Archives of Disease in Childhood, 1982, **57**, 49–53

Total colonoscopy in children

C B WILLIAMS, N J LAAGE, C A CAMPBELL, J R DOUGLAS, J A WALKER-SMITH, I W BOOTH, AND J T HARRIES

Endoscopy Unit, St Mark's Hospital, Gastroenterology Department, St Bartholomew's Hospital, and Gastroenterology Department, The Hospital for Sick Children, London

SUMMARY One hundred and twenty-three total colonoscopies were performed on 115 children with ages ranging from 3 months to 16 years. The major indications were suspected inflammatory bowel disease and unexplained rectal bleeding. Ninety-seven per cent of all procedures were carried out with sedation only. Adult colonoscopes were used in most of the patients but in babies and small children paediatric instruments were preferable. Total colonoscopy was possible in all patients with a patent colon. The terminal ileum was examined in 63 patients. Endoscopic snare polypectomy was successfully carried out in 8 children and multiple haemangiomas were electrocoagulated in one. Total colonoscopy in this paediatric series proved to be at least as easy, rapid, well-tolerated, and safe as in adults. In selected patients a single colonoscopy can give an accurate diagnosis with biopsy proof and sometimes the opportunity for definitive treatment.

There is now extensive literature on the techniques and clinical value of fibreoptic colonoscopy in adults[1–8] but little experience of its use in children.[9–22] Most paediatric reports refer to limited examinations and stress the technical difficulty of the procedure.

Other methods of colonic investigation in childhood are not without problems. A high-quality double contrast enema is an uncomfortable procedure and, because of this, poor quality or single-contrast films are often obtained in paediatric practice; adult studies show such films to be much less accurate than endoscopy.[23 24]

In many paediatric centres conventional proctosigmoidoscopy is performed under general anaesthesia, with its inherent risks. Colonoscopy under sedation allows accurate examination of the whole colon, with the ability to perform therapeutic procedures—such as snare polypectomy or electrocoagulation of bleeding lesions—and multiple biopsies for diagnostic purposes.

Our experience of 123 consecutive colonoscopies in children is reviewed; in each child total colonoscopy was felt to be indicated. Clearly, if colonoscopy is to be a useful alternative to barium enema, the diagnostic specificity and technical ability to examine the whole colon is important. Furthermore, the procedure must be safe, reasonably quick, and well-tolerated by the patient. We therefore detail practical aspects of our examinations.

Patients and methods

The series comprises 123 fibreoptic colonoscopies on 115 children performed by a single experienced endoscopist between 1973 and 1980, as part of a total series of at least 5000 adult examinations. The paediatric examinations were performed mainly at St Bartholomew's Hospital (58 examinations) and at The Hospital for Sick Children, Great Ormond Street (55 examinations). For administrative reasons, most were performed on an inpatient basis. The age at colonoscopy of the 64 boys and 51 girls ranged from 3 months to 16 years (Figure). Patients were chosen for colonoscopic examination by two of us (JAW-S and JTH) for the reasons given below or because of possible abnormality on barium enema, previously performed in the majority of cases.

Bowel preparation. All children were placed on a clear fluid diet (including fruit jelly, water-ice) from midday on the day preceding the examination. Most were given senna syrup (Senokot X-prep) during the afternoon of the day before the procedure in a single dose varying from 20 ml in babies, 30–50 ml in 3- to 8-year-old children (according to size), to 60 ml or more in older children, many of whom had the full adult dose of 80 ml. The aperient was acceptable to all patients and generally resulted in several bowel actions 1–6 hours after administration.

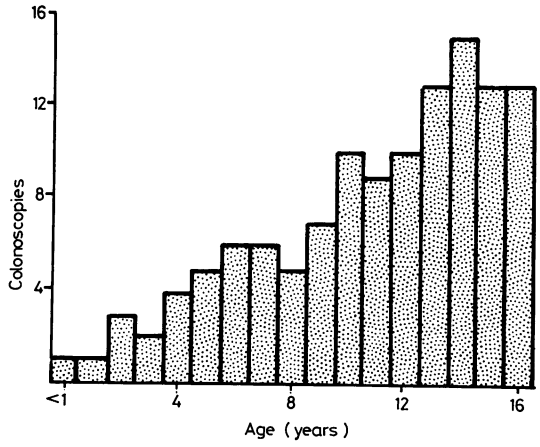

Figure *Age distribution of 123 total colonoscopies.*

Any child who had no response to senna was given a phosphate enema on the evening preceding colonoscopy in a volume as specified below. One hour before colonoscopy a cleansing enema was administered. In most cases a hypertonic phosphate enema was used (Fletchers); half an enema was found sufficient for an average 1-year-old child, an entire enema for children over age 2 years, and often two enemas for older children. In a few cases an additional large volume tapwater or isotonic saline enema was necessary. Castor oil or magnesium sulphate was given in a few cases but the pleasant taste of senna was considered an advantage. Cold mannitol solution (500 ml of 10% solution) was drunk by 5 older patients and was well tolerated. Intubational techniques were not used.

Sedation. One hundred and nineteen (97%) colonoscopies were performed with sedation only. An experienced paediatrician and paediatric nurse were responsible for the administration of medication and supervision of the patient.

Chlorpromazine (1·5 mg/kg) was generally given as intramuscular premedication one hour before the procedure. A 'butterfly' intravenous needle was then used in the endoscopy room for slow administration of a combination of diazepam 2·5–10 mg and pethidine 10–50 mg titrated until the child was nearly asleep. In children over age 8 years the normal adult dose of diazepam (10 mg) and pethidine (50 mg) was generally necessary. If the examination was particularly difficult or prolonged further 'top-up' doses were given, pethidine being used preferentially because of the ability to reverse its action with intravenous naloxone (Narcan). In 2 children naloxone had to be administered because of respiratory depression, and in some others naloxone was given at the end of the examination for excessive drowsiness.

Instrumentation and technique. Several different instruments were used—such as the Olympus CFLB3 and CFLB3R, ACMI TX91, and Fujinon FCQBF adult colonoscopes, small-diameter prototype paediatric colonoscopes, and Olympus GIFP2 paediatric gastroscopes.

Adult instruments were introduced after digital examination but the lubricated small-diameter instruments could be slipped in easily without a finger. Examinations were generally performed in the left lateral position, except for some small babies examined supine. No particular modification of colonoscopic technique was needed in children apart from delicate handling so as to pass straight through the sigmoid colon, avoiding loop formation in the fairly redundant and elastic colon. With careful technique the splenic flexure could be reached with only 25–30 cm of instrument in small children, the rest of the colonoscopy usually being rapid and easy. Manual compression of the lower abdomen sometimes helped to prevent loop formation and an internal stiffening wire was used in a few cases early in the series. Fluoroscopy was used in only 8% of cases. It rarely influenced the technique of insertion but demonstrated in some patients unusually free colonic attachments resulting in the formation of awkward loops.

Results

The endoscopist recorded the results of bowel preparation as being 'perfectly clean' (80%), 'acceptably clean' (13%) with small amounts of aspirated residue, or 'poor' (7%) with solid residue compromising the procedure.

Premedication proved to be important and resulted in a completely relaxed or drowsy child on arrival at the endoscopy room. Most patients required additional sedation before the procedure. The combination of the sedative or amnesic effects of diazepam with the analgesic effect of pethidine using the intravenous route, for a duration of effect of 10–20 minutes, proved to be ideal for colonoscopy.

The adult colonoscopes proved satisfactory in use for most of the patients, but were more uncomfortable for anal insertion than the paediatric instruments especially in babies and small children. The paediatric gastroscope was too rigid to pass easily if loops occurred and its acute and mainly upward tip-angling was inconvenient. The very

flexible prototype paediatric colonoscopes were suitable for most children except for those of adult size, in whom there could be excessive loops resulting in a more difficult total colonoscopy. The childhood colon is very elastic making it important to avoid formation of loops, which can be alarmingly large, but is also easily shortened because of the fairly mobile flexures. As a result the caecum can often be reached at only 50–60 cm. Total colonoscopy was possible in 118 (96%) of the 123 examinations, the failures being due to strictures (in 3 patients), and to poor bowel preparation in 2 patients (in whom re-examination was successful). Total colonoscopy was therefore performed in all patients with a patent colon. The time for the whole procedure was often under 15 minutes and rarely over half an hour. Thirty-two per cent of procedures were judged to be technically 'easy' and 48% 'ordinary', compared with 16% which were technically 'difficult' and 4% failures.

The terminal ileum was examined in 63 cases. The majority of the patients were known to have or were suspected to have inflammatory bowel disease. In a few patients stenosis of the ileocaecal valve made entry impossible, in which cases ileal biopsies were taken from the inner aspect of the valve or blindly with the forceps passed through the stenotic valve.

Clinical indications and yield. The indications for examination and the colonoscopic diagnosis are set out in the Table. The patients were highly selected and often referred from other hospitals not having colonoscopic facilities.

Inflammatory bowel disease known or suspected was the major indication, with a diagnosis being made and confirmed by histology in 76 (96%) of the 79 children (ulcerative colitis 32%, Crohn's disease 26%, indeterminate inflammatory bowel disease 5%, normal 33%). The other 3 patients had acute colitis with the aetiology not established. One child having normal colonoscopy and histology was shown to have Crohn's disease on re-examination 3 months later.

Table *Paediatric colonoscopy: indications and endoscopic diagnosis of 115 patients*

Clinical problem		*Colonoscopic diagnosis*	
Inflammatory bowel disease	79	Ulcerative colitis	25
		Crohn's disease	21
		Indeterminate inflammatory bowel disease	4
		Colitis ?aetiology	3
		Normal	26
Rectal bleeding	26	Polyp	5
		Haemangioma	3
		Ulcerative colitis	1
		Indeterminate inflammatory bowel disease	1
		Normal	16
Polyposis	4	Polyposis coli	2
		Peutz-Jeghers	1
		Normal	1
Polyp on barium enema	3	Polyp	3
Pain	3	Normal	3

Rectal bleeding (macroscopic 21 and occult 5) was the next important indication with the cause of blood loss established in 38% of the 26 children examined.

Abdominal pain alone, without clinical or other features on special investigation to raise a suspicion of inflammatory bowel disease, was an unrewarding indication since no abnormality was found in any patient.

Therapeutic colonoscopy. Snare polypectomy was performed in 8 patients (13 polyps, of which 5 were at least 2 cm in diameter).[25] The polypectomies in our series were considered technically easy for an endoscopist with experience of more than 1000 adult polypectomies, since the majority of the polyps were juvenile with characteristically thin stalks.

A 2-year-old child with rectal bleeding had 3 juvenile polyps ranging from 1 to 3 cm in diameter and located in the transverse colon. Colonoscopy was performed as the initial and only procedure, diagnostic and therapeutic, and lasted less than 30 minutes.

Another 2-year old child had a single 3 cm polyp in the proximal sigmoid colon. The polyp was seen to be on a thick stalk, making snare polypectomy an appreciable risk. The stalk was therefore only grasped with the snare loop at colonoscopy and the child transferred to the operating theatre. Under a 10-minute general anaesthesia the polyp was intussuscepted to the anus for local excision and suture ligation of the pedicle.

In a child with the blue-rubber-bleb naevus syndrome who presented with rectal bleeding, 34 haemangiomas throughout the colon were electrocoagulated using the 'hot-biopsy' forceps[26] for current application.

Complications. No complication occurred in the entire series of diagnostic colonoscopies after more than 500 diagnostic forceps biopsies in the colon and ileum, nor was there any complication after any therapeutic procedure.

Discussion

In our experience paediatric total colonoscopy proved, contrary to expectation, to be a well-tolerated, reasonably quick, and safe procedure. Each child's colon was different and colonoscopy was difficult in 16% of them; this led us to examine

whether a more limited examination would have been clinically sufficient.

Analysis of our series shows that, although a diagnosis could have been made in 74% of patients with limited colonoscopy (reaching to the splenic flexure), only 12 of 21 Crohn's patients would have been diagnosed (6 of our cases had only Crohn's ileitis), and 5 of 11 children with polyps would have remained undiagnosed. The true extent of inflammatory bowel disease would have been underestimated in most cases and the diagnosis of 'normality' would have been less certain in the 46 children in whom no abnormality was found on total colonoscopy.

Limited examinations, using small diameter and very flexible paediatric instruments are none the less easy to perform, require only limited bowel preparation with a disposable enema, and are virtually painless. We therefore envisage many paediatric gastroenterologists acquiring the skills to perform fibresigmoidoscopy in children as outpatients or at the bedside. Even if the instrument is inserted only 15–20 cm the diagnosis of ulcerative colitis can be made in all cases and of Crohn's colitis in many. Often the response of inflammatory bowel disease to therapy can also be followed.

Total colonoscopy will prove easy in a percentage of cases (one-third in our experience) but if the goal is clearly total colonoscopy or ileal biopsy, it may be thought preferable to arrange for an experienced adult colonoscopist to assist or perform the procedure: we know of only one paediatric gastroenterologist (S Cadranel, 1981, personal communication) with a fairly large experience of colonoscopies in children (about 300 cases). The basic technical skills of fibresigmoidoscopy or colonoscopy are best learned initially from an experienced adult endoscopist and probably on adult patients, so that the principles are assimilated and the more traumatic learning-phase passed before starting examinations on children.

Review of reports on children[9–22] showed no colon perforations in 254 diagnostic colonoscopies, but 4 (5%) perforations after 81 polypectomies with one perforation delayed, occurring 48 hours after the procedure. The thin childhood colon is presumably more easily heat-damaged, since perforation is an exceptionally rare complication of adult polypectomy.[27–29] It is therefore recommended that the therapeutic modalities of colonoscopy should, at least for the present time, be referred to the experienced adult colonoscopist. Our successful results in colonoscopic polypectomy[30 31] and electrocoagulation suggest that surgery should not be undertaken in such patients without first considering or attempting therapeutic colonoscopy.

Although we do not foresee total colonoscopy as a routine investigation in children, our results suggest that in certain categories of patients—such as those with rectal bleeding and suspected inflammatory bowel disease—it can be particularly rewarding. Perhaps colonoscopy should be considered a first-line procedure in such patients, since it is easy to establish or exclude bleeding pathology with the colour endoscopic view. In most of our patients with Crohn's colitis, the characteristic aphthoid ulcers were superficial and would have been radiologically unimpressive, but showed endoscopically obvious colour changes or friability. Colonoscopic biopsies, although small, proved adequate for diagnosis in nearly 90% of patients with inflammatory bowel disease. Diagnostic granulomata were seen in 25% of the Crohn's patients, a higher percentage than in our adult experience, possibly reflecting the earlier stage of the disease in children.

We conclude from our experience that colonoscopy is a practicable and rewarding procedure, likely to make a major contribution to paediatric gastroenterology.

References

1 Williams C B, Teague R H. Colonoscopy. *Gut* 1973; **14:** 990–1003.
2 Waye J D. Colonoscopy: a clinical view. *Mt Sinai J Med NY* 1975; **42:** 1–34.
3 Overholt B F. Colonoscopy: a review. *Gastroenterology* 1975; **68:** 1308–20.
4 Shinya H, Wolff W I. Colonoscopy. *Surg Annu* 1976; **8:** 257–95.
5 Williams C B, Waye J D. Colonoscopy in inflammatory bowel disease. *Clin Gastroenterol* 1978; **7:** 701–17.
6 Swarbrick E T, Fevre D I, Hunt R H, Thomas B M, Williams C B. Colonoscopy for unexplained rectal bleeding. *Br Med J* 1978; **ii:** 1685–7.
7 Wolff W I. Colonoscopy updated. *Adv Surg* 1979; **13:** 145–68.
8 Cotton P B, Williams C B. *Practical gastrointestinal endoscopy*. Oxford: Blackwell, 1980: 185.
9 Cremer M, Peeters J P, Emonts P, Rodesh P, Cadranel S. Fiberendoscopy of the gastrointestinal tract in children—experience with newly designed fiberscopes. *Endoscopy* 1974; **6:** 186–9.
10 King J F, Smith G E. Endoscopic removal of recurrent juvenile polyps in a six year old (abstract). *Gastroenterology* 1974; **66:** 815.
11 Livstone E M, Cohen G M, Troncale F J, Touloukian R J. Diastatic serosal lacerations: an unrecognised complication of colonoscopy. *Gastroenterology* 1974; **67:** 1245–7.
12 Gans S L, Ament M, Christie D L, Liebman W M. Pediatric endoscopy with flexible fiberscopes. *J Pediatr Surg* 1975; **10:** 375–80.
13 Gleason W A, Jr, Goldstein P D, Shatz B A, Tedesco F J. Colonoscopic removal of juvenile colonic polyps. *J Pediatr Surg* 1975; **10:** 519–21.
14 Skovgaard S, Sørensen F H. Bleeding hemangioma of the colon diagnosed by colonoscopy. *J Pediatr Surg* 1976; **11:** 83–4.

[15] Rodesch P, Cadranel S, Peeters J P, Cremer N, Cremer M. Colonic endoscopy in children. *Acta Paediatr Belg* 1976; **29:** 181–4.
[16] Cadranel S, Rodesch P, Peeters J P, Cremer M. Fiber-endoscopy of the gastrointestinal tract in children. *Am J Dis Child* 1977; **131:** 41–5.
[17] Liebman W M. Fiberoptic endoscopy of the gastrointestinal tract in infants and children. II. Fiberoptic colonoscopy and polypectomy in 15 children. *Am J Gastroenterol* 1977; **68:** 452–5.
[18] Nelson E W, Jr, Rodgers B M, Zawatzky L. Endoscopic appearance of auto-amputated polyps in juvenile polyposis coli. *J Pediatr Surg* 1977; **12:** 773–6.
[19] Holgersen L O, Mossberg S M, Miller R E. Colonoscopy for rectal bleeding in childhood. *J Pediatr Surg* 1978; **13:** 83–5.
[20] Lux G, Rösch W, Phillip J, Frühmorgen P. Gastrointestinal fiberoptic endoscopy in pediatric patients and juveniles. *Endoscopy* 1978; **10:** 158–63.
[21] Fisher S E, Harrison M, Adkins J C. Colonoscopic diagnosis of vascular anomalies in children. *Clin Pediatr (Phila)* 1979; **18:** 299–303.
[22] Habr-Gama A, Alves P R A, Gama-Rodrigues J J, Teixeira M G, Barbieri D. Pediatric colonoscopy. *Dis Colon Rectum* 1979; **22:** 530–5.
[23] Loose H W C, Williams C B. Barium enema versus colonoscopy. *Proc Roy Soc Med* 1974; **67:** 1033–6.
[24] Wolff W I, Shinya H, Geffen A, Ozoktay S, de Beer R. Comparison of colonoscopy and the contrast enema in five hundred patients with colorectal disease. *Am J Surg* 1975; **129:** 181–6.
[25] Williams C B, de Peyer R C. Bipolar snare polypectomy—a safer technique for electrocoagulation of large polyp stalks. *Endoscopy* 1979; **11:** 47–50.
[26] Williams C B. Diathermy-biopsy—a technique for the endoscopic management of small polyps. *Endoscopy* 1973; **5:** 215–8.
[27] Rogers B H G, Silvis S E, Nebel O T, Sugawa C, Mandelstam P. Complications of flexible fibreoptic colonoscopy and polypectomy. *Gastrointest Endosc* 1975; **22:** 73–7.
[28] Smith L E. Fiberoptic colonoscopy: complications of colonoscopy and polypectomy. *Dis Colon Rectum* 1976; **19:** 407–12.
[29] Frühmorgen P, Demling L. Complications of diagnostic and therapeutic colonoscopy in the Federal Republic of Germany. Results of an inquiry. *Endoscopy* 1979; **2:** 146–50.
[30] Gillespie P E, Nicholls R J, Thomson J P S, Williams C B. Snare polypectomy by sigmoid-rectal intussusception. *Br Med J* 1978; **i:** 1395–6.
[31] Douglas J R, Campbell C A, Salisbury D M, Walker-Smith J A, Williams C B. Colonoscopic polypectomy in children. *Br Med J* 1980; **281:** 1386–7.

Correspondence to Dr C B Williams, Endoscopy Unit, St Mark's Hospital, City Road, London EC1V 2PS.

Received 10 March 1981

Surveillance of Reye's syndrome

Much information about the epidemiology of Reye's syndrome in the USA has been gathered by the Center for Disease Control in Atlanta, but knowledge and understanding of the determining factors for this rare but serious disorder are limited.

A reporting scheme for Reye's syndrome in the UK was started on 1 August 1981 as a joint venture between the British Paediatric Association, the PHLS Communicable Disease Surveillance Centre (CDSC), and the Communicable Disease (CD) (Scotland) Unit.

BPA members have been informed of the project and were sent case report forms to complete should a child with suspected Reye's syndrome be admitted under their care. For the purposes of the reporting scheme the diagnostic criteria are (1) encephalopathy of unknown cause, plus (2) serum transaminases (AST or ALT) raised above 100 IU/ml, or liver histology showing characteristic fatty changes, or macroscopically pale fatty liver at necropsy. In addition a clinically enlarged liver, raised blood ammonia concentration, hypoglycaemia, prolonged prothrombin time, or characteristic muscle histology would be supportive evidence.

On receipt of the case report form a more detailed questionnaire will be sent from the CDSC. The clinician is also asked to request virological investigation and to collect acute and convalescent sera and urine, and any biopsy or necropsy tissue. Subsequently central storage of all pathological specimens at the Virus Reference Laboratory of the Central Public Health Laboratory will be arranged by the CDSC.

The objects are (1) to collect clinical and epidemiological data about Reye's syndrome, (2) to publish periodical analyses of the data in the *Communicable Disease Report* and in the report of the CD (Scotland) Unit (obtainable free of charge from CDSC/CD (Scotland) Unit), (3) to provide a case register, and (4) to collect a 'bank' of relevant pathological specimens. These data and samples will be available for research purposes.

The project will run for 2 years in the first instance and participants will be regularly reminded about it through BPA newsletters and the *Communicable Disease Report*. Its success depends on maximal co-operation and it is hoped that all paediatricians in the UK will participate fully in the scheme.

Enquiries and notifications to Dr Sue Hall, CDSC, 61 Colindale Avenue, London NW9 5EQ.