Technique of retrograde colonic intubation and its initial application to high colonic biopsy

J. A. FOX AND L. KREEL

From the Royal Free Hospital, London

The diagnosis of diseases of the colon is derived from a careful history, clinical examination, and subsequent ancillary investigations. Before investigations are started, the lower rectum and anal canal are digitally palpated and the terminal 25–35 cm. are directly viewed by the sigmoidoscope. When a mucosal abnormality is seen a biopsy may be taken either with cupped forceps under vision, or by means of a suction biopsy apparatus (Brandborg, Rubin, and Quinton, 1959; Truelove, Horler, and Richards, 1955; Matts, 1961). A biopsy taken from what appears to be normal mucosa in the rectum or lower sigmoid may show histological changes similar to an existing lesion higher in the colon (Flick, Voegtlin, and Rubin, 1962; Lumb, 1958). In such cases the radiological appearances on barium enema, coupled with the mucosal biopsy picture obtained either blindly or under direct vision, may enable one to infer fairly accurately the true nature of the proximal lesion.

Inflammatory conditions shown radiologically may be quite inaccurate in giving a true picture of the extent of the involved bowel although they are useful in providing information for a probable diagnosis (Goligher, 1961). Small polyps or an early carcinoma may often be demonstrated by double-contrast (Malmö) techniques (Young, 1966) but even this may fail to detect them.

Studies of the length of the alimentary tract in human volunteers have shown that the distance from the caecum to the anus measured by a swallowed soft polyvinyl tube is about 91 to 125 cm. (Blankenhorn, Hirsch, and Ahrens, 1955). Therefore only 10–30% of the colon may be visible on sigmoidoscopy in a given patient. Furthermore, peroral approach to the colon takes from two to five days by the swallowed tube technique and eventually requires the tube to be withdrawn upwards from the colon after obtaining the biopsy (Flick, Quinton, and Rubin, 1961).

Retrograde intubation of the caecum was described nearly 30 years ago by Hoff (1928). He managed to pass a specially softened Lockwood

colon tube from the anus to the caecum with radiological control. The tube was 75 cm. long and was connected to a second firm hose 75 cm. long to strengthen the proximal end. Warm water was injected along the tube which was then encouraged to pass along the colon as the flood of water emerged from its tip. These patients therefore absorbed water and needed to empty their bladders during the procedure.

A different technique of retrograde colonic intubation has been developed during the past year. Although the caecum has as yet not been reached, the transverse and descending colon was entered and by means of the Quinton multipurpose suction biopsy instrument (Brandborg *et al.*, 1959) specimens of mucosa have been obtained from the transverse, descending, and sigmoid colon well above the reach of sigmoidoscopic biopsy.

THE COLON TUBE

A soft graduated polyvinyl tube (Portex), 0.46 in. external diameter and 120 cm. long, is made with a rounded distal tip which is inclined at 45 degrees to its long axis. In the tip is a metal ball to render it radio-opaque and there is

FIG. 1. The colon tube as used for intubation.

FIG. 2a. Case 5: the first stage of the sigmoid intubation shows the tip of the tube apparently near the descending colon.

FIG. 2b. Case 5: the second stage shows the tube entering a further loop of the sigmoid colon.

FIG. 2c. Case 5: the tube has now traversed the whole of the sigmoid colon and begins to enter the descending colon.

FIG. 2d. Case 5: the colon tube finally lies well up the descending colon 80 cm. from the anus, its tip indicated by an arrow.

a hole cut in the long axis of the tube for exit of the nylon stilette or biopsy instrument as required. The nylon stilette is a closed tube of 0.24 in. external diameter which slides through a nipple at the proximal end where there is a T-piece whose side arm provides attachment for air insufflation by means of sigmoidoscopy bellows. The nylon stilette also has a metal marker at its tip (Fig. 1). The effective stiffness of the leading end of the tube can be varied by advancing or withdrawing the inner nylon stilette. It is most important that a solution of 50% dimethicone B.P.C. (silicone fluid) in solvent ether is run through the polyvinyl tube and over the nylon stilette and biopsy tubes before each intubation. The ether evaporates in a few minutes leaving silicone-lubricated tubes which do not stick during the many bends involved in navigating the colon.

METHOD

Preliminary investigations should include barium enema and sigmoidoscopy. Intubation has been performed on in-patients and out-patients but high colonic biopsy after intubation was generally reserved for in-patients. A low-residue diet and tabs propantheline bromide (Probanthine) 15 mg. t.d.s. et nocte are prescribed for three days. On the preceding evening an enema saponis is given and one hour before the examination a PCL 243 retention enema is administered and the patient encouraged to evacuate his bowels as completely as possible afterwards. No sedative premedication was used unless the patient appeared apprehensive in which case an oral barbiturate or pethidine was given one-and-a-half hours before the investigation commenced.

The procedure is carried out in the x-ray department with screening control. In the last 12 cases screening with image intensification and television monitoring has proved extremely valuable, although this is not essential for good results. A lead plate 24 in. square is placed beneath the patient, its upper edge at the level of the ischial tuberosities. This serves to limit direct irradiation of the male genital area of the patient and of the operator's hand. The patient is placed in the left lateral position with knees flexed, head and shoulders inclined towards the opposite side of the couch and the buttocks raised on a small sandbag. A 30 cm. long $\times$ 2.0 cm. bore Lloyd-Davies sigmoidoscope is then lubricated with lignocaine hydrochloride gel and passed as high as possible. The greased colon tube is inserted without the stilette or T-piece connexions. The sigmoidoscope is then withdrawn over the tube, following the sacral curve as accurately as possible and leaving the tube with as much as 32 cm. inserted. The stilette is replaced in the colon tube, the T-piece and bellows are connected and the patient lies supine after removing the sandbag.

The radiologist then screens the tube whilst the operator encourages it to pass up the colon by a combination of gentle air insufflation and pressure from below. The angled tip is most useful for guiding the tube around angulations at the apex of the sigmoid, the junction of descending with sigmoid colon, and the splenic flexure. By rotating the tube the soft tip can be made to enter these curves whilst the pathway is outlined by the in-

jected air and the resilience of the following tube increased by advancing the nylon stilette within it as required. The tip of the stilette should not be allowed to protrude through the end hole of the tube since it will impinge on the mucosa and if forced could possibly perforate the colon. When difficulty is encountered in negotiating sigmoid or descending-sigmoid angulation, assistance is derived by altering the patient's position to left or right lateral, prone, or knee-elbow positions. In some cases additional abdominal pressure by the gloved radiologist's hand has proved invaluable. The stages in negotiating a long sigmoid loop where the colon tube made a complete turn during intubation are shown in Figs. 2a-d (case 5).

Sometimes spasm of the colon has been relieved by intravenous hyoscine-N-butylbromide (Buscopan) 10 mg. or oxyphenonium bromide (Antrenyl) 4 mg., but on the whole the preliminary preparation for three days with propantheline bromide has proved sufficient.

Once the tube has been inserted to the required level, the stilette and T-piece are withdrawn and the suction biopsy tube is inserted until it protrudes through the polyvinyl tube into the colon. This is most easily seen on screening and can be verified if the required distance of insertion has been checked with the tubes against each other before the procedure started. A suction biopsy is taken and a note of the level in centimetres from the anus recorded by reference to the graduated colon tube. The biopsy tube is withdrawn, the specimen observed and if satisfactory, the colon tube can be withdrawn a few centimetres and further biopsies taken as required.

FIG. 3. Case 7: this coned view shows the suction biopsy tube taking a specimen from the transverse colon at a distance of 83 cm. from the anus.

TABLE I
RESULTS IN 17 CASES

Case No.	Initials	Age/Sex	Diagnosis	Sigmoidoscopy to (cm.)	Tube to (cm.)	Anatomical Level	Suction Biopsy	No. of Biopsies	Amended Diagnosis
1	A.C.	50F	Abdominal pain	—	47	Apex sigmoid	—	—	No help
2	A.H.	80F	Anaemia ? piles	—	40	Apex sigmoid	—	—	No help
3	O.M.	59M	Hemiplegia atonic colon	30	86	$\frac{1}{2}$ descending colon	—	—	Atonic colon
4	T.D.	62M	Ulcerative colitis	25	45	Apex sigmoid	—	—	No help
5	D.I.	79F	Anaemia, ? ca. stomach	18	80	Upper descending colon	—	—	No help
6	M.Q.	84F	Carcinoma or diverticular stricture	12	22	Sigmoid colon	Inflammation	3	Diverticulitis
7	A.A.	66M	Rectal bleeding	23	83	Left side transverse colon	1 Polypoid area	5	? Polyp
8	D.P.	76F	Carcinoma sigmoid	12	38	Apex sigmoid	Failed	0	No help
9	M.O.	79F	Anaemia, diverticulitis	17	35	Apex sigmoid	Slight inflammation	1	Diverticulitis
10	M.M.	60M	? Diverticulitis	18	40	Apex sigmoid	Normal mucosa	2	No help (granuloma at operation)
11	P.H.	75M	Diverticulitis	24	67	Upper descending colon	Haemorrhage, ? melanosis coli	1	Diverticulitis
12	E.W.	38M	? Diverticulitis and fistula	18	45	Sigmoid/descending colon	Oedema and congestion	1	? Carcinoma caecum (lympho-sarcoma at operation)
13	W.H.	73M	? Carcinoma or regional colitis	26	84	Sigmoid/descending colon	Congestion	5	Regional colitis
14	W.B.	70M	Reticulo-sarcoma ileum	21	55	Sigmoid/descending colon	Normal mucosa	4	No disease in sigmoid colon
15	E.H.	34M	? Ulcerative colitis	18	60	Sigmoid/descending colon	Ulcerative colitis	3	Ulcerative colitis
16	F.F.	44F	Diverticulitis	12	62	Splenic flexure	Normal mucosa	6	? Diverticulitis (ovarian cyst at operation)
17	C.R.	55F	Ulcerative colitis	25	62	Descending colon	Less colitis	5	Low proctocolitis

during withdrawal. In this way a composite picture of colon histology may be obtained in relation to any given lesion under investigation.

A patient with rectal bleeding (case 7) had intubation of the transverse colon (Fig. 3). Subsequent biopsies taken on withdrawal removed a small polyp from the region of the splenic flexure.

RESULTS

Seventeen intubations have been performed, the results of which are summarized in Table I. The first five cases were carried out with conventional screening, often without previous barium enema or sigmoidoscopy. They showed that intubation was a practicable procedure. The last 12 cases were performed with television monitoring and suction biopsies were attempted with satisfactory specimens

obtained in 11 cases. One (case 8) did not produce a specimen since barium enema examination carried out at the same time interfered with the suction biopsy apparatus.

In another patient (case 10) normal colonic biopsies were not assumed to mean that there was no pathological lesion. The suction tube was too far below a colo-vesical lesion which had shown chronic inflammatory changes on a bladder biopsy. Failure was probably due to the fact that the tip of the colon tube was resting in contact with the lesion and the emerging biopsy tube was not directed sufficiently near for a pathological specimen to be obtained. It is hoped that modification of the colon tube, with a shorter angulated tip, and the use of the correct colon biopsy capsule will help in future to avoid these near misses.

DISCUSSION

The first five biopsies were performed at the commencement of barium enema studies. However, the pumping of air into the colon tube for guidance and the narrowness of the tube which allowed barium to leak out of the rectum prevented pictures of diagnostic quality from being obtained.

In addition, it is an advantage to have preliminary barium enema studies in order to assess the pathology before advising intubation. These pictures also give an indication of the length and positions of the sigmoid and transverse colon and the possible regions where obstruction may be encountered.

The procedure of retrograde colonic intubation is not difficult to perform and improves with experience. It is essential to have the cooperation of a radiologist. Preliminary sigmoidoscopy, and passing the colon tube through the recto-sigmoid junction via a sigmoidoscope, helps to reduce the total period of radiological screening.

The distance of the tip of the tube in centimetres from the anus is only an approximate indication of its level in the colon (Table I). Thus the sigmoid colon appears to extend from the region of 20 to 50 cm. and the descending colon from 50 to 80 cm. These measurements are approximate since a long sigmoid loop, as in case 13, may allow 84 cm. of tube to be inserted when the tip is still at the sigmoid-descending colon junction. Other causes of an apparently longer length are stretching of the bowel around the tube when it is forced against an obstructive lesion at its tip, or curling up of the tube in a wide rectal ampulla. These conditions can usually be recognized during the screening procedure. It is hoped to achieve intubation as far as the caecum in selected cases as experience with the technique increases.

The subjective discomfort experienced by the patient has varied from 'no greater than sigmoidoscopy' in cases 7, 11, and 13 to a definitely painful procedure 'not to be repeated again' in cases 10 and 12. It is undesirable that pain should be experienced and one should therefore be as gentle as possible with air insufflation, pressure from below, and abdominal pressure. In view of the danger of perforation of the colon no general anaesthetics were given although the anus was lubricated with lignocaine hydrochloride gel to minimize the local discomfort. Premedication with barbiturates or pethidine was used in some cases. While it is realized that patients have themselves perforated the colon of a colostomy with a soft rubber tube (Aylett, 1966) it is felt that excessive air inflation or stretching of the colon by the tube cause sufficient discomfort to warn of any danger of perforation.

No case of perforation has occurred in the present series.

The dangers of suction biopsy with the various forms of the Quinton apparatus have been well described (Dobbins, Trier, Parkins, MacDonald, Ways, Barrett, and Rubin, 1963; Flick *et al.*, 1961). Although in this series as many as six biopsies were taken from one patient at a single examination there has been no episode of haemorrhage or pseudo-perforation. The biopsy tube in use has been the 120 cm. tube using a single small hole (0.093 in. diameter) intestinal capsule and a suction pressure of 7 in. Hg. It is hoped shortly to use the 180 cm. tube and the wide hole (0.109 in. diameter) colonic capsule. These will enable biopsies higher in the colon and of greater size for more accurate assessment to be obtained.

APPLICATIONS OF THE TECHNIQUE Retrograde colonic intubation should enable further studies of the length of the living large bowel to be made and the variation in distances from the anus of anatomical points in the colon may also be further investigated. Its application to high colonic biopsy has been demonstrated. In the manner described, serial colonic biopsies at short intervals will enable mucosal changes to be examined in such apparently localized conditions as segmental colitis, diverticular disease, or carcinoma. Specimens taken at a distance from the lesion, from the adjacent colon, and from the lesion itself will allow observation of the graduation of histological changes and may also indicate more accurately than barium studies the total length of colon involved.

An indication of the early changes of melanosis coli before macroscopic pigmentation was visible was demonstrated in case 11 of this series. It is possible that such changes would not be present in a simultaneous sigmoidoscopic biopsy and further studies are necessary to ascertain this.

Progress is being made with a direct viewing fibre-optic system for the colon. This flexible instrument will be threaded along the intubated pathway and should enable lesions in the sigmoid, descending, or even transverse colon to be seen directly from within the bowel without the necessity for either open operation and colotomy or a general anaesthetic. A colo-camera for insertion along the intubated pathway is also at an advanced stage of preparation. This camera will be used to give colour pictures of greater definition and clarity than the image obtainable at present by the fibre-optic viewing system. It is proposed to use the camera for regions which are suspect either on barium enema or on fibre-optic viewing. Both of these systems will be of help in locating polyps which are often not

demonstrated with barium contrast techniques. It may eventually be possible even to remove such polyps by a snare technique as at present used in rectal cases.

Intubation could be used for obtaining intraluminal colon pressure curves (Edwards, 1965; Connell, Jones, and Rowlands, 1965), in normal people and conditions such as spastic colon or ulcerative colitis. It may occasionally be possible to dilate benign strictures by a railroad method from below after a narrow stilette has been passed through the lesion and its nature has been confirmed by biopsy.

SUMMARY

A technique of retrograde colonic intubation is fully described. The results in 17 patients are tabulated. It is suggested that this investigation could be performed more often and future uses of the procedure are indicated.

We would like to thank Mr. E. J. Radley-Smith, Mr. Emlyn Williams, Miss P. George, and Dr. I. Bouchier of the Royal Free Hospital, Mr. Harland Rees of Hampstead General Hospital, and Mr. M. J. Lange and Dr. A. Beckett of New End Hospital for allowing us to investigate and quote details of patients under their care. We are grateful to the staff of the Radiological Departments at New End and the Royal Free Hospitals for their patience and cooperation.

This work has been supported by a grant (no. 46) to

one of us from the Royal Free Hospital Endowment Fund.

We thank Portland Plastics Ltd. for their cooperation in manufacture of the Portex colon tubes to specification no. 76/2. A later version is described in this article.

REFERENCES

- Aylett, S. (1966). Management of a colostomy. *Proc. roy. Soc. Med.*, **59**, 128-129.
- Blankenhorn, D. H., Hirsch, J., and Ahrens, E. H., Jr. (1955). Trans-intestinal intubation: technic for measurement of gut length and physiologic sampling at known loci. *Proc. Soc. exp. Biol. (N.Y.)*, **88**, 356-362.
- Brandborg, L. L., Rubin, C. E., and Quinton, W. E. (1959). A multi-purpose instrument for suction biopsy of the esophagus, stomach, small bowel, and colon. *Gastroenterology*, **37**, 1-16.
- Connell, A. M., Jones, F. A., and Rowlands, E. N. (1965). Motility of the pelvic colon IV. Abdominal pain associated with colonic hypermotility after meals. *Gut*, **6**, 105-112.
- Dobbins, W. O., Trier, J. S., Parkins, R. A., MacDonald, W. C. Ways, P., Barrett, B., and Rubin, C. E. (1963). A warning regarding the dangers of hydraulic biopsy in gastrointestinal research. *Gastroenterology*, **45**, 335-340.
- Edwards, D. A. W. (1965). Techniques and interpretations of measurement of gastrointestinal pressures. *Ann. roy. Coll. Surg. Engl.*, **37**, 275-284.
- Flick, A. L., Quinton, W. E., and Rubin, C. E. (1961). A peroral hydraulic biopsy tube for multiple sampling at any level of the gastrointestinal tract. *Gastroenterology*, **40**, 120-126.
- , Voegtlin, K. F., and Rubin, C. E. (1962). Clinical experience with suction biopsy of the rectal mucosa. *Ibid.*, **42**, 691-705.
- Goligher, J. C. (1961). *Surgery of the Anus, Rectum and Colon*, p. 48. Cassell, London.
- Hoff, H. C. (1928). Retrograde intubation of the cecum. *Amer. J. Roentgenol.*, **20**, 226-232.
- Lumb, G. (1958). Rectal biopsy in ulcerative colitis. *Dis. Colon Rect.*, **1**, 37-43.
- Matts, S. G. F. (1961). The value of rectal biopsy in the diagnosis of ulcerative colitis. *Quart. J. Med.*, **30**, 393-407.
- Truelove, S. L., Horler, A. R., and Richards, W. C. D. (1955). Serial biopsy in ulcerative colitis. *Brit. med. J.*, **2**, 1590-1593.
- Young, A. C. (1966). Radiology of colonic polyps. *Proc. roy. Soc. Med.*, **59**, 124.