It is a striking fact, however, that although by estimation of the CO_2 content of the blood in either of these two types of acidosis there might appear to be a degree equal to that met with when the condition arises spontaneously, yet no symptoms are apparent. It is admitted, of course, that if the doses of the salts of chlorine are enormous, symptoms do arise, but I have seen as severe an acidosis, at least as revealed by CO_2 content of the blood and the amount of acetone in the blood and urine, induced by a ketogenic diet as in many an example of gastro-enteritis or of cyclical vomiting, but I have never seen vomiting and hyperpnoea. Moreover, almost always within a day or two, in spite of a continuation of the ketogenic diet or administration of the drugs (CaCl_2 and NH_4Cl), the degree of the blood changes becomes modified. This brings home to us the remarkable powers of the body in accommodating itself to new conditions, and the completeness of these powers so long as the tissues are healthy. It also demonstrates that the symptoms of acidosis, and the progressive and cumulative nature of the condition as met with clinically, are not so much due to any peculiar pathological process as to the inability of the tissues, in consequence of the effect of disease in general on the cells, to exert their inherent regulating mechanism.

THE TREATMENT OF GASTRIC AND DUODENAL ULCER

A STATISTICAL INQUIRY

BY

A. RENDLE SHORT, M.D., B.S., B.Sc.

F.R.C.S.

SURGEON TO THE BRISTOL ROYAL INFIRMARY

It is useless to discuss the prognosis and end-results of the treatment of these ailments unless there is a clear understanding of what we mean by the terms in question. There was a time, up to, shall we say, 1910, when it was generally supposed that a patient with haematemesis, with or without other symptoms, had an ulcer, and that many patients with intractable dyspepsia had either ulcer or "gastritis." Needless to say, any conclusions as to the value of medical treatment derived from those days are not trustworthy. Then we learned that haematemesis without pain was seldom, if ever, due to an ulcer, or at any rate to an ulcer that a surgeon could demonstrate, but was the result of bleeding from multiple gastric erosions, or, less often, from a single soft acute ulcer. Haematemesis with pain did not necessarily mean peptic ulcer; it might be associated with a tiny, withered-up appendix. Again, it was thought that hunger-pain meant duodenal ulcer, but many fruitless operations revealed that this was also misleading; hyperchlorhydria, often of reflex origin, might give this symptom without any ulcer. There was an unhappy period—up to 1920, or a little after—during which we were all at sea with regard to the diagnosis of gastric conditions; our methods were inadequate, and we no longer believed, as we had done before surgery taught us otherwise, that gastric or duodenal ulcer could be recognized with certainty. In this period, therefore, we get little or no help towards reading the natural prognosis of peptic ulcer, or the end-results of medical treatment. Shortly after 1920, methods of x-ray examination were worked out, perfected, and came into general use, and the study of symptoms and of chemical analyses made advances, so that now the diagnosis can be made with reasonable accuracy, and often with absolute certainty. The time has come at last, by using the material collected since 1920, to form some conclusions as to the prognosis.

RESULTS OF MEDICAL TREATMENT

That cases of gastric ulcer, even when deeply adherent, can and do heal, either spontaneously or with medical treatment, is certain, partly on clinical, partly on post-mortem evidence, the scars being found at necropsy. According to Stewart, 5 per cent. of the cases examined in the post-mortem room at Leeds showed open or healed gastric ulcers. Simple pyloric stenosis nearly always indicates the presence of an ancient healed duodenal ulcer, just as hour-glass stomach means an ancient healed gastric ulcer. It is also certain that chronic gastric and duodenal ulcers, untreated or treated, may lead to fatal haemorrhage or perforation, and that these catastrophes are not infrequent. They are nearly always the result of chronic, not acute, ulcer. Lord Moynihan and Stewart found over a period of twelve years that of 61 cases of fatal perforated gastric ulcer, 60 were chronic ulcer and 1 was acute; of 14 cases of gastric ulcer with fatal bleeding, 13 were chronic ulcer and 1 was acute; and that of 117 cases of fatal perforated duodenal ulcer, 109 were chronic ulcer and 12 were acute. Acute and chronic ulcers were found in 4 cases.

Of 100 cases of chronic peptic ulcer there is no reliable evidence to indicate how many would heal, or bleed, or perforate. At Leeds, out of 96 cases in which death was attributed to gastric ulcer, 68 had perforated; this had occurred in 178 out of 200 cases due to duodenal ulcer. On the other hand, of 164 patients treated at New Lodge Clinic for gastric or duodenal ulcer between 1921 and 1927, only 3 are known to have perforated. The majority of these 164 cases have a long history; cases of perforated ulcer usually give a history of less than a year, so that the true incidence of perforation must be higher. It is the anterior ulcer that perforates into the general peritoneal cavity, whereas the long-standing ulcer is usually on the lesser curvature or posterior wall. According to Hurst, Moynihan, and Balfour, about 20 to 25 per cent. of cases of gastro-duodenal ulcer bleed. At Guy's Hospital, during the period 1911 to 1920 (Conybeare), 600 cases of haematemesis were admitted, and the mortality was about 2.5 per cent. Crohn of New York gives 94 cases treated medically, with 4 deaths; but Bulmer, at Birmingham, mentions 526 cases with 67 deaths, or 12.7 per cent.

In regard to recent statistical evidence relating to the results of medical treatment for gastric and duodenal ulcer, the following studies are available. The medical treatment adopted was, generally speaking, rest in bed, a milk diet, and alkalization.

Einhorn and Crohn, writing in 1926, present the results of a careful follow-up of 100 cases. One year after treatment, 67.5 per cent. were cured, and 22 per cent. were better; four years after treatment, 27 per cent. were cured, and 23 per cent. were better. Their statistics show very little difference between gastric and duodenal ulcers.

David Smith gives the immediate results in 214 cases treated between 1913 and 1922 as follows: 67 per cent. of the males "cured," 2 per cent. dead; 76 per cent. of the females "cured," 5 per cent. dead. In cases observed five to fifteen years later, 29 per cent. of the males were "cured," 19 per cent. were dead; while the corresponding figures for females were 40 per cent. and 15 per cent. The percentages were calculated on the original number of cases.

Forman, at Guy's Hospital, studying a series of 41 cases five years after treatment, found 22 per cent. of the patients well, 20 per cent. better, and 57 per cent. no better. Franklin White, in a series of 206 private cases followed up from three to five years, reported that 30 per cent. of the gastric patients were well and 24 per cent. better; while 57 per cent. of the duodenal patients were well, and 21 per cent. better. Of the gastric cases,

42 per cent. of the patients came to operation, and 4 died under medical treatment; of the duodenal cases 4 per cent. of the patients were no better, and 18 per cent. came to operation.

Barford, studying the late results of all the 160 cases treated at the New Lodge Clinic since 1921 (the diagnosis therefore being as accurate as possible), found that of the gastric cases (about 30) 39 per cent. were quite satisfactory, 13 per cent. fairly good, and that one-third had relapsed. Of about 130 duodenal cases, 41 per cent. were very satisfactory, 28 per cent. fairly good, and there was recurrence in 24 per cent., about half of these being ultimately operated upon. R. Hutchison comments: "Considering that these results were obtained in private patients treated under the best conditions, they must be regarded as disappointing."

Enthusiastic physicians often claim that they can see large deep gastric ulcers heal in a few weeks under x rays. There is a serious fallacy here. Large, deep ulcers on the leg do not heal so readily; why should gastric ulcers? After a jejunostomy for an ulcer too big to resect, months or years are necessary before it heals. I have myself operated on cases of ulcer supposed to have healed as shown by disappearance of the crater in the skiagram, and found the ulcer as large as ever.

The principal factor determining the probability of cure in any particular patient is the duration of symptoms. Nielsen believes that if relapse is going to take place it will nearly always occur within two years; he therefore made a study at the end of two and a half years after medical treatment, to see how patients with ulcers of various durations had fared. The results are given below.

Duration of Symptoms	Cured (per cent.)	Better (per cent.)
6 months	60	17
½ to 1 year	54	17
1 to 3 years	37	21
3 to 5 years	20	27
5 to 10 years	11	11
Over 10 years	5.3	17.6

We conclude, therefore, that given the best medical treatment, three out of four cases of gastric or duodenal ulcer, probably more, will become symptom-free. Only 40 per cent. of the patients will remain well, and from 15 to 19 per cent. will be dead in about ten years. Early cases do well, long-standing cases badly.

Obviously, every patient without mechanical obstruction ought to have a fair trial of medical treatment, but it is also clear that there comes a time when surgery is called for in a substantial minority of the patients.

RESULTS OF SURGICAL TREATMENT

We are, fortunately, in possession of unusually reliable information on this subject, thanks to the report drawn up by a physician, Dr. Luff, of the Collective Investigation, by the British Medical Association, into the After-History of Gastro-enterostomy, published in 1930.

Reports of 2,609 operations, performed by 86 surgeons—the after-results being for the most part reported by the family doctor—were sent in. These should at least be fair, and represent the work, not of a few picked surgeons, but of the rank and file—as seen not by themselves, but by others. Besides, the records are not vitiated by too early reporting; the operations were performed between the years 1920 and 1924, and the figures were collected in 1928. The general results may be gathered from Table I.

TABLE I.—*B.M.A. Collective Investigation: After-History Results of Gastro-enterostomy*

	Duodenal	Pyloric	Gastric Ulcer	Hour-glass Stomach
Cases	995	454	538	65
Males	83.6%	72.4%	66.2%	15.1%
Females	16.4%	27.6%	33.8%	84.6%
Operative mortality	5.0%	2.6%	8.9%	12.3%
Good recovery ...	91.5%	95.4%	90.5%	84.6%
Delayed recovery ...	3.5%	2.0%	0.6%	3.1%
Results.				
Very good	67.2	76.3	74.3	83.7
Good	22.3	16.2	16.1	7.0
Fair	5.1%	4.1%	5.4%	7.0%
Poor	5.4%	3.4%	4.2%	2.3%
Secondary gastro-jejunal ulcers	2.8%	0.9%	0.8%	—
Secondary haemorrhage	2.4%	1.2%	1.0%	—
Secondary haemorrhage fatal	0	0	0	—
Post-operative cancer	0	0	2 doubtful cases	—

As Lord Moynihan pointed out, the term "pyloric ulcer" is not a very satisfactory one; probably these ulcers are nearly all of duodenal origin. It will be observed that for both gastric and duodenal ulcer the good results are about nine out of ten, and the failures 5 per cent. The alarmist statements of certain Americans as to the frequency of gastro-jejunal ulcer are discounted; it was recognized only in 3 per cent. of the duodenal cases, and in 1 per cent. of the gastric cases. There was no known instance of secondary cancer among the duodenal and pyloric cases, and only two, both open to doubt, after gastric ulcer. Diarrhoea was reported to be slight in about 5 per cent., and severe only in 0.5; constipation was commoner. Patients returned to work within three months in 73 per cent. of the duodenal cases and in 75 per cent. of the gastric; more than 90 per cent. were able to return to full work.

Lord Moynihan has analysed the figures to determine the difference between a mere gastro-enterostomy and a gastro-enterostomy combined with removal or infolding of the ulcer (Tables II and III).

TABLE II.—Percentage Mortality According to Treatment

Operation	Duodenal Ulcer	Pyloric Ulcer	Gastric Ulcer
Gastro-jejunostomy with removal or infolding of ulcer ...	1.8	1.3	4.6
Gastro-jejunostomy only	5.7	2.5	11.4

TABLE III.—Percentage of "Very Good" Results According to Treatment

Operation	Duodenal Ulcer	Pyloric Ulcer	Gastric Ulcer
Gastro-jejunostomy with removal or infolding of ulcer ...	81.2	72.4	81.7
Gastro-jejunostomy only	61.5	44.7	50.9

The report presents some surprises. The death rate is too high; in the best hands it is less than half that given in the report. It was generally thought that the end-results of operation for gastric ulcer, apart from big resections, were not nearly as good as for duodenal ulcer, but these figures reveal little difference, except a rather higher operation mortality.

The results of the inquiry have been criticized by physicians, notably A. F. Hurst, on the grounds that many cases were lost sight of, and perhaps did badly, and that four to eight years is not a sufficiently long period to give true end-results. This may be admitted, but the general experience is that our successes pass right away from us, and our failures hang around our necks for ever, so there is no reason to believe that the lost cases did worse than those followed up. If there is to be a controversy about end-results between the physician and the surgeon, is it not probable that a more extensive observation period will disconcert the former at least as much as the latter by bringing to light some late relapses?

Turning to the results of individual surgeons, or particular hospitals, we have to take into account the nature of the operation performed. Those coming under consideration are: gastro-jejunostomy only; gastro-jejunostomy with local excision of ulcer; pyloroplasty; partial gastrectomy.

The following tables, culled from recent publications, give representative results in England, America, Russia, Germany, Rumania, France, and Hungary.

TABLE IV.—Mortality of Gastro-jejunostomy for Gastric and Duodenal Ulcer

	Cases	Mortality per cent.
A. Gastric and duodenal ulcer:		
Paterson	499	0.8
Coffey	375	2.4
Solkov and Iljin	1022	3
Sawkoff	617	3.2
Schwarz: Anterior	203	20
Posterior	65	10.8
Total	273	17.5
Tanasesco	170	4
De Takats	270	5.8
B. Duodenal ulcer:		
Sherren	763	2
Walton	172	2.3
Fremont Smith and McIver (some infolding of ulcer)	393	6
G. Gastric ulcer:		
Sherren	620	4.6
Walton (+ wedge excision)	67	3
Fremont Smith and McIver (often + infolding or excision)	251	9

TABLE V.—End-results of Gastro-jejunostomy

A. Gastric and Duodenal Ulcers	Cases Followed	Quite Well (per cent.)	Better (per cent.)	Poor (per cent.)
Paterson	447	78	14	8
Solkov and Iljin	580*	71	3.6	2.6
Sawkoff	327	63	13	18
Schwarz	221	53	14	35
Coffey	305	73	14	4
De Takats	270	53	22	28

* Figures given do not tally. Many died of unconnected causes.

B.	Cases Followed	Better	Not Better	Died Since
Walton:				
Duodenal ulcer	157	146 (88.4%)	7	4
Gastric ulcer	66	59 (92%)	4	3

TABLE V (continued).

C.	Cases Followed	Quite Well	Mild Symptoms	Poor Result
Fremont Smith and McIver:				
Duodenal ulcer	261	66%	15%	19%
Gastric ulcer	151	69%	12.5%	18.5%
D.	Cases Followed	Quite Well	—	—
Sherren:				
Duodenal ulcer	500	92%	—	—
Gastric ulcer	403	78%	—	—

Gastro-jejunostomy

English surgery is represented by the writings of J. Sherren and of A. J. Walton of the London Hospital, published in 1928, and of H. Paterson, published in 1927. Sherren used gastro-jejunostomy in all cases of duodenal ulcer operated on, and in most cases of gastric ulcer; large, deep, adherent gastric ulcers were treated by partial gastrectomy. His statistics represent cases followed up for two or more years. Walton treats gastric ulcer as a routine by a wedge excision plus gastro-jejunostomy. Paterson, unlike the great majority of surgeons, practises an anterior gastro-jejunostomy by itself for both duodenal and gastric ulcers. The results relating to operation mortality are given in Table IV, and those relating to end-results, collected some years later, in Table V. It will be observed that the death rate is a good deal lower than that recorded in the Collective Investigation, that Walton's end-results are about the same, but that Paterson's and Sherren's, for gastric ulcer, are not so good, which may be attributed to leaving the ulcer behind.

Fremont Smith and McIver, writing from Boston, made a special study of the later end-results. They found that there was little difference between the gastric and duodenal cases. The proportion of poor results rose from 10 per cent. after one year, 15 per cent. after four years, to 20 per cent. after six years, but fell to 14 per cent. after ten years. Coffey also represents American surgery.

Solkov and Iljin report a huge series of Russian cases extending over many years, gastro-jejunostomy being performed almost to the exclusion of resection or excision operations. Another similar series is given by Sawkoff, also of Russia. These cases were published in 1927 and 1928 respectively. The immediate mortality was low, but the end-results poor, with many deaths from unconnected causes. This is not surprising in view of social conditions in Russia. German figures, given by Schwarz of Rostock, are truly dreadful, and can scarcely represent the best surgery in that country. The operation mortality at Jassy (Rumania), given by Tanasesco in 1928 (rather complicated by the inclusion of a certain number of resections, etc.), is much the same as in England, as are the French results published by Gosset and Loewy (also mixed with a few resections).

De Takats of Budapest shows a death rate of 5.8 per cent., but agrees with other Central European surgeons that the end-results are bad; only half the patients are really well, and in 28 per cent. the sequel was disappointing. It may be that food habits in America and on the Continent are more conducive than those in the British Isles to recurrence of ulcer symptoms, but there is a strange difference, which can scarcely be due to varying methods of appraising the results, between the 25 per cent. of bad results abroad, as compared with only 5 per cent. in this country. Balfour, at the Mayo Clinic, has published the end-results of gastro-jejunostomy in 100 doctors suffering from duodenal ulcer. There were 90 who were

quite well, 5 better, and 5 no better—a singular resemblance to the British figures.

Pyloroplasty

For many years at Finney's clinic it has been maintained that pyloroplasty is a more physiological treatment for gastro-duodenal ulcer than gastro-enterostomy. The comparative results, for a series of patients operated on between 1900 and 1925 at the Johns Hopkins and Union Memorial Hospitals, were found in 1929 to be as follows:

TABLE VI.—Results following Gastro-enterostomy and Pyloroplasty for Duodenal Ulcer

	Gastro-enterostomy	Pyloroplasty
Number of cases	95	139
Died within six months	16 (16.6%)	8 (5.8%)
Not traced	15	25
New total	65	106
Living:		
Improved	54	91
Unimproved	4	11
Dead:		
Causes related to original condition ...	2	0
Causes unrelated to original condition ...	5	4
Improved by operation	59 (90.8%)	95 (89.6%)
Not improved by operation	6 (9.2%)	11 (10.4%)

It will be observed that, as far as the end-results are concerned, the benefits of gastro-enterostomy and of pyloroplasty are practically identical, but that at this clinic there is a high post-operative mortality, mostly from obstruction, after gastro-jejunostomy. This does not accord with the experience of others (see the figures of the British Medical Association Inquiry).

Resection Operations

The large proportion of poor end-results, and certain theoretical considerations, have led most of the prominent American and Continental surgeons, and some British, to advocate big resection operations for both gastric and duodenal ulcers. It has been maintained by Lewisohn, for instance, that gastro-jejunal ulcer, a most unpleasant complication which usually needs a second serious operation and even then may relapse, follows gastro-enterostomy for duodenal ulcer in as many as 34 per cent. of the cases, in his experience. English surgeons put it at less than 4 per cent. Digby Chamberlain, searching the records of Lord Moynihan's cases over twelve years, reported after a two-year interval that he had found 1.8 per cent. of gastro-jejunal ulcers. Walton admits 3.4 per cent. Sherren had 29 cases of secondary ulcer out of 903 followed up for two years or more (0.4 per cent.). I do not know of a case following my own gastro-duodenal operations, though I have treated a good many patients who had been operated on by others. The B.M.A. Collective Inquiry brought to light 2.8 per cent. of cases of gastro-jejunal ulcer after an anastomosis operation for duodenal ulcer.

More serious even than gastro-jejunal ulcer is gastro-jejuno-colic fistula, which is usually fatal in spite of treatment. Fortunately it is quite rare. Only two cases, both originally operated on elsewhere, have come under my care.

There has been some difference of opinion as to the frequency with which a carcinoma may develop in an old ulcer of the stomach. According to Wilson and McCarty of the Mayo Clinic (1910), 71 per cent. of their cases of cancer of the stomach started in ulcer, and 68 per cent. of the resected ulcers showed commencing malignant

changes. Obviously, if this were true, gastro-jejunostomy without excision of a gastric ulcer would more often than not be followed by the development of a cancer, and resection ought to replace short-circuiting. This is contrary to all sound experience. It is true that, at the same clinic, Balfour found that there was a rather high death rate during the first few years following gastric operations—three times that of the general population—and in 40 per cent. these deaths were due to cancer. On the other hand, most pathologists discount the theory that there is a very great risk of cancer in cases of gastric ulcer. Stewart of Leeds found that of 70 cancers, 11 (or 15.7 per cent.) arose in ulcer, and of 180 chronic ulcers resected, 11 (or 6 per cent.) showed cancer in the margin. Most surgeons, myself included, have seen cases of ulcer excised which unexpectedly displayed early cancer on histological examination; and, again, most surgeons have seen a few, but only a few, of their patients with gastric ulcer treated by gastro-jejunostomy return with a cancer. The figures published are as follows: Paterson (1914) 1 per cent.; Rehlfuss (1924) 1.2 per cent.; Exalto (1918) 2 per cent.; Anschutz and Konjetzky (1920) 3.3 to 6.9 per cent. In the B.M.A. Collective Report there were only 2 cases among 538 followed up, and both of these were doubtful. Cancer never develops on the site of a duodenal ulcer.

We may conclude, therefore, that a simple gastro-jejunostomy may be followed by gastro-jejunal ulcer in about 4 per cent. of the cases, and by cancer in, say, 2 per cent. If the surgeon contented himself with a mere anastomosis, even in cases of thickened and adherent ulcer, the latter figure would probably be nearer 10 per cent.

Turning now to the results of partial gastrectomy for gastric ulcer, recent publications are summarized in the appended tables. The B.M.A. Collective Report is here somewhat misleading; only 101 gastrectomies are included, with a death rate of 6 per cent. (which is very reasonable), but only 63.6 per cent. showed "very good" results. Lord Moynihan remarks that he himself had had far more gastrectomies than 101, with excellent end-results.

English surgery is represented by Garnett Wright, Morley, and Lake, whose mortality figures vary from 3 to 9 per cent. Bastianelli of Rome has lost only 1.5 per cent. Louria, reporting from von Haberer's clinic at Graz, Austria, records 150 cases resected by the Billroth I method, with 6 per cent. of deaths, and 134 by the Billroth II method, with 11 per cent. In Finsterer's clinic at Vienna, of 175 resections for gastric ulcer, 4 per cent. of the patients died; and of 357 resections for duodenal ulcer, 2 per cent. died. Schwarz of Rostock has again a high mortality, 18 per cent., and de Takats of Budapest reports 226 cases with 5.4 per cent. of deaths. The general mortality, then, in good clinics, is from 4 to 10 per cent.

TABLE VII.—Mortality of Resection Operations for Gastric Ulcer

	Cases	Mortality (per cent.)
Garnett Wright	62	4
Lake	65	9
Morley: Pólya method	47	6
Schoemaker	68	3
Bastianelli	137	1.5
Schwarz	210	13
Von Haberer—Billroth I	150	6
Billroth II	134	11
Finsterer	175	4
De Takats	226	5.4

TABLE VIII.—Results of Resection Operations for Gastric Ulcer

	Cases Followed	Excellent (per cent.)	Fair (per cent.)	Poor (per cent.)	Died Since (per cent.)
Morley	82	74	12	5	9
Lake	51	98	—	2	—
Garnett Wright	44	75	13	2	8
Friedemann—Billroth I	221	78.5	17	4.5	—
Billroth II	153	80	15	5	—
De Takats	226	84	10	6	—
Schwarz	161	90	7	3	—
Von Haberer	54	83	17	—	—

The "follow-up" works out as follows. The three English authors have 75 to 98 per cent. of "excellent" results, and 2 to 5 per cent. of failures. De Takats and Schwarz have 84 to 90 per cent. "excellent," and 6 to 3 per cent. poor. Friedemann finds no difference between the end-results after Billroth I and Billroth II operations; both give about 80 per cent. of "excellent" results, and 5 per cent. of failures. In von Haberer's clinic, also, the perfect results are about 83 per cent. We may summarize the whole by regarding 80 per cent. as perfectly well, and 5 per cent. as unrelieved.

Comparing these figures with those of gastro-jejunostomy, with or without excision or destruction of the ulcer, the confident claims that have been made out for better end-results following resection seem to lack proof. The mortality is much the same as that given for gastric ulcer in the B.M.A. Report on gastro-enterostomy; the failures are about the same, and over against 80 per cent. of "excellent" results after resection, we have 74 per cent. "very good" and 16 per cent. "good." In expert hands, of course, the death rate after gastro-enterostomy is less, say 3 per cent. Admittedly, on the Continent and in America, gastro-jejunostomy has been much less successful.

There is, however, another aspect of the question to be considered. It is well known that patients with pernicious anaemia have usually an underlying achlorhydria. It has been stated by A. F. Hurst and others that an artificial achlorhydria induced by removal of the acid-bearing area of the stomach occasionally induces a grave anaemia. One such case has occurred in my own practice. The matter has been investigated by Gordon Taylor and collaborators, and also by Morley. In the series of 52 gastric resections investigated at Gordon Taylor's clinic some degree of secondary anaemia was found in 44 per cent., but it produced no symptoms. Of Morley's 115 cases, 16 were found to have become anaemic (that is, haemoglobin below 60 per cent.): He concludes that the Pólya operation carries with it a serious liability to future anaemia; with the Schoemaker method this is less marked.

The special danger following gastro-enterostomy, therefore, is gastro-jejunal ulcer; and the special danger after a big resection is a serious anaemia. Occasionally, gastro-jejunal ulcer follows a partial gastrectomy (0.6 per cent. in 2,310 operations—von Haberer).

Treatment of Large Gastric Ulcers

The very large gastric ulcer, often adherent to the liver or pancreas, requires special consideration. A simple gastro-jejunostomy is not likely to cure, though quite good results are often obtained when there is a large adherent mass at the pylorus, with a deep ulcer in the middle of it. Local excision with gastro-enterostomy is difficult and dangerous for a large, deep ulcer of the

posterior wall of the stomach. If partial gastrectomy is possible, it is the best treatment, especially as there is always a danger of malignancy with this type of ulcer. If it is too large for resection, the choice lies between cholecysto-gastrostomy, in the hope that the bile will neutralize the gastric juice and promote healing, and a jejunostomy to allow of direct feeding into the jejunum instead of the stomach. We have no adequate statistical evidence to enable us to judge of these procedures. According to Frenkel, the result of cholecysto-gastrostomy was good in 83.6 per cent. of 68 cases in Bogoras's clinic.

Excision of Duodenal Ulcer

A number of surgeons have tried to improve the end-results in cases of duodenal ulcer by resecting the first part of the duodenum. Many surgeons, of course, make a small incision and cut out an anterior duodenal ulcer in the course of performing a gastro-enterostomy, but this is a simple matter compared with resection of the first part of the duodenum.

Pannett declared that resection is possible in 71 per cent. of his cases, that the mortality is only 4 per cent., and that it cures 85 per cent., whereas in his hands gastro-jejunostomy cures only 55 per cent. At von Haberer's clinic, where a partial gastrectomy is used for duodenal ulcer, according to Louria, 8.4 per cent. of the patients died, and of 107 cases followed up, 83 per cent. were excellent, 16 fair, and 5 poor (2 developed a gastro-jejunal ulcer). At Finsterer's clinic, of 357 cases, 2 per cent. of the patients died.

At the Mayo Clinic, according to Judd and Nagel, a smaller operation has often been performed; in the first series a simple excision of the ulcer, in a later series combined with removal of the front of the pyloric sphincter. The results were as follows:

In 140 cases of simple excision of ulcer there were 4 deaths. Of 108 patients followed up, 57 per cent. were cured and 24 per cent. were better, failure resulting in 19 per cent.

Of the series of 85 cases of excision of ulcer with partial resection of the pylorus 2 patients died; and of the 58 followed up 60 per cent. were cured, 32 per cent. showed improvement, and 7 reported failure.

It does not appear that any of these results are better than those of a simple gastro-jejunostomy.

CONCLUSIONS

1. Until about ten years ago the diagnosis of gastric and duodenal ulcer, unless verified by perforation, operation, or necropsy, was so precarious that the older statistics of medical treatment are untrustworthy.

2. Spontaneous healing can undoubtedly occur, and is not infrequent. Perforation and haemorrhage are marks of the chronic rather than the acute ulcer. About 25 per cent. of cases of peptic ulcer bleed. Perforation is common in ulcers of the anterior wall and usually occurs within a year or two of the onset; only a few, under 3 per cent., of ulcers of the posterior wall, of long standing, perforate.

3. The medical treatment of gastro-duodenal ulcer, in the best clinics, gives good immediate results. At least 75 per cent. become symptom-free. Only 40 per cent. remain so. From 15 to 20 per cent. of the patients will die within ten years. If the duration of symptoms was under a year, more than half the patients remain well; over a year, far fewer.

4. Obviously, therefore, efficient medical treatment should have a good trial. Equally obviously, a considerable number of the patients ought eventually to be operated on. Mechanical obstruction, or a large, deep ulcer that may be malignant, demands early operation.

5. The mortality and end-results of gastro-jejunostomy are set forth fairly, in an adequate number of cases treated by rank-and-file surgeons, followed up for at least four years, in the B.M.A. Collective Report. The operation mortality for duodenal, pyloric, and gastric ulcer was 5, 2.6, and 9 per cent. The follow-up, for both gastric and duodenal ulcer, showed 90 per cent. of successes (75 per cent. perfect) and about 4 per cent. of failures. Secondary gastro-jejunal ulcers followed in 2.8 per cent. of the duodenal and 0.8 per cent. of the gastric cases. Subsequent cancer was rarely, if ever, reported.

6. Individual English surgeons report a lower mortality (1 to 2 per cent. in duodenal and 3 to 4 per cent. in gastric cases). End-results are about the same as in the Collective Report, except that when a gastric ulcer is not removed the cure rate is at least 10 per cent. lower.

7. Continental and American results for gastro-jejunostomy are, for some reason not well understood, far less satisfactory. The mortality is about the same as in the Collective Report, but only 50 to 70 per cent. are cured, and 20 to 30 per cent. do badly.

8. Pyloroplasty gives results very similar to those of gastro-enterostomy.

9. Partial gastrectomy is advocated, to avoid gastro-jejunal ulcer or cancer, and to obtain a larger percentage of cures. Gastro-jejunal ulcer in England follows gastro-jejunostomy in 0.4 to 3.4 per cent. of the patients operated on. Cancer follows in about 2 per cent. of the cases. After partial gastrectomy, gastro-jejunal ulcer follows in about 0.6 per cent. of cases. Some anaemia may result from an extensive gastrectomy—mild in nearly half, serious in perhaps 10 per cent.; in a few cases, quite severe.

10. The operative mortality of partial gastrectomy for gastric ulcer is from 4 to 10 per cent. Excellent results are obtained in about 80 per cent.; poor results in 5 per cent.

11. Except in cases of large, deep, adherent gastric ulcers, which call for a resection, the results of partial gastrectomy for gastric ulcer are no better than those of simple gastro-enterostomy, in spite of a doubled operation mortality. They are not as good as those of gastro-enterostomy with wedge excision of the ulcer. This apparently does not hold good on the Continent or in America, owing to the poor results following gastro-jejunostomy in those countries. The end-results of this operation on 100 doctors at the Mayo Clinic, however, accord well with the figures obtained by English surgeons.

12. In cases of duodenal ulcer, partial gastrectomy or duodenectomy gives results no better than those of the B.M.A. report on gastro-jejunostomy, and the mortality is higher. Local excision of the ulcer, by itself, gives poor results (57 per cent. cured, 19 per cent. no better). Local excision with partial resection of the pyloric sphincter is better, but not as good as gastro-jejunostomy.

13. The deductions for treatment are: (a) If mechanical obstruction is not present, and cancer can be excluded with confidence, efficient medical treatment ought to be given a fair trial. (b) If it fails, or recurrence takes place, operation is indicated. For gastric ulcer the best operation is gastro-enterostomy with local removal of the ulcer. If the ulcer is large, deep, and adherent a partial gastrectomy is often better. (c) For simple pyloric stenosis, gastro-jejunostomy is best. It is safe and satisfactory. (d) For duodenal ulcer, gastro-jejunostomy is the best treatment. If the ulcer is readily accessible it should be excised.

It is a trite saying that statistics can be made to prove anything. It may be desirable to add, therefore, that the conclusions we have drawn from our statistical study coincide exactly with my own experience of the results of medical and surgical treatment of gastric and duodenal ulcer.

BIBLIOGRAPHY

- Hurst and Stewart: *Gastric and Duodenal Ulcer*, 1929.
Moynihan: *British Medical Journal*, 1928, ii, 1021.
Conybeare: See Hurst and Stewart.
Crohn: *Affections of the Stomach*, 1927.
Bulmer: *Lancet*, 1927, ii, 168.
Einhorn and Crohn: *Amer. Journ. Med. Sci.*, 1926, ii, 691.
Smith, David: *British Medical Journal*, 1928, ii, 293.
Forman: *Ibid.*, 1927, i, 926.
Franklin White: *Boston Med. and Surg. Journ.*, 1926, cxcv, 986.
Barford: *Guy's Hospital Reports*, April, 1928, 127.
Nielsen: *Acta med. Scand.*, 1923, lviii, 1.
Luff: *British Medical Journal*, 1929, ii, 1074, 1125; 1930, i, 348.
Moynihan: *Ibid.*, 1930, i, 458.
Paterson: *Med. Press and Circular*, November, 1927, 385.
Coffey: *Journ. Amer. Med. Assoc.*, July, 1928, 1.
Sherren: *Lancet*, 1924, i, 477.
Solkov and Iljin: *Nov. Chir. Arch.*, 1927, xiii, 368.
Sawko: *Rev. de Chir.*, 1928, 353.
Schwarz: *Arch. f. klin. Chir.*, August, 1928, 280; September, 445.
Tanasesco: *Bull. et Mém. Soc. Nat. de Chir.*, July, 1928, 935.
De Takats: *Amer. Journ. Med. Sci.*, July, 1926, 45.
Walton: *British Medical Journal*, 1928, ii, 784.
Fremont Smith and McIver: *Amer. Journ. Med. Sci.*, January, 1929, 33.
Gosset and Loewy: *Presse méd.*, June, 1929, 797.
Finney: *Annals of Surgery*, November, 1929, 904.
Balfour: *Ibid.*, November, 1927, 691.
Wilson and McCarty: *Amer. Journ. Med. Sci.*, 1909, cxxxviii, 846.
Garnett Wright: *Brit. Journ. of Surg.*, October, 1928, 253.
Balfour: *Annals of Surgery*, 1919, lxx, 522; 1922, lxxvi, 405.
Morley: *Brit. Journ. of Surg.*, October, 1928, 239.
Lake: *Lancet*, 1928, ii, 268.
Bastianelli: *Arch. Ital. di Chir.*, 1928, i, 22.
Louria: *Surg., Gynecol. and Obstet.*, October, 1928, 493.
Finster: *British Medical Journal*, 1926, ii, 557.
Von Haberer: *Zentralbl. f. Chir.*, January, 1930, 66.
Friedemann: *Ibid.*, 1927, liv, 3015.
Gordon Taylor: *Brit. Journ. of Surg.*, April, 1929, 641.
Frenkel: *Arch. f. klin. Chir.*, December, 1928, 407.
Pannett: *Lancet*, 1927, i, 966.
Judd and Nagel: *Surg., Gynecol. and Obstet.*, July, 1927, 17.

CONVULSIONS DURING SURGICAL ANAESTHESIA

NOTES ON A SERIES OF CASES*

BY

J. ROSS MACKENZIE, M.D.

LECTURER ON ANAESTHETICS, UNIVERSITY OF ABERDEEN; ANAESTHETIST,
ROYAL HOSPITAL FOR SICK CHILDREN, AND ROYAL INFIRMARY,
ABERDEEN

The convulsions in these cases must not be confused with ether clonus. They are generalized, epileptiform convulsions, commencing in most cases on the left side of the face and rapidly affecting the whole body. The movements may become so violent that the surgeon is compelled to discontinue the operation, and in some cases the patient has had to be protected against personal injury. Seven cases have come under my observation, and the salient features which characterize this alarming and serious complication of surgical anaesthesia will be narrated.

The subjects of these convulsions were all young people. They occur at a time in life when the central nervous system is very unstable, and therefore very vulnerable. They all had a temperature and a rapid pulse. They were all suffering from an acute septic condition with general toxæmia. In two cases a haemolytic streptococcus was found in the discharge, and in one case in the blood. In the seven cases ether, unheated,¹ formed part of the anaesthetic agent during the induction or maintenance of anaesthesia, and the convulsion appeared after the operation was well under way.

Appended are brief notes of the first, fourth, fifth, and sixth cases.

The first case occurred in March, 1926. It was of special interest to me as I had, until then, never seen anything of the kind during surgical anaesthesia.

A female, aged 5, very ill with an acute abdomen. Temperature was 102.6°, pulse rate 130. Atropine sulphate

* Delivered to the Aberdeen Medico-Chirurgical Society on January 15th, 1931.