Refractory duodenal ulcer

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SUMMARY A refractory duodenal ulcer was arbitrarily defined as one that had failed to heal completely after treatment with cimetidine 1 g daily for three months. Of 66 patients with refractory duodenal ulcer, healing eventually occurred in 37 patients, after treatment for an average of 7·4 months. But 28 patients did not heal despite treatment for an average of 9·4 months; and one patient defaulted. In 41 patients the daily dose of cimetidine was increased to 2 g; the ulcers in 31 patients healed. In eight patients the daily dose was increased to 3 g and healing occurred in four patients. Eighteen patients required admission on 22 occasions because of severe symptoms despite treatment. Nine patients underwent surgery but in five the results were poor. Differences in clinical and endoscopic features between refractory and non-refractory ulcer patients were small. Acid and pepsin secretion were similar and gastrin concentrations normal. Blood levels of the drug and suppression of acid secretion were both satisfactory. Identification of refractory ulcer patients at the start of treatment was therefore not possible. Refractoriness could occur at any time during the course of the disease, previous treatment with cimetidine often having resulted in rapid healing, but subsequent relapses were also usually refractory. The cause of refractoriness remains unknown and the rather poor results of surgery in this series suggests that optimal management of these patients remains to be determined. Refractoriness probably indicates a changed natural history of the disease and in some patients a more poor prognosis.

Most duodenal ulcers heal within a month of treatment with cimetidine. Of the remainder the majority heal in another one to two months of continued treatment. Some ulcers do not heal even after a longer period of cimetidine therapy and can be considered as being 'refractory' or resistant to standard treatment. This paper presents observations on the characteristics and the course of the first 66 such patients, encountered between 1977 and 1980.

A refractory duodenal ulcer is arbitrarily defined as one that has failed to heal fully within three months of treatment with cimetidine 1 g daily, taken as 200 mg tablets three times daily and 400 mg at bedtime. This definition derives from personal experience of 495 episodes of duodenal ulceration treated between 1978 and 1980 with cimetidine 1 g daily. The cumulative healing rate was as follows: at one month, 78%; at two months, 83%; and at three months, 93%. Healing was defined as complete disappearance of all ulcers and erosions and replacement either by a scar(s) or by mucosa, even if the mucosa still appeared inflamed.

Methods

Patients with duodenal ulcer(s) or with erosion(s) or with both, proven by endoscopy, were treated with cimetidine 1 g daily. Endoscopy was repeated after one to two months to check for healing. If ulcer(s) or erosion(s) were still present, the treatment was continued and healing was reassessed by endoscopy at three months. If healing was incomplete at about six to nine months, cimetidine was doubled to 2 g, even if the patient was asymptomatic, although in some patients the increase in dose was made earlier if symptoms continued or recurred. Cimetidine was increased to 3 g in the few patients in whom the combination of the 2 g dose, high dose antacid (up to 300 ml, equivalent to about 1000 mmol, daily) and rest, usually in hospital, failed to relieve severe symptoms.

In 45 patients with refractory ulcers, basal and maximal gastric secretion were each collected for one hour, the latter after stimulation with intramuscular pentagastrin 6 μg/kg (Peptavlon®;
Imperial Chemical Industries, Alderley Park, Macclesfield, UK). Acid was measured by electro-
metric titration to pH 7, and pepsin assayed by a modified haemoglobin substrate colorimetric
method. In order to assess the effect of cimetidine on acid and pepsin secretion, 30 of these 45 patients
had a further gastric secretion study after taking cimetidine. They took their tablets (200 mg, 400 mg,
or 600 mg if their daily dose was 1 g, 2 g, or 3 g respectively) one hour before starting basal
collection. For comparison, similar studies were also performed in seven patients with non-refractory
ulcer.

Blood cimetidine concentrations were measured in 37 patients. A single sample was drawn one hour
after taking the tablets and the serum was frozen at −20°C. Cimetidine concentrations were later
measured by high pressure liquid chromatography on Lichosorb SI-60 support using an acetonile-
water-ammonia solvent (Wickham Laboratories, Wickham, Hampshire, UK). Serum gastrin concentrations of refractory ulcer patients were measured by radioimmunoassay (Supra-
regional Assay Service at the Hammersmith Hospital, London) in fasting blood samples; the
patients were on cimetidine at the time the blood was taken. The antibody used measures both G17
and G34 gastrins.

Statistical Methods
Differences in characteristics between refractory and non-refractory ulcer patients was assessed by
Student’s t test and χ² test as appropriate. The degree of acid and pepsin inhibition produced by
cimetidine was assessed by a one-tailed Student’s t test, and analysis of variance was used when
comparing the inhibition in the refractory ulcer patients as a whole with the non-refractory ulcer
patients.

Ethical Considerations
This study is part of a wider programme on ulcer treatment and follow up, which was approved by the
Rotherham Ethical Committee. Informed consent was obtained from all patients.

Results

Healing

Thirty seven of 66 refractory duodenal ulcers eventually did heal, after a mean treatment period
of 7-4 months (range four to 14 months) but 28 did not heal, despite an average treatment period of 9-4
months (range four to 20 months), one patient being lost to follow up.

Of the 37 patients whose ulcers were judged to have healed, in the majority this was confirmed by
endoscopy. In eight patients, the assessment was made at operation. The latter patients had active
lesions (proven by endoscopy) a few weeks earlier, but as at laparotomy the duodenum was not opened
in every instance, healing may have been over-
estimated.

Dose of Cimetidine and Healing

The relation between the dose of cimetidine and healing is shown in Figure 1. Only eight patients
healed on the standard (1 g) dose of cimetidine; but 29 of 41 patients given higher doses (2 g and 3 g)
did eventually heal.

Surgery

Despite being on cimetidine 18 of the refractory duodenal ulcer patients had to be admitted on 22
occasions to control severe pain which either persisted after starting treatment or developed after
initial improvement or after a pain free interval. On the first admission, six patients came to surgery as
their pain could not be controlled. The remaining 12 patients improved and were discharged; but four of
these patients had to be readmitted as their symptoms worsened, often within a few weeks. On the
second admission, three of the four patients had surgery. The indication for surgery in all nine
patients (seven men, two women) was intractable pain despite treatment.

At laparotomy only one patient was found to have

![Fig. 1 Dose of cimetidine and healing. * These nine patients had healed on cimetidine 1 g daily but their ulcers recurred despite continued treatment. Therefore no further treatment at this dose was given but instead it was increased to 2 g. ** In two, three, and three patients on the 1 g, 2 g, and 3 g dose respectively, healing was judged by appearances at laparotomy. *** Includes the single patient found to have an active ulcer at operation. Among patients unhealed at the end of the study, 17 were on cimetidine 1 g, seven on 2 g, and four on 3 g.]
Refractory duodenal ulcer

an active ulcer. Seven patients had a vagotomy and drainage and the other two patients had highly selective (proximal gastric) vagotomy. Five of the nine patients operated, however, have had bad results after surgery (follow up one to three years). In three the ulcer has recurred, and two continue to have disabling pain, heartburn, vomiting, and diarrhoea, although their ulcers remain healed. Of the three patients with ulcer recurrence, two have responded to further treatment with cimetidine.

OUTCOME OF PREVIOUS TREATMENT WITH CIMETIDINE

Refractoriness developed unpredictably and seemed unconnected with the number of previous short courses of cimetidine treatment. Eighteen patients had a refractory ulcer on their first exposure to the drug. The others had had between one and six courses of cimetidine for healing earlier but only occasional episodes of ulceration were refractory. Thus 20 patients had one previous course of cimetidine and in five of these patients the ulcer took longer than three months to heal. In contrast five patients had three courses of cimetidine and another five patients had four courses of cimetidine and in each instance healing was rapid. Relapses after a refractory episode occasionally healed quickly but in general once refractoriness developed, subsequent attacks were also refractory.

Table 1 Differences between patients with refractory and non-refractory duodenal ulcer: history

<table>
<thead>
<tr>
<th></th>
<th>Refractory</th>
<th>Non-refractory</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Age: mean (years) ± SE ≤40 years</td>
<td>40-4±1-6</td>
<td>45-7±1-2</td>
<td>p&lt;0-05</td>
</tr>
<tr>
<td>2 Sex: men</td>
<td>52%</td>
<td>30%</td>
<td>NS</td>
</tr>
<tr>
<td>3 Smokers</td>
<td>73%</td>
<td>84%</td>
<td>NS</td>
</tr>
<tr>
<td>4 Duration symptoms</td>
<td>12-0±1-2</td>
<td>9-6±0-8</td>
<td>p&lt;0-01</td>
</tr>
<tr>
<td>(a) Mean (years) ± SE ≤5 years</td>
<td>25%</td>
<td>52%</td>
<td></td>
</tr>
<tr>
<td>(c) 6-20 years</td>
<td>60%</td>
<td>34%</td>
<td>NS</td>
</tr>
<tr>
<td>5 Pattern of symptoms</td>
<td>21%</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>(b) Unchanged</td>
<td>32%</td>
<td>24%</td>
<td></td>
</tr>
<tr>
<td>(c) Steady increase of symptoms</td>
<td>34%</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>(d) Steady increase followed by an abrupt increase of symptoms</td>
<td>13%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td>Mean time since sudden worsening of symptoms (years)</td>
<td>3-3</td>
<td>3-2</td>
<td>NS</td>
</tr>
<tr>
<td>6 Complications</td>
<td>15%</td>
<td>4%</td>
<td>p&lt;0-01</td>
</tr>
<tr>
<td>(a) Haemorrhage</td>
<td>3%</td>
<td>0%</td>
<td>NS</td>
</tr>
<tr>
<td>(b) Perforation</td>
<td>60%</td>
<td>41%</td>
<td>p&lt;0-01</td>
</tr>
<tr>
<td>7 Family history of ulcer</td>
<td>79%</td>
<td>39%</td>
<td>p&lt;0-001*</td>
</tr>
<tr>
<td>8 Had used cimetidine earlier</td>
<td>42%</td>
<td>61%</td>
<td></td>
</tr>
<tr>
<td>(b) Placebo (part of trial)</td>
<td>6%</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>(c) Cimetidine 400 mg nightly (low dose maintenance treatment)</td>
<td>38%</td>
<td>22%</td>
<td></td>
</tr>
<tr>
<td>(d) Cimetidine 1 g daily (full dose maintenance treatment)</td>
<td>14%</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>

* Statistical analysis was done by comparing combined numbers of patients on cimetidine and combined numbers of patients not on active treatment. A significantly higher (p<0-001) proportion of patients already on cimetidine were in the refractory duodenal ulcer group.
Table 2  Differences between patients with refractory and non-refractory duodenal ulcer: investigations

<table>
<thead>
<tr>
<th></th>
<th>Refractory</th>
<th>Non-refractory</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Endoscopy*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Ulcer medium or large</td>
<td>80%</td>
<td>63%</td>
<td>p&lt;0.005</td>
</tr>
<tr>
<td>(b) ≥2 ulcers</td>
<td>17%</td>
<td>19%</td>
<td>NS</td>
</tr>
<tr>
<td>(c) Erosions present</td>
<td>36%</td>
<td>34%</td>
<td>NS</td>
</tr>
<tr>
<td>(d) Duodenitis moderate or severe</td>
<td>64%</td>
<td>41%</td>
<td>p&lt;0.001</td>
</tr>
<tr>
<td>(e) Deformity moderate or severe</td>
<td>37%</td>
<td>41%</td>
<td>NS</td>
</tr>
<tr>
<td>2 Gastric secretion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Basal acid output: mean (mmol) ± SE</td>
<td>4.8±0.6</td>
<td>5.6±0.4</td>
<td>NS</td>
</tr>
<tr>
<td>(b) Maximal acid output: mean (mmol) ± SE</td>
<td>10%</td>
<td>13%</td>
<td>NS</td>
</tr>
<tr>
<td>(c) Basal pepsin output: mean (mg) ± SE</td>
<td>35±3</td>
<td>44±2</td>
<td>NS</td>
</tr>
<tr>
<td>(d) Maximal pepsin output: mean (mg) ± SE</td>
<td>108±8</td>
<td>123±4</td>
<td>NS</td>
</tr>
<tr>
<td>3 Fasting gastrin: mean (pmol/l) (normal up to 50)</td>
<td>10%</td>
<td>4%</td>
<td>not measured</td>
</tr>
</tbody>
</table>

* Findings at endoscopy before starting cimetidine. Ulcer size was judged arbitrarily, and most ulcers were round or oval. Duodenitis was assessed by appearances, not by histology: it takes into account extent and severity of oedema and inflammation. Deformity of duodenal cap was assessed by number and depth of pseudo diverticulae, distortion, and by extent of shortening along its long axis.

90 pmol/l) in seven patients, all of whom were on high dose cimetidine at the time the blood samples were taken. Measurements could be repeated in only two patients and in both the concentrations had returned to normal. Gastrin concentrations were not measured in non-refractory ulcer patients as there was no clinical indication.

EFFECT OF CIMETIDINE ON PAIN
At the time of the latest ulcer recurrence two-thirds of the 66 patients with a refractory ulcer had moderate or severe symptoms. The remainder had little or no symptoms: these patients were either already on cimetidine or on placebo (in a separate study) and their ulcer recurrence was detected at periodic routine check endoscopy. Unlike the patients with non-refractory duodenal ulcer where pain reduction on cimetidine was swift and sustained, in the refractory ulcer patients the course was often variable and unpredictable, and the relationship between the symptomatic response and ulcer healing erratic.

EFFECT OF CIMETIDINE ON THE LESIONS
A total of 255 endoscopies was performed during 274 patient months. At the start of treatment, two-thirds of the patients had duodenal ulcers, a quarter both ulcers and erosions, and the remaining one-tenth had erosions only. During treatment the proportions were reversed: patients with only ulcers decreased to about a quarter whereas those with erosions, with or without ulcer(s), increased to three-quarters.

CIMETIDINE: BLOOD CONCENTRATIONS
Blood concentrations of cimetidine at one hour after taking the drug were measured in 31 patients with refractory ulcer. The therapeutic range is 0.5 to 1.5 μg/ml, at which levels acid secretion is inhibited to the degree required for ulcer healing. Only three patients, including one patient with a non-refractory ulcer, had blood concentrations below 0.5 μg/ml, although it is possible that the peak could have been missed. Eleven patients, including the remaining five with non-refractory ulcer, had blood concentrations within the therapeutic range. The other 23 patients with a refractory ulcer had blood cimetidine concentrations above this range.

EFFECT OF CIMETIDINE ON ACID AND PEPsin secretion
The degree of acid reduction varied markedly between individuals (Fig. 2) but the mean reduction of acid secretion was as great in the resistant as in the responsive patients; and several patients who had failed to heal showed marked reduction in acid secretion. The degree of inhibition of acid secretion did not appear to be dose related, and the inhibition in the non-refractory ulcer group was not different from that in the refractory ulcer groups (Table 3). In contrast with the marked effect on acid output, cimetidine produced less consistent and relatively little change in pepsin secretion.

Discussion
Duodenal ulcers that fail to heal quickly on
Refractory duodenal ulcer

Fig. 2 Maximal acid secretion before (circles) and during (triangles) cimetidine treatment.

cimetidine are increasingly recognised to be a problem but until recent years have been little studied.\textsuperscript{1-3} There is no uniform definition of such 'cimetidine resistance' and the only common feature has been that the 'resistant' patients had delayed or absent healing on cimetidine.

The cause of refractoriness is unknown, except in the Zollinger-Ellison syndrome,\textsuperscript{10,11} which was excluded in the present study. Factors that might retard the rate of healing have been extensively studied.\textsuperscript{1} These include the effects of: age, sex,\textsuperscript{12-14} smoking, drinking, manual occupation,\textsuperscript{6} army service,\textsuperscript{5,8} the size and shape of the ulcers,\textsuperscript{15,16} duodenal stenosis,\textsuperscript{17} and the pretreatment levels of acid secretion. The results, however, are conflicting or inapplicable to the patients in the current study.

Other possible causes for refractoriness are failure to take the drug, inadequate absorption, and failure to suppress acid secretion. Although non-compliance was not studied in detail, failure of normal drug absorption was excluded and others have shown that the blood cimetidine concentrations observed are therapeutically effective.\textsuperscript{18-24} The observations made by other investigators that suppression of acid secretion by cimetidine is similar in those with refractory and with non-refractory ulcers was confirmed,\textsuperscript{25} although another group noted that the suppressibility of nocturnal acid secretion was decreased in patients with delayed healing and that doubling the dose of cimetidine had no further effect.\textsuperscript{26}

The correct method of management of patients with refractory duodenal ulcer is uncertain. There are three approaches: measures to increase acid inhibition, or to increase mucosal defence, and surgery. Increased acid inhibition can be effective as ranitidine, which is more potent than cimetidine, heals ulcers when the latter in standard doses has failed,\textsuperscript{5,8,9,27} but healing does not occur in all patients.\textsuperscript{28} There is little information available on the effects of promoting mucosal defence with drugs such as carbenoxolone or prostaglandins but sucralfate, which forms an 'ulcer seal', has been claimed to heal duodenal ulcers resistant to cimetidine.\textsuperscript{29}

Surgery has been found effective when cimetidine has failed\textsuperscript{4,7} but not in the current study where half the patients have had unsatisfactory results, which is twice that expected.\textsuperscript{30} One possible explanation for the poor results is that patients in the current study were 'more refractory' than those reported by others in that their ulcers had not healed on high dose cimetidine whereas other investigators had used only standard doses. A second possibility is that an 'inadequate' operation was chosen and that vagotomy with antrectomy would have been more logical. The latter operation was indeed planned but in the surprising absence of evidence at laparotomy.

Table 3 Effect of cimetidine on acid secretion

<table>
<thead>
<tr>
<th>Patient group</th>
<th>Basal Before treatment</th>
<th>Basal During treatment</th>
<th>Significance</th>
<th>Maximal Before treatment</th>
<th>Maximal During treatment</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refractory DU On cimetidine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 g (n=6)</td>
<td>6.1±2.1</td>
<td>2.1±0.9</td>
<td>NS</td>
<td>32.7±3.3</td>
<td>15.1±3.3</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>2 g (n=15)</td>
<td>6.6±1.8</td>
<td>2.0±1.1</td>
<td>p&lt;0.005</td>
<td>31.0±2.0</td>
<td>21.0±2.2</td>
<td>p&lt;0.005</td>
</tr>
<tr>
<td>3 g (n=9)</td>
<td>6.6±1.6</td>
<td>5.2±2.4</td>
<td>NS</td>
<td>33.7±4.5</td>
<td>24.5±4.7</td>
<td>p&lt;0.05</td>
</tr>
<tr>
<td>Non-refractory DU On cimetidine</td>
<td>4.4±1.1</td>
<td>0.2±0.1</td>
<td>p&lt;0.005</td>
<td>25.3±2.1</td>
<td>14.4±4.2</td>
<td>p&lt;0.005</td>
</tr>
</tbody>
</table>

Patients who had secretion studies both before and during cimetidine treatment.

Acid secretion. mmol/h: mean ± SEM.
of aggressive ulceration, such as penetration and dense adhesions, this seemed a drastic step; but in retrospect it may have been a better choice.

The present study suggests that the development of refractoriness may mark a change in the natural history of duodenal ulcer disease, and in some patients indicates the onset of an increased virulence of the disorder and a worsening of the prognosis. But none of the findings in this study or in those by other investigators adequately explain why some duodenal ulcers are refractory, particularly those of patients who had previously had ulcers which responded to cimetidine in standard dosage. This emphasises our continuing lack of knowledge of factors other than acid secretion which initiate and maintain ulceration of the duodenal mucosa.

I am indebted to Dr C D Holdsworth and Dr K G Wormsley for their helpful advice; to my colleagues in Rotherham for their support, and to Mr John Beresford, Miss Caroline Franks, and Dr D Rowley-Jones (of Smith, Kline & French) for statistical analysis and blood cimetidine assays.

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