude microscopic colitis (collagenous or lymphocytic). Chronic inflammatory bowel disease affecting more than one-half of the colon carries an increased long- term risk of cancer or mucosal dysplastic (precancerous) change, and so indicates intermittent surveillance from 8 to 10 years after onset of symptoms. Ischaemic colitis, typically affecting a short seg- ment around the splenic flexure, can show changes ranging from mild reddening to marked ulceration or even near gangrene. Fig. 15.3.1.1 Angiodysplasia in the right colon. From Marks D, Harbord M (2013). Emergencies in gastroenterology and hepatology. By permission of Oxford University Press.

section 15 Gastroenterological disorders 2738 Polyps Polyps of almost any size can be removed endoscopically (Fig. 15.3.1.3, Video 15.3.1.2). Removal of very large sessile polyps in the distal rectum, for which transanal proctological manage- ment has been indicated, was traditionally not attempted by endoscopists but these are now manageable by endoscopic sub- mucosal dissection, with superior view and greater safety. The place of laparoscopic removal or a combined approach for large sessile polyps in the proximal colon is in evolution. Otherwise even overtly malignant polyps or polypoid cancers with no ad- enoma present can be managed by endoscopy alone if complete removal is confirmed histologically and histological factors are favourable (well- or moderately well-differentiated tumour, no lymphovascular invasion, <1 mm of invasion below the muscularis mucosae). Around 5 to 10% of polyps will contain focal, high-grade dys- plasia or invasive carcinoma but are endoscopically removable. Placing one or more sterile carbon tattoos near a polypectomy site gives a permanent marker for endoscopic follow-up, or localizes it if surgery or laparoscopy becomes indicated by the histology results. Lasers were previously used for ablation of postpolypectomy rem- nants, but the alternative of argon plasma coagulation is cheaper, easier, and safer. Surveillance Cancer prevention or surveillance colonoscopy gives a good guar- antee to the patient, even when negative, both because of the accuracy of colonoscopy

and the generally slow time course of de- velopment of colonic neoplasms (Fig. 15.3.1.4). Follow-up at 3- to 5-year intervals after polypectomy yields further (usually small) adenomas in 30 to 50% of patients, especially those with three or more, or large, polyps on the initial examination. There is reason- able evidence to suggest that the incidence of colorectal cancer is significantly reduced by polypectomy and follow-up, but occasional breakthrough cancers occur and any bleeding or suggestive symp- toms should be reported. Patients at genetic risk merit colonoscopic surveillance, especially those with a first-degree relative with (a) (b) Fig. 15.3.1.2 Colonoscopic appearance of (a) normal colon and (b) inflamed colon. From Keshav SC (ed) (2008). Medical masterclass: Module 8, Gastroenterology and hepatology, 2nd edition. London: Royal College of Physicians. Fig. 15.3.1.3 Cold snaring diminutive adenoma. From Marks D, Harbord M (2013). Emergencies in gastroenterology and hepatology. By permission of Oxford University Press. Fig. 15.3.1.4 Colon cancer. From Marks D, Harbord M (2013). Emergencies in gastroenterology and hepatology. By permission of Oxford University Press.

15.3.1 Colonoscopy and flexible sigmoidoscopy 2739 colorectal cancer under 45 years of age, two or more affected first- degree relatives, or those assessed genetically as belonging to a Lynch syndrome (hereditary nonpolyposis colon cancer) family with autosomal dominant risk (see Chapter 15.16). Follow-up, ablating minute or ‘flat’ adenomas, is scheduled at intervals of 1 to 5 years according to perceived individual risk. Other indications Abnormalities found on other diagnostic methods, when checked colonoscopically, frequently turn out to be spurious—presumably faecal. Most positive occult blood tests prove to be false positive for neoplasm. Other findings, such as anastomotic strictures, typ- ically after Crohn’s resection, are usually easily and effectively di- lated by the endoscopist using a ‘through-the-scope’ balloon. Even patients with typical malignant ‘applecore’ strictures should ideally have preoperative total colonoscopy to exclude other synchronous neoplasms, if necessary using a small-diameter instrument (some- times a paediatric gastroscope). If this proves impossible, colon- oscopy should be rescheduled within 6 months after resection. Colonoscopy has effectively supplanted diagnostic laparotomy and avoids the numerous resections previously performed for diver- ticular disease when the radiologist ‘could not exclude the possibility of malignancy’, which the endoscopist can achieve in a few minutes. Low-yield indications There are low-yield indications for colonoscopy, where alternative in- vestigations such as flexible sigmoidoscopy or ‘virtual colonoscopy’ may be justified. These include patients with simple constipation of long standing, bloating, left iliac fossa discomfort, or combinations of these symptoms suggesting ‘irritable bowel syndrome’. In many patients, the extra accuracy and therapeutic potential of one-off col- onoscopy may be justified. In older patients, however, the greater like- lihood of diverticular disease and difficult (therefore more hazardous) colonoscopy is a disincentive compared to the rapidity and safety of scanning. Contraindications, risks, and limitations There are few contraindications to colonoscopy. It is, however, a rela- tively strong vasovagal assault with potential for arrhythmias and so is contraindicated for 2 to 3 months after myocardial infarction. The tip, shaft, and air pressure involved in insertion have potential to exacerbate any existing risk of perforation. Colonoscopy is thus contraindicated in the acute phase and 2 weeks after an episode of diverticulitis and in severe acute or deeply ulcerated colitis of any variety (ulcerative, Crohn’s, ischaemic, or infective). Patients with acute localized or rebound tenderness of the abdomen, free air, or dilated colon on radiography should not be submitted to colon- oscopy without special reason, due consultation, and by an expert endoscopist—who may decide to abandon the procedure. The risks of diagnostic colonoscopy, as implied earlier, are to a great extent related to the training, personality, and manual skills of the endoscopist. Regrettably, large-scale audit shows figures of around 1

perforation in 1500 to 2000 examinations, whereas in specialist centres complications are exceedingly rare. The overall figures can be justified by the avoidance of the morbidity and mortality of surgery. Therapy inevitably increases the likelihood of complications, principally bleeding but occasionally perfor- ation after polypectomy or dilatation. Perforation may be actual (perhaps needing surgery) or threatened as the ‘postpolypectomy syndrome’ (managed conservatively with rest and antibiotics). Immediate bleeding can occur in around 1% of polypectomies but is usually easily stopped by submucosal adrenaline injection or by local electrocoagulation, clipping, or nylon loop application. Delayed haemorrhage can occur up to 14 days after removal or local coagulation of even small polyps; it is usually self-limiting, but can be substantial and require admission to hospital and trans- fusion. Aspirin is no longer considered a risk factor but antiplatelet agents such as clopidogrel should be stopped for a week before and after polypectomy. Anticoagulants should similarly be discon- tinued or special measures instituted. The greatest causes of colonoscopy-related mortality (1 in 10 000 examinations) are patients referred (not always correctly) for sur- gery following endoscopic complications and deaths directly due to oversedation, usually in older people. There have been unnecessary deaths when a physician has persisted in conservative management without involving a surgeon in management of suspected perfor- ation. Surgical fatalities or major morbidity have resulted in other patients found at operation to have sustained only a point perfor- ation, which would clearly have sealed spontaneously. In managing suspected perforation, due consultation between endoscopist and an endoscopically aware, preferably laparoscopy-oriented, sur- geon is essential. The endoscopist should not be too proud to abandon an examination which is proving unreasonable, rather than to oversedate the patient; it is safer and kinder to change to CT colonography (‘virtual colonoscopy’) to image the unexamined proximal colon, ideally during the same visit. The major limitations of colonoscopy relate to the fact that it is dependent on manual skills and that tortuous, angulated, and haustrated colonic anatomy results in some blind spots for the endoscopist. Areas that the endoscopist sees are extremely accur- ately evaluated, with a resolution of less than 1 mm. The percentage of mucosa unseen is uncertain but is probably around 10 to 15% overall. The likelihood of larger and ‘significant’ lesions being missed is much lower than this because colonic neoplasms are usually pro- tuberant. Paradoxically, pathology can be missed in the capacious distal rectum or the anal canal, which can be avoided by retroverting the endoscope and/or examining with a rigid proctoscope as well. Cost-effectiveness and relationship to other techniques Flexible endoscopy seems superficially expensive and is demanding of professional time. However, modern colonoscopes are surpris- ingly robust and, properly handled and maintained, will perform thousands of examinations without expensive repairs. Newer teaching methods, including the use of computer simula- tion and imaging techniques that do not use X-rays, should help to improve manual skills and instrument handling and speed up the training and assessment of doctors or nurse practitioners performing colonoscopy or flexible sigmoidoscopy. There has been shown to be considerable variation between endoscopists in detecting adenomas, which translates into increases in postcolonoscopy cancers and death from postcolonoscopy cancers for poor detectors; hence, quality

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