Papers and Originals

Aetiological Factors in Chronic Atrophic Gastritis

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Not until the introduction of the flexible gastric-biopsy tube (Wood *et al.*, 1949) was a simple and harmless method of sampling the gastric mucosa available. Since then investigation of this structure has been directed mainly to discovering the incidence of chronic gastritis in different conditions and its relation to other pathological states (Motteram, 1951; Palmer, 1954; Davidson and Markson, 1955; Joske *et al.*, 1955; Williams *et al.*, 1958). Little light has been shed on its cause (Coghill, 1960; Taylor, 1961; Vilardell, 1963).

A relation between gastritis and carcinoma of the stomach was suggested by Hurst (1929), and investigated by Stout (1945), Hebbel (1950), and Magnus (1952); the subject was reviewed by Ivy (1955). Morsen (1955a, 1955b) related gastric carcinoma to intestinal metaplasia (which in most instances must have signified the presence of chronic gastritis), and Siurala and Seppälä (1960) thought that atrophic gastritis was a probable forerunner of gastric cancer. While it is accepted that patients with Addisonian pernicious anaemia are more likely to develop gastric carcinoma than others, the precise risk is the subject of debate (Berkson *et al.*, 1956), and carcinoma often occurs in the pyloric antrum, the mucosa of which is unaffected in pernicious anaemia (Mosbech and Videbaek, 1950).

The adult form of pernicious anaemia is invariably accompanied by either atrophic gastritis or gastric atrophy (Magnus and Ungley, 1938; Doig and Wood, 1950; Joske *et al.*, 1955; Magnus, 1958; Williams *et al.*, 1958); its relation to atrophic gastritis has been studied by Callender *et al.* (1960), Whiteside *et al.* (1964), Wood *et al.* (1964), and Coghill *et al.* (1965). While there is no evidence that chronic gastritis *per se* carries a greater liability to the subsequent development of gastric carcinoma or pernicious anaemia, there is no doubt about its common occurrence in these two conditions. Chronic gastritis often accompanies gastric ulcer (Magnus, 1937), and may even play a part in its cause (du Plessis, 1965). The association of chronic gastritis with these disorders indicates the need to inquire into its aetiology.

Chronic gastritis is known to be related to age but not to sex (Doig and Wood, 1952; Williams *et al.*, 1957; Siurala and Vuorinen, 1963). The increased incidence of blood group A in both gastric cancer and pernicious anaemia (Aird *et al.*, 1953; *Brit. med. J.*, 1956; Callender *et al.*, 1957; Glass *et al.*, 1962) and of blue eyes in pernicious anaemia (Minot, 1927; Callender *et al.*, 1957; Wintrobe, 1961) suggested that there might be similar associations with chronic gastritis. Immunological mechanisms may also be of importance in the development of chronic gastritis (Taylor and Truelove, 1962; Mackay, 1964; Coghill *et al.*, 1965).

Gastric ulcer and gastric carcinoma are known to be particularly common among the lower social strata (Doll *et al.*, 1951;

Cohart, 1954; Jones, 1954; Doll, 1956, 1958). Alcohol has been regarded as a cause of chronic gastritis (Joske *et al.*, 1955; Williams, 1956; Debray *et al.*, 1957), and we thought that smoking should also be investigated. An association between chronic gastritis and the intake of tea at high temperatures has been shown (Edwards and Edwards, 1956). Aspirin damages the gastric mucosa, causing haemorrhage (Douthwaite and Lintott, 1938; Hurst and Lintott, 1939; Strubbe, 1958; Summerskill and Alvarez, 1958; Wood *et al.*, 1962).

In this paper we present the results of a study of various constitutional and environmental factors which might be causally related to the chronic atrophic gastritis found in non-ulcer dyspepsia.

Method of Study

During the course of a study of the clinical features of gastritis and peptic ulcer 221 patients with non-ulcer dyspepsia were examined. In the great majority of instances the dyspepsia was the main reason for referral to hospital; in none of the patients had any gastric lesion been diagnosed previously, and very few were anaemic. No evidence of peptic ulcer or of any other cause for their symptoms was found in these patients after appropriate investigations, which included at least one barium swallow and meal. Gastric biopsy was performed by the method of Coghill and Williams (1955) by means of a modified Australian suction biopsy tube (Wood *et al.*, 1949). The gastric biopsy specimens were examined by Dr. A. Wynn Williams without knowledge of any of the other data. Most of the patients were the same as those reported by Williams *et al.* (1957).

Information on factors of possible causal significance in gastritis was obtained at interview, almost all the interviews being carried out by one of us (F.C.E.). In most cases the gastric histology was unknown at the time. Data were recorded on prepared forms and coded on punch-cards.

Patients were assigned to one of four groups based on the most abnormal lesion found in any biopsy specimen (Williams *et al.*, 1957): (1) normal (96 patients); (2) miscellaneous minor mucosal changes (70)—normal except for irregularity of the surface epithelial cells and/or infiltration of the stroma with inflammatory cells; (3) chronic superficial gastritis—partial atrophy of the body glands and inflammatory infiltration of the stroma (15 patients—C.S.G. in 11; mixed C.S.G. and normal or miscellaneous changes in 4); and (4) chronic atrophic gastritis—as No. 3 but with virtually complete atrophy of the glands with or without intestinal or pyloric gland heterotopia (40 patients—C.A.G. in 25; mixed C.A.G. and normal or miscellaneous changes or C.S.G. in 15). The 55 patients with chronic superficial and atrophic gastritis were considered together, and form the chronic gastritis group. Patients with a normal mucosa and those with miscellaneous minor changes were considered separately where possible.

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Results

Table I shows the histological changes in the whole series and in men and women. One in four patients had chronic gastritis, one in three had miscellaneous minor mucosal changes, and the remainder had no abnormality in the gastric mucosa.

TABLE I.—Percentage Incidence of Mucosal Changes in the Whole Series and in Men and Women Separately

	Mucosa			No. of Patients
	Normal	Miscellaneous Minor Changes	Gastritis	
Men	44.3	30.9	24.8	149
Women	41.7	33.3	25.0	72
Whole series	43.4	31.7	24.9	221

Constitutional Factors

Sex.—The distribution of mucosal changes was the same in men and women (Table I).

Age.—Table II shows the percentage incidence of each type of mucosa in different age groups. Gastritis affected not more than one in ten patients under the age of 40, and then rose steadily to a peak incidence of 52% in patients aged 60 and

TABLE II.—Percentage Incidence of Mucosal Changes According to Age at Biopsy (Whole Series)

Mucosa	Age (Years)					Mean Age at Biopsy (Years)
	< 30	30–39	40–49	50–59	60+	
Normal	51.3	59.2	43.1	31.9	19.0	39.0
Miscellaneous minor changes	38.5	32.6	32.3	25.5	28.6	41.0
Gastritis	10.2	8.2	24.6	42.6	52.4	49.7
Total No. of patients	39	49	65	47	21

FIG. 1.—Percentage distribution of patients, separately for each sex, according to age at biopsy and gastric histology.

over. The incidence of miscellaneous minor changes was fairly similar in each age group. Only one patient in five over 60 had an entirely normal mucosa. The mean age at biopsy of the normal and miscellaneous groups was close; patients with gastritis had a mean age of about 10 years older (Table II). The percentage distribution of patients according to age at biopsy and histology is shown, separately for each sex, in Fig. 1.

Blood Group.—In half the cases the ABO blood group was known. The numbers were small, but few comparable data are available. The incidence of the ABO blood groups in each of the two main histological categories and in a control series is shown in Table III. There was no association of group A with gastritis, but there was an excess of patients with blood group O among those without gastritis (55%).

TABLE III.—Distribution of Patients According to Gastric Histology and ABO Blood Group

Blood Group	Mucosa				Control Series*
	Normal + Miscellaneous Minor Changes		Gastritis		
	No.	%	No.	%	%
O	41	54.7	18	46.2	45.8
A	30	40.0	16	41.0	42.2
B	4	5.3	3	7.7	8.9
AB	—	—	2	5.1	3.1
Total No. of patients	75	100.0	39	100.0	100.0

* Discombe and Meyer (1952).

Eye Colour.—The colour of the iris was recorded as one of six categories (grey, grey-blue, blue, hazel, green, brown). Numbers in the four categories other than blue or brown were too small for meaningful analysis; however, more patients with clearly blue than with brown eyes had gastritis (Table IV).

TABLE IV.—Percentage Incidence of Gastritis Among Blue-eyed and Brown-eyed Patients

Eye Colour	Mucosa				No. o. Patients
	Normal and Miscellaneous Minor Changes		Gastritis		
	No. of Patients	%	No. of Patients	%	
Blue	60	69.8	26	30.2	86
Brown	61	82.4	13	17.6	74

Gastric and Thyroid Antibodies.—Techniques for the estimation of autoantibodies were not available at the start of this study, but a small number of patients were subsequently investigated for the presence of gastric and thyroid antibodies in the blood by the methods described by Taylor *et al.* (1962). Three men with superficial and eight with atrophic gastritis were tested. Only one had weak antibodies to gastric tissue and none had antibodies to thyroid. One woman with superficial gastritis and six women with atrophic gastritis were tested; two had had hypochromic anaemia unrelated to haemorrhage. Three (all with atrophic gastritis and one with previous hypochromic anaemia) had parietal cell antibodies (titres 16, 4, and 64). One of these possessed thyroid antibodies of moderate titre.

Environmental Factors

Social Class

Social class was assessed from the occupation of each patient (General Register Office, 1956). The class of patients who had retired was assessed from their main pre-retirement work; married women were classed according to their husband's occupation. A few young patients who had not yet begun work were classed according to their father's occupation.

Table V shows the incidence of mucosal changes according to social class. Because of small numbers, classes I and II were combined, and classes IV and V. The proportion of patients with gastritis rose from 16% in classes I and II to 38% in classes IV and V, while a normal mucosa was found in two-thirds of those in classes I and II and in only one-quarter of those in classes IV and V.

TABLE V.—Percentage Incidence of Mucosal Changes According to Social Class*

Social Class	Mucosa			No. of Patients
	Normal	Miscellaneous Minor Changes	Gastritis	
I and II ..	64.7	19.6	15.7	51
III ..	39.8	35.8	24.4	123
IV and V ..	27.5	35.0	37.5	40

* Excluding 7 patients whose social class was unknown.

Because of the relation of age and gastritis (Table II) the possible contribution of age to any other apparent association with gastritis had to be examined. Table VI shows the percentage distribution of patients according to age at biopsy and social class: classes I and II had the highest, and classes IV and V the lowest, proportion of patients under 40, while in classes IV and V half as many patients again were aged 50 and over as in either of the other two social groups. Mean age at biopsy rose from 40 (classes I and II) to 46 (classes IV and V). Nevertheless, when allowance was made for age by dividing the patients into those under and over 50, gastritis was found to be more than ten times as common in classes IV and V as in classes I and II in patients under 50 (Fig. 2). In patients aged 50 and over this difference disappeared and gastritis affected a similar proportion of patients in each class.

TABLE VI.—Percentage Distribution of Patients According to Age at Biopsy and Social Class*

Social Class	Age (Years)						No. of Patients	Mean Age at Biopsy (Years)
	0-19	20-29	30-39	40-49	50-59	60+		
I and II ..	2.0	19.6	35.3	13.7	19.6	9.8	51	40.1
III ..	4.1	15.4	17.9	35.8	20.3	6.5	123	42.1
IV and V ..	2.5	5.0	20.0	27.5	30.0	15.0	40	46.2

* Excluding 7 patients whose social class was unknown.

FIG. 2.—Percentage incidence of gastritis, according to social class and age at biopsy (excluding seven patients whose social class was unknown). Numbers in the columns are the numbers of patients in each group.

Smoking Habits

The amount and type of tobacco smoked by each patient was recorded. In nearly everyone smoking habits had been consistent for many years prior to interview and classification was straightforward; in the few instances where there had been a recent change in smoking habit the patient was classified according to the previous habit. Table VII shows the incidence of mucosal changes according to smoking habits: gastritis affected

about 20% of non-smokers, of pipe and mixed smokers, and of those who smoked under 10 cigarettes daily, while a slightly higher incidence (28%) was found in smokers of 10-19 cigarettes a day. The incidence of gastritis was over 40% in smokers of 20 or more cigarettes a day.

TABLE VII.—Percentage Incidence of Mucosal Changes According to Smoking Habits*

Smoking Habits	Mucosa			No. of Patients	Mean Age at Biopsy (Years)
	Normal	Miscellaneous Minor Changes	Gastritis		
Non-smokers	47.2	32.1	20.7	53	38.2
Cigarettes smoked { 1-9 ..	46.5	32.1	21.4	28	43.0
{ 10-19 ..	36.2	36.2	27.6	58	43.2
{ 20+ ..	34.1	22.7	43.2	44	44.3
Pipe and mixed smokers ..	50.0	31.3	18.7	16	48.6
Former smokers ..	63.2	36.8	—	19	41.0

* Excluding 3 patients whose smoking habits were unknown.

The age distribution of patients was examined in relation to smoking habits, but no consistent differences were found which could explain the results shown in Table VII; the mean age at biopsy of each group is shown in the final column of this Table. However, when the incidence of gastritis was estimated in relation to smoking habits in those aged over and under 50 it was found that the association with heavy cigarette-smoking was much more pronounced in the older of the two age groups (Fig. 3), three-quarters of patients aged 50 and over who were heavy cigarette smokers having gastritis. The independent effect of age is indicated by the fact that non-smokers of cigarettes aged 50 and over had a higher incidence of gastritis than heavy cigarette smokers in the younger age group.

Table VIII shows the incidence of gastritis according to smoking habits and social class: both non-cigarette smokers and smokers of under 20 cigarettes a day showed a markedly increased incidence of gastritis with decline in social status, but in heavy cigarette smokers this trend disappeared.

FIG. 3.—Percentage incidence of gastritis, according to smoking habits and age at biopsy (excluding three patients with unknown smoking habits). Numbers in the columns are the numbers of patients in each group.

TABLE VIII.—Percentage Incidence of Gastritis According to Social Class and Smoking Habits*

Social Class	Non-smokers, Pipe, Mixed, and Former Smokers		Cigarette Smokers. No. Smoked per Day			
			1-19		20 and Over	
	Total No.	% with Gastritis	Total No.	% with Gastritis	Total No.	% with Gastritis
I and II ..	21	9.5	21	4.8	9	55.6
III ..	52	17.3	45	28.9	25	32.0
IV and V ..	13	23.1	16	37.5	10	60.0

* Excluding 9 patients with unknown smoking habits and/or social class.

Consumption of Alcohol

In each case alcohol intake was recorded and patients were assigned to one of four groups: non-drinkers; those who occasionally drank the amounts customary at social gatherings (social drinkers); those who drank either beer or spirits heavily but intermittently; and those who drank beer regularly, either daily or several times a week. Only four patients drank anything other than beer regularly, and these have been omitted from the analysis.

The incidence of mucosal changes according to drinking habits is shown in Table IX. Taking the non-drinkers and social drinkers together we find that 21% had gastritis, compared with 35% of heavy irregular drinkers and 46% of regular beer drinkers. This trend could not be explained on grounds of age: there were no consistent differences either in mean age (Table IX) or in the age distribution of these four groups. The incidence of gastritis according to age and drinking habits is shown in Fig. 4: in both age groups gastritis was commoner among regular beer drinkers and heavy irregular drinkers than among social or non-drinkers. The independent effect of age is clearly shown, non-drinkers over 50 having a higher incidence of gastritis than regular beer drinkers under 50.

Table X shows the incidence of gastritis according to social class and drinking habits. Because of small numbers in some categories social classes I–III were combined. A sharp increase in the incidence of gastritis in non-drinkers and social drinkers

TABLE IX.—Percentage Incidence of Mucosal Changes According to Alcohol Consumption*

Drinking Habits (see text)	Mucosa			No. of Patients	Mean Age at Biopsy (Years)
	Normal	Miscellaneous Minor Changes	Gastritis		
Non-drinker ..	38.3	37.0	24.7	73	44.5
Social ..	50.5	30.5	19.0	95	40.5
Heavy irregular ..	39.1	26.1	34.8	23	42.2
Regular beer ..	31.8	22.7	45.5	22	45.0

* 8 patients were excluded: in 4 the drinking habits were unknown; 2 regularly drank spirits, and 2 regularly drank other alcoholic beverages.

FIG. 4.—Percentage incidence of gastritis, according to alcohol consumption and age at biopsy (excluding the same eight patients as in Table IX). Numbers in the columns are the numbers of patients in each group.

TABLE X.—Percentage Incidence of Gastritis According to Social Class and Alcohol Consumption*

Social Class	Non-drinkers and Social Drinkers		Heavy Irregular, and Regular Beer, Drinkers	
	Total No.	% with Gastritis	Total No.	% with Gastritis
I–III ..	134	17.9	35	40.0
IV and V ..	28	35.7	9	44.4

* Excluding the same 7 patients as in Table V and the same 8 as in Table IX.

was associated with lower social class, but in heavy and regular drinkers this trend disappeared.

When tobacco and alcohol consumption were considered together gastritis was found most frequently (63%) in patients who smoked 20 or more cigarettes a day and who were also heavy irregular drinkers or regular beer drinkers (Table XI).

TABLE XI.—Percentage Incidence of Gastritis According to Tobacco and Alcohol Consumption*

Smoking Habits	Non-drinkers and Social Drinkers		Heavy Irregular, and Regular Beer, Drinkers	
	Total No.	% with Gastritis	Total No.	% with Gastritis
Non-smokers, pipe, mixed, and former smokers ..	71	16.9	14	14.3
Cigarette smokers: 1–19 daily ..	73	24.7	12	33.3
20+ daily ..	22	27.3	19	63.2

* Excluding 10 patients: the same 8 as in Table IX (in one of whom smoking habits were also unknown) and 2 others with unknown smoking habits.

When smoking and drinking habits of the 55 patients with chronic gastritis were examined in relation to sex it was found that none of the 18 women was a heavy cigarette smoker or heavy irregular or regular beer drinker, these habits being found only in the men. Analysis of the whole series of 221 patients revealed a marked difference between the sexes in both habits: 26% of men but only 7% of women were heavy cigarette smokers, while 28% of men and 4% of women were either heavy irregular or regular beer drinkers.

Tea Temperature

An association between gastritis and the intake of tea at high temperatures, which was independent of both age and sex, has previously been shown (Edwards and Edwards, 1956): two-thirds (101) of these patients were subsequently included in the present study. Their preferred tea temperatures ranged from 108 to 154° F. (42.2 to 67.8° C.), the mean temperature being 131° F. (55° C.) and the median 130° F. (54.4° C.). The social class of these 101 patients has been analysed, and the mean temperature at which tea was drunk was found to vary, though not consistently, with social class: 129° F. (53.9° C.) in classes I and II, 132° F. (55.5° C.) in class III, and 130° F. (54.4° C.) in classes IV and V. Table XII shows the incidence of gastritis according to both preferred tea temperature and social class; division has been made at the median temperature, and classes I–III have been combined because of small numbers. An increased incidence of gastritis was associated independently both with lower social class and higher tea temperature.

TABLE XII.—Percentage Incidence of Gastritis According to Social Class and Preferred Tea Temperature*

Social Class	Preferred Tea Temperature			
	Under 130° F. (54.4° C.)		130° F. and Over	
	Total No.	% with Gastritis	Total No.	% with Gastritis
I–III ..	29	10.3	49	24.5
IV and V ..	11	27.3	9	66.7

* Excluding 3 patients whose social class was unknown.

Aspirin Consumption

Patients were questioned regarding their intake of aspirin (but not about any other kind of tablet or preparation) and were assigned to one of four groups: (a) those never taking it; (b) those taking it only occasionally, for instance, every two or three months; (c) those taking it regularly—for instance, every

week or few weeks; and (d) those taking it frequently, including those often taking it more than once weekly.

Table XIII shows the mucosal findings related to consumption of aspirin. Gastritis was least frequent among those who never took aspirin, and, although the association was not consistent, gastritis was commoner among the aspirin-takers as a whole. Of the 17 patients with gastritis who took aspirin, 10 were men and 7 women. There was no apparent relation between social class and aspirin consumption.

TABLE XIII.—Percentage Incidence of Mucosal Findings According to Consumption of Aspirin*

Aspirin Consumption	Mucosa		No. of Patients
	Normal, and Miscellaneous Minor Changes	Gastritis	
None	78.6	21.4	173
Occasional .. .	55.5	44.5	18
Regular or frequent ..	65.4	34.6	26
	61.4	38.6	44

* In 4 patients aspirin consumption was unknown.

Regularity of Meals

Patients were grouped into those who took meals at regular intervals and those who ate irregularly. Gastritis affected 23% of the former and 34% of the latter.

Particular Foods

Patients were asked whether their dyspepsia tended to occur after taking particular foodstuffs, and Table XIV shows the mucosal findings in relation to seven of the more commonly mentioned foods. The only notable difference was that eggs were a cause of symptoms in 11% of those with gastritis and only 2% of those with a normal mucosa.

TABLE XIV.—Percentage of Patients Who Related Their Dyspeptic Symptoms to Certain Foods, According to Gastric Histology

Foods	Mucosa	
	Normal and Miscellaneous Minor Changes	Gastritis
Fried foods	53.0	50.9
Pork	0.6	1.8
Other meat	4.2	7.3
Cheese	5.4	9.1
Eggs	1.8	10.9
Spices	3.0	1.8
Fruit	5.4	9.1
Total No. of patients	166	55

Other Diseases

Three women with gastritis (5.5%) had previously suffered from hypochromic anaemia (haemoglobin less than 11.5 g.); seven other women had hypochromic anaemia at the time of interview, and three of these had gastritis and were under 20 years of age. No patients with gastritis had any history or clinical evidence of thyroid disease. Pulmonary tuberculosis, chronic bronchitis, hypertension, and psychiatric illness (of sufficient severity to require treatment) occurred with the same frequency in patients with and without gastritis.

Discussion

Constitutional Factors

Of the constitutional factors examined age has been widely investigated. With few exceptions (Palmer, 1954; Valencia-Parparcén and Römer, 1963) most biopsy studies of the gastric mucosa have, like ours, shown an increased incidence of chronic

gastritis with age. Although such biopsy data are based on groups of selected patients, post-mortem studies of patients dying from extragastric causes show a similar trend (Guiss and Stewart, 1943; Hebbel, 1943). As in our series, neither of these authors demonstrated any difference in the sex incidence of gastritis.

An association of blood group A with gastritis was not found in the small number of patients tested. The finding that gastritis was almost twice as common among blue-eyed as brown-eyed patients supports the hypothesis that genetic influences play some part in the production of gastritis.

Only a few patients, all with gastritis, were tested for the presence of gastric antibodies. More women than men possessed antibodies to parietal cells, and possessed them in higher titre. Coghill *et al.* (1965) have discussed the possible reasons for this sex difference. Thyroid and gastric antibodies often occur in patients with pernicious anaemia, with simple atrophic gastritis, and with thyroid diseases (Irvine *et al.*, 1962; Markson and Moore, 1962; Doniach *et al.*, 1963; Coghill *et al.*, 1965); and Adams *et al.* (1964) found atrophic gastritis in 18 out of 20 patients possessing parietal-cell antibodies.

Environmental Factors

It is known that gastric carcinoma (Fig. 5) and gastric ulcer (Doll *et al.*, 1951) are commonest among people of low social class, but an association between simple chronic gastritis and social class has not been reported before. Several factors, all likely to vary with social class (alcohol, temperature of food and drink, varieties of food and of fats used in cooking, methods of preparation and cooking, and utensils used), have been suggested as of possible importance in the aetiology of carcinoma of the stomach (Ivy, 1955; Doll, 1958; Dungal, 1961). The difficulties inherent in obtaining an accurate dietary history are obvious, and the results of several retrospective inquiries have been inconclusive (Acheson and Doll, 1964; Boyd *et al.*, 1964). The implications of the association between gastritis and drinking hot tea were discussed in an earlier paper (Edwards and Edwards, 1956). The markedly increased incidence of gastritis found with lower social class was less apparent in the presence of old age, heavy smoking, or heavy drinking, three factors which each had an independent association with gastritis. Analysis of smoking and drinking habits according to age and social class revealed no consistent differences such as would explain these findings. The temperature at which patients preferred to drink tea was not clearly related to class, nor were habits of aspirin consumption. The reason

Fig. 5.—Standardized mortality ratios by social class for men and married women aged 20–64 years with malignant neoplasms of the stomach, for the period 1949–53 (Registrar-General, 1958).

for the increasing incidence of gastritis with diminishing social status, found here in patients under 50, remains unknown.

The role of tobacco in the production or maintenance of peptic ulceration has often been discussed, but a recent review of smoking and the alimentary tract did not mention gastritis (Packard, 1960). It may be supposed that repeated contact with substances mixed with saliva and swallowed during smoking could damage the gastric mucosa; this might explain the association of gastritis with heavy cigarette-smoking found in this study. On the other hand, chronic bronchitis, with its attendant swallowing of infected sputum, was equally common in our patients with and without gastritis.

Alcohol has often been regarded as a likely cause of chronic gastritis, but gastric biopsy studies have given inconsistent results (Finckh *et al.*, 1952; Joske *et al.*, 1955; Williams, 1956; Debray *et al.*, 1957). The acute changes encountered in the mucosa after isolated bouts of heavy drinking have been shown to resolve completely (Motteram, 1951; Palmer, 1954). The present study has shown a clear association between chronic atrophic gastritis and a history of either regular beer drinking or of heavy intermittent bouts of drinking.

Douglas and Johnston (1961) estimated that aspirin-taking was much commoner in patients with chronic gastric ulcer than in the general population. Langman *et al.* (1964) were unable to demonstrate any relation between aspirin and gastritis in a relatively small series of patients with gastroduodenal haemorrhage. Our findings suggested that there might have been some relation between taking aspirin and the development of gastritis in the patients surveyed, but the results were not conclusive.

Any association between gastritis and irregular meals is difficult to interpret because the gastritis itself may have produced symptoms, such as anorexia, that led to the alteration of eating habits; it is also likely that irregular eating habits go with ill-chosen or badly cooked food. The association of gastritis with certain foods might be worth further study in view of the apparently greater likelihood of eggs, cheese, and fruit to cause symptoms in patients with gastritis.

With such comparatively small numbers of patients it was impossible to assess the relative importance of constitutional and environmental factors. Whether gastritis is due to involutional changes, cumulative damage to the mucosa, or protracted operation of other factors the relation with age is probably complex. Recurrent acute gastritis (Judd, 1942; Magnus, 1952) or repeated minor traumata (Schoen, 1963; Vilardell, 1963) may cause chronic gastritis, possibly through autoimmune mechanisms, but there is little to support such hypotheses. Although in our patients age was independently as strongly related to gastritis as were some environmental factors, age also appeared to enhance the relation between gastritis and both tobacco and alcohol consumption, possibly owing to the time required for such external factors to cause permanent damage to the gastric mucosa.

The interpretation of the results given in the tables in this paper is difficult, and the difficulties are not reduced by any of the usual procedures of testing statistical significance, since the procedures do not take account of the trend of the observations. There is no doubt that a consistent trend exists. In view of the small numbers various trends might be expected to show up by chance; however, the consistency of those we have found seems unlikely to be wholly fortuitous, and we think that at least some of them must reflect biological variation.

Summary

Constitutional and environmental factors of possible aetiological significance in chronic atrophic gastritis were studied in 221 patients with non-ulcer dyspepsia whose gastric mucosa was

investigated by gastric biopsy. Fifty-five patients (25%) had chronic superficial or atrophic gastritis.

There was no difference between the sexes in the distribution of mucosal changes. The incidence of chronic gastritis rose steadily with advancing age. An increased incidence of gastritis was also associated with blue eyes, low social class, heavy cigarette-smoking, heavy consumption of alcohol, drinking hot tea, and possibly aspirin-taking. These factors appeared to act independently of each other.

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Study of Myocardial Ischaemia in Surgical Patients

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The clinician is concerned about any possible harm which anaesthesia and surgery may do to the patient with ischaemic heart disease.

Retrospective studies (dePeyster *et al.*, 1952; Etsten and Proger, 1955; Arkins *et al.*, 1964; Topkins and Artusio, 1964) have shown that patients who are known to suffer from this disease incur a considerable risk from surgery and anaesthesia, and that the likelihood of and the mortality from myocardial infarction postoperatively are much higher in them than in healthy individuals. It is therefore important to know whether a surgical patient is suffering from ischaemic heart disease. A precise history with clear electrocardiographic (E.C.G.) evidence of infarction may be obtained, but there are many patients in whom the picture is not so definite but who nevertheless may be at risk as a result of a surgical operation. However, the extent to which unrecognized and perhaps subclinical ischaemic heart disease exists in surgical patients passing through a busy hospital is not known. There are practical difficulties in conducting a detailed cardiovascular investigation of every patient, and in the majority of hospitals the most that can usually be done is a fairly rapid assessment by the anaesthetist a day or two before operation. It would therefore be valuable if "markers" could be defined which would indicate those patients who may have ischaemic heart disease, and to whom special attention should be paid by the anaesthetist preoperatively.

Previous studies (Driscoll *et al.*, 1961; Chamberlain and Edmonds-Seal, 1964) have inferred that a comparatively large number of patients develop postoperative E.C.G. changes suggestive of ischaemic damage but short of frank infarction. Associations between ischaemic heart disease and such factors connected with the nature of the surgical operation as the site of operation, hypotension, and the duration of surgery were suggested in those papers. The reported incidence of E.C.G. changes ranged from 17% of general surgical patients to 43% of patients already suffering from clinical or suspected ischaemic heart disease or from severe hypertension. Many of these E.C.G. changes might have been due to minor degrees of ischaemic damage occurring in association with the surgical

operation. In view of the possible value of these findings in terms of ultimate prognosis, it seemed important to examine this matter further.

We therefore decided to carry out a pilot prospective study of our own hospital surgical population to determine the prevalence of myocardial ischaemia or infarction in a defined group of patients and to relate, if possible, any myocardial ischaemic changes to factors connected with the operation. Myocardial ischaemia was judged by E.C.G. and by clinical evidence not only preoperatively but also during operation and postoperatively. As a result it was hoped to define groups of patients which might be studied in more detail.

Method

This study was carried out on all patients aged 35 to 66 admitted to our surgical wards from the waiting-list during a period of four months. Emergencies and patients transferred from other wards were not included. The age range was chosen partly because these patients represent a major numerical section of the surgical work in the Cardiff Royal Infirmary. In addition, the age range extends from younger adults in whom any ischaemic heart disease may be subclinical to older adults in whom it is more likely to be overt. Any relation between surgery and cardiac ischaemia would be expected to make more evident ischaemic heart disease that might otherwise pass unrecognized.

A detailed anaesthetic record of all inpatients anaesthetized has been kept for over 15 years (Mushin *et al.*, 1954), and the data are transferred to Hollerith cards for rapid sorting. It was an easy matter to add to this record not only E.C.G. readings but also certain specially graded factors.

The following are the data to which special attention was paid.

Preoperative Data.—(a) Blood pressure was graded as normal, moderate hypertension (either systolic over 160 mm. Hg or diastolic over 100), or severe hypertension (either systolic over 200 or diastolic over 120). (b) Angina. (c) Previous myocardial infarction and the date of occurrence. (d) Obesity: height and weight tables were used to calculate relative obesity as the percentage deviation from normal (*Documenta Geigy Scientific Tables*, 1962).

Operative Data.—Hypotension during operation was defined as a fall of more than 25% of the preoperative systolic blood pressure

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