Gut, 1988, **29**, 157–160

Alimentary tract and pancreas

Oesophageal function before, during, and after healing of erosive oesophagitis

F BALDI, F FERRARINI, ANNAMARIA LONGANESI, M ANGELONI, M RAGAZZINI, M MIGLIOLI, AND L BARBARA

From the Department of Internal Medicine and Gastroenterology, University of Bologna, Bologna, Italy

SUMMARY In order to investigate the relationship between oesophageal motor abnormalities and oesophagitis, we carried out four hour studies of oesophageal motility and 24 hour pH measurements in fasting and fed conditions in eight patients before, during (pH only), and after medical healing of erosive oesophagitis. Gastrooesophageal acid reflux decreased (ns) during the treatment, but tended to return to basal values at the end. Oesophageal body motility was unchanged after healing, while the lower oesophageal sphincter basal tone was significantly increased at the end of the study in the postcibal period. The results suggest that the impairment of the sphincter tone in reflux oesophagitis is secondary to the presence of the oesophageal lesions. Macroscopic healing is not paralleled by improved major pathogenic factors of the disease, however – that is, acid reflux and oesophageal body motility.

It is well established that oesophageal motor abnormalities play a major role in the pathogenesis of reflux oesophagitis.[1–3] Moreover, animal[4 5] and studies in man[6 7] have shown that the impairment of the lower oesophageal sphincter (LOS) tone parallels the severity of the oesophageal lesions. It is, however, not yet clearly defined whether the motor abnormalities precede or follow the appearance of the mucosal lesions. In fact, only few studies,[8 9] performed for short periods of time, have investigated the oesophageal function before and after healing of the oesophagitis.

Our aim was, thus, to evaluate both oesophageal motility and acid gastrooesophageal reflux for prolonged periods, before and after regression of erosive oesophagitis.

Methods

SUBJECTS AND EXPERIMENTAL DESIGN

Eleven outpatients with endoscopic evidence of uncomplicated erosive oesophagitis (II-III degree according to Savary)[10] underwent oesophageal motility and acid reflux evaluations at the start of a 12 week course of ranitidine, 150 mg tid. Acid reflux was also assessed after six weeks of therapy. An endoscopic evaluation was repeated on the last day of treatment and the patients who showed healing of the oesophageal lesions (O-I degree according to Savary)[10] underwent a further assessment of oesophageal motility and acid reflux within 10 days. Of 11 patients, nine were healed at the end of the treatment but one refused the pH and motility studies. Thus, our report is based on eight patients (seven men and one woman) aged 25–65 years, who gave their informed consent before starting the study.

OESOPHAGEAL MOTILITY

We used a polyvinyl probe (Dentsleeve, Australia) consisting of eight catheters (ID 0·8 mm, OD 1·2 mm) fused together (OD 4·5 mm) with distal side holes 1 cm distal to the distal end of the sleeve and 5 and 10 cm proximal to its proximal end respectively. Each catheter was continuously perfused with distilled water (0·5 m/min) by means of a pneumohydraulic system (Beckman, mod. 999449); the pressure rise rate was always greater than 450 mmHg/sec on sudden occlusion of the side holes. The

Address for correspondence: Dr F Baldi, Servizio di Gastroenterologia, Policlinico S Orsola, via Massarenti N9, 40138 Bologna, Italy.

Received for publication 9 July 1987.

recording catheters were connected to pressure transducers (Statham P23 ID, Puerto Rico) and the deglutitions were recorded with a belt pneumograph placed around the patient's neck. These and the endoluminal pressures were recorded on a 6-channel polygraph (C6s, OTE Biomedica, Italy) running at a paper speed of 1·25 mm/sec. The subjects were studied in the morning after an overnight fast. No medication was allowed for 48 hours before the experiments. The manometric assembly was passed nasally into the stomach, the LOS was located by a continuous pull through technique and the sleeve sensor was positioned across the highest pressure zone which showed relaxation upon swallowing. The recordings continued for four hours, with the patient changing his body position at hourly intervals (supine, sitting, sitting, supine). At the end of the second hour a standardised balanced meal was given. The meal consisted of a soup with pasta 30 g, homogenised meat 70 g and ham 45 g, Parmesan cheese 5 g, mashed potatoes 170 g, whipped apple 150 g to which 35 g of a mixture of oligosaccharides (385 KCal/100 g) was added, sunflower seed oil 10 g and tap water 200 ml. The total caloric content was 850 KCal with 46% carbohydrates, 36% fats, and 18% proteins.

GASTROOESOPHAGEAL REFLUX

At the end of the manometric study the subject was extubated and a miniature combined glass electrode (Ingold 440 M, Switzerland), whose calibration was checked with two buffer solutions (pH 4 and 7) before and after each study, was introduced nasally. The electrode was positioned 5 cm above the previously determined LOS and was connected with a portable recording unit (Autronicord CM 18 pH, WG). The patient was then sent home with the advice to eat during meals only, to avoid cigarette smoking, coffee, alcoholic drinks and foods with an acidic pH and to return to our laboratory 24 hours after the start of the pH recording. A diary card was also given in order to record the timing of the meals and of bedtime.

Table *Acid gastrooesophageal reflux, expressed as mean reflux time per hour (min/h ± SD) and mean duration of reflux episodes (min ± SD), before, during, and after successful treatment of oesophagitis*

	Min/h			*Minutes*		
	Before	*During*	*After*	*Before*	*During*	*After*
Fasting	9·0±	4·5±	6·4±	5·5±	1·8±	2·2±
	10·4	5·4	12·1	11·0	1·6	2·3
Fed	12·9±	4·6±	9·1±	5·6±	2·0±	2·8±
	10·9	1·6	5·3	7·3	0·7	1·7
Nocte	4·0±	2·0±	4·7±	9·7±	1·5±	6·7±
	2·1	2·8	2·7	16·8	1·4	7·1

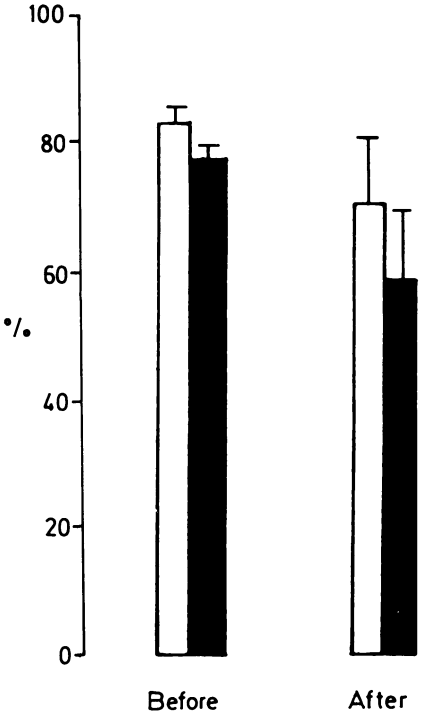

Fig. 1 *Oesophageal peristaltic activity, expressed as per cent of total motor activity (MV ± SEM), before and after healing of oesophagitis, in fasting (□) and fed (■) periods.*

ANALYSIS OF THE RECORDINGS

The manometric tracings were coded and visually evaluated at the end of the study, according to a previously reported protocol,[3] by the same observer who was unaware of the order in which the studies had been done. The LOS basal tone was calculated every minute by subtracting the corresponding fundic pressure. The measurements were not done during and immediately after relaxations of the sphincter and in correspondence with abdominal straining, as indicated by an increase of the fundic pressure. All the motor sequences occurring in the oesophageal body were counted and defined as peristaltic – that is, monophasic non-repetitive waves moving distally between the recording levels in temporal sequence, or synchronous – that is, monophasic waves occurring simultaneously. The oesophageal body motility was evaluated as the per cent frequency of peristaltic sequences of all the oesophageal body motor events.

The pH data were analysed with a computerised system (TRS 80, mod. II). Acid gastrooesophageal

reflux was considered to be present when the oesophageal pH fell below 4 for at least 20 seconds and it was evaluated by subdividing the 24 hour study period into three fractions (postcibal=three hours after each meal; night=seven to nine hours; fasting=the remainder up to 24 hours). The parameters used were the mean reflux time per hour (min) and the mean duration of reflux episodes (min).

The statistical analysis of the results was carried out by the Student's *t* test for paired data.

Results

Acid gastrooesophageal reflux decreased, not significantly, during treatment, in the fasting, fed and nocturnal periods. This was true for the duration of oesophageal acid exposure and for the mean duration of the reflux episodes (Table). One week after the cessation of ranitidine treatment both reflux parameters showed higher values than during treatment (not significant).

The frequency of oesophageal peristaltic activity (Fig. 1) was not significantly different before and after healing of the oesophageal lesions, neither in fasting nor in fed conditions (83·1±2·6% *v* 70·2±9·9% and 77·0±2·2% *v* 58·3±10·6% MV±SEM). The LOS basal pressure (Fig. 2), evaluated before the treatment, decreased after the meal, reaching the statistical significance during the first postcibal hour (12·5±1·6 *v* 3·5±0·5 mmHg (MV±SEM) $p<0·01$). The behaviour of the LOS was quite different after healing of the oesophagitis. In fact, the ingestion of the meal was not followed by a significant decrease of the sphincteric tone (12·1±2·7 *v* 10·5±1·7 mmHg, MV±SEM). The difference between the postcibal values before and after healing was statistically significant ($p<0·01$).

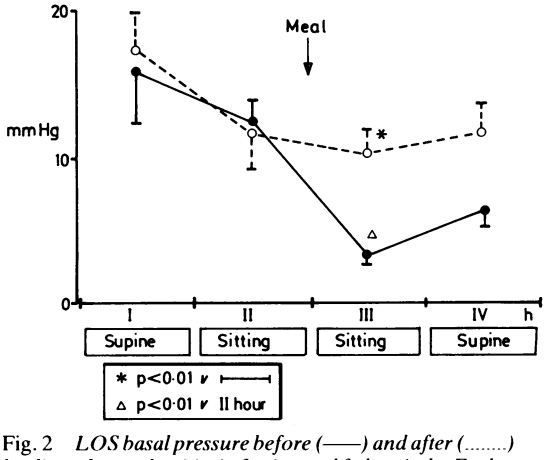

Fig. 2 *LOS basal pressure before (——) and after (.....) healing of oesophagitis, in fasting and fed periods. Each point represents the MV±SEM of values taken at one minute intervals (see Methods).*

Discussion

In our study acid gastrooesophageal reflux decreased, albeit not significantly, during ranitidine, thus explaining the favourable outcome of the treatment. This effect was not longstanding, because one week after the end of therapy acid reflux tended to return to pretreatment values. This was true for the mean reflux time and for the mean duration of the reflux episodes, thus confirming that the clearing capacity of the oesophageal body was unaffected by the treatment. In fact, the oesophageal peristaltic activity, which was slightly impaired in our patients at the start of the study according to the normal values for our laboratory (≥90% of the deglutitions followed by peristaltic sequences),[7] was also unchanged after successful ranitidine treatment. The peristaltic function was evaluated in our patients exclusively after spontaneous dry swallows, thus we did not take into account the amplitude, duration and velocity of the waves, as these parameters are rather variable in the same subject under these conditions.[11,12]

Our data show that the short term treatment with H_2 blockers does not modify the motor activity of the oesophageal body. Similar results were reported by Russell *et al*,[8] who did not find any modification of the oesophageal peristalsis (evaluated with scintigrafic methods) before and three months after successful surgical treatment of reflux oesophagitis.

As far as the LOS is concerned, previous studies[13–16] have not shown significant differences of its resting tone before and after medical treatment of oesophagitis with cimetidine at doses ranging from 1·2–1·6 g/day and for periods from eight to 104 weeks. Similar results are reported in the only study[9] which evaluated the sphincter pressure according to the outcome of the treatment. It must be noted, however, that all the aforementioned authors assessed the LOS tone in fasting conditions, for short periods and with discontinuous sampling. In our study the sphincter tone was evaluated for four hours with a continuous technique, in fasting and fed conditions. In fact, LOS pressure before and after healing was found to be significantly different only in the postcibal period, which is characterised by a physiological pressure drop.[13]

Our results regarding the LOS are in agreement with previous experimental studies in the cat[4,5] and suggest that the impairment of the sphincter tone in reflux oesophagitis is secondary to the presence of the oesophageal lesions. On the other hand, the main pathogenetic factors of the disease – for example, acid reflux and oesophageal peristalsis, are not

significantly modified by a successful 12 week medical treatment, thus suggesting that macroscopic healing of the oesophageal lesions is not accompanied by a functional improvement.

References

1 Dodds WJ, Dent J, Hogan WJ, *et al*. Mechanisms of gastroesophageal reflux in patients with reflux esophagitis. *N Engl J Med* 1982; **307:** 1547–52.
2 Corazziari E, Bontempo I, Anzini F, Torsoli A. Motor activity of the distal oesophagus and gastro-oesophageal reflux. *Gut* 1984; **25:** 7–13.
3 Baldi F, Ferrarini F, Balestra R, *et al*. Oesophageal motor events at the occurrence of acid reflux and during endogenous acid exposure in healthy subjects and in patients with oesophagitis. *Gut* 1985; **26:** 336–41.
4 Eastwood GL, Castell DO, Higgs RH. Experimental esophagitis impairs lower esophageal sphincter pressure. *Gastroenterology* 1975; **69:** 146–53.
5 Higgs RH, Castell DO, Eastwood GL. Studies on the mechanism of esophagitis-induced lower esophageal sphincter hypotension in cats. *Gastroenterology* 1976; **71:** 51–7.
6 Ahtaridis G, Snape WJ jr, Cohen S. Clinical and manometric findings in benign peptic strictures of the esophagus. *Dig Dis Sci* 1979; **24:** 858–61.
7 Baldi F, Ferrarini F, Cassan M, Balestra R, Miglioli M, Barbara L. Manometric evaluation of the oesophageal peristalsis and of the lower oesophageal sphincter in reflux oesophagitis. *Ital J Gastroenterol* 1982; **14:** 145–9.
8 Russell COH, Pope CE II, Gannan RM, Allen FD, Velasco N, Hill LD. Does surgery correct esophageal motor dysfunction in gastroesophageal reflux? *Ann Surg* 1981; **194:** 290–6.
9 Sonnenberg A, Lepsien G, Mueller-Lissner SA, Koelz HR, Siewert R, Blum AL. When is esophagitis healed? Esophageal endoscopy, histology and function before and after cimetidine treatment. *Dig Dis Sci* 1982; **27:** 297–302.
10 Savary M, Miller G. The esophagus. *Handbook and atlas of endoscopy*. Solothurn: Gassmann, 1977.
11 Dodds WJ, Hogan WJ, Ried DP, Stewart ET, Arndorfer RC. A comparison between primary esophageal peristalsis following wet and dry swallows. *J Appl Physiol* 1973; **38:** 851–4.
12 Hollis JB, Castell DO. Effect of dry swallows and wet swallows of different volumes on esophageal peristalsis. *J Appl Physiol* 1975; **38:** 1161–5.
13 Behar J, Brand DL, Brown FC, *et al*. Cimetidine in the treatment of symptomatic gastroesophageal reflux. *Gastroenterology* 1978; **74:** 441–8.
14 Wesdorp E, Bartelsman J, Pape J, Dekker W, Tytgat GN. Oral cimetidine in reflux esophagitis: a double blind controlled trial. *Gastroenterology* 1978; **74:** 821–4.
15 Fiasse R, Hanin C, Lepot A, Descamps C, Lamy F, Dive C. Controlled trial of cimetidine in reflux esophagitis. *Dig Dis Sci* 1980; **25:** 751–5.
16 Wesdorp E, Bartelsman J, Schipper M, Tytgat GN. Effect of long-term treatment with cimetidine and antacids in Barrett's oesophagus. *Gut* 1981; **22:** 724–7.