constriction such as Dr. Charles Mayo has recorded and which led him to prefer the anterior operation.

This operation is well borne. In my view the most important points in the technique are: first, such infiltration anaesthesia as to give satisfactory relaxation; second, sound closure of the duodenum; third, great care in suture of the stomach to the jejunum with small suture gaps; fourth, a watchful haemostasis throughout. In the cases recorded the post-operative recovery was free from complications, from undue shock, from haemorrhage, and from vomiting. The post-operative treatment is as follows: Sterile water is given at once and the patient is encouraged to suck formalin tablets—they allay thirst and keep the mouth clean; on the second day milk, sterilized and alkalized; on the third day an egg, beaten up and divided, is added, and on this day medicine is started for the purpose of controlling the activity of the gastric juice—it contains bismuth carbonate, magnesia ponderosa, and tinctura belladonnae. As the diet is increased powders are given in addition, consisting of calcium carbonate and magnesia.

This operation is the one to be chosen in inveterate penetrating gastric ulcer. Whether it is feasible in a given case cannot be decided until the abdomen is opened. Probably in 10 or 15 per cent. of the cases in which it is desirable it will prove to be not feasible. Some alternative will then have to be adopted. The real alternative is a transgastric operation (excision, or cauterization, or suture, or a combination of these), together with gastro-jejunostomy. If the stomach is so fixed that a posterior gastro-enterostomy is difficult, there is the valuable alternative of pyloroplasty—Finney's operation. This operation, which I should perhaps call gastro-duodenostomy, aims at relieving stasis and modifying the chemistry of the gastric secretion, as does gastro-jejunostomy.

The best contribution to the study of the treatment of gastric ulcer, whether that treatment be surgical or medical, is the collection of careful records. We want to appreciate the immediate risks of operative procedures, the early results, the late results. We want to know much more as to the persistence of the favourable results that are claimed for methods of medical treatment. Impressions and opinions are of little value to the argument; the question requires the same kind of handling as a laboratory problem, and similar methods of recording and analysing results.

THE TREATMENT OF PERFORATED GASTRIC AND DUODENAL ULCER.

BY

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THE treatment of perforated gastric and duodenal ulcer is entirely surgical, and the prognosis largely depends on the time when operation is performed. Recovery is contingent on early diagnosis and prompt surgical treatment, for delay almost inevitably leads to a fatal termination. During a period of two years I operated upon a consecutive series of 46 cases of acute perforated gastric and duodenal ulcer at the Manchester Royal Infirmary. Four patients died following the operation, giving an operation mortality of under 9 per cent.

There is still considerable difference of opinion as to whether an ulcer which has perforated will, after operation, give rise to further trouble, and whether gastro-enterostomy is necessary. I have endeavoured to throw some light on this question by following up the after-histories of the cases in this series. The following are the details of the cases:

Sex and Age.

Forty-four of the patients were males and two females. It is remarkable to note the preponderance of the male sex. The youngest patient was 19 years of age, the oldest being a man of 71. The greatest number of perforations occurred between 30 and 60 years of age.

History of Previous Indigestion.

This could be elicited in most cases. In four patients perforation was the first sign, no previous gastric disturbance being present. In a considerable number of the duodenal cases the symptoms of previous indigestion were very slight.

Situation of the Ulcer.

Forty of the ulcers were duodenal or pyloric in situation. In only five cases were the ulcers found to be gastric. There was, in addition, one case of perforated gastro-jejunal ulcer.

Hours Perforated and Operative Results.

The time that had elapsed before operation is shown in the following table, together with the mortality rate:

Hours Perforated.	Duodenal Perforations.			Gastric Perforations.			Total Mortality.
	No. of Cases.	Died.	Mortality.	No. of Cases.	Died.	Mortality.	
1-12 hours	24	0	Nil	1	1	100 %	4 %
12-18 ..	6	0	Nil	—	—	—	Nil
18-24 ..	4	0	Nil	3	1	33 %	14 %
Over 24 ..	6	2	33 %	1	0	Nil	28.6 %
Total ...	40	2	5 %	5	2	40 %	9 %

This does not include one case of perforated gastro-jejunal ulcer which recovered.

Mortality.

Four patients died following operation, giving an operative mortality of 8.7 per cent. for the series of 46 cases. Thirty-four cases of perforated duodenal ulcer were operated upon within twenty-four hours and all recovered. Six were operated upon after this period and four recovered; the patients who succumbed were both in poor condition when submitted to operation, and died in thirteen and eighteen hours respectively following operation, from shock. Of the five cases of gastric ulcer, two died subsequently from pulmonary complications. One died on the fifth day following operation from acute oedema of the lungs, the second succumbed on the tenth day after operation from bronchopneumonia. Autopsies were held on both these cases. The ulcers were found to be large chronic spreading ulcers near the pyloric end of the stomach. Microscopical examination showed that both the ulcers were malignant, one being a glandular carcinoma, whilst the other was a spheroidal-celled carcinoma.

Death occurred in one of the patients subsequently from acute appendicitis. He had made an uneventful recovery following a perforated duodenal ulcer and had been discharged from hospital. He was readmitted shortly afterwards with a perforated appendix, and died following operation for this condition. All the remaining cases are, to the best of my knowledge, alive at the present time.

OPERATIVE TREATMENT.

Immediately the diagnosis of perforated ulcer has been made laparotomy should be performed without delay. Time should not be spent in attempts to improve the patient's condition; shock can best be relieved by early operation, and a successful result depends essentially on prompt treatment.

The technique of the operation is now so well known that it requires no special description. The perforation is closed with fine thread sutures passed at some distance from the edges of the ulcer. In cases of duodenal perforation the sutures are passed from side to side and thereby avoid narrowing the lumen of the gut. When tightened these infold the ulcer and a piece of omentum is then turned up and stitched over the suture line. I have always found it possible to close the ulcer successfully by suture. Any method other than suture must be attended with a high mortality owing to the danger of leakage.

The peritoneal cavity is carefully swabbed out with gauze swabs wrung out of very hot saline. Some surgeons advocate irrigation in preference to swabbing, but irrigation adds the diffusion of the extravasated material and increases the risk of subphrenic abscess.

The operation lasts twenty minutes, rarely longer, and subcutaneous saline may be administered whilst it is in progress with advantage. Drainage is seldom employed. In perforation of under eighteen hours' duration it is never necessary. After twenty-four hours when there is gross soiling it may be advisable. This is best done through a suprapubic stab incision and the tube removed as soon as possible.

After-Treatment.

The Fowler position is adopted as soon as the patient is returned to bed; rectal salines are given at four-hourly intervals for two days. For the first forty-eight hours the patient is only permitted small sips of water by the mouth; fluids in increasing quantities are given later. An enema is given daily, no purgative being allowed till the seventh day. The stomach is thus kept at rest as far as possible, and opportunity given for the healing of the ulcer to start. After discharge from hospital the patient is instructed to take a careful diet for six months. Sodium bicarbonate should be taken regularly for a time, as this appears to diminish any tendency to hyperchlorhydria, and defective teeth are attended to. This post-operative treatment, so often neglected, undoubtedly assists in obtaining satisfactory results after operation.

Should an Immediate Gastro-enterostomy be Performed?

There is at the present time no general agreement among surgeons as to the advisability and need for performing a gastro-enterostomy simultaneously with the closure of the perforation. Some surgeons advocate that this should be done as a matter of routine in all cases; but it is only by a comparison of the results and experience of different surgeons that the necessity or otherwise of this procedure can be determined.

Perforation of a gastric or duodenal ulcer is an acute crisis, and a successful result depends essentially on early and rapid operation. However quick the surgeon may be no increased risks are allowable, and time should not be spent where it can be avoided. The actual performance of the operation should occupy as short a time as possible, for prolongation must add to the shock and thereby increase the risk to the patient's life.

Lewisohn,¹ who is an advocate of primary gastro-enterostomy, says that the operative recoveries are not impaired by the extra loss of time involved. He, however, admits that a Murphy's button should be used in acute cases "to save undue lengthening of the operation." This contrivance has long since been discarded in England, on account of its dangers and disadvantages. Surely if he has to adopt this means to shorten the operation it were best to leave the gastro-enterostomy until a later date.

Paterson² states that he invariably performs a gastro-enterostomy after closure of the perforation, and thereby greatly improves the patient's immediate chance of recovery. He states that a number of patients die shortly after operation for perforation, either from perforation of a second ulcer, haematemesis, or leakage along the line of suture, and the mortality from these causes is 11 per cent. He considers that these deaths should, to a great extent, be prevented by a primary gastro-enterostomy. I submit these complications should be largely avoidable by making a careful search for a second ulcer and by care in suturing, whilst fatal haemorrhage following simple suture must be a rare event and is not unknown after a gastro-enterostomy. Further, Moynihan³ has shown that even after a gastro-enterostomy a chronic duodenal ulcer may perforate, so that a gastro-enterostomy does not necessarily exclude this risk.

In ulcers situated near the pylorus it is asserted that narrowing will be produced by the suturing, causing subsequent stenosis and recurrence of the symptoms. If the suturing has been carefully carried out this does not often appear to be the case, as I have proved by radiological examination of a number of cases at a later date. Even if some stenosis is produced this does not persist, and we know that attempts to produce occlusion of the pylorus often fail when that object is desired. Again, an immediate gastro-enterostomy is said to simplify the after-treatment and feeding, but I have experienced no difficulty from this cause, and recovery has usually been straightforward and given no anxiety.

It must be allowed that disappointments following gastro-enterostomy are not unknown, even when performed by the best surgeons and with the most approved technique. A gastro-jejunal ulcer is one of those unfortunate complications which occur in a small percentage of cases. Though doubtless a rare occurrence—perhaps 1 to 2 per cent. of all gastro-enterostomies—the possibility must always be taken into account.

In the following case it is reasonable to assume that the man might have recovered with simple suture of the perforation and been able to lead a useful life, but instead his condition is far from satisfactory.

The patient, a male, aged 34 years, whilst on duty in France in May, 1917, was suddenly seized with acute abdominal pain. He was operated upon about three hours later at a casualty clearing station, where he was found to have a perforated duodenal ulcer. This was sutured and a gastro-enterostomy performed. He made a satisfactory recovery, and was placed on home service.

In February, 1919, he was admitted to the Manchester Royal Infirmary with symptoms of a perforated ulcer. The notes of the operation, which was performed by Mr. Alan Roberts, the assistant resident surgical officer, state: "A small perforation (peptic ulcer) found just beyond gastro-enterostomy; fluid in pelvis; ulcer sutured. Scar of old ulcer seen near pylorus; no drain." He was discharged from hospital four weeks later.

Just before midnight on June 2nd, 1920, he was again admitted with a third perforation. I operated immediately, and found a perforation on the line of the anastomosis. This was closed in the usual manner. He made an uninterrupted recovery, and went home on June 23rd.

Walton⁴ advocates that a gastro-enterostomy should always be performed simultaneously with the closure of the perforation, except when the patient is very ill. In 51 recorded cases treated by this method he gives a mortality of 35.2 per cent. and states that this figure is admittedly high. Pfeiffer and Deaver⁵ are also advocates of a primary gastro-enterostomy, and in their paper quote statistics to support this view. They assert that the mortality is not increased by this procedure if it is carried out quickly and not attempted in cases obviously shocked. They urge that gastro-enterostomy is the acknowledged treatment for an ulcer in the pre-perforative condition, and so should be combined with suture after perforation. There is, however, a considerable difference between the chronic duodenal ulcer for which a gastro-enterostomy carried out as a routine operation usually gives most satisfactory results, and the type of duodenal ulcer which undergoes acute perforation.

It is, I think, now generally recognized that there is a variety of acute perforating duodenal ulcer which, when treated by inversion and simple suture, may be followed by a permanent recovery and no subsequent symptoms make their appearance; whereas a second type of ulcer, treated on similar lines, may be followed by a persistence of symptoms which can only be relieved by a further operation. One must admit that it is difficult to find a satisfactory explanation of this fact, owing to our lack of real knowledge of the cause of gastric and duodenal ulcer.

An ulcer is probably produced by the action of bacterial toxins, or, as Mayo⁷ has suggested, by a localized thrombosis or infarction emboli of bacteria, causing a lowering of the resistance of the mucous membrane, which then undergoes digestion in the presence of the gastric juice.

Now certain cases of ulcer, particularly the small and soft type of ulcer, will under careful medical treatment heal; and, again, other cases after perforation and simple suture may show no evidence of ulcer when examined at a later date. To explain the mechanism whereby some cases fail to heal under the above conditions it is suggested that there is some accessory factor present which prevents healing and leads to a continuation of symptoms.

What this additional factor may be is at present unknown; it may depend on some abnormal condition of the gastric juice, or perhaps it is dependent on some product of bacterial activity.

It appears probable, then, that there is a type of acute perforating ulcer, more commonly found in the duodenum, which, when put at rest by infolding and suture, combined with careful diet, will result in healing. If an ulcer can heal under these conditions—and that this may happen is shown by the evidence of healed scars—it is surely better to leave the stomach in its natural condition without the added complication of a gastro-enterostomy; whereas if the ulcer should subsequently prove to be of the unhealable type, a gastro-enterostomy can be performed with greater safety at a later date to relieve the symptoms. As is subsequently shown, a gastro-enterostomy does not appear to be necessary in a large proportion of cases.

The Need for Secondary Gastro-enterostomy.

It has already been pointed out that there are a number of cases which appear to heal after suture and give rise to no further symptoms, and it is only by carefully following up the after-histories in these patients that it is possible to tell what the ultimate result will be in each case. With this object in view I have followed up the after-results in the 37 surviving cases of perforated duodenal ulcer in this series treated by simple suture. The period that has elapsed since operation varies up to two and a half years. In four of these cases a secondary gastro-enterostomy became necessary at a later date.

Twenty-eight patients have for periods up to two years remained free from any gastric disturbance. Five patients suffer from symptoms of digestive discomfort; these have been so slight and their general condition is so satisfactory that further treatment has not been considered necessary. Twenty-four of these patients have been readmitted to hospital, at different periods after their operation, for radiological examination of the stomach and duodenum. This has been kindly carried out for me by Dr. J. B. Higgins, radiological registrar to the Royal Infirmary.

The x-ray examination was carried out with special reference to the condition of the stomach itself, whether there was any evidence of delayed emptying, and if any degree of pyloric obstruction or spasm was present.

The report of the radiologist has been identical in twenty-two cases. He states: "The stomach empties satisfactorily, and there is no delay in emptying. The food passes the duodenum normally, and there is no obstruction." Some irregularity of the duodenum was noticed in several of the cases. In two cases he reports: "The stomach was atonic and the duodenum was not satisfactorily filled." The first of these cases has been free from indigestion since his operation. The second keeps well unless he eats a heavy meal; then he feels some discomfort and flatulence.

A study of the after-histories of cases of perforated duodenal ulcer treated by simple suture shows that in the series under review 90 per cent. of cases required no further operative treatment. Apart from the cases already mentioned, no patient had reported himself as having relapsed up to the time of this record. In 10 per cent. of cases a secondary gastro-enterostomy was necessary on account of recurrence of gastric disturbance; the results of this operation have been completely satisfactory.

These four cases all gave a history of indigestion extending over a prolonged period, and at the operation were found to have chronic ulcers. The symptoms of indigestion recurred within a few months after perforation. It would appear from this that cases giving a long history of indigestion are less likely to show a permanent cure after simple suture than cases with a short history and mild symptoms.

Subsequent Treatment in Cases of Perforated Gastric Ulcer.

The after-treatment in these cases requires special consideration. It is undoubtedly a fact that perforated gastric ulcer is a more serious condition than perforation of a duodenal ulcer, both as regard its immediate and remote results.

Of the five cases of gastric perforation which came under my care two were proved to be malignant at necropsy and microscopic examination. A third case appeared malignant at operation and was in poor condition when he left hospital; he was alive two months after operation, but has not been heard of since that time. The fourth case, a female with perforation of a large chronic ulcer in the anterior stomach wall, still suffers from pain after food, but refuses further operation.

The last case has written to me recently from Birmingham, where he was in hospital under treatment. He had a perforation of the anterior stomach wall about one inch in diameter, and had suffered from indigestion for years. He states that he still suffers from flatulence and vomiting, and it would appear as if some further operative treatment will be necessary. It is not within the scope of this paper to discuss the relationship of ulcer and carcinoma of the stomach, but it must be realized that the types of ulcer found in the stomach and duodenum differ widely.

The duodenal ulcer is often a simple, small, punched-out ulcer, whilst the gastric ulcer may be a large chronic and spreading area. Further, the fact that a malignant ulcer of the duodenum is almost unknown, whereas the malignant ulcer of the stomach is of comparatively common occurrence, must be remembered. It is suggested, therefore, that it might be safer to regard all large and chronic ulcers of the stomach as potentially malignant, and treat them as such at a later date by some form of excision wherever practicable. This would be more likely to produce a permanent cure than a gastro-enterostomy alone, which operation is often unsatisfactory for this condition.

REFERENCES.

¹ *Annals of Surgery*, November, 1910. ² Paterson, *Surgery of the Stomach*. ³ Moynihan, *Abdominal Operations*, vol. i. ⁴ Jacobson, *Operations of Surgery*, vol. ii, sixth edition. ⁵ *Lancet*, 1922, vol. i, p. 270. ⁶ *Annals of Surgery*, April, 1921. ⁷ *Annals of Surgery*, March, 1921.

IN the United States during 1920 lethargic encephalitis was given as a cause of death on 1,505 death certificates, a death rate of 1.7 per 100,000 of the population; in New York State 364 deaths from this cause were reported, a death rate of 3.5 per 100,000 of the population.

A RECENT report issued by the United States Public Health Service announces the demonstration of an anaerobic organism producing a soluble toxin which affects animals in a manner similar to that of the botulism organism, but is not neutralized by polyvalent botulinus antitoxin. The organism apparently differs markedly from the botulinus isolated in the United States, and is possibly more nearly related to the European type described by von Ermengem in 1912, although it differs from this in certain respects.

HEREDITARY MICROPTHALMIA.

BY

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In presenting the following history of a family affected with hereditary microphthalmia I will refer to statistics in order that the prevalence of congenital blindness may be appreciated. The most recent reference is in an article on "Cause and prevention of blindness," by Mr. Bishop Harman, in the *BRITISH MEDICAL JOURNAL*.¹ Of the total number of cases of blindness between 3 and 4 per cent. are congenital; Magnus, in Germany, found 97 cases in 2,528 cases, or 3.83 per cent.; Trousseau, in France, 3.04 per cent.; Dumont, in the Paris Blind Asylum, 3.7 per cent.; Oppenheimer, in New York City, 3.84 per cent. In the United States of America, according to the census of 1890, of 50,411 blind, 4,267, or 8.46 per cent., were recorded as congenitally blind.

Heredity and Consanguinity.

In the eleventh U.S.A. census 43,326 blind persons reported 8,342 blind relatives—that is, 19.25 per cent. had such relatives; whilst of 4,156 congenital blind, 1,608, or 38.7 per cent., had blind relatives. From this it appears that the proportion of blind relatives was twice as great amongst the congenital blind as amongst the blind from all causes.

Mr. Bishop Harman, referring to congenital defects, says: "A few are hereditary—that is to say, the same defect is found repeatedly in the same family for two or more generations."

The influence of consanguinity was investigated by Trousseau,² who reached the conclusion that, "independent of heredity, consanguinity does not play any rôle in the production of blindness." Magnus also holds that there is no proof that consanguinity is a cause of blindness.

That heredity is a cause of blindness seems certain, as the cases which I am reporting go to prove. The diseases of the eye which are most frequently transmitted from parent to offspring are:

Malformation—for example, coloboma of iris and choroid.
Microphthalmia.
Persistence of the pupillary membrane.
Congenital cataract and amblyopia.
Nystagmus.
Albinism and retinitis pigmentosa.

These may be transmitted in the same or like form. It is, perhaps, not out of place to mention here that myopia is frequently hereditary. Motais, quoted by Trousseau,³ stated that 67.5 per cent. of cases of myopia are hereditary.

The accompanying genealogical tree of the "H." family,

which goes as far back as the great-grandmother, shows that amongst thirty-four traced members there are eleven cases of congenital blindness. I was unable to obtain any definite history of members of the family farther back than the great-grandparents. All the affected members are males, the condition being transmitted through healthy females, as in haemophilia; the children of male members of the family are normal. In that branch of the family in which I have been particularly interested it will be noted that of four boys three are blind from congenital microphthalmia, whilst the twin brother of one of the boys is normal. The one female child is normal. The father and mother of this branch are normal persons. In fact, the parents of all the blind children throughout the family are apparently normal individuals. There is no evidence of consanguinity in the family and no history or evidence of syphilis. One of the boys of the "H." family is an epileptic; all the other children are free from congenital or acquired disease apart from microphthalmia.

One of the boys in the "H." family has been for some time in a blind institution. His report for last term states:

"Distinct speaker. Intelligent. Excellent memory and no mannerisms. Self-control good. Intends to study music. Eye report: Congenital microphthalmia."