are as good in their calcifying properties as those served in children's residential homes to-day, and in few is the intake of cod-liver oil and even milk likely to be nearly so regular or so long maintained. It seems to us, therefore, that the excellent diet given in these homes is responsible for their low caries incidence. The reduction noted since the previous survey five years ago is no doubt partially the result of improvement in dental structure, but it may have been enhanced by the even better diets provided for these children in recent years.

It is a challenging thought that, on the whole, children brought up in orphanages and other public institutions have a better chance of remaining free from caries (at least up to the age of 5 years) than children of the same age brought up in private families.

Summary

The new results given in this paper are compiled from the individual dental charts of a survey in 1950 of 542 children aged 5 years living in homes (orphanages and institutions) and 560 children of the same age attending independent and private day schools, mainly in London and surrounding counties.

These two groups of children are compared with similar groups examined in 1945 and with each other, as regards both dental structure (according to the standards originally set up by May Mellanby) and caries incidence and extent. Reference is also made to surveys among L.C.C. school-children in 1945 and 1949.

Among the children in the homes, tooth structure was found to have improved since 1945, there now being 42.0% of the teeth free from both gross and M-hypoplasia as compared with 32.3% previously. Concurrently there was also a reduction in caries incidence from 10.5% to 7.2%.

The private-school group showed much the same average structure in 1950 as before, while the caries incidence had declined only slightly, 12.7% of all teeth being carious as compared with 14.2% previously.

The average dental structure of the residential-home group still lagged behind that of the private-school children, but the difference between the two groups was not as great as before.

In spite of worse dental structure, the children in the residential homes had a lower caries incidence and extent.

The relationship between dental structure and caries in both groups in 1945 and 1950 was such that the greater the degree of M-hypoplasia the greater was the liability of the teeth to caries, but for each grade of structure the residential-home children had less decay than the others. This relation between structure of the teeth and liability to decay has been observed in all similar surveys where the same standards have been adopted.

In each group of children there was an increase in the amount of dental treatment, both fillings and extractions, but particularly the former. At each inspection the percentage of filled teeth among the private-school group greatly exceeded that among the residential-home children.

Approximately 33% of the children from residential homes showed black or brown staining on their teeth in both years, as compared with only 6.7% and 4.8% in the two groups of the private-school children.

Suggestions are made to account for the differences found in both structure and caries incidence between residential homes and private schools, and for the change occurring between 1945 and 1950.

We would like to put on record our grateful thanks to the many people who have so generously assisted us, and without whose help this survey would not have been possible. Particularly we acknowledge our indebtedness to the medical officers and governing bodies for permission to examine the 5-year-olds in children's homes, and to the superintendents, matrons, and teachers who helped with the actual inspections. In the case of the private-school children we thank sincerely all the principals

and teachers who so willingly gave us time and assistance to further our researches. We also much appreciated the help given by Miss Irene Allen, of the Medical Research Council's Statistical Department.

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POSTERIOR GASTRO-ENTEROSTOMY IN PEPTIC ULCER: LONG-TERM RESULTS

BY

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Gastro-enterostomy in the treatment of peptic ulcer has been the subject of many reports, often conflicting and in recent years seldom favourable. Although to-day abandoned by many, there are still some who champion its cause. In this country Sir James Walton (1950), on careful and complete follow-up of a large series of cases, has found a constant incidence of stomal ulcer of only 2%, but most other workers put the figure much higher, even as high as 40%. The results obtained by Heuer (1944) agree with the experience of the majority of recent writers. In his series of 159 cases followed for periods of 3 months to 10 years (85 followed from 5–10 years) 21.4% developed recurrent symptoms.

In comparing the end-results of gastro-enterostomy and gastrectomy, Heuer found on both short-term and long-term follow-up that the outcome was 10% in favour of gastrectomy; but, as he pointed out, this advantage is reduced by the lesser immediate mortality of gastro-enterostomy. To the debit side of the gastrectomy will have to be added a still undetermined but probably considerable percentage of unsatisfactory results in the form of "small-stomach" syndromes. It is also probably fair criticism of the more extensive procedure that when medical men, and especially surgeons, contemplate operation as a personal issue gastro-enterostomy is given more than fleeting consideration.

With such thoughts in mind, it was felt that a further report on the results of gastro-enterostomy, stressing the long-term results, would be of interest.

Clinical Material

The material in this review consists of 330 patients subjected to gastro-enterostomy for peptic ulceration during the 14 years between January 1, 1924, and December 31, 1937. All cases were under the care of one surgical unit in the Western Infirmary, Glasgow.

All came from Glasgow and adjacent districts. The majority were cases of elective operation. In six cases gastro-enterostomy was performed at the time of closure of a perforation. In two cases gastro-enterostomy with ligation of vessels was performed for haematemesis.

Follow-up

An attempt was made to trace all the survivors and recall them for examination. Altogether 165 patients were traced and were interviewed; 21, now at a distance in the U.K. or abroad, could be contacted only by letter-questionary. With the aid of the almoner, Red Cross workers, and other voluntary organizations, 50 were traced and found to have died. The information available from their records, relatives, family doctors, and death certificates allowed of some assessment, albeit second-hand. The remaining 70, despite all effort, remained untraced. Many of these patients had lived in an area which had suffered from enemy action. The total number of cases traced, including 24 operative deaths, was 260 out of 330—that is, 78.7%. The investigation was carried out during 1948 and 1949.

It is probably inaccurate to claim this study as a follow-up. Recapitulation would be a more apt term, since many of the cases were being seen for the first time 11–22 years after the event. Where patients were known to have reported to other hospitals at home or abroad, information was obtained from these hospitals.

The distribution of the cases by operation year and their appropriate places in this follow-up are shown in Table I. Table II lists the cases according to diagnosis.

TABLE I.—Distribution of Operation Survivors by Year of Operation

Year	Traced Alive	Traced Dead	Untraced	Total
1924	2	2	4	8
1925	6	2	1	9
1926	10	2	6	18
1927	9	1	7	17
1928	12	5	7	24
1929	14	1	4	19
1930	17	5	6	28
1931	22	5	6	33
1932	20	2	6	28
1933	17	7	5	29
1934	21	8	5	34
1935	8	6	5	19
1936	14	0	3	17
1937	14	4	5	23
	186	50	70	306

TABLE II.—Distribution of Operation Survivors by Diagnosis

Diagnosis	Traced Alive	Traced Dead	Untraced	Total
Pyloric stenosis ..	19	7	5	31
Duodenal ulcer ..	156	30	61	247
Gastric ulcer ..	11	13	4	28
	186	50	70	306

Assessment of Results.—The results have been divided into (a) satisfactory—those entirely free from symptoms—and (b) unsatisfactory—those who at any time since operation (1) have had pain of ulcer type; (2) have suffered from haematemesis or melaena; (3) have been treated in hospital for medical or surgical treatment of peptic ulceration; (4) have had x-ray evidence of stomal ulcer or reactivation of the original ulcer.

Grades of Severity.—The cases grouped as unsatisfactory were not all poor results. Many, though not cured, benefited by the operation. Accordingly, these results

were further graded into: (a) severe—pain as severe as or more severe than before operation; those who had complications or who had required further operation because of peptic ulcer. (b) Moderate—pain less severe and more easily controlled by food and alkalis. (c) Mild—pain slight, infrequent, and with dyspepsia (flatulence, heartburn, etc.) which required diet restrictions and alkali therapy amounting to some limitation of the normal mode of life.

Failure Curve.—The onset of symptoms after operation has been dated as accurately as possible. The percentage of unsatisfactory results for each follow-up year for the entire series of patients traced (excluding the immediate post-operative deaths) was calculated and plotted in a failure curve. Similar curves were plotted separately for severe, moderate, and mild relapses. It should be noted that, for this study, any patient who had symptoms which amounted to an unsatisfactory result was considered as such from the onset of the recurrence through the remaining years of follow-up: that is, the curve was charted on the basis "once a recurrence, always a recurrence." There was no modification of the curve for those who, for example, had only four years' symptoms in 18 years of follow-up. Similarly, those cases modified by further surgical or medical treatment were regarded as failures from the onset of symptoms. This method no doubt represents a more gloomy picture than a year-to-year assessment would, but in view of the years that had elapsed since operation it was thought that the more simple method was a sufficient tax on the memory of the patient and limited the scope of his imagination.

Results

The relapse rates for years 1–20 have been calculated, but only those of the first five years and for the 10th, 15th, and 20th years are listed in Table III. The failure curves for total, severe, moderate, and mild relapses are shown in Fig. 1.

FIG. 1.—Incidence of total, severe, moderate, and mild relapses.

TABLE III.—Cumulative Incidence of Relapses

Year of Follow-up	Cases Observed	Percentage Relapses			
		Severe	Moderate	Mild	Total
1	236	8.89	1.27	0.43	10.59
2	228	14.47	4.38	3.95	22.80
3	226	18.14	5.75	7.08	30.97
4	224	17.85	5.81	8.48	32.14
5	221	19.45	6.79	9.05	35.29
10	206	23.30	8.73	11.16	43.19
15	131	25.18	9.22	9.22	43.62
20	40	25.00	17.50	20.00	62.50

It will be seen that the incidence of relapse is most marked in the first five years, 35% having relapsed at the end of that period. Thereafter there is a slower but

steady increase in incidence. In approximate figures it may be said that after a period of between 15 and 20 years 50% have remained symptom-free. Compared with their pre-operative state, 12.5% were markedly improved; 12.5%, though improved, still suffered considerable disability, and 25% were no better or worse. In other words, in 37.5% the results left much to be desired.

Factors Influencing Results

The total relapse rates and the cumulative incidence of severe, moderate, and mild relapses were calculated separately (1) for duodenal ulcer, gastric ulcer, and pyloric stenosis; (2) for males and females; (3) according to age at time of operation; and (4) according to length of pre-operative history.

1. Duodenal Ulcer, Gastric Ulcer, and Pyloric Stenosis.

Of the cases traced, 186 were duodenal ulcer, 24 were gastric ulcer, and 26 were pyloric stenosis. It is necessary to define the last-named group, for there are many degrees of pyloric stenosis and it may be organic or

FIG. 2.—Comparison of total relapses in duodenal ulcer, gastric ulcer, and pyloric stenosis.

spasmodic or both. In this paper cases were assigned to this group when there was x-ray evidence of considerable retention, and when copious vomiting, characteristic of gastric delay, was present. Pain was not a marked feature of these cases. The total relapse rates are compared in Fig. 2. In the duodenal group the relapses mount rapidly to 35% in five years. In the subsequent 15 years a further 27% recur. In the gastric ulcer group the large failure rate in the first five years is partly explained by six cases of carcinoma of stomach, the operation having been performed in the belief that these ulcers were simple. In the group with obstruction, though considerably better, the relapse rate is surprisingly high—approximately 25%. However, it was noteworthy that in cases of pyloric stenosis the relapses

FIG. 3.—Comparison of total and severe relapses in males and females

on the whole were less severe, in marked contrast to the duodenal and gastric ulcer groups, in both of which the incidence of severe relapses was considerable (25% at the tenth follow-up year).

2. *Sex.*—In the series traced there were 200 males and only 36 females. In Fig. 3 the incidence of total and severe relapses is plotted. In view of the disparity of numbers fair comparison cannot be drawn; however, the impression is gained that whereas the total relapse rates are similar the incidence of severe relapses in females is markedly less.

3. *Age at Operation.*—The cases traced were placed in the following age groups: under 30 (44), 30–39 (81), 40–49 (60), and 50 and over (51). The total relapses are compared in Fig. 4. The findings show that the results of gastro-enterostomy are better in the older age groups. Though not recorded in Fig. 4, it was noted that the incidence of mild and moderate relapses was much the same in all age groups. The better results in older patients represent a lower incidence of severe relapses.

FIG. 4.—Total relapse rates according to age group at time of operation.

4. *Duration of Pre-operative Ulcer History.*—In order to study the relation of the end-results to the pre-operative history, the cases have been allotted to four groups, according to the duration of symptoms prior to operation. The number of cases in these groups is as follows: 1–4 years, 66; 5–9 years, 76; 10–14 years, 57; and 15 years and over, 37. The result is shown in Fig. 5, from which it will be seen that the total relapse rates are closely similar in the different groups. Although not shown in Fig. 5, it was noted that the incidence of severe relapses was considerably higher in the 1–4 years group than in the group of 15 years and over. As an example, at the tenth year the short-duration group gave 30% severe relapses compared with 11% in the long-duration group. The better results in the last group

FIG. 5.—Total relapse rates according to years of duration of pre-operative history.

are probably due to the fact that it contains a higher proportion of older patients, of women patients, and of patients with pyloric stenosis. The results in the 5-9 year and 10-14 year groups are similar and intermediate—for example, the severe relapse rates at the tenth year being 27% and 23% respectively.

Incidence of Major Complications, and Late Deaths

Over the total follow-up period, gastro-intestinal haemorrhage occurred in 20 patients (12.2%). There were five perforations in four patients, an incidence of 2.1%. Nine patients (3.8%) found it necessary to undergo further operation for relief of symptoms. Four of the patients already noted as having sustained a haemorrhage also elected to undergo a further operation. Thus the "hard core" of recurrences amounted to 18.1%. Almost two-thirds of these severe relapses occurred within the first five years. No case of gastro-jejuno-colic fistula was encountered in the series traced.

Fifty of the patients traced were found to have died. In the majority the cause of death was unrelated to peptic ulcer. Four patients died from causes directly attributable to peptic ulcer—two as a result of gastrectomy for stomal ulcer, and two as a result of haemorrhage.

In six of the gastric ulcer cases traced the cause of death was carcinoma of the stomach. In only two of these was necropsy performed; in one, malignant change had supervened on a simple gastric ulcer. In the other case necropsy details were not available. Three died within three years, the remainder within five years. Gastro-enterostomy, by leaving the ulcer, carries an immediate risk of mistaken diagnosis and a later risk of malignant change. Carcinoma of the stomach was the cause of death in three cases of duodenal ulcer, death occurring at 10, 12, and 17 years after the operation.

Discussion

The results of this investigation confirm the higher relapse rates reported in the literature. It must be stressed, however, that the method of assessment used has presented the results of the operation in the worst possible light. A year-to-year assessment would no doubt present a more pleasing prospect. Many, though not "cured," were considerably improved. Among those were several who had suffered a complication as an incident in an otherwise uneventful post-operative history. These cases, according to the criteria used, were noted as severe relapses. Similarly, a few cases had a total of only about four years' stomach trouble in as many as 15 follow-up years. Viewed from the vantage-point of "cure" of peptic ulcer by operation, the present results assume a proper perspective. In round figures, after a period of 15-20 years 50% remained symptom-free, and 12.5% whose symptoms were slight were markedly improved. In the remaining 37.5% the operation had failed.

In view of this high failure rate, it seems pertinent to try to obtain a true assessment of the value of the operation. To do so it is necessary to compare the results obtained with those expected without treatment and with those obtained by other methods of operation—for example, gastrectomy. Furthermore, since gastro-enterostomy possesses the cardinal advantage of low initial mortality, the question arises how cases likely to gain permanent benefit by this procedure might be selected pre-operatively.

Comparison with Untreated Cases

Obviously it is not now possible to obtain for study as a control an untreated group of cases strictly comparable with those reported above. Information regarding a somewhat similar group of cases is, however, available from the follow-up studies of Illingworth *et al.* (1946). These studies refer to the progress after perforated peptic ulcer and relate to patients from the same region and of the same social class. The age and sex distribution in the two series are remarkably similar, and by a coincidence the proportion of gastric to duodenal ulcers is almost identical. The two are similar also in that after discharge from hospital their dietary control and anti-acid treatment were generally haphazard. Patients in the gastro-enterostomy group with pyloric stenosis have been excluded, since obstruction is not a factor in the perforation series and would, by inclusion, improve the results of the present series. They differ, of course, in that in the Illingworth series the sole criterion for inclusion was the fact of perforation and in only a small proportion had the symptoms before perforation been severe enough to warrant surgical treatment. These two differences would seem to imply a better prognosis as regards relief of symptoms, and so in comparing the results the scales would be weighted against the present series.

In Table IV the incidence of relapses in the present series and that after perforation are compared at the end of the fifth follow-up year. Fig. 6 shows the year-by-year comparison for the first five years. In Table V and

TABLE IV.—Five-year Relapses: Comparison with Perforation Series

	No. of Cases	Percentage Relapses
Present series	197	36.1
Perforation series (Illingworth <i>et al.</i>)	166	70.0

TABLE V.—Five-year Incidence of Major Complications: Comparison with Perforation Series

	No. of Cases	Percentage Complications
Present series	197	10.5
Perforation series (Illingworth <i>et al.</i>)	166+ (See text)	20.0

Fig. 7 the incidence of major complications is similarly compared. Here, however, it should be noted that Illingworth *et al.* (1946) arrived at their estimate on the basis of 166 patients followed for the full five years, but used additional information from patients followed for shorter periods.

Compared with the untreated group, gastro-enterostomy has halved the relapses and the complications.

Comparison with Cases Treated by Gastrectomy

Though the results reported for gastrectomy vary, it seems clear that recurrent ulceration is infrequent, not more than 4% (Lancet, 1950), and in more extensive ablation of the stomach (Visick, 1948) this complication has been reduced to *nil*. Comparison on this score alone leaves no doubt about which operation is preferable. The position becomes less clear, however, when assessing the importance of those disturbances of alimentary function which are the sequelae of gastrectomy. There is no unanimity in the reported results as regards the incidence, severity, and duration of these complica-

FIG. 6.—Comparison of relapses after gastro-enterostomy with those after perforation.

tions. Muir (1949) found that 75% of patients in his series suffered at some time from the dumping syndrome and that in 34% the patients were considerably handicapped. According to the same author, although this complication sometimes disappeared within three months, not infrequently it persisted for years. That they are better off with their dumping syndromes than with their peptic ulcers is readily admitted by most patients—but not by all (M.D., 1949).

Comparison on the basis of recurrent ulcer is in favour of gastrectomy by a wide margin. How much this margin will be reduced by small-stomach syndromes is as yet unknown.

Selection of Cases for Gastro-enterostomy

The occurrence of good results in at least half the cases has encouraged previous authors to inquire into methods of selection. For example, many surgeons have

FIG. 7.—Comparison of complications after gastro-enterostomy with those after perforation.

advocated the use of gastro-enterostomy, particularly in elderly patients with a long history, in women, and in patients of either sex with severe pyloric stenosis. Reference has been made above to the results to be expected in these different categories of cases.

The pre-operative gastric acidity has been used as a criterion by some surgeons on the hypothesis that stomal ulcer is less likely to occur if the acid level is low. Several workers have found this criterion unreliable. For example, Holman and Sandusky (1938) and Nicol (1942) found little relation between the reduction in the acid concentration and the clinical improvement produced by the operation. High pre-operative and post-operative levels of free HCl were consistent with good results. On the other hand, severe relapses were encountered in patients with low acid levels before and after operation.

Taylor (1944) has based selection on gastroscopic appearances and has succeeded in reducing the incidence of recurrence to a low figure. Where the mucosa is very vascular and the rugae exaggerated, relapses tend to occur after gastro-enterostomy. Gastrectomy is advised in these cases.

Walton (1950) is convinced that certain people are more prone to develop gastro-jejunal ulceration. Such patients tend to develop duodenal-ulcer symptoms early in life; there is a high free acid response to a test meal, and both radiography and gastroscopy reveal hypertrophy of the mucosal folds.

Visick (1948) carefully examined stomachs removed because of recurrent ulcer. Abnormally extensive mucosal folds were not a noteworthy feature.

Conclusion

In gastric ulcer, in view of the high relapse rate and the possibility of mistaken diagnosis and malignant change, the operation of choice is gastrectomy.

In duodenal ulcer, the present investigation suggests that the short-circuit procedure has a place in the elderly, in women, and in organic pyloric stenosis. These factors, however, carry no guarantee of permanent cure. With regard to the large proportion of duodenal ulcers requiring operative treatment, until some means of selection is forthcoming, gastric resection will remain the most certain method of cure, an opinion which may require some modification when the true incidence, severity, and duration of post-gastrectomy syndromes are better known.

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A free booklet, *District Nursing in the Metropolitan Police Area*, gives the names and addresses of all the nursing associations in London. It is available on request from the Central Council for District Nursing, 25, Cockspur Street, London, S.W.1.