

# Towards safer colonoscopy: a report on the complications of 5000 diagnostic or therapeutic colonoscopies

F A MACRAE, K G TAN, AND C B WILLIAMS

*From St Mark's Hospital, London*

**SUMMARY** The diagnostic and therapeutic benefits of colonoscopy are well known but most large-scale surveys, especially those involving multiple centres, may underestimate the range and incidence of complications. The detailed records of 5000 colonoscopies in a specialist unit have been analysed and conclusions drawn which may help to make the procedure safer. The incidence of haemorrhage was 1% and bowel perforation 0.1%. All the major haemorrhages occurred during polypectomies over 2 cm in size. Secondary haemorrhage was an unpredictable occurrence, one to 14 days later. Three deaths followed colonoscopy: one cardiorespiratory death was related to oversedation; a second was due to mismanaged ischaemic colitis developing two days after traumatic instrumentation, and the third was due to peritonitis. Minor complications included thrombophlebitis, abdominal distension, and vasovagal episodes. Because of experience during the first half of the series and also due to improvements in instrumentation, the complication rate of the later part of the series was halved. Recommendations include the avoidance of oversedation, review of previous barium enema films so as to be aware of large polyps which are more likely to bleed, and the recognition of situations where perforation or septicaemia is likely to occur.

Fibreoptic colonoscopy has become a routine investigation in the diagnosis and treatment of colonic disease. A limitation to its usefulness is its relative technical difficulty, discomfort, and possible danger compared with less accurate investigations such as the barium enema. A survey of the literature reveals a number of case reports of complications<sup>1-13</sup> including pneumoperitoneum,<sup>9</sup> perforation of the colon or ileum,<sup>10</sup> electrocardiographic abnormalities,<sup>11</sup> volvulus,<sup>12</sup> and incarceration of inguinal herniae.<sup>13</sup> Larger combined series<sup>14-20</sup> have suggested a complication rate for diagnostic colonoscopy of one in every 300-700 examinations, related to the experience of the endoscopist, and a mortality rate of 1 in 10 000. Complications occur more frequently after polypectomy, with 2% incidence of haemorrhage, 0.3% incidence of perforation, and 0.1% mortality rate. This

complication rate for a therapeutic procedure is not insignificant but satisfactory in view of the greater morbidity and mortality of the abdominal surgery that it frequently replaces.<sup>21 22</sup>

Sporadic case reports and postal surveys may not reflect the true incidence of complications and may tend to record dramatic occurrences but suppress the embarrassing ones.

## Methods

We reviewed all complications related to the 5000 colonoscopies performed between January 1971 and November 1980 at St Mark's Hospital, London, with a view to providing recommendations based on this experience. The majority of the examinations were performed by one experienced endoscopist; in 70% of cases a total colonoscopy was performed and accurate records were kept of each case on a punch card system. Immediate complications were always recorded but late complications may not always have been notified.

Address for correspondence: Dr C B Williams, St Mark's Hospital, City Road, London EC1V 2PS.

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## Results

The 5000 colonoscopies included 1795 snare polypectomies, 1458 hot-biopsies, and over 5000 mucosal forceps biopsies.

### GENERAL COMPLICATIONS

#### *Thrombophlebitis*

This complication, caused by intravenous injection of diazepam, is known to have occurred in six patients, but, as no routine survey was made in the period after examination, the incidence may have been higher.

#### *Abdominal distension*

Distension occurred in two elderly patients, causing the procedure to be abandoned; it was shown radiographically to be due to reflux of air into the small intestine. Minor degrees of distension occurred in other patients but discomfort was minimised by avoiding overinsufflation, aspirating excess air during withdrawal, or using carbon dioxide for insufflation.

#### *Vasovagal complications*

There were complications of clinical significance in five patients; in three of these respiratory arrest or prolonged apnoea occurred after sedation, reversed by ventilation with the Ambu bag – for example:

A 55 year old man showed signs of a severe vasovagal episode with hypotension. Electrocardiogram revealed sinus bradycardia and the patient recovered when he was put in the head down position.

A 72 year old unsedated woman developed acute respiratory distress during limited colonoscopy and the procedure was abandoned. The patient recovered spontaneously.

Many other patients had transient episodes of pallor, sweating, and bradycardia during difficult or prolonged colonoscopy but recovered within a few minutes after the procedure. All patients were kept flat during the recovery period.

### HAEMORRHAGE

A single haemorrhage occurred during more than 5000 diagnostic mucosal biopsies. This episode was in our early experience before the development of hot-biopsy forceps.

A 73 year old man was already anaemic and bleeding from multiple telangiectases of the right colon, too numerous for diathermy. The rate of blood loss appeared to increase after colonoscopy and biopsies and 3 units of blood were transfused.

No bleeding complicated any of the 1458 hot-biopsies<sup>23</sup> to destroy small polyps or telangiectases.

After snare polypectomy of the 1795 polyps over 7 mm in size, there were 48 haemorrhages (Table).

#### *Minor haemorrhage*

Snare polypectomies in 29 patients were complicated by haemorrhage of more than 20 ml but not requiring blood transfusion. The bleeding stopped spontaneously in six patients who were estimated endoscopically and in the suction bottle to have lost 40–400 ml blood. In the remaining 23 patients, local treatment with either stalk strangulation by the snareloop, local stalk coagulation, adrenaline and ice water or a combination of these measures was required.

#### *Major haemorrhage*

This occurred in 13 patients after snare polypectomy in all of whom local measures failed to control the bleeding and transfusion with 1–5 units of blood was required. The bleeding stopped after colonoscopic control of the stalk at one to six hours after polypectomy in 10 patients, but three required operative treatment.

A 34 year old man had 15 juvenile polyps removed by snare polypectomy. The last polyp, with a head of 3.5 cm in diameter with a broad fleshy stalk, bled uncontrollably. Seven hours later after an 8 unit transfusion, he was submitted to laparotomy at which the stump was oversewn.

#### *Secondary haemorrhage*

This occurred at five to 14 days after polypectomy in six patients. In four the bleeding stopped spontaneously without transfusion, one patient requiring a further colonoscopy with local coagulation.

A 73 year old haemophiliac had a 4.5 cm polyp of the sigmoid colon which caused persistent rectal bleeding; colonoscopic polypectomy under cryoprecipitate cover was successful but subsequently further rectal bleeding occurred. At repeat colon-

Table Number of patients with haemorrhage after 1795 polypectomies, according to size of adenoma removed

Maximum diameter adenoma (cm)	Haemorrhage (no.)		
	Minor	Major	Secondary
0.5–1.0	2	—	1
1.1–2.0	9	—	—
2.1–3.0	12	7	2
3.1–4.0	—	4	2
>4.1	2	2	—
Unknown	4	—	1
Total	29	13	6

oscopy four weeks later another unsuspected 2.5 cm polyp was seen in the descending colon and snare polypectomy was again performed without haemorrhage. One week later, after the patient was transferred back to the referring hospital, bleeding recurred and eventually he was submitted to laparotomy without recolonoscopy. He died of postoperative complications not related to the colonoscopy.

A 66 year old woman had an 8 mm adenoma snared in the sigmoid colon. From the seventeenth to the nineteenth day after polypectomy, a secondary haemorrhage of approximately 800 ml occurred, ceasing spontaneously.

The incidence of bleeding in this series of 5000 colonoscopies was 1%. Forty-eight of the haemorrhages, however, followed 1795 snare polypectomies, representing a postpolypectomy haemorrhage rate of 2.7%. In the latter part of the series there were five haemorrhages after 496 polypectomies (1%) occurring in 324 patients (1.5%) and in the subsequent year none at all.

#### PERFORATION

There were six perforations in this series, four during diagnostic colonoscopy and two after attempted polypectomy.

A 69 year old woman with an unexplained stricture of the sigmoid colon had a fixed loop in the distal sigmoid colon that had perforated without the occurrence of obviously undue force. Laparotomy revealed extensive carcinomatosis involving the perforated bowel. The patient recovered uneventfully but died 18 months later.

A 59 year old man proved difficult to examine, the two-channel instrument looping in the sigmoid colon. The single-channel instrument was reinserted and passed through the apex of the sigmoid loop, without any obviously excessive force being used. Damage to the bowel wall may have occurred with the first instrument facilitating perforation with the tip of the second. The laceration was oversewn at operation and the patient made an uneventful recovery.

A 55 year old woman was examined with the two-channel colonoscope, an alpha-loop being noted in the sigmoid colon during insertion. On withdrawal there was fresh blood in the mid-sigmoid colon and extracolonic fat was seen. At operation there was 1500 ml blood in the abdominal cavity. The bleeding point was ligated, the laceration oversewn, and the patient made an uneventful recovery.

A 58 year old man with previous ureteric implants into the colon developed unexplained rectal bleeding. Full clinical details were not available at

the time of endoscopy and he was thought to have ureterosigmoidostomies. A 3.5 cm irregular polypoid lesion was seen in the mid-descending colon and after snare removal the patient experienced severe pain. The polypectomy specimen showed cystic dilatations in a ureteric stoma without evidence of malignancy. As renal function on the affected side was previously known to be insignificant, nephrectomy was performed and, after a protracted postoperative course, the patient recovered.<sup>24</sup>

A 74 year old man had a 2.5 cm polyp broad-based snared. Twenty-four hours later, after discharge, he developed left iliac fossa and epigastric pain with abdominal distensions. He was referred back seven days after polypectomy with signs of peritonism in his lower abdomen. At laparotomy a 2 cm perforation of the sigmoid colon was successfully closed.

A 68 year old man with myasthenia gravis developed abdominal pain, altered bowel habit, and a diagnosis of pseudo-obstruction was entertained. After limited bowel preparation colonoscopy was performed with some difficulty as there was marked diverticular disease in the sigmoid colon. Abdominal rigidity developed after the procedure and radiographs showed free intraperitoneal gas. After nine days of conservative management with antibiotics, an abscess was drained per rectum. A large abdominal mass and pyrexia persisted and, at laparotomy several days later, a small collection was drained adjacent to the sigmoid colon. The patient made a slow but complete recovery.

Two other patients developed transient localised abdominal tenderness and short-lived pyrexia 12 hours after polypectomy. Radiography showed no free abdominal air; both were managed conservatively with antibiotic cover and both recovered spontaneously. In one of them, subsequent laparotomy for other reasons confirmed the clinical suspicion of a 'sealed perforation'. Another two patients had no symptoms after polypectomy, but later operation showed evidence of full thickness damage at the polypectomy site sealed by adherent omentum or small intestine.

#### SEPTICAEMIA

Two patients became septicaemic after colonoscopy; one of them died.

A 69 year old man had follow-up colonoscopy three years after the removal of sigmoid adenomas. He had had mild left iliac fossa pain for several weeks before the examination. The colonoscope was passed without difficulty through diverticular disease to the caecum. A single 5 mm polyp was diathermied with hot-biopsy forceps at 25 cm. Six

days later he was admitted shocked and severely ill to another hospital with a *Proteus mirabilis* septicaemia. After intensive intravenous antibiotic treatment, he made a complete recovery.

A 20 year old man with ascites due to advanced cirrhosis secondary to sclerosing cholangitis was awaiting liver transplantation. A barium enema showed an abnormal transverse and ascending colon thought to be due to Crohn's disease. The colonoscope was passed without difficulty through a redundant colon, the patient experiencing no excessive pain. No abnormality was found endoscopically or on biopsy. Hepatic angiography was performed the following day. Peritonitis developed a day later, confirmed by the presence of pus cells in the ascitic tap. No culture was taken for bacteriology. He died despite intensive antibiotic therapy. Postmortem examination showed biliary cirrhosis with suppurative peritonitis; the transverse and ascending colon showed areas of superficial ulceration histologically suggestive of Crohn's disease but no obvious perforation.

#### DEATH

There were three deaths in this series of 5000 colonoscopies. One death appeared to be directly related to the sedation used for colonoscopy and another resulted from mismanagement of an ischaemic episode, apparently consequent on colonoscopy. The third death is described above.

A 75 year old woman with possible carcinoma of the ascending colon was judged to be a poor operative risk and referred for colonoscopic biopsy. Diazepam 15 mg and pethidine, 25 mg, were given by slow intravenous infusion at the start of the procedure. During technical difficulties in passing the sigmoid colon, the patient became uncontrollable 30 minutes after the initial dose. An additional 10 mg diazepam and 25 mg pethidine were given. The procedure continued uneventfully and the radiological diagnosis was confirmed. The patient was apparently in a good state 15 minutes later at the end of the examination but five minutes after this she was noted to be pulseless and apnoeic. Although cardiac resuscitation and intubation were immediately instituted and spontaneous pulse and respiration established within 30 seconds, the patient remained hypotensive and died two days later. Postmortem examination gave the cause of death as circulatory failure due to myocardial degeneration.

Colonoscopy in a 74 year old woman with unexplained anaemia proved to be extremely difficult. Three different instruments were used before the proximal sigmoid colon could be passed and total colonoscopy performed. The patient was

transferred back to the referring hospital and at the time of discharge the following day she complained of some left iliac fossa pain. Her symptoms continued at home during the next three days while under the conservative management of her own doctor without reference to the hospital. She was subsequently admitted to a small local hospital as an emergency four days after colonoscopy, but her condition deteriorated rapidly and she died before full resuscitation or operation was possible. The cause of death was given as ischaemic colitis of the sigmoid colon, possibly related to colonoscopic trauma.

#### Discussion

The colon is a long and tortuous organ which requires vigorous cleansing before examination. Even a barium enema is regarded by most patients as an extremely disagreeable experience and intubation with an endoscope is potentially more traumatic. The patients submitted for these examinations are often elderly and infirm and many patients are specifically selected for colonoscopy because they are judged unfit for surgery. It is, if anything, surprising that such a group of patients molested with bowel preparation and instrumentation did not have a higher complication rate. In our first 850 examinations no complication occurred. With greater numbers the complications that we have described ensued and the haemorrhages followed the institution of colonoscopic polypectomy.

#### PREPARATION OF PATIENT

Some patients can become significantly dehydrated after the diarrhoea induced by some preparations, particularly if hypertonic solutions such as mannitol or magnesium sulphate are used without adequate fluid intake. The routine use of oral mannitol seems particularly inadvisable in view of the report<sup>25</sup> of a fatal colonic explosion after bowel preparation; this was presumably due to hydrogen formation by colonic bacteria acting on the sugar solution and ignition of the gas during polypectomy.

#### PREMEDICATION OF PATIENT

Thrombophlebitis is a minor but painful complication and it can be avoided by using an oil-in-water emulsion of diazepam (Diazemuls). Instrumentation or distension of the colon might stimulate the vagi sufficiently to cause bradycardia or hypotension and cardiac irregularities can occur.<sup>11 26</sup> We frequently use the anticholinergic, antispasmodic N-hyosine bromide during colonoscopy to counter spasm or help intubation in patients with diverticular disease, and this could protect patients from the effects of

vagal stimuli. The additional use of sedation such as diazepam or pethidine can potentiate these cardiac effects or cause primary respiratory depression, particularly if the medication is given in a rapid bolus injection.

The opiate antagonist naloxone, 0.2 mg administered intravenously and 0.2 mg intramuscularly, is a valuable addition to the endoscopist's emergency kit; its use enables a small dose of an opiate such as pethidine to be safely used in elderly patients, thus reducing the dose of diazepam that is needed. Whether the recently reported benzodiazepine antagonist Ro-15-1799 will be clinically useful awaits further trials.<sup>27</sup> Other essential emergency measures include the use of a tipping table, the availability of a resuscitation bag (Ambu), and nursing staff trained to observe the patient carefully, particularly at the start of the procedure. We do not routinely use blood pressure or cardiographic monitoring devices, but these may be useful in high risk patients.

#### CLEANING AND DISINFECTION OF COLONOSCOPES

In this series we could find no suggestion that the colonoscope was responsible for transmitting infection between patients, and there have been no reports of transmission *via* the colonoscope in the literature. Staff in endoscopy units are increasingly aware of the potential hazard of cross-infection and assiduous mechanical cleaning followed by disinfection is important.<sup>28 29</sup>

#### HAEMORRHAGES

The reason for the relatively large number of haemorrhages occurring after snare polypectomy in this series (2.7%) is uncertain but these may be due to the disproportionate number of patients with large polyps who were referred from other hospitals. Since modifying our electrosurgical technique by using only coagulation current at low settings (usually 15–25 Watts), the incidence of haemorrhage after polypectomy has fallen appreciably and there has been none in the year subsequent to this study. In assessing the likely risk of bleeding the diameter of the stalk is of more importance than the size of its head. The stalk, however, is often poorly demonstrated on barium enema and may also be difficult to measure endoscopically; in this series all the major haemorrhages occurred in polyps with a head diameter greater than 2 cm. Such large polyps can normally be seen on barium enema and require extra care with the patients staying overnight in hospital; before colonoscopy, blood should be taken for grouping and serum saved for later cross-matching if necessary. Coagulation status (prothrombin time, partial prothrombin time (PTTK),

and platelet count) could be checked at this time, especially in any patient with a history of a bleeding diathesis. Patients with smaller polyps are normally managed as outpatients but are occasionally admitted if difficulties arise. Review of the barium enema is, therefore, an important safety factor in planning polypectomy. We now recommend snaring polyp stalks at the narrowest point near the polyp head, the snare being immediately replaced lower down the stalk and strangulation applied for 15–20 minutes if bleeding occurs. Slow oozing from a polypectomy site may be difficult to locate and coagulate but it normally stops spontaneously after two to five hours. Pulsatile bleeding requires active measures and we have found that, when this occurs, the greater suction capacity of the two-channel endoscope or some fibre-sigmoidoscopes is very desirable.

Persistent haemorrhage can also be arrested angiographically,<sup>30</sup> although this technique was not available to us at the time of the postpolypectomy haemorrhages requiring operation. Our experience suggests that the risk of secondary haemorrhage is not so predictable. All patients should be warned of the possibility of secondary haemorrhage and advised that they should report to hospital if more than slight bleeding occurs within three weeks of snare polypectomy.

#### PERFORATIONS

The four frank perforations of the sigmoid colon that we saw during diagnostic colonoscopy would be less likely to happen with the more flexible instruments that are now available, but difficult examinations do occur unexpectedly. Any colonoscopist should be aware of the possibility of perforation, particularly in a fixed loop, and should be prepared to abandon the procedure. Even in the most skilled hands, colonoscopy is sometimes technically impossible or clinically unreasonable. No perforation occurred in our series as a result of air pressure, possibly because of our awareness of this hazard.<sup>31</sup> Air insufflation should be gentle at all times, particularly in the presence of inflammatory bowel disease and diverticular disease. It is our practice to aspirate whenever feasible, to use as little insufflation as possible to obtain an adequate view, and never to continue insufflation unless the patient is comfortable. Carbon dioxide, which is rapidly absorbed from the colon, may be increasingly used for diagnostic colonoscopy in the future.

#### SEPTICAEMIA

Evidence is conflicting about the incidence of bacteraemia during colonoscopy.<sup>32–37</sup> Clearly septicæmia can sometimes occur and should be

anticipated particularly in the immunosuppressed patient – for example, with an organ transplant, very sick children, cirrhotic patients with ascites, and possibly those with known valvular heart diseases or prostheses.<sup>33</sup> Prophylactic antibiotics – for example, an aminoglycoside with or without metronidazole and a broad spectrum penicillin – should probably be given in such patients two hours before the procedure. We use gentamicin 80 mg intravenously, a combination penicillin (Triptopen, 1 vial intramuscularly), and 400 mg metronidazole orally. It has not been our practice to give antibiotic cover to patients with inflammatory bowel disease on azathioprine or corticosteroids.

#### DEATHS

Of the three patients in our series who died, one was probably oversedated. As a result of this experience and improved endoscopic technique, we tend to use less sedation, especially avoiding diazepam in the older patients. The second death appeared to be related to instrument trauma at the sigmoid descending junction. The sigmoid colon is frequently the most difficult area to examine and serosal or mesenteric damage has been described.<sup>38-40</sup> Undue force should be avoided during colonoscopy and patients who prove difficult to examine should be referred to an experienced endoscopist. Clinicians proposing to use the flexible sigmoidoscope or colonoscope should have some training by experienced endoscopists. It is during the learning phase that complications are most likely to arise.<sup>15-17</sup> The more flexible and more acutely angling instruments that are now becoming available may reduce the number of perforations in diagnostic colonoscopy as they make the more forceful manoeuvres, such as that of the alpha loop, unnecessary.

The aetiology of the peritonitis in our patient who died while awaiting liver transplantation cannot be ascertained, as bacteriological studies were not performed. Even if there were no frank perforation, it is likely that a bacteraemia induced by his colonoscopy (or perhaps angiography) led to the development of peritonitis. Indeed, the pathogenesis of primary bacterial peritonitis in cirrhotics with ascites is probably haematogenous spread of organisms from the gastrointestinal tract.<sup>41 42</sup> We now cover such patients with antibiotic prophylaxis.

We conclude that diagnostic colonoscopy is, by surgical standards, a relatively safe procedure with few complications. In the last 3000 diagnostic colonoscopies the one perforation occurred in the presence of occult and unsuspected diverticulitis which, if clinically recognised, would have contraindicated the examination. Postpolypectomy

haemorrhages were less frequent in this later experience and avoided altogether in the year thereafter. Nonetheless, the complications that we have encountered are a warning that this procedure, like any other interventional technique, should not be undertaken lightly without good clinical indication. The low complication rate of therapeutic colonoscopy justifies it as the procedure of choice in the management of colonic polyps. Increased risk of electro-surgical procedures in the management of polyps and angiodysplasia inevitably increase the hazards of colonoscopy. If diagnostic colonoscopy and fibresigmoidoscopy are to fulfil their true potential it is essential that complications be kept to a low level. On the basis of our experience certain recommendations seem possible.

#### Recommendations

##### PREMEDICATION AND SEDATION

Low-dose sedation is preferable. A minimal dose of diazepam (2–10 mg) but more liberal use of pethidine (25–75 mg) enables oversedation or respiratory depression to be reversed with naloxone. It is hazardous to attempt to control restless patients with increasing increments of sedation. Resuscitation facilities and ECG/Monitor should be readily available.

Antibiotic cover should be given to all patients with valvular heart disease, cardiac prostheses, or severe immunodepression (whether induced by drugs or disease), and cirrhotic patients with ascites.

##### PROCEDURE

Peritonism or severe mucosal ulceration are contraindications to colonoscopy. Forceful movements are rarely necessary. Careful insertion is particularly important in diverticular disease and other situations when the colon is fixed by adhesions. Blind passage of the colonoscope is dangerous if the mucosa stops moving or whitens. Unexplained pain during the procedure is a warning to deflate and pull back; after the procedure, persistent pain requires clinical examination and plain radiographs of the abdomen.

Carbon dioxide insufflation should be considered to avoid over-distension in patients with irritable bowel, diverticular disease, or stricture, as well as to avoid the risk of explosion with electrocoagulation if mannitol preparation is used.

##### POLYPECTOMY

Preliminary review of radiographs will identify patients with polyps over 2 cm in size; they have a high risk of haemorrhage and require admission, fully informed consent, and haematological precautions.

The likelihood of bleeding is minimised by use of coagulation current only, at a low setting (15–30 watts) and with very gentle snare closure to avoid too rapid cutting.

Bleeding usually occurs immediately and the endoscopist should have sufficient experience to be able at once to resnare the stalk. Bleeding not controlled by these local measures usually stops spontaneously but 5 units or more of blood transfusion may be needed. Secondary haemorrhage is rare but may occur between one and 14 days after polypectomy. Although it is more likely in patients on anticoagulants, with a bleeding diathesis, or with large polyps, all patients should be warned of the possibility and the need to present to an emergency department if profuse or persistent haemorrhage occurs.

Risks should not be taken in attempted removal of possibly malignant lesions. Broad-based polyps should only be snared piecemeal if 'mucosa over muscle' movement shows that invasion is unlikely.

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