

*Methods and techniques***An evaluation of the gastroduodenal fibrescope**

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EDITORIAL SYNOPSIS One hundred and sixty patients have been examined with the flexible gastroduodenoscope. Passage of this instrument is easier than of the conventional gastroscope, and the stomach can be examined down to the pyloric canal and pylorus. Duodenoscopy is sometimes possible but some modification is required in order to guarantee success. Examination of a gastrojejunal stoma is practically always possible and is superior to that obtained with the gastroscope. The fibrescope can be used in patients with haematemesis within a few hours of their admission to hospital, and with it definitive early diagnosis is possible in two out of three patients.

The value of the conventional gastroscope has been established for many years. However, its usefulness has been limited by its rigidity and by difficulties in visualizing the pyloric antrum, particularly the part immediately proximal to the pylorus. As a result of the recent development of fibre optics, it has become possible to design a gastroscope with a flexible shaft (Curtiss, Hirschowitz, and Peters, 1957; Hirschowitz, Curtiss, Peters, and Pollard, 1958) and preliminary reports on an instrument using this optical principle have already appeared (Hirschowitz, 1961; LoPresti, Scherl, Greene, and Farrar, 1962). This instrument has been available in Britain since 1961 and there have been several early comments on its value (Avery Jones and Kellock, 1961; Burnett, 1962a and b; Kemp, 1962). The present report describes the technique which has been evolved for use with this new type of gastroscope. Its value in diagnosis has been assessed after using it to examine 160 patients during a period of five months. The results obtained with the fibrescope have been compared with those in a group of 160 patients selected at random from a much larger personal series examined with the Hermon Taylor gastroscope before the fibrescope became available.

THE INSTRUMENT

The instrument is the gastroduodenoscope described by Hirschowitz (1961). The shaft, which is quite flexible, contains a bundle of 150,000 glass fibres of 0.006 in. diameter. The fibre bundle diameter is approximately 0.25 in. and the diameter of the complete instrument,

including the plastic sheath, is 0.5 in. Light transmission along the fibres is by the principle of total internal reflectance, and the fibres are fixed at either end and so arranged spatially, that an image is built up from the 150,000 individual spots of light emerging from the proximal end of the fibre bundle. Further details are as given by Hirschowitz (1961).

TECHNIQUE

The examination is carried out with the patient in the fasting state. The patient is given a subcutaneous injection of morphine sulphate and atropine sulphate, in dosage appropriate to his size and general condition, one hour before the examination. At this time also, a Decicaine lozenge is given to anaesthetize the pharynx, a further lozenge being given half an hour later. With this preparation, it has rarely been found necessary to spray the throat with a local anaesthetic. After covering the patient's eyes, the fibrescope is introduced with the patient in the left lateral position. It is not necessary to support the head which lies comfortably on a pillow. This position was chosen as it has been found to be satisfactory for a full gastroscopic examination, and intra-gastric orientation is assisted, provided the endoscopist has had previous experience with a conventional gastroscope. The fingers of the left hand pull the tongue and the epiglottis forward, and the fibrescope is fed into the pharynx and oesophagus with the right hand as in the passage of a stomach tube. The proximal rather heavy end of the instrument is supported by an assistant standing somewhat behind the endoscopist. It is important that the patient's neck should remain flexed until the instrument enters the oesophagus, as extension of the neck makes entry into the oesophagus more difficult. It is sometimes necessary to ask the patient to swallow in

order to get the tip of the fibroscope into the oesophagus but this is seldom required. No patient has been refused fibroscopy because of physical reasons such as a small mouth, the presence of teeth, prominent cervical vertebrae, kyphosis, or other such physical reasons which sometimes make examination with the conventional gastroscope difficult or impossible.

After the fibroscope is in position, the air and electrical leads are attached, and some air is instilled while inspecting with the variable-output transformer at half power. This arrangement has given a satisfactory intensity of illumination. Full power may be used briefly for detailed examination but the metal end of the fibroscope gets too hot for intragastric work if maximal illumination is used for more than a minute or two.

RESULTS

One hundred and sixty unselected patients have been examined. This group represents a cross-section of those coming for diagnosis to a general surgical unit with an interest in the upper gastrointestinal tract. Many of these patients had been investigated previously by radiology. The largest group was referred because of the association of negative radiological findings with clinical suspicion that some gastric lesion might be present. A further group was referred to confirm a diagnosis made by the radiologist. A group of 50 patients was gastroscopied because of symptoms which had arisen some time after gastric surgery had been carried out. All members of this latter group had a gastro-jejunal fistula. A relatively large group of 44 patients was seen following recent haematemesis or melaena which had resulted in admission to hospital. The group of 160 patients described below represents the entire series examined since the instrument came into use in this unit.

Examination was successful in 145 (91%), failed in eight (5%), and partially failed in seven (4%). On four occasions during the first 30 cases we failed to pass the instrument into the oesophagus. Other failures resulted from the patient's inability to retain instilled air, and to the presence of excess secretions which completely impaired vision. Partial failure was recorded when complete examination of the stomach proved impossible either because of the patient's extreme nervousness leading to a termination of the procedure, excess secretions, or failure of the light bulb. These results have been compared with a series of the same size examined with the Hermon Taylor gastroscope (Table I). This comparison is biased in favour of the conventional gastroscope as the series was to some extent selected, certain patients on whom the examination was likely to have failed not being submitted to gastroscopy with the Hermon Taylor gastro-

TABLE I
COMPARISON OF RESULTS OF ENDOSCOPY
WITH THE FIBROSCOPE AND THE HERMON TAYLOR
GASTROSCOPE IN TWO GROUPS OF 160 PATIENTS

Result of Examination	Fibroscope	Gastroscope
Success	145 (91%)	114 (71%)
Failure	8 (5%)	13 (8%)
Partial failure	7 (4%)	33 (21%)

scope; furthermore, a considerably greater experience was available in gastroscopy by the conventional method. Nevertheless, although the fibroscope series was quite unselected, the success rate (91%) is considerably higher than that for the conventional instrument (71%). Failures with the Taylor gastroscope (13 cases) were mainly due to physical reasons (short neck, kyphosis, etc.) or to nervousness and inability to tolerate the instrument. The partial failures (33 cases) were due to inability to visualize the antrum (17 cases), a limited view of the body of the stomach being obtained (11 cases), or to the presence of excess secretions (5 cases). Finally, the patient is considerably more comfortable during an examination with the fibroscope in comparison with gastroscopy with a conventional instrument.

GASTROSCOPY This was successful in 61 out of 70 cases. In general, a satisfactory view of all areas of the stomach is obtained except for the fundus which cannot be seen. The upper portion of the lesser curvature and the cardio-oesophageal region are best examined on withdrawing the instrument and the whole circumference in this area can be brought into view by rotating the fibroscope. In a minority of cases, the tip of the instrument enters the antrum at the start of the examination without any special effort. However, the following manoeuvre has been found to be successful in the majority of the remaining cases. With the patient in the left lateral position, the instrument is held taut by the right hand; the left hand of the operator pushes the tip onwards, and while viewing the stomach through the eyepiece, the fibroscope is rotated clock-wise with the right hand using the one-to-one torque obtained by a copper wire spiral built into the sheath. When the antrum has been entered in this way the tip of the instrument may be advanced with successive antral waves down to the pyloric canal until the pylorus is reached. The terminal inch of the stomach and the pyloric canal are not normally seen with the conventional gastroscope.

The principal findings in this group of patients are shown in Table II. The stomach was found to be apparently normal in 16 patients. Chronic peptic ulceration was found in various sites in the stomach in 24 patients. Diagnosis was missed radiologically

TABLE II
RESULTS OF GASTROSCOPY WITH THE FIBROSCOPE
IN 70 CASES

<i>Examination successful</i>	
Normal stomach	16
Gastric ulcer	24
Gastric erosions	7
Atrophic gastritis	4
Carcinoma of stomach	9
Malignant polyp	1
<i>Examination failed</i>	
	9

and made with the fibroscope in six patients; a doubtful radiological diagnosis was confirmed by fibroscope on two occasions. On the other hand, three ulcers seen radiologically were not seen with the fibroscope: one stomach appeared normal, a second had only erosions, and a third had signs of localized chronic inflammation but no ulceration. In the last case, a small ulcer was found high on the posterior wall of the stomach at operation. Diagnosis was made or modified by fibrescopy in 20 out of

27 cases. These have been summarized in Table III. Diagnosis of carcinoma of the stomach as suggested by radiographs was changed to benign ulcer by fibrescopy in four cases, and on the four occasions where surgery has been carried out so far for ulcer thought to be benign by fibrescopy, the diagnosis of benign ulcer was confirmed.

Carcinoma of the stomach was positively diagnosed by the fibroscope on nine occasions; this diagnosis has been confirmed histologically in all eight patients from whom histology is available. A comparison between the radiological and the fibroscopic findings is made in Table IV.

GASTROSCOPY IN THE PRESENCE OF A STOMA The stoma and jejunum were adequately seen in 37 out of the 40 cases examined (Table V). It has proved relatively easy to find and examine a stoma with the fibroscope wherever in the stomach the stoma may have been made. The stoma can usually be entered in the left lateral position but occasionally it is

TABLE III

DIAGNOSIS OF BENIGN GASTRIC LESIONS MADE OR MODIFIED BY FIBROSCOPY

Case No.	Radiology	Fibrescopy	Remarks
G3	Ulcer ? benign ? malignant	Benign gastric ulcer	Treated conservatively
G4	Pyloric stenosis	Large benign antral gastric ulcer	Confirmed at operation
G8	Duodenal ulcer + ? pre-pyloric ulcer	Bleeding pyloric ulcer	Treated conservatively
G15	Not available	Bleeding lesser curve gastric ulcer	Confirmed at operation
G16	High lesser curve gastric ulcer	Redness and oedema No actual ulcer	At operation duodenal ulcer and small high posterior wall gastric ulcer
G18	Lesser curve ulcer ? carcinoma	Benign gastric ulcer	Treated conservatively
G30	Not available	Benign lesser curve gastric ulcer	Confirmed at operation
G42	Gastric ulcer	High gastric ulcer bleeding from vessel in base	Confirmed at operation
G43	? Carcinoma	Very high gastric ulcer healing	Subsequently healed
G44	? High gastric ulcer	Erosions only	Subsequently healed
G47	Chronic gastric ulcer	Healing ulcer	Subsequently healed (radiograph)
G48	Duodenal ulcer	Shallow bleeding gastric ulcer	Subsequently healed
G52	Pyloric niche	Small prepyloric gastric ulcer	Treated conservatively
G59	High posterior gastric ulcer	Normal stomach	Treated conservatively
G60	Normal stomach	High lesser curve gastric ulcer	Treated conservatively
G62	? Benign prepyloric ulcer	Small healed prepyloric ulcer	Treated conservatively
G63	Hiatus hernia and duodenal ulcer	Bleeding prepyloric gastric ulcer	Treated conservatively
G66	Gastric ulcer	Healed gastric ulcer	Treated conservatively
G67	Normal stomach	Bleeding gastric ulcer posterior pillar of antrum	Treated conservatively

TABLE IV

COMPARISON OF RADIOLOGY AND FIBROSCOPY IN CARCINOMA OF THE STOMACH

Case No.	Radiology	Fibrescopy	Operation	Remarks
5	Prepyloric crater	Carcinoma antrum	—	Lung metastases
7	Antral tumour	Carcinoma antrum	Gastrectomy	Carcinoma proved histologically
13	? Carcinoma ? peptic ulcer	Carcinoma antrum	Gastrectomy	Carcinoma proved histologically
19	Negative	Carcinoma antrum	Gastrectomy	Carcinoma proved histologically
31	Diverticulum mid-stomach, pylorospasm, duodenal ulcer	Pseudo-diverticulum and carcinoma body of stomach, no duodenal ulcer	Inoperable	Carcinoma proved histologically
32	Prepyloric filling defect consistent with carcinoma	Prepyloric ulcerating carcinoma	Gastrectomy	Carcinoma proved histologically
33	? atrophic gastritis ? carcinoma	Carcinoma antrum	Gastrectomy	Carcinoma proved histologically
36	Probable carcinoma	Carcinoma antrum	Gastrectomy	Carcinoma proved histologically
65	? prepyloric ulcer	Carcinoma antrum	Gastrectomy	Carcinoma proved histologically

necessary to ask the patient to lie on his back to bring the stoma into view. It is usually possible to examine the proximal one to two inches of afferent and efferent jejunal loops, but it has never been possible to visualize the 12 inches or so described by Hirschowitz (1961). In a series of 160 cases examined with the Taylor gastroscope, there were 33 stomata, and 24 of these were seen well, four badly, and five not at all. In one case acute jejunitis was diagnosed, otherwise no jejunal pathology was seen. In the fibrescope series (Table V) three jejunal ulcers were seen and there were six examples of acute jejunitis,

TABLE V
GASTROSCOPY WITH THE FIBRESCOPE
IN THE PRESENCE OF A GASTROJEJUNAL STOMA
IN 40 CASES

Examination		
Successful		Failed
Suspected jejunal ulcer excluded	21	Stoma not visualized
Jejunum normal	4	
Jejunal erosions	1	
Acute jejunitis	6	
Antral ulcer	1	
Carcinoma stomach	1	
Total	37	

three of which had been associated with a recent episode of bleeding, and all of which were present in patients who had presented with symptoms suggestive of stomal ulcer. None of the three stomal ulcers seen with the fibrescope had been found radiologically: in one of the patients where fibrescopy demonstrated an intense jejunitis, a jejunal ulcer distal to this was found at subsequent operation. Jejunal ulcer was excluded by fibrescopy in 21 patients where it had been suspected on clinical (15) or radiological grounds (6).

FIBRESCOPY IN CASES OF HAEMATEMESIS Fibrescopy was carried out within 24 hours of admission on 44 patients. Information of diagnostic value was obtained in 29 (66%) and is set out in Table VI.

TABLE VI
RESULTS OF EARLY FIBRESCOPY IN
44 CASES OF HAEMATEMESIS

Information of diagnostic value	29 (66%)
Bleeding gastric ulcer	6
Bleeding pyloric ulcer	3
Bleeding duodenal ulcer	4
Bleeding jejunal ulcer	1
Acute jejunitis	3
Acute gastric erosions	6
Atrophic gastritis	4
Gastric telangiectasis	1
Duodenitis	1
No abnormality seen	13 (34%)

Examination was made in the endoscopy room in the majority of cases after nasogastric suction had emptied the stomach of blood. Later it was found to be very easy and indeed preferable to fibrescope a patient in bed and this procedure was followed in subsequent cases in the series.

DUODENOSCOPY Duodenoscopy was attempted in 50 patients. In the remaining larger group of patients in the series of 160, a gastric lesion was found or a stoma was present and duodenoscopy was therefore not attempted.

The following technique has been evolved for entering the duodenum. After the tip of the fibrescope has reached the pyloric canal, the patient is turned on his back and the tip of the instrument is then pushed onwards through the pylorus into the duodenum. In some cases this manoeuvre is assisted by turning the patient somewhat towards his right side, but more often than not this results in a flooding of the pyloric area with gastric contents which had been lying in the fundal region. Care must be taken not to confuse a mucosal recess near the contracted pyloric muscle with the entry to the duodenum. In the earlier part of this series this recess proved misleading, particularly because this most distal part of the stomach is not normally seen with the conventional gastroscope.

The results of attempted duodenoscopy are given in Table VII. Although 12 duodenal ulcers have

TABLE VII
RESULTS OF ATTEMPTED DUODENOSCOPY WITH THE
FIBRESCOPE IN 50 CASES

Lesion	Seen at Duodenoscopy	Confirmed to Date at Laparotomy
Duodenal ulcer	12	6
Possible duodenal ulcer	5	3
	(indirect evidence)	
Duodenitis	3	1
Pyloric ulcer or erosion	7	1

definitely been seen, the instrument is not really suitable for duodenoscopy. A similar view was expressed by Avery Jones and Kellock (1961) and later by Kemp (1962). In its present form the fibrescope is too big and bulky to pass a pylorus which is narrowed by ulceration and stiff because of nearby inflammation and oedema. Furthermore, it would be an advantage if the vision were terminal instead of lateral. Six of the duodenal ulcers seen, including two in patients who presented with haematemesis, have been examined subsequently at operation and the site of ulceration confirmed as being definitely in the first part of the duodenum. A normal duodenum was reported in 20 patients.

TABLE VIII

IMPROVEMENT IN RADIOLOGICAL DIAGNOSIS IN DUODENAL CAP LESIONS BY FIBRESCOPY

Case No.	Radiological Diagnosis	Duodenoscopy	Remarks
D6	? Small duodenal ulcer	Normal	Duodenoscopy complete
D9	Deformed cap	Normal	Laparotomy negative
D14	Deformed cap	Active duodenal ulcer	Confirmed at surgery
D37	? Duodenal ulcer	Large posterior duodenal ulcer	
D38	? Prepyloric ulcer	Active duodenal ulcer	
D39	Deformed cap	Superficial posterior duodenal ulcer	
D43	Negative	Chronic posterior duodenal ulcer	
D44	? Duodenal ulcer	Posterior active duodenal ulcer	Confirmed at surgery

In three of this group subsequent laparotomy has disclosed one chronic anterior duodenal ulcer, one small posterior ulcer far down the first part of the duodenum, and one duodenum with extensive pouching and scarring. Finally, radiological diagnosis has been improved in eight cases by duodenoscopy (Table VIII). In a further four cases duodenal ulcers seen radiologically were not seen at duodenoscopy. In one of these four cases laparotomy has supported the radiological findings.

DISCUSSION

There is no doubt that the development of the flexible gastroduodenoscope is a very significant advance in gastroscopy. The instrument is much easier to pass than the conventional gastroscope, and is better tolerated by the patient. Being much more comfortable for the patient, the examination can be conducted over longer periods. In this series the failure rate is significantly less than in a corresponding group examined with the Hermon Taylor gastroscope. Furthermore, most failures with the fibrescope occurred early in the series.

It is a considerable advantage to be able to enter the antrum easily and examine the stomach down to the pylorus and in this series identification of juxtapyloric lesions with the fibrescope has been of great diagnostic value. While the duodenum can be seen on occasion with the fibrescope, modification of the instrument is required in order that entry into the duodenum may be guaranteed in those cases where it would be most useful. If part of the fibre bundle were to be used for light transmission in a distal direction, the tungsten bulb and its connexions could be eliminated thus effecting a considerable reduction in the size of the distal head. However, in the great majority of patients requiring gastroscopy, the lesion to be assessed is in the stomach or there is a stoma. In these circumstances

the fibrescope is most useful and quite adequate. A stoma can be seen in nearly every case and examined with greater ease than with the conventional gastroscope. In this series 37 out of 40 cases were seen. Very similar results were reported by LoPresti *et al.* (1962) who visualized 18 out of 21. The use of the fibrescope in haematemesis opens up a field for early diagnosis which has not been practical before now with the gastroscope. Although modification to the instrument has been suggested above, it is, even in its present form, sufficiently far advanced to replace the conventional gastroscope.

I am grateful to the Board of Management of the Western Infirmary, Glasgow, for providing me with an opportunity to evaluate the fibrescope, to Sir Charles Illingworth for his encouragement, and to my colleagues for allowing me to study many of the patients included in this report.

I thank Professor E. J. Wayne for inviting me to participate in an investigation into modern methods of early diagnosis and management of patients with haematemesis. An appreciation of the value of the fibrescope in these circumstances will be included in the report of this study to be published later.

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