Progress report

Barium examination of the small intestine

Radiological studies showing the small intestine were first performed at the beginning of this century. In 1901 Cannon observed radiographically the stomach and small intestine of animals after they had ingested food mixed with bismuth subnitrate.1 Rieder2 observed the small intestine in human subjects when he performed his bismuth meal examination. The small intestine was also visualised radiographically by Hulst using bismuth subnitrate.3 Little attention was given to the radiological investigation of the small intestine with contrast medium until papers by Morse and Cole in 19274 and Pesquera in 1929.5 Since then barium studies have become well-established in the diagnosis of diseases of the small intestine. This report is a review of the different techniques available for examining the small intestine with barium—their development, advantages, and shortcomings.

Indirect techniques

FOLLOW-THROUGH OF ORAL BARIUM

The anatomy of the small intestine as shown on the barium follow-through was described by Cole and his colleagues.46 A moderately thick paste using 227 ml (8 oz) barium mixed with 142 ml (5 oz) water was given. This consistency of contrast medium was chosen so that it would pass out of the stomach at a fairly rapid and uniform rate and be of sufficient consistency to pass evenly, and preferably very slowly, through the small intestine. Large films were taken, mostly in the prone position, one half hour after the upper gastrointestinal tract examination and then at two, four, and six hours. The time interval was varied according to the rate of gastric emptying.

The importance of carrying out a special study of the jejunum and ileum with barium was emphasised in 1936 by Golden7 and also by Pendergrass and his colleagues.8 Golden perfected the barium follow-through technique. He pointed out that the small intestine could be the source of the trouble in patients with diarrhoea and deserved a radiological study if the large intestine were found to be normal.7 At that time he recommended that 57 ml (2 oz) of barium sulphate mixed with water should be given on an empty stomach first thing in the morning. With the patient prone, films were taken at half-hourly intervals, sometimes quarter-hourly, until barium reached the ascending colon or until adequate information concerning the small intestine was obtained. Films were taken routinely after five, six, nine, and 24 hours. Fluoroscopic observations of the intestinal movements, mobility and tenderness, were made two or three times during the examination. He noted that the opaque material began to pass through the ileocaecal valve one-and-a-half to four hours after ingestion in normal individuals.

In later years he recommended a large amount of barium, (113 g; 4 oz) pure barium sulphate suspended in 114 or 142 ml (4 or 5 oz) of normal saline solution or the equivalent quantity of a non-flocculating barium suspended in
Barium examination of the small intestine

Water. He stated that the non-flocculating preparations were better for the demonstration of organic disease. The importance of using a non-flocculating barium suspension for showing the maximum mucosal detail of the small intestine was first recognised by Ardran and his colleagues.10

The barium follow-through examination of the small intestine has a big disadvantage in that it is time-consuming for the patient, the radiologist, and the radiology department. A number of suggestions have been made for increasing the speed of barium through the small intestine. Weintraub and Williams11 found that a marked decrease in the transit time of the contrast medium through the small intestine was obtained when the barium-saline mixture was followed by ice-cold normal saline. The mucosal pattern was more clearly delineated and there was more complete filling of the entire small intestine than with the hourly film technique, they claimed. They found that 90% of examinations were completed in one hour.

Metoclopramide has proved to be an effective agent for increasing the speed of oral barium through the small intestine. A dose of 20 mg may be given intravenously12,13 after examination of the oesophagus and stomach with barium. Kree14 gave the same dose of metoclopramide orally 5–10 minutes before barium meal and follow-through examinations. Metoclopramide promotes gastric emptying and accelerates the transit of barium through the small intestine thus allowing the routine follow-through to be undertaken with the minimum of extra films and radiation. Apart from an increase in the number of contracted segments there was no detectable difference in the pattern of the small intestine or its calibre.14

Adding Gastrografin to the barium also reduces the transit time taken for barium to pass through the small intestine.15 Other pharmacological agents have been suggested such as neostigmine,16 glucagon,17 cholecystokinin,18,19 and ceruletide.20,21 However, the advantage of decreasing the transit time is offset by diminished anatomical detail, particularly in the terminal ileum.21

Preliminary cleansing of the colon, combined with the use of 284 ml (10 oz) or more of oral barium suspension and placing the patient in the right lateral recumbent position was suggested by Nice.22,23 He stated that this technique produced rapid uniform filling of the small intestine resulting in an excellent diagnostic pattern.

The barium follow-through is the most widely used procedure for examining the small intestine with contrast medium. A barium meal examination followed by a conventional follow-through examination of the small intestine was recommended by Laws and Pitman.24 They also advocated an examination of the small intestine using duodenal or jejunal intubation in certain selected cases, notably when an anatomical lesion of the intestine was suspected and had not been satisfactorily demonstrated by conventional means. They stated, however, that in some cases the barium enema was the best way of demonstrating chronic strictures of the lower ileum.

A number of reports show that the barium follow-through is not accurate for assessing the small intestine in Crohn’s disease. In a review of 100 patients with regional enteritis seen over a period of 26 years examined by the barium follow-through, Meyers and his colleagues25 stated that it was not uncommon for the radiologist to fail to find the lesion after it had been demonstrated on the operating table. The results of the National Cooperative Crohn’s Disease Study in the United States have recently been published.26 The follow-through and single contrast barium enema gave inadequate
radiographic definition of one or more segments and prevented evaluation of that segment in a surprisingly high number of instances. Evaluation of the extent and depth of the disease was unsatisfactory and it seemed likely that mucosal irregularity was undetected. As a result the data concerning the nature and extent of Crohn’s disease were treated with caution. The poor quality of the radiographic examination was likely to result in underestimation of the extent of ileal involvement. Better visualisation of the ileum was obtained with barium refluxed into the terminal ileum during barium enema examinations. The barium studies were from 14 University hospital centres and probably reflect the average level of radiographic technique currently practised.

The only merits of the barium follow-through are that it is simple to perform and causes no discomfort to the patient.

**Oral Double Contrast**

It is possible to obtain double contrast views of the small intestine after the oral administration of barium. Pajewski and his colleagues in 1970 injected 60 mg propantheline (Probanthine) intramuscularly and passed a flexible tube to the stomach about 40 minutes after a barium meal. Air pumped into the stomach passed through the duodenum and as a result distended the loops of small intestine. The oral barium coated the walls of the intestine and double contrast views were obtained. Later they changed their technique and used a duodenal tube to introduce the barium and air. A method for performing double contrast examinations of the small intestine without intubation has been described. Oral barium followed by capsules that effervesce in the small intestine were prescribed and hypotonia was produced by propantheline (Probanthine) or glucagon. Successful double-contrast examinations of the small intestine were obtained in 90 out of 130 patients and the average transit time of the contrast medium through the small intestine was 78 minutes.

**Complete Reflux Examination**

The terminal ileum can be examined by refluxing barium through the ileocaecal valve during a barium enema examination. This method has been advocated as the technique of choice for demonstrating the terminal ileum radiologically. The whole small intestine can be demonstrated by refluxing barium from the colon into the terminal ileum. A large volume of barium suspension is required (2000–4500 ml) and it is possible to make it reflux as far as the duodenum and into the stomach. The complete reflux examination is particularly useful in the investigation of patients with small intestinal obstruction.

**Per Oral Pneumocolon Examination of Ileocaecal Region**

Excellent visualisation of the ileocaecal region can be obtained by administering barium orally and introducing air rectally when the barium is in the region of the terminal ileum and caecum. The patient is prepared as for a double-contrast enema and then barium suspension is given orally. The progress of the barium column is checked and when the head of the column reaches the transverse colon, air is introduced rectally and films are taken. Crohn’s disease of the terminal ileum and carcinoma of the caecum are particularly well demonstrated by this technique.
The oral double-contrast method, the complete reflux examination, and the oral pneumocolon technique have never gained acceptance and are used only occasionally.

**Direct techniques for introducing barium into the small intestine**

**Duodenal intubation**

Duodenal intubation for the purpose of introducing contrast medium and obtaining radiographs of the distended duodenum for diagnostic purposes was described by a number of investigators in the early part of the century.34-36 Pesquera in 1929\(^4\) was the first to advocate duodenal intubation for introducing contrast medium directly to outline the small intestine and to overcome the shortcomings of the barium follow-through. He infused a mixture of barium, acacia, and water under gravity through a tube into the duodenum. The column of contrast medium was observed fluoroscopically as it advanced through the small intestine and the contours of the coils of intestine and their freedom under the palpating hand were assessed. Deformities and abnormalities were detected and radiographs were taken. He found that the entire small intestine could be studied in less than half-an-hour and he hoped that the method he described would prove valuable in the detection of small intestinal pathology. He illustrated his paper with an example of two strictures of the distal ileum that had not been shown on a previous barium follow-through.

Nine years passed before another paper by Ghelew and Mengis appeared advocating a similar technique.37 Ghelew and Mengis passed a tube to the fourth part of the duodenum and injected thorium dioxide suspended in water to outline the small intestine. They also injected air through the tube to obtain double-contrast views. A simple water suspension of barium sulphate was infused under gravity, like an enema, through a duodenal tube by Gershon-Cohen and Shay.38 They found that complete filling of the entire small intestine could be accomplished in eight to 15 minutes using 800–1200 ml barium. A very satisfactory radiographic examination of the small intestine was performed. They also injected air to obtain double-contrast views in order to check on the findings of the single contrast examination. The technique was called 'barium enteroclysis' and considered to be far superior to the progress meal. They suggested that it would prove useful in the diagnosis of regional enteritis, ileoceleal tuberculosis, tumours, obstruction, and diverticula of the small intestine. Wissenberg\(^5\) examined 21 patients with the technique described by Gershon-Cohen and Shay and found that it gave an even distribution of contrast medium throughout the intestine and showed morphological changes clearly.

The small bowel enema was the title used by Schatzki when he reported his experience with the technique in 72 examinations in 1943.40 He suggested that it was helpful but not obligatory to have the colon empty before performing the examination. Like Gershon-Cohen and Shay he also used a large volume of dilute barium (500–1000 ml) and allowed it to run into the duodenum under gravity from a container. The head of the column reached the caecum in normal cases in about 15 minutes. A constant flow of fluid was necessary and any interruption delayed the examination markedly according to Schatzki. He stated that the primary purpose of the method was the demonstration of organic pathology and when successfully carried out it was
better than any other available method for the study of morphological changes in the small intestine. The results were so good that he recommended it to be used as a routine procedure.

The experience of Lura was similar when he performed 300 examinations during a four year period using a technique similar to that described by Schatzki. The technique, according to Lura, made inspection of the whole small intestine possible in 15 minutes. The advantages mentioned were that the examination was independent of pyloric function, complete filling of the small intestine was obtained, and part of the contrast medium could be withdrawn and air introduced.

Any improvement in the degree of accuracy of radiological diagnosis of localised lesions of the small intestine must depend on some method of examination other than a barium follow-through as the routine technique according to Scott-Harden. He believed that the method advocated by Schatzki had not found universal favour for two reasons. There was difficulty experienced in performing the duodenal intubation and the complete filling had the disadvantage of obscuring the individual coils of small intestine. He designed a tube comprised of a stiff outer sheath for use in the stomach with a more flexible duodenal element which could slide inside the gastric tube and be accurately manipulated at the pylorus and passed to the duodenojejunal flexure fairly easily. With the tip of the tube at the duodenojejunal flexure a syringe with a two-way tap injected 60–90 ml of barium. A tube was attached to the other opening of the two-way tap; it was then connected to a bottle containing 0·9 litres (1½ pints) of water which was injected. The barium flowed freely to the caecum leaving a varying length of small intestine outlined by mucosal adhesion with double-contrast. Proximal to this, the barium was washed from the mucosa leaving a clear field, thus preventing obscured vision of the segment under examination at any time. The outline of the whole small intestine was usually complete within 10 minutes of the start of the injection.

Pygott and his colleagues in 1960 stated that a satisfactory demonstration of the entire small intestine with the barium follow-through, or one of its modifications, was often not obtained particularly in the presence of disease. They adopted the Scott-Harden tube and used successive injections of barium suspension and tap water and observed the progress of the contrast medium. Controlled filling of the intestine was obtained and in the normal subject the caecum was reached in 15–20 minutes. They found it an accurate method in infiltrative lesions such as Crohn's disease and very valuable in patients in whom an obstructive or constrictive lesion of the small intestine was likely to be found.

The Scott-Harden technique was also used by Trickey and his colleagues. It gave excellent results in the duodenum and proximal ileum. They frequently failed to show the mucosal detail of the terminal ileum because of dilution of the barium suspension by the ensuing water 'flush'. To avoid this they used 1·1 litres (2 pints) of a solution, containing methylcellulose and a wetting agent as a flushing fluid, which they injected after the initial injection of barium suspension. They considered that the technique reduced considerably the chances of missing a lesion and that the lines of demarcation between normal and abnormal intestine were exaggerated because of the mild distension obtained.

A grey KIFA catheter was used for introducing the barium into the
Barium examination of the small intestine

duodenum by Glanville and Hugh. They emphasised the importance of using a radiopaque catheter rigid enough to be manipulated through the stomach yet sufficiently supple to negotiate the sharp bend between the first and second parts of the duodenum. The catheter was passed through the nose with the patient sitting in a chair. When the tip reached the third part of the duodenum the barium was injected to outline the small intestine. They succeeded in getting the catheter to enter the duodenum in 21 consecutive examinations.

During the last decade there has been renewed interest in duodenal intubation techniques for examining the small intestine mainly due to Sellink’s work. He indicated that the specific gravity of the contrast fluid was an exceedingly important factor which had not received sufficient attention and barium suspensions were often used with a specific gravity which was much too high. After experiments with a phantom to test contrast fluids he decided that the best results could be obtained with a barium suspension of 1·2 specific gravity for a thin patient and 1·25 for an obese patient. However, when he started using the contrast medium in patients he found that a specific gravity of 1·25–1·32 was better.

He suggested the use of a large quantity of contrast fluid, 1200 ml of dilute barium, administered by infusion into the duodenum. Thorough cleansing of the colon was necessary as the presence of faeces in the caecum retarded the passage of barium through the distal part of the ileum. The other major contribution by Sellink was the adoption of the Bilbao-Dotter tube for duodenal intubation. The tube was originally developed for performing hypotonic duodenography, based on the Seldinger technique for vascular catheterisation. Sellink used a lengthened version of the Bilbao-Dotter tube because it could be inserted further into the duodenum. He concluded that the radiological examination of the small intestine by means of the infusion could save considerable time, the information obtained was far superior to that achieved with the conventional method and he suggested that the oral administration of contrast medium should be abandoned and replaced by the infusion as a routine technique.

The Bilbao-Dotter tube was further modified when the gauge was reduced from a size 14 French to a size 12 French. Its smaller size gives increased flexibility and enables it to be passed with ease through the nose, stomach, and duodenum. The modified catheter passes quickly through the duodenum and in most cases it is possible to advance the tip about 10 cm into the jejunum.

The technique used by Sellink for examining the small intestine has been described in detail. A low residue diet and aperients are prescribed and fluids are encouraged on the day before the examination in order to obtain a clean distal ileum and colon. Cleansing enemas are not performed as the cleansing fluid and faecal material may be washed into and retained in the distal ileum. The patient fasts overnight before the barium examination.

The catheter* is passed so that the tip lies at or just distal to the ligament of Treitz. Barium suspension diluted to a specific gravity of 1·25–1·3 for adult patients and more dilute for younger patients is used for the infusion. A barium hydrometer† is necessary to obtain the correct specific gravity. The

*William Cooke Europe ApS.
†Phillips Medical Systems.
dilute barium is infused under gravity at a rate of 100 ml per minute. A total of 800–1200 ml of the dilute barium suspension is used. If the head of the barium column has not reached the terminal ileum after the infusion of 1200 ml of barium, water is infused at the same speed so that a constant flow is maintained until barium reaches the terminal ileum.

Large radiographs are taken to show all the loops of small intestine. Spot views are taken, often with compression, of the pelvic loops of ileum, the terminal ileum and any other segments of interest. The radiographs are taken at high kilovoltage (115–120 kV). Patients may develop an episode of diarrhoea after the examination and they should be warned of this.

Fleckenstein and Pedersen\(^5^3\) considered that the Sellink method was the best of the duodenal intubation techniques for examining the small intestine. They carried out a study in which they compared the infusion technique (Sellink modification) with the conventional barium follow-through in the same patients. Fifty-two patients were examined by both methods and it was concluded that visualisation of the jejunum and ileum, with the exception of the terminal ileum, was significantly better with the infusion technique. Although the two methods gave equal visualisation of the terminal ileum they stated that the infusion method was better suited to demonstrate the extension of a pathological process in this region.

After the publications by Sellink, a number of centres have adopted his technique or a modification of it. An air-contrast modification of the Sellink examination is performed by some radiologists,\(^2^8\)\(^5^4\)\(^5^5\) while others prefer the single contrast dilute barium technique described by Sellink.\(^5^2\)\(^5^8\)\(^6^2\) A double-contrast method using barium and an 0.5% aqueous suspension of methylcellulose is preferred by Herlinger\(^6^3\)\(^6^4\) and Vallance.\(^6^5\) The increasing number of radiologists using duodenal intubation techniques for introducing barium into the small intestine is in itself an indication that many are dissatisfied with the conventional barium follow-through.

The barium infusion is considerably better than the barium follow-through in the diagnosis and management of Crohn’s disease. Eighteen patients with Crohn’s disease, verified histologically, were included in Sellink’s first communication.\(^4^6\) He found the infusion examination much more accurate than the follow-through. Four patients with histories of previous resections showed clear evidence of recurrent Crohn’s disease on the barium infusion. These had not been identified on the previous barium follow-through examinations.

Thirty-six cases of Crohn’s disease were confirmed by pathological examination in the series by Dyet and his colleagues\(^5^4\) and no false-positives or false-negatives were found. They concluded that the barium infusion was not only useful in making the diagnosis, but essential for demonstrating the full extent of the disease in the small intestine, including complications such as fistulae, particularly if surgery were contemplated. They used Sellink’s method, but injected air after the barium reached the terminal ileum in order to get double-contrast views.

Sanders and Ho\(^4^8\) showed Crohn’s disease in 37 out of 150 patients examined by the Sellink method, nine of whom had previous conventional follow-through examinations. Crohn’s disease was missed in two of the follow-through examinations, they were reported to be normal. A fistula to the sigmoid colon had not been seen on the follow-through in another patient. Crohn’s disease with multiple strictures and obstruction was shown
in another where the follow-through showed possible obstruction only. They concluded that the infusion examination was better for assessing the small intestine radiologically.

Ekberg examined 43 patients who had Crohn’s disease with the barium follow-through and then with an intubation technique at intervals varying from four days to four-and-a-half years. Sixty per cent were examined within an interval of less than one year. The intubation method was an air-contrast modification of Sellink’s technique. The double-contrast examination revealed more clearly all the pathological changes of Crohn’s disease except fistulae and showed the demarcation of diseased intestine from normal intestine more distinctly.

During a two-and-a-half year period 100 patients with Crohn’s disease of the small intestine were examined by the Sellink technique at the Radcliffe Infirmary, Oxford. The dilute barium distended the normal and diseased segments of the small intestine and proved to be an excellent contrast agent. The radiological signs of Crohn’s disease were well demonstrated. Discrete and fissure ulcers, longitudinal ulceration, sinuses, and fistulae were well shown. Other signs that were clearly identified included thickening and distortion of the mucosal folds, cobblestoning, strictures in many cases with proximal dilatation, asymmetrical involvement, skip lesions, and pseudopolyps. The extent of diseased and normal small intestine was correctly estimated before resection in all patients who came to operation and there was excellent correlation between the radiological appearances and the findings at morbid anatomy. The ability to differentiate between normal small intestine and diseased segments without repeated examinations was a major advantage of the Sellink technique.

Other investigators have testified to the superiority of intubation methods in Crohn’s disease of the small intestine. The improved accuracy of the barium infusion in making a diagnosis and demonstrating the changes of Crohn’s disease of the small intestine is recognised by physicians and surgeons interested in the disease. The examination is particularly useful in the detection of recurrent disease after previous surgery.

The barium infusion is an excellent method for detecting and demonstrating other diseases of the small intestine such as carcinoid tumours, lymphomas, Yersinia enterocolitica infection, and in the diagnosis of Meckel’s diverticulum.

The site of small bowel obstruction can be shown and in many cases the cause identified. It should also prove helpful in identifying adhesions after surgery for previous inflammatory bowel disease. We recently demonstrated ischaemic strictures of the small intestine in two patients after blunt abdominal trauma. In each case the stricture was clearly identified by the infusion examination.

The changes seen on the infusion examination in the small intestine of patients with coeliac disease have been described. However, in my experience it is not reliable and a jejunal biopsy should be the initial diagnostic procedure when coeliac disease is suspected. The infusion examination should be reserved for patients with a suspected complication of coeliac disease such as small bowel lymphoma, or those in whom the jejunal biopsy is normal.

Dilute barium is an excellent contrast agent in the small intestine when radiographs are taken at high kilovoltage; it is particularly good at demon-
strating fissure ulcers, sinuses, and fistulae. It gives better distension of the intestine than air, which passes through very quickly and fails to distend narrowed segments adequately. Severe stenosis may be overlooked on the double-contrast views because prestenotic dilatations do not distend as easily and overlapping ring shadows are not as clear and diagnostic as a loop well-filled with barium.\textsuperscript{52} Ekberg\textsuperscript{55} prefers a double-contrast method using barium and air. The air-contrast method is unlikely to demonstrate sinuses and fistulae as well as the dilute barium. Fistulae were demonstrated less frequently by Ekberg using the double-contrast method than with the barium follow-through.\textsuperscript{66}

The use of barium and an aqueous solution of methylcellulose can result in excellent detail of the normal mucosa.\textsuperscript{63,64} The barium is injected first and when the aqueous suspension is injected it pushes the barium forward leaving a thin coating of barium on the mucosa. The diseased segments, however, appear to be demonstrated much better by the barium at the head of the column than by the double-contrast produced by the combined barium and aqueous suspension of methylcellulose. It may be that the increased secretions of the abnormal mucosa make it difficult for the thin layer of barium to remain adherent to the wall of the diseased segment as the aqueous solution flows past. The dilute barium on the other hand distends the diseased segment and need not adhere to the mucosa to produce good visualisation.

Some radiologists are reluctant to perform duodenal intubation as they consider it time-consuming, difficult to perform, and uncomfortable for the patient. Once the technique is mastered it normally takes only 5–10 minutes to pass the tube to the ligament of Treitz. With the colon prepared and clean the barium usually reaches the caecum in 5–15 minutes. If there is no obstructive lesion the whole examination is completed in 15–30 minutes in the great majority of patients. Technicians are trained in some departments to perform the intubation part of the procedure\textsuperscript{51} and as a result the examination is less time-consuming for the radiologist. Most patients tolerate the procedure very well.

When the intubation technique is first adopted there can be difficulties, but it becomes relatively easy with experience. The part of the procedure likely to give most problems to the inexperienced is getting the tip of the catheter to pass through the pylorus and past the junction of the first and second parts of the duodenum. If the patient is turned on his left side or upward pressure is exerted on the greater curve aspect of the prepyloric gastric antrum or both, it is nearly always possible to get the tip of the catheter into the second part of the duodenum. Only on rare occasions, usually when there is an abnormality of the pylorus or proximal duodenum, is it impossible to pass the catheter to the ligament of Treitz. Reflux of barium from the duodenum to the stomach can occur and may induce vomiting. It rarely occurs if the tip of the catheter is positioned distal to the ligament of Treitz. The large catheter sometimes proved impossible to pass into the third part of the duodenum and it never passed the ligament of Treitz.

It has been suggested that the radiation dose to the patient is high with the infusion technique.\textsuperscript{19} However, Vogel and Löh\textsuperscript{81} found that the radiation dose was similar to that obtained with the barium follow-through.
INTUBATION OF SMALL INTESTINE

A number of intestinal tubes are used for decompressing the distended intestine in patients with small intestinal obstruction. The Miller-Abbott tube\(^82\) has a balloon at the tip which is inflated with air when it reaches the duodenum. The peristaltic activity takes it through the small intestine until it stops at the site of obstruction. Other tubes have a mercury filled bag at the end which is taken to the site of obstruction by peristalsis.\(^83\)\(^-\)\(^85\) Very useful diagnostic information can be obtained by injecting barium through these intestinal tubes when they are no longer advancing and have reached the site of obstruction.\(^63\)\(^86\)\(^-\)\(^89\)

Friedman and Rigler\(^90\) felt that satisfactory delineation and demonstration of lesions of the small intestine remained a challenge to the radiologist. They used a triple lumen small intestinal tube with two balloons and side holes in between. With this tube it was possible to inflate both balloons and inject barium and air so that a double-contrast examination of the intestine in between could be obtained. If the proximal balloon only was inflated the distal part of the intestine could be examined. On the other hand if the distal balloon only was inflated the proximal intestine could be demonstrated. A similar technique was advocated by Greenspon and Lentino\(^91\) in selected cases and they called it retrograde enteropathy. A modified Miller-Abbott tube was used and the balloon was partially inflated when it reached the duodenum so that it would act as a bolus and pass through the small intestine. The balloon was fully distended in the distal part of the small intestine so that it obstructed the lumen and barium was injected to outline the proximal intestine. The balloon was then deflated and an examination of the distal intestine carried out.

These types of catheters have not become popular for routine investigations of the small intestine, but they are used in a few centres\(^63\)\(^64\) to investigate small intestinal obstruction.

Summary

The barium follow-through is still the most widely used technique for examining the small intestine with contrast medium despite evidence that it is not accurate for detecting and demonstrating diseases that cause morphological changes in the small intestine. Duodenal intubation techniques are now replacing the follow-through in many centres. Excellent visualisation is achieved when the barium is introduced directly through a tube into the small intestine. The single-contrast dilute barium infusion method described by Sellink is very satisfactory. Reports from centres using intubation methods indicate that they give much more accurate information than the follow-through. Diagnostic information may be obtained by injecting barium through intestinal tubes that are being used to decompress the distended intestine in patients with small intestinal obstruction. Per oral pneumocolon examination of the ileocaecal region and the complete reflux examination help to evaluate the ileum, particularly the terminal ileum.

Department of Radiology
John Radcliffe Hospital
Headington, Oxford

D J Nolan

Received for publication 15 January 1981
References

Barium examination of the small intestine
