

## Further Experience with Epigastric Pain Reproduction Test in Duodenal Ulceration

RICHARD J. EARLAM

### Summary

Further evidence is presented that the epigastric pain of duodenal ulceration, situated between the rib margins and just below the xiphisternum, arises from the lower oesophagus.

One-hundred patients with duodenal ulceration were divided into those with epigastric pain (61) and those with pain in the upper abdomen but not in the epigastrium (39). Perfusion of 0.1 N HCl into the lower oesophagus reproduced epigastric pain in 53 of the 61 with epigastric pain (mean 37 ml) but in none of the 39 without (mean 125 ml). All those who had been woken by epigastric pain at night in the previous four weeks had a positive test.

---

The London Hospital, London E.1

RICHARD J. EARLAM, M.CHIR., F.R.C.S., Consultant Surgeon

---

In five the test remained positive even though the acid was neutralized by a continuous perfusion of alkali just below the gastro-oesophageal junction. In another five 200 ml 0.1 N HCl instilled into the stomach for 21 minutes did not reproduce epigastric pain, even though 30 ml perfused for three minutes into the lower oesophagus did.

### Introduction

If weak hydrochloric acid is perfused into the lower oesophagus of patients with duodenal ulceration under accurate manometric control epigastric pain, indistinguishable from that normally suffered, can be reproduced (Earlam, 1970). When a patient had duodenal ulcer pain in sites other than the epigastrium the test was always negative. But not all those with epigastric pain had a positive test in the original study so further experiments have been evolved to establish whether epigastric pain really did arise from the lower oesophagus and why there was possibly an individual variation. The oesophageal origin of this type of pain would be likely if large amounts of intra-

gastric acid did not cause epigastric pain and if the perfused oesophageal acid were neutralized before it could take effect on the stomach. It would also fit the previously-known fact that the oesophagus is susceptible to acid (Bernstein and Baker, 1958). This study was therefore designed to establish the reliability of the test by taking more careful note than in the previous study of when the last attack of pain occurred. It also presents further evidence to suggest that the origin of epigastric pain can be localized to the lower oesophagus.

### Patients and Methods

One-hundred patients with a duodenal ulcer shown radiologically were divided into two groups on the basis of whether they had epigastric pain or not. Localization of abdominal pain was recorded on a small diagram by a doctor after the patient had pointed to the site in question with one finger on his bare skin. The definition of epigastric pain for the purpose of this study was accepted as pain between the rib margins and just below the xiphisternum in the midline. Patients who had never suffered such pain but had pain, burning, or "indigestion" in other parts of the upper abdomen were designated as the non-epigastric pain group. Altogether 61 had epigastric pain and 39 had non-epigastric pain.

All the patients were asked when they had last been woken by this pain at night. This is a normal feature of severe duodenal ulcer pain and affected both groups similarly, although the aetiological mechanism is unknown. Awakening at night must depend on the depth of sleep, gastric acid and pepsin basal secretion, and other factors but was accepted for this study as a more objective criterion of when the pain was last severe than an assessment of pain during the day, which might be related to dietary indiscretions.

Pressure measurements of the gastro-oesophageal junction were made with techniques previously described (Fyke *et al.*, 1956). The recording units were passed through the mouth into the stomach and then withdrawn slowly at 0.5-cm intervals to obtain the pressure profile of the gastro-oesophageal junction in its resting state. Pressures were recorded with three water-filled, non-perfused polyethylene tubes (external diameter 1.65 mm; internal diameter 1.12 mm). The distal tube was covered with a 0.5 cm balloon and the two remaining tubes had lateral openings 5 and 10 cm from the balloon.

*Lower Oesophageal Acid.*—After two resting studies the balloon was accurately positioned at the sphincter by noting where relaxation and contraction occurred. Solutions were perfused through the proximal open tip 10 cm above the balloon at a constant rate of 8-10 ml/min. If the patient had no pain immediately before the test either 0.9% NaCl or 0.1 N HCl, chosen at random without the patient knowing which, was perfused until either pain was produced or 100 ml or more had passed through the tube. Then 2.74% NaHCO<sub>3</sub> was perfused until the pain disappeared. If the patient already had pain NaHCO<sub>3</sub> was used first until relief was obtained.

*Lower Oesophageal Acid and Simultaneous Intra-gastric Alkali.*—In a group of five patients simultaneous perfusion of 0.1 N HCl above and 2.74% NaHCO<sub>3</sub> below the gastro-oesophageal junction was performed to eliminate any effect the acid might have on the stomach. A modified recording unit was used with three open tips and no balloon. The middle opening was positioned in the sphincter and acid was perfused through the proximal open tip 5 cm above and alkali through the distal open tip 5 cm below the sphincter. The perfusion rates of both solutions were similar at 8-10 ml/min.

*Lower Oesophageal Acid and Consecutive Intra-gastric Acid.*—A further five patients had 200 ml 0.1 N HCl instilled into the stomach for 15 to 30 minutes (after a positive epigastric pain reproduction test) in an attempt to discover whether any pain would arise from the stomach itself with a larger amount of weak acid than that put into the lower oesophagus.

## Results

### LOWER OESOPHAGEAL ACID

#### *Epigastric Pain Group*

Of the 100 patients with duodenal ulceration 61 suffered from epigastric pain. Of these 53 had a positive epigastric pain reproduction test and 8 did not have epigastric pain after perfusion of more than 100 ml 0.1 N HCl (mean 128 ml).

The patients with this type of pain were subdivided further according to when they were last awoken at night by duodenal ulcer pain. Of the 53 with a positive test 45 had been awoken at night by epigastric pain within four weeks before the test. Five who had never been awoken at night and the remaining three who had been pain-free for three months also had a positive test. Eight of the 61 had a negative test in spite of a history of epigastric pain. Three of these had mild symptoms and had never been awoken at night and five had not been awoken by this pain within the last three months. All patients who had been awoken by epigastric pain at night in the four weeks before the test had a positive epigastric pain reproduction test.

The mean amount of 0.1 N HCl needed to produce pain was 37 ml and relief was obtained with 22 ml 2.7% NaHCO<sub>3</sub>. The amount of acid causing pain was usually well below 100 ml, but in three of the 53 positive tests more was needed (112 ml, 117 ml, and 125 ml). There was no correlation between the amount of acid needed to cause pain and the quantity of alkali needed to relieve it ( $r = 0.1277$ ). If a patient was awoken by pain during the night before the test the amount of acid needed to reproduce pain ( $22 \text{ ml} \pm 21$ ) was less than if the pain had occurred two to seven nights before ( $50 \text{ ml} \pm 43$ ,  $P = 0.02$ ). But otherwise there was no relation between the amount of acid which caused pain and when the pain last awoke the patient at night.

#### *Non-epigastric Pain Group*

None of the 39 patients without epigastric pain had a positive test (mean 125 ml 0.1 N HCl). Altogether 27 had experienced non-epigastric duodenal ulcer pain within the last four weeks, of whom 5 had been awoken the previous night, 12 during the week before the test, and 10 in the last month. Five had never been awoken by pain and five had been pain-free for more than a month. The test was not declared negative unless more than 100 ml had been perfused.

### LOWER OESOPHAGEAL ACID AND SIMULTANEOUS INTRAGASTRIC ALKALI

The epigastric pain in this group of five patients was reproduced by 22 ml of acid and relieved by 18 ml of NaHCO<sub>3</sub>. All had had pain at night in the previous week. The perfusion of NaHCO<sub>3</sub> through the distal open tip below the sphincter at 10 ml/min neutralized the acid in the stomach but did not prevent acid in the lower oesophagus producing pain.

### LOWER OESOPHAGEAL ACID AND CONSECUTIVE INTRAGASTRIC ACID

Five patients who had had epigastric pain during the two nights before the test had a positive pain reproduction test within three minutes of 0.1 N HCl perfusion (mean 30 ml). Instillation of 200 ml 0.1 N HCl into the stomach immediately afterwards did not cause any pain in 15 to 30 (mean 21) minutes, suggesting that although the lower oesophageal mucosa is sensitive to acid the gastric mucosa is not.

### Discussion

The first description of the epigastric pain reproduction test showed that this pain could be reproduced by weak acid in the lower oesophagus but not in every patient with a duodenal ulcer (Earlam, 1970). This study was undertaken to analyse the quantitative aspects of the test and to investigate further those in whom it was negative. It has now been shown that all patients with duodenal ulceration awoken by epigastric pain in the four weeks before the test had a positive reaction (mean 37 ml) and that the test must not be considered negative until at least 125 ml 0.1 N HCl has been perfused into the lower oesophagus. The classification of epigastric pain according to when it last occurred at night is admittedly a crude method of assessing when severe pain last occurred, but it is taken as the best objective measurement of this autonomic pain available at the moment. It is not necessary for a patient to be awoken at night before having a positive pain reproduction test, so the use of night pain as the sole indication of the severity of duodenal ulcer pain is obviously limited.

The reliability of the test, when epigastric pain had been present recently, together with the further experiments to neutralize acid in the stomach and show that the gastric mucosa is insensitive to acid are considered further evidence to suggest that the epigastric pain of duodenal ulceration arises from the lower oesophagus. When night pain is used as an indication of when the pain was last severe there is no really clear correlation

between pain and the amount of acid needed to reproduce it. This discrepancy could be caused by inherently different sensitivities of the lower oesophagus to this stimulus. There is, however, some evidence to suggest that patients with a duodenal ulcer but without epigastric pain have a more competent gastro-oesophageal junction than those with such pain and since it would be more capable of protecting the lower oesophageal mucosa from the effects of gastric reflux (Earlam, 1971).

For a long time it has been known that the severity of duodenal ulcer symptoms does not necessarily depend on the radiological appearances of the duodenum. If the epigastric pain of duodenal ulceration arises from the lower oesophagus and not the ulcer itself some of the incongruities of these symptoms would disappear and patients could be assessed more accurately for medical or surgical treatment.

I would like to thank the physicians and surgeons in charge of these patients at The London Hospital and Mile End Hospital for permission to perform these studies and the patients themselves for their co-operation.

### References

- Bernstein, L. M., and Baker, L. A. (1958). *Gastroenterology*, **34**, 760.  
Earlam, R. J. (1970). *British Medical Journal*, **4**, 714.  
Earlam, R. J. (1971). *British Journal of Surgery*, **58**, 296.  
Fyke, F. E., jun., Code, C. F., and Schlegel, J. F. (1956). *Gastroenterologia (Basel)*, **86**, 135.