THE SCIENCE COMMITTEE OF THE British Medical Association.

REPORT CXIV.

TWO CASES OF JEJUNAL ULCER FOLLOWING GASTRO-JEJUNOSTOMY,

IN ONE OF WHICH GASTRIC ANALYSES WERE MADE BEFORE
AND AFTER OPERATION FOR JEJUNAL ULCER.*

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NOTWITHSTANDING all that has been written in recent years on the subject of gastro-jejunostomy, there remains at least one problem in connexion therewith in need of further investigation and elucidation. The fear of the possible occurrence of a jejunal ulcer still casts a shadow, faint, it is true, over the otherwise admirable results which follow this operation when performed in appropriate cases. It is of the utmost importance that all instances of this condition should be published, in order that we may have all the available material from which to draw conclusions as to the etiology of this condition, as to the best methods of preventing it, and of treatment should it occur:

The notes of the following case which has been under my care are of interest, as it is, so far as I can gather, the first case in which an attempt has been made to obtain an accurate analysis of the gastric contents, and of the fluid escaping from a jejunal fistula before and after operation for ulcer of the jejunum.

CASE I.—*Anterior Gastro-jejunostomy for Pyloric Stenosis: Perforation of a Jejunal Ulcer Five Years later: Resection of Affected Portions of Jejunum, and Anterior Gastro-jejunostomy "en Y."*

H. I., married, aged 47, was admitted into the London Temperance Hospital on August 21st, 1902, under the care of my colleague, Dr. Soltan Fenwick, suffering from pain after food, vomiting, and loss of flesh.

The patient stated that she had always been healthy until two years previously, when she began to suffer from pain after food, which gradually increased in severity, and she had lost 3 st. in weight. For one year she had suffered from vomiting, usually two or three times weekly, large quantities of undigested food being brought up. On admission the patient was much wasted and weak, and weighed 6 st. 5 lb. instead of 9½ st. The stomach was markedly dilated, the lower border reaching a handbreadth below the umbilicus. There was constant visible peristalsis and a marked succussion splash. At the level of the umbilicus close to the outer border of the right rectus muscles there was a hard movable lump rather larger than a walnut. There was a marked free hydrochloric acid reaction in the stomach contents after a test breakfast, and also in the contents of the fasting stomach. Lactic acid was not present. Dr. Fenwick thought that the dilatation of the stomach was due to cicatricial stenosis of the pylorus, and asked me to see the patient with a view to operation. The patient declined to have anything done, and left the hospital on August 27th. On September 6th the patient returned, looking a good deal worse, and stating that she had been vomiting constantly. She had lost over 4 lb. in weight, and now readily consented to operation.

First Operation.

On September 8th I opened the abdomen. The stomach was large and much hypertrophied. In the region of the pylorus was a densely hard mass, about the size of a walnut, and situated mainly in the posterior wall. There were no adhesions and the lump was freely movable. Anterior gastro-jejunostomy was performed by means of a single layer of Halsted sutures, the opening made measuring 2 in. The pylorus was explored from within, and a dense, almost complete, stricture was found. The patient made an uninterrupted recovery, and left the hospital three weeks later. This was one of my earlier gastro-jejunostomies, and I must admit at the operation I thought the pyloric lump to be malignant, and I proposed to reopen the abdomen, remove a portion of the lump for microscopical examination, and if, as I anticipated would be the case, the lump were malignant, perform partial gastrectomy. Clearly I was wrong in my opinion, but fortunately the patient felt so well that she declined to have any further operation.

* Part of a paper read before the Surgical Section of the Royal Society of Medicine on May 11th, 1909. The expenses of the investigations referred to in the course of the paper were defrayed by a grant from the Science Committee of the British Medical Association.

After-History.

Two years later—in August, 1904—I saw the patient again. She then told me that she had never had a day's illness or pain of any kind, and that she was able to eat ordinary food. She looked a different being, and weighed 9 st. 4 lb., a gain of over 3 st. The abdominal wound was soundly healed, and no trace of the pyloric lump could be felt.

On August 13th, 1907, the patient was readmitted into the hospital. She stated that ever since the operation she had enjoyed excellent health. Two years before readmission she began to have some pain after food, but the pain was not severe and did not cause her much inconvenience. During the previous nine months the pain had increased, nevertheless she continued to eat all kinds of food—cheese, tinned foods, etc. For three months she had noticed a lump forming in the abdominal wall above the umbilicus. On August 13th the skin over the lump gave way, and much yellowish fluid escaped. She was seen by Dr. Percy Edmunds, who at once sent her into the hospital.

The patient looked exceedingly well, and had become very stout, and weighed over 12 st. Midway between the umbilicus and the ensiform cartilage, immediately to the left of the middle line, was an aperture in the abdominal wall, with shelving indurated edges, from which escaped a turbid yellowish fluid apparently containing bile. Around the aperture there was considerable induration, and the skin for some distance around was much thickened. A diagnosis of perforated jejunal ulcer was made. As the patient was so well nourished, I thought that it would be advisable to postpone operation with a view to getting the skin into a more healthy condition, and also to reducing the gastric acidity, and rendering the intestinal contents sterile by keeping her on an exclusively milk diet. This period of waiting was utilized to make a series of examinations of the gastric contents, and of the fluid escaping from the fistula. The examinations were as follows:

August 20th. Test breakfast. One hour later stomach contents drawn off, 110 c.cm.

Total acidity, 85.	
Total chlorides	0.433
Free HCl	0.072
Protein HCl	0.208
Mineral HCl	0.153

During the digestion of the test breakfast and for half an hour later the fluid escaping from the fistula was collected and analysed, with the following result:

Total chlorides	0.405
Free HCl	0.044
Protein HCl	0.175
Mineral HCl	0.186

On August 27th, after patient had been on a milk diet for a week, the analysis of the gastric contents was as follows:

Total acidity, 80.	
Gmelin's reaction absent.	
Total chlorides	0.361
Free HCl	0.018
Protein HCl	0.187
Mineral HCl	0.146

At the same time 60 c.cm. of fluid was collected from the fistula.

Gmelin's reaction present.	
Total chlorides	0.372
Free HCl	0.004
Protein HCl	0.092
Mineral HCl	0.276

September 3rd 70 c.cm. fluid collected from fistula.

Total acidity 60.	
Total chlorides	0.401
Free HCl	0.004
Protein HCl	0.109
Mineral HCl	0.292

Second Operation.

On September 5th, 1907, an oval incision was made through the skin around the fistula, and carried downwards through the fasciae and muscles. The peritoneum was cut through in the middle line well below the fistula, and a finger introduced into the peritoneal cavity. The jejunum was found adherent to the abdominal wall for some distance on either side of the fistula. The fistula was plugged with gauze, and the peritoneum carefully cut through clear of the area adherent to the jejunum. It was then apparent that the fistula led directly into the efferent limb of the jejunum 1 in. below the site of the anastomosis with the stomach; 6 in. of jejunum, including the perforated ulcer and the skin attached to it, were resected. After separating the jejunum from the stomach, the opening in the stomach measured 1 in. by ½ in. This opening was enlarged, and the distal end of the jejunum implanted into it; the proximal end of the jejunum was implanted into the side of the jejunum 4 in. below the anastomosis with the stomach. Both anastomoses were performed by means of two continuous sutures. Great difficulty was experienced in suturing the abdominal wound, as after removal of the fistula and dense hard tissue around it there was a considerable interval between the edges of the wound. It is interesting to note that all trace of the pyloric lump felt at the first operation had disappeared.

After-History.

The patient made an uninterrupted recovery, and on October 12th, after a test meal, 150 c.cm. of gastric contents were drawn off and analysed.

Total acidity, 59.	
Gmelin's reaction absent.	
Total chlorides	0.302
Free HCl	0.007
Protein HCl	0.164
Mineral HCl	0.138

She left the hospital in excellent health on October 12th, weighing 9 st. 13 lb.

I did not see the patient again until August 26th, 1908. She then told me that she had remained quite well until a month previously, when she began again to suffer from pain in the epigastrium bearing no relation to food. On passing a tube in the early morning the stomach was found empty. After a test meal 40 c.cm. of gastric contents were drawn off, containing a good deal of mucus and some blood.

Total chlorides	...	...	...	...	0.430
Free HCl	...	...	...	...	0.032
Protein HCl	...	...	...	...	0.317
Mineral HCl	...	...	...	...	0.080
No lactic acid.					

In view of the recurrence of hyperacidity and the presence of blood in the stomach I feared the recurrence of ulceration. When the patient left the hospital I had advised her never to take meat again, a warning which she had disregarded. I again cautioned her as to her diet, and prescribed bismuth and alkalis. The patient so strongly objected to the use of the stomach tube, and was so alarmed at the sight of blood in the gastric contents that she discontinued attendance for some months, so I lost sight of her again, although I heard indirectly that she was better.

In February, 1909, I saw her again. She was then much better although occasionally she suffered from attacks of pain, usually coming on during the night, accompanied by an acid taste in the mouth, and not bearing any relation to food. Her weight was 10 st. 12 lb. There was no tenderness of the abdomen, the abdominal scar remained soundly healed, and the patient looked in excellent health. On bismuth and hydrocyanic acid she quickly lost her pain, and I believe that if only she would be more careful in her diet, she would remain well.

In a few of the recorded cases the total acidity of the gastric contents was estimated before operation, and in still fewer the amount of free hydrochloric acid, as estimated by Topfer's method, is noted. The estimation of free HCl by this method, however, is very inaccurate, and the amount of total acidity includes both organic and inorganic acids. The important point, it appears to me, is the amount of free hydrochloric acid present in the gastric contents, and this is well illustrated in the case just related. On admission into the hospital for the second time, the free HCl in the gastric contents was 0.072 per cent., more than three times the normal amount. The percentage of free HCl in the fluid escaping from the jejunal fistula—that is, in the jejunal contents—was 0.044, or more than double the amount normally present in the stomach. This observation appears to me of considerable significance with regard to the etiology of jejunal ulcer. Here we had evidence of the presence of a fluid rich in free HCl in a portion of intestine normally unused to the presence of acid contents. That under such circumstances ulceration should ensue is not surprising. The analysis of the gastric contents after a week on milk diet showed a very different state of affairs. The percentage of free HCl was then only 0.018, or just about normal, and the percentage of free HCl in the jejunal contents had diminished from 0.044 to 0.004. From these analyses we may, I think, draw the following inferences:

1. That the presence of an ulcer in the jejunum was connected with the large percentage of free hydrochloric acid present in the jejunal contents.

2. That as the high percentage of free hydrochloric acid in the gastric contents rapidly diminished to a normal amount on a milk diet, the excess of free hydrochloric acid in this case was probably due to errors in diet.

3. That the bile and pancreatic juices in the jejunum usually neutralize the free hydrochloric acid which escapes from the stomach. When, however, free hydrochloric acid reaches the jejunum in great excess, the alkaline juices are insufficient to neutralize all the free hydrochloric acid present.

Incidentally I may point out that although after a week on a milk diet the amount of free HCl had diminished by nearly two-thirds, the total acidity had diminished only from 85 to 80. This illustrates how little information Topfer's method gives us as to the amount of inorganic acids present in the gastric contents.

ASE II.—Anterior Gastro-jejunostomy (May, 1899) for Pyloric Stenosis supposed to be Malignant: Recurrence of Pain Five Years later: Seven Years later Separation of Adhesions round Jejunum: Good Health until March, 1908: Death in September, 1908.

Anterior gastro-jejunostomy by means of a Murphy's button was performed by the late Mr. Walsham in May, 1899, on a man aged 69 years suffering from pyloric stenosis, which was thought to be malignant. He remained well for nearly five years, but

then began to suffer constant pain after food. He was sent to see me by Dr. Howard Distin, who thought that the pain was due to the irritation of the Murphy button, which, so far as was known, had never been passed. The patient's weight was 8 st. 6 lb., a gain of 3 st. since the operation. The stomach was somewhat dilated, and just above the level of the umbilicus there was a rounded induration in the left rectus muscle.

Under medical treatment the patient improved and remained well until the beginning of 1906, when he began to suffer severe pain in the left side, with occasional attacks of vomiting. I saw him again in July. He looked thinner and more careworn than when I last saw him, and he had lost 2 st. 4 lb. In the left rectus muscle was a tender nodular swelling about the size of a small Tangerine orange. A test meal showed the presence of free hydrochloric acid, a trace of lactic acid. An x-ray photograph did not show the presence of a button in the stomach.

Operation.

On July 20th I reopened the abdomen. There were adhesions at the pyloric end of the stomach. The pylorus was markedly stenosed, but all trace of the former tumour had disappeared. The anastomosed loop of jejunum was firmly fixed to the anterior abdominal wall for a distance of 2 in. There was considerable induration of the jejunal wall as if there existed, or had existed, an ulcer of the jejunum which had resulted in the adhesion of the jejunum to the abdominal wall. The separation of these adhesions would have involved an extensive operation, which I did not think justifiable in view of the patient's age. The other adhesions were divided, and the abdominal wound sewn up.

After-History.

The patient remained well until March, 1908, when his appetite began to fail. He suffered no pain, but he vomited occasionally. I saw him again in July. The stomach was then considerably dilated, and there was marked stomach splash. It was evident that the stomach was not emptying itself properly. With occasional lavage he improved for a time, but later his strength gradually failed, and he died in September, 1908.

Through the courtesy of Dr. Distin I was able to examine the abdominal viscera. On opening the abdomen an interesting state of things was found. The stomach was enormously dilated and flabby. High up towards the cardiac end the button could be plainly felt loose in the cavity of the stomach. The anterior wall of the stomach had been drawn downwards and backwards, so that the site of the anastomosis was posterior rather than anterior. Although an anterior operation with a long loop had been performed, the length of the afferent limb from the ligament of Treitz to the junction with the stomach now measured 4 in. only, and it emerged from under the colon near the splenic flexure. Until a careful examination had been made it was difficult to believe that an anterior and not a posterior operation had been performed. The stomach was distended with formalin and examined at a later date. When the stomach was opened I found that the anastomotic opening was much contracted and admitted only the tip of the little finger, and was surrounded with a considerable amount of indurated tissue. In the jejunum just below the anastomosis the mucous membrane was puckered as if the site of an old ulcer, and microscopical examination showed old chronic inflammation. The pylorus was indurated and almost completely stenosed, so that its lumen was diminished to the size of a cedar pencil.

This case bears out a view I expressed some years ago—that, after the anterior operation, the afferent limb, although at the time of operation it is drawn up round the colon, becomes later displaced outwards so that it emerges from under the colon at or near the splenic flexure. Nature thus appears to protect the afferent loop from the influence of the excursions of the movable part of the transverse colon.

REPORT CXV.

THE CARBON MONOXIDE METHOD OF DETERMINING THE TOTAL OXYGEN CAPACITY AND THE BLOOD VOLUME IN ANIMALS:

WITH SOME EXPERIMENTS ON ANAEMIA AND TRANSFUSION.

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THE carbonic oxide method of determining the total oxygen capacity and the blood volume described by Haldane and Lorrain Smith¹ has been applied to experiments on rabbits. Using the apparatus previously described by Douglas,² we find that this can be done with a considerable degree of accuracy.

1. In a series of experiments, we have withdrawn from or added to the circulating blood of a rabbit a quantity of