Epidemiological study of peptic ulcer in the south of India

Observations from Madras on the changing incidence of peptic ulcer, with special reference to causation

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EDITORIAL COMMENT The evidence from this study suggests that peptic ulcer in India is no different essentially from peptic ulcer seen in western countries. This is a valuable epidemiological study with interesting speculation on aetiology. The study of regional differences may contribute towards the final solution of the ulcer problem.

Big differences in the prevalence of peptic ulcer are known to exist in different parts of India (Somervell and Orr, 1936; Dogra, 1940; Hadley, 1959; and Malhotra, 1964). It is also believed that peptic ulcer is different from the disease in the west in being less acute and less likely to bleed or perforate (Somervell and Orr, 1936; Raghavachari, 1959; and Gregg, 1959). Although the geographical variations in ulcer frequency noted by previous workers are mirrored in more recent studies (Konstam, 1959; Hadley, 1959; Malhotra, 1964, 1965; Malhotra, Majumdar, and Bardoloi, 1964), it is less certain whether the disease is different from the disease in the west, and our previous study of peptic ulcer in Assam (northeast part of India) has formed the basis for the conclusion that peptic ulcer in India is no different from peptic ulcer seen in the west (Malhotra et al., 1964). The study reported in this paper was undertaken to determine the incidence and behaviour of ulcer, as it now occurs in the south of India.

MATERIAL AND METHODS

The study is confined to 30,942 railway workers, all south Indians, between the ages of 18 and 55 years, and their families who live and work in the city of Madras. This number is derived by totalling the number of railway employees on the pay-rolls for the period 1 January 1961 to 31 December 1964, and dividing this by 4. The hospital services for this population are provided almost exclusively by the Perambur Railway Hospital at Madras and its associated units. The services provided are comprehensive, free of charge, and include all the specialities.

ASCERTAINMENT OF CASES The following methods of case findings were used:

1. All case records of peptic ulcer patients admitted to the hospital during the period from 1 January 1961 to 31 December 1964 were collected by a systematic search of the case records, which were then individually studied, and the relevant clinical data were gathered for each case on a separate record card modified from I.C.M.R. (1959). Patients treated as out-patients have not been included because of the serious disadvantages of the out-patients' records occasionally being less precise and complete and of varying competence. Data on perforation were especially studied, as perforation of an ulcer is usually a particularly painful and serious disease and expedites hospital admission in all in whom it develops. The incidence of perforation, therefore, would give an indication of the incidence of ulcer.

<table>
<thead>
<tr>
<th>Employees Served</th>
<th>Total In-patient Admissions for All Diseases</th>
<th>No. of Peptic Ulcer Cases</th>
<th>Percentage of Total Admissions</th>
<th>Four-year Incidence Rates (% of population)</th>
<th>Annual Incidence Rates of Active Ulcer (% of population)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30,942</td>
<td>29,694</td>
<td>469</td>
<td>1.6</td>
<td>1.5</td>
<td>0.4</td>
</tr>
</tbody>
</table>

180
Epidemiological study of peptic ulcer in the south of India

2 Railway employees have to obtain a medical certificate in the case of absence due to illness. Those certificates bearing a diagnosis of ulcer provided an additional source of information to check the clinical data.

To get a more realistic picture of the incidence of ulcer, a survey of a random sample of railway staff was undertaken at the head office of the railway and at the integral coach factory, in which 520 railway employees from the head office of the railway and 840 railway employees from the furnishing shops of the integral coach factory were interviewed directly, using a prepared proforma (I.C.M.R., 1959).

DIAGNOSTIC CRITERIA The diagnostic criteria are the same as used in previous reports (Malhotra, 1964; Malhotra et al., 1964), and consist of clinical signs and symptoms corroborated by radiological findings: an ulcer crater or a persistent and characteristic deformity of the duodenal cap with localized tenderness; or surgical demonstration of ulcer, scar, or perforation; or the presence of acute complications such as haemorrhage or perforation. In the case of the survey, the criteria used for inclusion in the list were epigastric pain lasting for a quarter of an hour or more at a time, occurring in bouts of at least a week with periods of freedom of more than two weeks, related to meals and relieved by food, alkali, or vomiting; or if there was a history of ever having been found radiologically positive at hospital; or of confirmation of ulcer at operation; or haematemesis; or perforation; but the final diagnosis had to be a matter of clinical judgment.

RESULTS IN ACCEPTED CASES

HOSPITAL RECORDS Four hundred and sixty-nine cases were admitted to the list of causes conforming to the diagnostic criteria, of which 204 were treated surgically, and this also confirmed the diagnosis in the latter. The admissions for ulcer expressed as a percentage of all admissions were 1-6%, which is consistent with the experience of Hadley (1959) from Vellore, but is considerably less than our experience from Assam (Malhotra et al., 1964). The number of admissions expressed as a percentage of population works out as 1-5 for the four-year period. In other words 0-4% of the population per year suffer from sufficiently acute symptoms so as to compel them to seek hospital admission. This is an underestimate of ulcer frequency, as nearly one half of the patients with active disease do not seek admission to the hospital. If this contention is correct, our figures are consistent with the survey data of Gault (1959) who found that nearly 1% of the general population suffers from active ulcer.

In a study using the retrospective approach several criticisms about the validity of data arises.

1 These studies almost invariably result in underestimates because of the difficulty of retrieving case records as one searches further back in time. Even though in this study we are concerned with a short and recent period of four years, this possibility must be considered. As one means of testing the possibility of loss of case records, we have followed the method of Evans and Acheson (1965) and have analysed the secular trends of prevalence which showed that the incidence rates have been more or less identical over the period. In fact, in 1963 there were more cases than in 1964 which makes any failure to retrieve older records unlikely. As a second and perhaps more convincing test, we collected from an independent source, namely, the operation registers of the hospital, all cases of peptic ulcer treated surgically. This showed that only two names had been missed from our list, one in 1962 and the other in 1964. It will not be unreasonable to assume, therefore, that ascertainment was fairly accurate as otherwise it would have shown its effect on the surgically treated cases also.

2 A number of patients may not have sought admission if the symptoms were mild; or the patient may have been treated in the Out-patient Department and, therefore, not been included in our list. These limitations would almost always result in underestimates of frequency and in the present mode of inquiry such errors are inevitable and have, to some extent, been overcome by carrying out a survey of the railway population.

| TABLE II |

<table>
<thead>
<tr>
<th>Age (yr.)</th>
<th>Male</th>
<th></th>
<th></th>
<th>Female</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gastric</td>
<td>Duodenal</td>
<td>Total</td>
<td>Gastric</td>
<td>Duodenal</td>
<td>Total</td>
</tr>
<tr>
<td>Below 20</td>
<td>0 (0%)</td>
<td>4 (0-9%)</td>
<td>4 (0-8%)</td>
<td>0 (0%)</td>
<td>3 (2-1%)</td>
<td>3 (0-6%)</td>
</tr>
<tr>
<td>21-30</td>
<td>1 (0-2%)</td>
<td>129 (28-3%)</td>
<td>130 (27-7%)</td>
<td>3 (23-1%)</td>
<td>5 (38-4%)</td>
<td>8 (1-7%)</td>
</tr>
<tr>
<td>31-40</td>
<td>12 (2-6%)</td>
<td>195 (42-8%)</td>
<td>207 (44-1%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>41-50</td>
<td>2 (0-4%)</td>
<td>96 (21-0%)</td>
<td>98 (20-9%)</td>
<td>2 (15-4%)</td>
<td>0 (0%)</td>
<td>2 (0-4%)</td>
</tr>
<tr>
<td>above 51</td>
<td>2 (0-4%)</td>
<td>15 (3-3%)</td>
<td>17 (3-8%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Total</td>
<td>17 (3-7%)</td>
<td>439 (96-3%)</td>
<td>456 (97-3%)</td>
<td>5 (38-5%)</td>
<td>8 (61-5%)</td>
<td>13 (2-7%)</td>
</tr>
</tbody>
</table>

1 Figures in parenthesis indicate proportion of case expressed as a percentage of the total number of cases.
SEX AND AGE Of the 469 proved cases, 456 were men and 13 women, the male preponderance of 35:1 being even more marked than in other Indian series (Raghavachari, 1959; Somervell and Orr, 1936; Dogra, 1940; Raghavan, 1962; Malhotra et al., 1964). The age incidence is displayed in Table II. The peak age for gastric ulcer in men was 31–40 years and for duodenal ulcer 21–50 years; in women the peak age was 21–30 years, for both gastric and duodenal ulcers, after which the incidence dropped to rise again between 41 and 50 years (Table II).

GASTRIC ULCER/DUODENAL ULCER RATIO The duodenal ulcer/gastric ulcer ratio was 13:1 (Table III). Fifteen patients (3%) had both gastric and duodenal ulcers. Three others were interesting in that they had duodenal ulcers with normal acidities and developed gastric ulcers following gastro-jejunostomy.

### TABLE III
ANATOMICAL DISTRIBUTION OF THE LESIONS IN 469 CASES OF PEPTIC ULCER ADMITTED TO MADRAS RAILWAY HOSPITAL

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of Cases</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duodenal ulcer</td>
<td>301</td>
<td>64</td>
</tr>
<tr>
<td>Gastric ulcer</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>Duodenal and gastric ulcers</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Perforation</td>
<td>32</td>
<td>6</td>
</tr>
<tr>
<td>Obstruction</td>
<td>92</td>
<td>20</td>
</tr>
<tr>
<td>Miscellaneous, including stomal ulcers,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and inadequate information</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>469</strong></td>
<td></td>
</tr>
</tbody>
</table>

DISTRIBUTION OF ABO GROUPS The ABO blood groups were originally available only in 204 surgically treated patients. An attempt was made to ascertain the blood groups in the remaining patients subsequently during this investigation in order to get the complete picture. Fifty-eight patients defaulted. The ABO distribution in 411 patients is given in Table IV. Forty-one percent belonged to group O, 35% to group B, 18% to group A, and the remaining 6% to group AB.

GASTRIC ANALYSIS Results of gastric analysis were available in 371 patients and are presented in Table V, which shows that hyperchlorhydria was present in 188 (51%); 160 (43%) showed either a normal or an hypochlorhydric curve. In 23 (6%) there was achlorhydria.

CLINICAL FEATURES An analysis of signs and symptoms is presented in Table VI. Pain was the

### TABLE IV
DISTRIBUTION OF ABO BLOOD GROUPS IN 411 CASES OF PEPTIC ULCER OF 469 CASES ADMITTED TO THE RAILWAY HOSPITAL, MADRAS

<table>
<thead>
<tr>
<th>Blood Group</th>
<th>Duodenal</th>
<th>Gastric</th>
<th>Total</th>
<th>Percentage of Total</th>
<th>Frequency of Blood Groups in Local Population (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Railwaymen¹</td>
</tr>
<tr>
<td>A</td>
<td>70</td>
<td>3</td>
<td>73</td>
<td>18</td>
<td>17-38</td>
</tr>
<tr>
<td>AB</td>
<td>22</td>
<td>3</td>
<td>25</td>
<td>6</td>
<td>5-01</td>
</tr>
<tr>
<td>B</td>
<td>137</td>
<td>8</td>
<td>145</td>
<td>35</td>
<td>31-75</td>
</tr>
<tr>
<td>O</td>
<td>154</td>
<td>14</td>
<td>168</td>
<td>41</td>
<td>45-73</td>
</tr>
<tr>
<td>Total</td>
<td>383</td>
<td>28</td>
<td>411</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹Data based on an analysis of a survey of 1,957 persons for blood donors, from Railway Hospital, Madras.
²After Reddi (1943).
³After Seshadrinathan and Timothy (1942).
most frequent symptom being present in 353 (75%) of all the patients. Vomiting, either self-induced or spontaneous, was present in 305 (65%) and 184 (39%) showed loss of weight. Anaemia (Hb 70% and R.B.C.s 3.5 m./cmm.) was a particularly frequent symptom, being present in 345 (73%) patients.

**TABLE VI**

<table>
<thead>
<tr>
<th>Symptom</th>
<th>No. of Patients</th>
<th>Percentage of Total No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>353</td>
<td>75</td>
</tr>
<tr>
<td>Vomiting</td>
<td>305</td>
<td>65</td>
</tr>
<tr>
<td>Loss of weight</td>
<td>184</td>
<td>39</td>
</tr>
<tr>
<td>Periodicity</td>
<td>374</td>
<td>80</td>
</tr>
<tr>
<td>Haematemesis</td>
<td>33</td>
<td>7</td>
</tr>
<tr>
<td>Melaena</td>
<td>24</td>
<td>5</td>
</tr>
<tr>
<td>Anaemia</td>
<td>345</td>
<td>73</td>
</tr>
<tr>
<td>Visible peristalsis</td>
<td>62</td>
<td>13</td>
</tr>
<tr>
<td>Perforation</td>
<td>32</td>
<td>6.8</td>
</tr>
<tr>
<td>Epigastric tenderness</td>
<td>192</td>
<td>41</td>
</tr>
<tr>
<td>Indigestion</td>
<td>162</td>
<td>35</td>
</tr>
<tr>
<td>Hookworm infestation</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>

**TABLE VII**

<table>
<thead>
<tr>
<th>Social Class</th>
<th>No. at Risk</th>
<th>No. of Peptic Ulcers</th>
<th>Four-year Incidence Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>56</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>(Rs. 700 to Rs. 2,250)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>56</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>(Rs. 350 to Rs. 950)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>14,429</td>
<td>184</td>
<td>1.27</td>
</tr>
<tr>
<td>(Rs. 110 to Rs. 575)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>16,401</td>
<td>283</td>
<td>1.72</td>
</tr>
<tr>
<td>(Rs. 70 to Rs. 110)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30,942</td>
<td>469</td>
<td>1.51</td>
</tr>
</tbody>
</table>

The operative mortality was extremely low, there being only one death out of 204 operated cases and this was in a patient with delayed perforation, who died of post-operative pulmonary complications.

**SURVEY DATA**

The result of the survey is given in Tables VIII and IX which show the incidence of active as well as healed ulcers is 8.3% among workshop staff (manual workers) and 15% among the clerical staff (sedentary workers) between the ages of 18 and 55 years. These figures are comparable with the figures found by Doll, Jones, and Buckatzsch (1951) in their notable London survey. It will be seen that only 52.8% of ulcer patients sought admission to the hospital for treatment (Table VIII). If this is to be accepted as the usual trend for admissions, our hospital data would obviously give an underestimate of ulcer frequency. This is further borne out by the estimate of ulcer cases provided by the number of perforations in this series. Ordinarily, if 3.6% of all ulcers perforate (Haubrich, 1963), we should have had an estimated 861 ulcer cases against our figure of 469.

Since our data are not large enough, it is impossible to work out the limits within which the general incidence must lie. But clearly nearly half of the patients are not admitted to a hospital, and either take treatment as out-patients or resort to self-medication with alkalis. This inference is supported by the survey data of Gault (1959) from an independent survey of peptic ulcer in villages in south India. He found 1% of the general population as suffering from active ulcer, whereas our hospital data show the incidence of active ulcer in the general population to be 0.4%.

**INDUSTRIAL MORBIDITY RECORDS**

The number of railway employees who reported sick and remained absent with a diagnosis of peptic ulcer was studied for 1964. There were 56 sick certificates issued for...
S. L. Malhotra

TABLE VIII
RESULTS OF THE SURVEY OF GENERAL POPULATION AT THE FURNISHING SHOP OF INTEGRAL COACH FACTORY (PHYSICALLY ACTIVE WORKERS)

<table>
<thead>
<tr>
<th>Total Interviewed</th>
<th>Total with History of Ulcer Pain and Periodicity (active and healed ulcers)</th>
<th>History of Taking Alkali for Relief of Pain</th>
<th>History of Induced Vomiting for Relief of Pain</th>
<th>History of Haemorrhage</th>
<th>History of Taking Alkali for Dyspepsia Regularly</th>
<th>History of Perforation</th>
<th>History of Proved Ulcer from Earlier Hospital Admission</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>840</td>
<td>70 (8·3% of total interviewed)</td>
<td>51 (6% of total interviewed)</td>
<td>66 (94·3% of cases)</td>
<td>18 (25·5% of cases)</td>
<td>3 (4·4% of ulcer cases)</td>
<td>40 (57·1% of cases)</td>
</tr>
</tbody>
</table>

Total with pain and dyspepsia during preceding three months (active ulcers) 33 (3·9% of total interviewed and 47% of cases)

TABLE IX
RESULTS OF THE SURVEY OF THE CLERICAL STAFF AT THE SOUTHERN RAILWAY HEAD OFFICE

<table>
<thead>
<tr>
<th>Total Interviewed</th>
<th>Total with History of Ulcer Pain and Periodicity (active dyspepsia and healed ulcers)</th>
<th>History of Taking Alkali for Relief of Pain</th>
<th>History of Induced Vomiting for Relief of Pain</th>
<th>History of Haemorrhage</th>
<th>History of Proved Ulcer from Earlier Hospital Admission</th>
<th>History of Taking Alkalis, Antacids, or Anticholinergics for Dyspepsia or Pain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>520</td>
<td>78 (15% of total interviewed)</td>
<td>32 (6·1% of total interviewed)</td>
<td>59 (75·6% of cases)</td>
<td>33 (42·2% of cases)</td>
<td>13 (16·6% of cases)</td>
</tr>
</tbody>
</table>

gastric ulcer and 83 for duodenal ulcer. The total number of railway employees who reported sick for all diseases during this period was 10,998 and these figures, therefore, indicate that 1·3% of all illnesses is due to peptic ulcer or the annual incidence rate of active peptic ulcer in the general population \(\left(\frac{\text{No. of cases in the year}}{\text{the mean population}} \times 100\right)\) is 0·4%, a result which is consistent with the figures derived from our data on hospital admissions.

DISCUSSION

Previous work on peptic ulcer in India has given rise to a belief that the disease was different from the disease in the west in being less likely to bleed or perforate. Somervell and Orr (1936) came across only four cases of perforation in a series of 2,500 cases of peptic ulcer, an incidence of 0·16% only. In contrast to this, the incidence of perforation encountered in this study is very high, 7% of ulcer admissions being for perforation. If 15 others in this series are also taken into account who had a previous history of perforation, the incidence of acute and old perforations would be 10%. These figures are comparable with Hadley’s (1959) study from Vellore and our study from Assam (Malhotra et al., 1964).

The incidence of haemorrhage in our data is also not so low as reported by previous workers (notably Raghavachari, 1959; Somervell and Orr, 1936; and Gopala Rao, 1959) but is in keeping with the experience of Hadley (1959) who found this complication in 15·5% of his patients as against 12·1% in the present series. The incidence of haemorrhage reported by us from Assam was unusually high, being 30·5%. The reasons for these wide geographical differences are not clear, but may perhaps be due to the modes of enquiry, as in Assam we especially looked for this complication, whereas in this study it was recorded only if the patient volunteered the statement.

The tendency of the south Indian ulcer towards cicatrization noted by others (Gopala Rao, 1959) is mirrored in this study also, though it was present to a much lesser extent.

SEX DISTRIBUTION The reasons for the very high incidence of the disease in men as compared with women are difficult to explain. The male/female ratio was 18 : 1 in Dogra’s (1940) series from Madras General Hospital, 15 : 1 in Hadley’s (1959) series...
from Vellore, 10 : 1 in Gopala Rao’s (1959) series from Hyderabad, and 16 : 1 in Raghavachari’s (1959) series from Trivandrum, whereas it is 35 : 1 in the present series from a railway population in Madras, mirroring the experience of Konstam (1959). The reasons for this very marked sex discrepancy in our data are not clear but may possibly be explained by the age structure of our population. The age of superannuation from service for railwaymen is 55 years, and, therefore, the wives of railwaymen will be generally below 45 years of age; and because ulcer is less common in women in the reproductive period of life, our population, therefore, has fewer women in the vulnerable age group at risk, as compared with the general population in the country. This may partly explain the sex discrepancy; but obviously there must be other factors not yet determined.

We carried out a survey to find out if there were any difference between men and women in the pattern of eating, and this showed that in nearly 95% of the families interviewed, women ate less and took longer over their meals than men, who were largely ‘meal scrampers’. This was further confirmed by timing the actual eating times of meals in the men’s and the women’s wards at the Railway Hospital at Madras and Bombay, in which 57 men and 57 women were included: women took one-and-a-half times to twice as long with their meals as compared with men, the mean chewing times per meal being 10 minutes for men and 16.5 minutes for women, even though their meals were much smaller than those of the men. The pattern of eating was also different in that men tended to bolt down large boluses of rice whereas women macerated this with their fingers and made much smaller morsels which they chewed well before swallowing. Jennings (1965) has made a similar observation, and of his 22 patients with duodenal ulcer, all ‘meal scrampers’, only one was a woman. This is of relevance in view of the effect of chewing movements of the jaw on the buffer capacity and the mucin content of saliva reported by several workers (for references see Afonsky, 1961) and more recently by the author (Malhotra, 1965, 1966a; 1967. Malhotra, Saigal, and Mody, 1965); and may thus be responsible for a better protective action of saliva in the case of women as compared with men, as discussed fully elsewhere (Malhotra, 1966b).

**GASTRIC ACIDITY** The incidence of hyperchlorhydria in the present study is comparable with our Assam study and is not dissimilar from the western experience, although it is different from the reports of Raghavan (1962), Raghavachari (1962), and Hussain (1959). The results of a fractional test meal, as it is usually performed, lack constancy and repeatability and, therefore, much reliance cannot be placed on this variance. Vakil and Mulekar (1965) have found that the results varied from 5 to 20% on the same individuals when repeated. This has also been our experience and there were at least 25 patients in this series on whom the fractional test meal had been done more than once with widely varying results.

**BLOOD GROUPS** Aird, Bentall, Meighan, and Roberts (1954) found a positive association between peptic ulcer and blood group O. A number of subsequent studies have confirmed this relationship (Clarke, Cowan, Edwards, Howel-Evans, McConnell, Woodrow, and Sheppard, 1955) from other countries although not from India. Ghosh, Biswas, and Chatterjee (1957) and Raghavan (1962) found no significant difference in the frequency of group O in duodenal ulcers as compared with gastric ulcers. The present data show a higher frequency of group O and group B in duodenal as well as gastric ulcers and a much lower frequency of groups A and AB (Table IV). Even though this controverts the observations of Ghosh and Raghavan, and is in agreement with the accepted preponderance of blood group O in peptic ulcers, any causal significance of blood groups in peptic ulcer is uncertain because of a similar ABO blood group frequency in the general population in Madras (Table IV).

**ULCER FREQUENCY AND HOOK WORM INFESTATION** Gopalan (1959) and Konstam (1959) have suggested that hook worm infestation may have a possible role in causing peptic ulcer. This suggestion has been revived by the recent work of Raju and Narielvala (1965). In this series there were only five (1.1%) patients who showed evidence of hook worm infestation. Although helminth infestations are common in south India, they are less prevalent in railway colonies because of the higher standards imposed by measures for environmental hygiene. Moreover, in Gurdaspur district of the Punjab, although heavy hook worm infestation is present, ulcer is practically unknown, and conversely, while ulcer is frequent in railway populations in Assam (Malhotra et al., 1964), hook worm infestation is practically non-existent. These results, therefore, do not support the hook worm thesis.

**VOMITING** Vomiting was a very frequent feature, being present in 65% of the patients, and in more than half of them it was self-induced, mirroring the experience of Hadley (1959), whose series showed this complication in well over 70% of his 406 patients. Unfortunately other workers interested in
the peptic ulcer problem in the south of India have not collected this information. Since vomiting will reduce gastric acidity not only by mere emptying of the gastric contents but possibly also by a re-gurgitation of the alkaline intestinal chyme into the stomach, it is interesting to speculate if this accounts for the greater cicatrization noticed by several workers (Somervell and Orr, 1936; Gopala Rao, 1959), and may also account for a lower rate of haemorrhage compared with Assam (Malhotra et al., 1964).

SOCIO-ECONOMIC FACTORS AND DUODENAL/GASTRIC ULCER RATIO Whereas the top people have a duodenal ulcer, gastric ulcer has been regarded in western Europe for the past half century as an affliction of the materially and mentally under-privileged (Lancet, 1959). Doll et al. (1951) found that the gastric to duodenal ulcer ratio rises progressively from 1 : 3 to about 1 : 1 as age increases and as the level of the social class decreases. Dogra (1940) found the gastric ulcer: duodenal ulcer ratio was 1 : 30 whereas in Hadley's (1959) series the ratio was 1 : 13 and in the present series this was 1 : 12. Taking into account only the surgically confirmed cases, the gastric ulcer/duodenal ulcer ratio in our series was 1 : 6.

The south Indian peptic ulcer is thought to be a disease of the poor (Gopala Rao, 1959; Dogra, 1940; Konstam, 1959). The present data do not show this to be the case, and it is to be noted from Table VI that the ulcer is equally distributed in the various social classes. One criticism of the data of others (Gopala Rao, 1959; Dogra, 1940) is that they have based their impression from the much larger numbers of poorer people in their series. In the present series too, the number of the poorer people is high (Table VI), but when the incidence rates are examined not as a percentage of total number of patients but in relation to the population at risk, social class has no relation to ulcer prevalence. The lack of social-class gradient in this series can be explained by the fact that the pattern of eating among the rich and the poor shows no great differences in the south of India: both eat sloppy foods which do not require much mastication (Malhotra, 1964).

SOUTH INDIAN ULCER CHANGE In view of the marked discrepancies between the present results and earlier studies, certain pertinent questions need to be discussed more fully: Does the present investigation show a change in the behaviour of ulcer as compared with previous studies? If so, how can the present findings be reconciled with previous studies? Are there any apparent reasons for this change?

The first question must be answered in the affirmative. Because our findings of higher frequencies for perforation, haemorrhage, vomiting, and a higher gastric ulcer/duodenal ulcer ratio are consistent with another independent study from south India (Hadley, 1959), these are unlikely to have resulted merely from sampling variations. Moreover, when data collected in several different ways give the same conclusion, it is not unreasonable to say that it is independent of bias due to sampling. There are reports of similar ulcer changes from other parts of the world (Lancet, 1965) and, therefore, it may be reasonably concluded that there has been an ulcer change in the south of India also.

It is more difficult to answer the second question as to how the present findings can be reconciled with previous studies. While improvements in radiographic facilities and diagnostic methods and an increased awareness of the problem could be claimed to account for the change in the gastric ulcer/duodenal ulcer ratio, or even a higher incidence of haemorrhage, because, when one looks for a thing one is more likely to find it. Our experience of haemorrhage in ulcer in Assam showed that this complication was present in 30-5% of the cases, but, when especially looked for, 51.1% of the patients gave a history of haemorrhage, at some time or another (Malhotra et al., 1964), so it is less easy to obtain a precise appraisal of the importance of these factors because in the absence of a single uniform opinion in different studies, using different methods of collection of data, varying emphases and criteria are inevitable. Perforation, on the other hand, is so dramatic in onset and has such a high mortality if untreated, that its diagnosis may well be expected to have been reasonably accurate and uniform for many years past. It could, however, be argued that because of the lethal nature of this complication fewer such patients reached hospital in earlier days, especially as the report of Somervell and Orr (1936) concerns mostly village populations, where difficulties of transport were then not inconsiderable. In spite of these criticisms, the very marked changes in the behaviour of ulcer in the south of India over the past 30 years seem to be real, especially when there have been similar changes in other parts of the world (Alsted, 1939; Billington, 1965).

The answer to the third question is even more difficult and far less certain. The familial and genetic factors associated with ABO blood group which have been claimed to predispose to gastric ulcer cannot explain this ulcer change, as it is unlikely that any significant changes in the distribution of blood groups in the population have taken place. It is also unlikely that the temperaments of
people have changed over the years; nor is there any
evidence that smoking may be responsible for the
change, because if anything, the sale of cigarettes
per 1,000 of population is five times more in the
Punjab compared with Madras (data from trade
sources), even though the Punjabis are immune and
the South Indians prone to ulcer. Such variations in
disease patterns occurring from place to place and
from time to time point to changes in environmental
factors, chiefly dietary.

As reported elsewhere (Malhotra, 1964), the diets
in south India are sloppy and the pattern of eating
is such that the boiled rice or Ragi gruel are bolted
down without much chewing. Such a pattern of
eating does not exploit the increase in the total
quantities, the buffer capacity, and the mucin con-
tents of saliva which result from diets requiring
mastication and prolonged chewing movements of
the jaw (Malhotra, 1966a; Malhotra et al., 1963;
for other references see review by Afonsky, 1961).
The part played by variations in the patterns of diet
and eating in the causation of ulcer has been dis-
cussed (Malhotra, 1965). While the pattern of diet
and eating can explain the higher prevalence of
peptic ulcer in south India as compared with the
Punjab, north India, (Malhotra et al., 1965), the
changes in the pattern of diet and eating which have
undoubtedly taken place in the south during the
last three decades, especially with regard to the
methods of cooking and eating, are also of signif-
cance. For example, rice has replaced tapioca in
several parts of south India and this has meant a
change in the pattern of eating.

Two other factors, which almost certainly are
recent, may bear responsibility for the change in
the ratio of gastric to duodenal ulcers: (1) the very
highly prevalent practice of inducing vomiting and
(2) the habit of taking 'soda' (sodium bicarbonate)
to relieve pain and dyspepsia. In our survey data
57% of patients were habituated to taking alkalis
and nearly 65% of our hospital patients have a
history of vomiting, chiefly induced. Both these
factors would reduce gastric acidity, one by duodenal
reflux and the other by neutralizing the Hcl. With a
fall in acidity the mucus becomes fluid and its
barrier action is weakened (Ball and James, 1961).
The increased duodenal reflux can also produce
gastritis predisposing to gastric ulcer (Lawson, 1964;
du Plessis, 1965; Malhotra, 1966b). It may be worth
mentioning here that in the present series, three
patients with duodenal ulcer with low acidities
developed gastric ulcers after previous gastro-
jejunoostomies, possibly due to the same mechanism;
and it could perhaps be anticipated that if these
trends towards the liberal consumption of alkali and
antacids for dyspepsias continue, further changes
in the ratio of gastric ulcer to duodenal ulcer will
take place, as has happened in the west.

SUMMARY

The epidemiological aspects of peptic ulcer have
been studied in a population employed on the
railways in south India to define the prevalence,
the clinical features, the effect of treatment, and
the incidence of complications of the disease.

The report concerns a total of 469 patients. The
sex discrepancy was more marked than in other
reported series, the male:female ratio being 35:1;
the peak age was much lower than in the west and
a greater degree of cicatrization was noticed in
operated cases. The incidence of haemorrhage and
perforation was much higher than reported by
earlier observers and is not very different from that
in the west. The reasons for this ulcer change are
not certain but are possibly related to changes in
the pattern of eating, and to a higher consumption
of alkalis, and possibly to a more frequent habit of
vomiting, than in previous decades. There was a
preponderance of blood group O and B; very few
patients belonged to groups A and AB in this series.
Operative mortality was low, there being only one
death out of a total of 204 operated patients. The
effect of surgery (partial gastrectomy) as determined
after a four-year follow-up of the cases treated in
1961, was complete relief of symptoms and a gain
in weight as well as an increase in haemoglobin in
the majority of the patients.

After gastro-jejunoostomy on the other hand, three
patients with duodenal ulcer developed gastric ulcer.
The possible causal relationship of diet to the
development of ulcer is briefly discussed.

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