

Endoscopic examination of the duodenal bulb: clinical evaluation of forward- and side-viewing fiberoptic systems in 200 cases

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SUMMARY Two-hundred fiberoptic examinations of the duodenal bulb were carried out on 149 patients. The importance of combining the initial examination with a general endoscopic survey of the oesophagus and stomach is stressed. At the present time full examination of the duodenal bulb requires the use of both a side-viewing and forward-viewing endoscope in more than a quarter of cases. The safety and acceptability to the patient of multiple endoscopic examinations carried out as an outpatient procedure has been demonstrated, and the value of the procedure in *x*-ray negative dyspepsia, in the follow up of ulcer therapy, and in acute upper gastrointestinal haemorrhage has been shown.

Although indirect duodenoscopy was described by Hirschowitz, Balint, and Fulton (1962) and Burnett (1962) soon after the introduction of fiberoptics into gastrointestinal endoscopy (Hirschowitz, Curtiss, Peters, and Pollard (1958), and gastro-cameras designed for use within the duodenum were used (Matsunaga, 1962; Ishihara, 1962), it was not until later that direct vision fiberoptic duodenoscopes were developed (Takagi, 1969; Shindo, 1969). At the present time duodenoscopy comprises two distinct procedures: (1) examination of the duodenal bulb (bulboscopy); (2) distal duodenoscopy in which the papilla of Vater, the peri-ampullary region, and the duodenal loop can be examined. It is during this procedure that cannulation of the papilla with retrograde choledochopancreatography may be performed (Oi, Kobayashi, and Kondo, 1970; Salmon, Brown, Htut, and Read, 1971; Cotton, Salmon, Blumgart, Burwood, Davies, Lawrie, Pierce, and Read, 1972).

Both these procedures have separate indications and techniques. In this paper, which is concerned chiefly with endoscopic examination of the duodenal bulb (bulboscopy), we describe the indications, procedures, and results obtained in 200 consecutive examinations, with particular reference to the advantages and limitations of each optical system.

In view of the high cost of fiberoptic equipment (which is nevertheless small compared with the cost

of supplying and maintaining *x*-ray equipment) we consider it important that the indications for each fiberoptic system become widely known.

Materials and Methods

Two hundred examinations were performed on 149 patients. Table I shows the indications for endoscopy in these patients, in nearly all of whom a duodenal ulcer was suspected, either on clinical or radiological grounds.

Condition	No. of Cases
Dyspepsia	102
Postoperative symptoms	9
Gastrointestinal haemorrhage	23
Anaemia and weight loss	3
Assessment of ulcer healing	51
Postbulbar problems	12
Total	200

Table I *Indications for bulboscopy*

All patients had had prior upper gastrointestinal radiology. A barium meal was performed at the same time as endoscopy in 75 patients but in the remaining patients, all with dyspepsia, radiology had been carried out six weeks or longer from this time. The examination was performed as an outpatient investigation in 134 instances. Patients were not routinely premedicated. Topical anaesthesia of the

fauces and posterior pharyngeal wall was obtained using a 30 mg amethocaine lozenge and in some patients this was followed by 2 ml of a 4% lignocaine gargle. Immediately before intubation diazepam (Valium), was injected intravenously at the rate of 2.5 mg every 30 seconds until the patient developed ptosis or dysarthria (usually 10-15 mg). All endoscopies were performed with the patient in the left lateral position. Radiological screening was not employed for examination of the duodenal bulb but was used on three out of 12 occasions to check the position of the endoscope when examination of the distal duodenum was required. Initial examination of the duodenal bulb was always performed as part of a combined procedure incorporating oesophago-gastroscopy. Because of this the A.C.M.I.¹ FO 7089-A forward-viewing system was employed initially in all cases. This instrument has an effective length of 125 cm, a 70° field of view, facilities for distal tip manipulation (120° in two directions), lens washing, aspiration, and biopsy under direct vision. In cases where information could not be obtained with the forward-viewing system or where there was difficulty in intubating the pylorus, the Olympus² JF-B side-viewing duodenoscope was employed. This instrument has a working length of 120 cm, four-way distal tip manipulation (120° up, 120° down, 60° right, 60° left), a 69° field of view, and eye-piece magnification of 22.7. In addition to powered lens washing and air feed, there are aspiration facilities and a controlled forceps raiser at the distal end allowing very accurate location of biopsies.

Photography was used extensively to record endoscopic findings. High-speed Ektachrome film (EHB-135 Tungsten) was employed. For the forward-viewing endoscope (7089-A) we used an Olympus Pen FT camera with 70 mm Zuiko lens, an A.C.M.I. Littman adaptor and the A.C.M.I. FCB-1000 photographic light source. Exposure bracketing was employed using the through-the-lens exposure meter.

In the case of the side-viewing endoscope (JF-B) an Olympus Pen F camera was used with a special adaptor. Both these pieces of equipment were supplied with the duodenoscope. Automatic exposure control was employed using the Olympus CLE light source.

Following intubation the oesophagus was examined, paying particular attention to the gastro-oesophageal junction. During gastroscopy the endoscope was advanced whilst rotating it in a clockwise direction and angling the tip upwards.

¹A.C.M.I. equipment may be obtained from Medical Supply Association, Crayford.

²Olympus equipment may be obtained from Key Med Specialised Medical equipment Ltd, Maitland House, Warrior Square, Southend.

This identifies the angulus and in the majority of patients brings the tip of the instrument into the pyloric antrum. The pylorus was examined before bulboscopy paying particular attention to its shape, presence of hyperaemia or oedema, and the pattern of gastric peristalsis ('pylorus spiel'). The pylorus was usually negotiated by bringing the tip of the endoscope as close as possible under direct vision and then applying gentle pressure. Passage through the pylorus results in a 'red-out'. At this point 40 mg (2 ml) of hyoscine N-butyl bromide (Buscopan) was injected intravenously. As the stomach and duodenum relaxed the instrument was slowly withdrawn until the duodenal bulb came into focus. It is important during this manoeuvre that withdrawal of the instrument is carefully controlled by holding it at the patient's mouth, so as to avoid pulling it back into the stomach. The superior duodenal angle (see Fig. 5) was identified, and using this as a landmark the duodenal bulb was examined by a combination of distal tip manipulation and rotation. The inferior wall of the bulb, on which the endoscope is lying, and that part of the bulb just within the pyloric ring, may not be seen with this instrument. For these reasons, and also in cases where the bulb was distorted by scars or where there appeared to be an ulcer which could not be seen well with the forward-viewing system, the side-viewing duodenoscope was employed. Where it was used the following technique was employed.

Intubation was performed with the distal lens facing anteriorly. After intubation the instrument was inserted until the tip came up against the gastric antrum. At this stage the endoscope was rotated 90° in a clockwise direction and the tip angled upwards. Sufficient air was insufflated into the stomach in order to obtain a clear view. This manoeuvre usually brought the pylorus into view. Further angling of the tip in an upwards direction completed inversion so that one was able to see the angulus, lesser curve, and cardia with the instrument entering the stomach and passing down the greater curve. The tip was then angled downwards so that the pylorus came into view. This was then brought as near to the lens as possible. Passage through the pylorus was accomplished by angling the tip of the instrument sufficiently upwards to bring the pylorus into the lowest part of the field of view. The tip of the instrument now lay in the pyloric canal. Gentle pressure allowed the endoscope to enter the duodenum, an event which was usually felt as a slight 'give' of the apparatus. Hyoscine was injected intravenously as with the previous endoscope.

Examination of the bulb was performed in a systematic manner. The instrument was rotated anticlockwise through an angle which varied from

90 to 180°. The tip was then angled so as to bring the lumen of the second part of the duodenum into view. Angling the tip in the opposite direction then brought the superior duodenal angle into view. The instrument was then gradually withdrawn and rotated whilst examining the bulb. The eyepiece magnification of 22.7 allowed one to see individual villi quite clearly. We did not routinely use the inversion technique described by Ogoshi, Tobita, and Hara (1970) for visualizing the pylorus from within the bulb.

Results

Table II shows the extent to which either the forward-viewing system (7089-A) or side-viewing system (JF-B) was used.

<i>Fibreoptic System</i>	<i>No. of Examinations</i>
7089-A alone	144
JF-B alone	26
7089-A + JF-B	29
7089-A + GF-BK ¹	1

Table II *Relative use of fibreoptic systems for bulboscopic examination*

¹Olympus side-viewing gastroscope

The side-viewing system was required in 51 examinations (25.5%) and was used alone in 17 out of 137 initial examinations. It has already been stressed that we normally consider endoscopic examination of the duodenal bulb as part of a general survey of the oesophagus, stomach, and duodenal bulb. This is in agreement with other authorities (Classen, 1971; Belber, 1971). Intubation of the pylorus failed completely in four cases (2%). Table III shows that this was nearly always due to failure to pass the 7089-A. In only one case was it found

<i>Instrument</i>	<i>No. of Cases</i>
7089-A	11
	3 JF-B not used
	7 JF-B passed
	1 JF-B failed

Table III *Failed duodenal intubation*

impossible to pass the narrower, more flexible and less traumatic tip of the side-viewing system (JF-B) through the pylorus. In the three cases where the JF-B was not used, the instrument was not available at the time of examination. In our experience failure to intubate the pylorus is only rarely due to organic narrowing. The commonest reason is faulty technique or a stomach that is hypotonic due to the previous use of anticholinergic drugs. Table IV shows the

results of endoscopic examination of the duodenal bulb. It should be noted that the number of lesions exceeds the total number of examinations, since in some patients more than one lesion was present. For example, some patients with an abnormal pylorus had in addition either duodenitis or a duodenal ulcer. The pylorus was considered to be endoscopically abnormal if there was definite oedema or narrowing (Fig. 1) or if the usual round orifice was permanently distorted (Fig. 2). In order to ascertain this point the pylorus was examined for several minutes and the effect on it of gastric peristalsis was observed ('pylorus spiel'). Duodenitis was defined endoscopically as the presence of obvious superficial inflammation as shown by the presence of hyperaemia, intramural haemorrhage, or superficial erosions (Belber, 1971). We were not able to relate our findings to histology as we do not routinely biopsy the duodenal bulb. The large number of duodenal ulcers diagnosed endoscopically represents follow-up data on a number of patients. Thirty-nine patients were diagnosed as having a duodenal ulcer endoscopically, although as seen from Table IV, 70 positive examinations were made. Twelve of the duo-

<i>Diagnosis</i>	<i>No. of Cases</i>
Normal examination	62
Oesophagitis	10
Oesophageal erosions	2
Oesophageal varices	2
Gastrooesophageal reflux	3
Gastric erosions	2
Gastric ulcer	6
Atrophic gastritis	2
Gastric carcinoma	1
Gastric diverticulum	1
Abnormal pylorus (see text)	21
Stomal gastritis	2
Duodenal ulcer	70
Duodenitis (see text)	9
Scarred duodenal bulb	12
Duodenal diverticulum	1
Duodenal polyps	1
Total	207

Table IV *Endoscopic diagnosis*

denal ulcers were situated within the pyloric canal, and were seen better with the side-viewing duodenoscope (JF-B) (Fig. 3). In several of these cases there were multiple ulcers in the pyloric canal. The oedema produced was often considerable so that the ulcer crater was hidden when viewed with the forward-viewing endoscope. Of the 75 barium meals performed at the same stage of the disease, there was good agreement in 40 cases (53.2%). Table V lists the endoscopic findings not revealed by radiology. Many of the duodenal ulcers not shown radiologically were shallow (Fig. 4) and this may have contributed



Fig. 1 *Narrowing of pylorus with inflammatory changes in a patient with a duodenal ulcer.*



Fig. 2 *Distorted pylorus (pyloroplasty).*



Fig. 3 *Pyloric canal ulcer seen with side-viewing duodenoscopy.*



Fig. 4 *Shallow duodenal ulcer.*



Fig. 5 *Duodenal bulb viewed by direct duodenoscopy (forward viewing duodenoscopy). Note the superior duodenal fold.*



Fig. 6 *Duodenal bulb on same patient as in Fig. 5 but viewed from the pyloric antrum (indirect duodenoscopy).*



Fig. 7 *Duodenal bulb with suggestion of lesion on inferior (lower) wall (forward-viewing endoscope).*



Fig. 8 *Inferior wall duodenal ulcer, same patient as in Fig. 8 seen with side-viewing endoscope.*



Fig. 9 *Healing duodenal ulcer. Same patient as in Figure 8.*

Endoscopic Finding	No.
Duodenal ulcer	13
Duodenal scarring	2
Scarred pylorus	1
Gastric ulcer	4
Oesophageal varices	2

Table V *Endoscopic findings not shown radiologically*

to these figures. In four cases there was an ulcer crater in addition to a deformed pylorus, the radiograph revealing only the deformity. Nine cases of *x*-ray negative dyspepsia in the series showed endoscopic evidence of peptic ulceration.

In cases of acute upper gastrointestinal haemorrhage the forward-viewing system (7089-A) was invaluable, allowing a positive diagnosis in the majority of cases. In other cases it enabled us to obtain a good general picture of the duodenal bulb (Fig. 5), a considerable advance on the earlier technique of indirect bulboscopy (Fig. 6, taken from the same patient as Fig. 5). We consider it essential, however, to have a side-viewing instrument capable of entering the duodenum, and possessing sufficient depth of focus to allow close observation (JF-B).

Figure 7 shows the duodenal bulb of a patient with dyspepsia, as seen with the forward-viewing system. At the lower margin (inferior wall of the duodenal bulb) there was a suggestion of an ulcer edge, but it was not possible with this endoscope to obtain a better view. Subsequent use of the side-viewing endoscope demonstrated a well defined duodenal ulcer on the anterior wall (Fig. 8). Follow-up endoscopy during treatment established that the ulcer was healing (Fig. 9).

Duodenal ulcers have a much greater range of appearance when viewed endoscopically than gastric ulcers which are usually well defined. Of the 70 duodenal ulcers reported in this paper, the appearances ranged from a deep, round crater to a shallow, irregular ulcer.

Acceptability to Patients

Fifty patients were sent a questionnaire within three months of endoscopy in order to establish the degree of acceptability of the procedure. In particular, they were asked whether they would be prepared to reattend for further endoscopy. Of 40 replying, 39 said that they would reattend if asked. Nineteen found the procedure preferable to a barium meal examination. Of 20 patients who had had a gastric function test, 17 preferred duodenoscopy to having a nasogastric tube passed. One patient stated that he would refuse further endoscopy. These findings are in accordance with our experience in an endoscopic

follow up of peptic ulcer patients. Only one of 26 patients failed to reattend for follow up endoscopies over a three-month period to assess healing.

Discussion

Our findings demonstrate the value and use of endoscopic examination of the duodenal bulb and stress the importance of making the initial examination in each patient part of a combined upper gastrointestinal endoscopic survey. There is little doubt now of the safety of fiberoptic endoscopy and multiple examinations performed at the same session, using two or even more endoscopes in order to make a full examination, appears to be justifiable. We do not subscribe to the view implied commercially that there is yet a panendoscope capable of visualizing all areas of the upper gastrointestinal tract. With careful preparation of the patient aided by a skilled endoscopy nurse there is a high reattendance rate for follow up endoscopy and this experience has been confirmed by a postal survey. There is no doubt that many lesions would have been missed if we had only used a forward-viewing endoscope for examination of the duodenal bulb. This is reflected by our use of the side-viewing endoscope in over a quarter of the examinations (25.5%). On the other hand, full examination of the duodenal bulb by the side-viewing endoscope alone, although possible, cannot be easily verified due to the high eye-piece magnification ($\times 22.7$). It was not part of this investigation to make a close comparison between *x*-ray and endoscopic findings at this stage. To do so and have data from 200 endoscopic examinations in addition would have been impracticable. However, in the 75 examinations performed shortly before endoscopy 15 cases of duodenal pathology (20.0%), four cases of gastric pathology (5.2%), and two cases of oesophageal pathology (2.4%) were not diagnosed radiologically. These figures compare favourably with those of the Erlangen group (15.2% and 6.0% respectively) and demonstrate the skill of our radiologists. In addition nine patients (12.0%) with *x*-ray negative dyspepsia had a positive diagnosis made endoscopically. This compares with 14.9% at Erlangen (Classen, 1971). There is disagreement as to the meaning of the term duodenitis. We have used the term in this paper solely to signify a number of endoscopic appearances and not to imply the presence of underlying histological changes. In this respect we have followed the practice of Belber (1971). Using his definition as requiring the presence of obvious superficial inflammation as shown by hyperaemia, intramural haemorrhage, or superficial erosion we were surprised to find a poor correlation between these findings and the presence of a duo-

denal ulcer. This lack of correlation has been noted by Classen, Koch, and Demling (1970). We feel that the value of endoscopic examination of the duodenal bulb (bulboscopy), lies in patients with x-ray-negative dyspepsia, in the early diagnosis of acute upper gastrointestinal haemorrhage, and in the follow-up control of peptic ulcer therapy (Salmon, Htut, and Read, 1971). The data presented in this paper support the first and last of these views. Further work will need to be carried out to substantiate these views individually but will only be meaningful if the correct fiberoptic systems and the optimum techniques are employed.

Since submitting this work we have had experience with the Olympus GIF-D² gastrointestinal fibrescope. This is an advanced forward viewing endoscope of superior design. It has a working length of 1 metre, an angle of view field of 75°, and facilities for remote control angulation of the tip in four directions (150° up, 150° down, 100° right, 100° left). Angulation occurs at two points in this instrument thus allowing effectively nearly 180° angulation, relative to the axis of the instrument. A continuous focusing mechanism allows a clear view even when in contact with the mucosa.

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