

THE FUNCTION OF THE GASTRO-ENTEROSTOMY OPENING IN CASES OF PERMEABLE PYLORUS.*

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WHAT becomes of the gastrojejunal mouth and how does it work in case of a permeable pylorus? Such are the two points to which I wish to draw attention.

I. *Does the gastro-intestinal mouth obliterate anatomically in case of patulous pylorus?* Kelling,¹ in Germany, suggested that in cases where the pylorus is free, the gastro-intestinal opening might be subject to anatomical obliteration in consequence of the fact that the chyme passes through the pylorus and does not pass through the artificial opening. His opinion has been accepted in France by Tuffier,² Reynier,³ Jaboulay,⁴ Mathieu,⁵ Ricard,⁶ and is almost general.

Personally, I disagree with this opinion, being unwilling to admit that the anastomosis thoroughly lined by a mucous membrane and free from any scar tissue should become obliterated merely because of its non-use. This would be against all the rules of general pathology.

When we refer to the cases of anatomical obliteration of the gastro-intestinal anastomosis, we see that these obliterations are in no way connected with the permeability of the pylorus.

In 45 cases of anatomical obliteration of the gastro-intestinal mouth, which we gathered in literature, we only found 4 cases of permeable pylorus. In 7 cases the cause of obliteration has been undoubtedly the secondary development and the cicatrizing of a peptic ulcer of the gastrojejunal mouth (Kauffmann,⁷ Krönlein,⁸ Navarro,⁹ Gosset,⁹ Leriche,⁹ Oviatt¹⁰). In the 34 other cases the mechanism of the obliteration appears less distinctly. We observe, however, that in 23 cases buttons were used (Bérard ¹¹ 1 case, Czerny ¹² 4, Ettlinger ¹³ 1, Feldmann ¹⁴ 1, Ferrari ¹⁵ 2, Jaboulay ⁴ 1, Kehr ¹⁶ 1, Leriche ¹⁷ 1,

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W. Mayo¹⁸ 4, Moynihan¹⁹ 2, Schloffer²⁰ 5), that in 4 cases sutures were used (Eiselsberg,²¹ Hartmann, Ricard, Tuffier), and that in 3 cases Y-shaped gastro-enterostomy was performed (Fedoroff,²² Monprofit, Roux). In the last 4 cases technical details are lacking.

Briefly then:

(1) The obliteration of the gastro-intestinal mouth is in no way connected with the more or less permeability of the pylorus.

(2) Undoubtedly the obliteration results sometimes from the cicatrization of a peptic ulcer having developed itself in the mouth.

(3) The technic used has a direct bearing on the result. Obliteration of the anastomosis is exceptional in cases not operated with button or by the Y-method. On the other hand, the integrity of the anastomosis has been anatomically ascertained in cases of pylorus functionless, by Henck,²³ after 3 months, by Scheuen²⁴ after 28 months, by Busch²⁵ after 6 years, by myself after 5 years.

II. *Are the gastro-intestinal anastomoses functionally useless in cases of permeable pylorus?* In 1908, after summarizing the experiments made by Blake and Cannon, Leggett and Maury, Kelling, Delbet, Tuffier, adding to these experiments some radiosopic examinations on men, two observations of duodenal fistula by Berg, in which all the gastric contents passed through the fistula notwithstanding a gastro-enterostomy, Guibe²⁶ concludes: "All the experiments on animals and observations on men seem to agree sufficiently to prove that as long as the pylorus remains permeable, the stomach has an almost invincible tendency to drive out its content through this orifice without being inclined to utilize the artificial mouth. Nothing whatever passes through the new opening; on the contrary, everything passes through the pylorus."

This opinion, clearly expressed, may be considered as generally accepted, even up to this day.

However, when we read the reports of the radiologists, we see that the facts do not agree absolutely with these con-

clusions. Legueu²⁷ observes that in a case of permeable pylorus all the gastric contents pass through the mouth. Bérard and Delbet²⁸ have shown us that the gastric contents pass as well through the mouth and through the pylorus. Pess,²⁹ after having studied 40 gastro-enterostomies by the X-rays, comes to the conclusion that the stomach (its pylorus being permeable or not before the operation) empties itself continually by the mouth and by the pylorus. Gray,³⁰ in a case of ulcer without stenosis, finds that the gastric contents pass specially through the mouth. Petrév³¹ examines 9 cases of gastro-enterostomy for gastric lesion with integrity of the pylorus; 4 times all the gastric contents passed through the mouth, twice through the pylorus, 3 times through the pylorus and through the anastomosis. In 4 cases of normal pylorus, Härtel³² finds that the evacuation takes place as well through the pylorus as through the mouth (1 case 2 years, and one 7 years after operation). Hesse³³ finds in 9 patients that the gastric contents pass through the mouth and through the pylorus.

These quotations prove sufficiently that the opinion of those who affirm the functional uselessness of the gastro-enterostomy in cases of permeable pylorus, is not as exact as they suppose, and that it is necessary to modify their too absolute affirmation.

To elucidate the question, I have made two kinds of researches:

1. Experiments on dogs.
2. Radiological examinations of patients.

EXPERIMENTS ON DOGS (IN COLLABORATION WITH MY PUPIL, M. MÉTIVET).

Dog 1.—Gastro-enterostomy joining the terminal portion of small intestine and pyloric antrum. Section of the intestine above the anastomosis suturing its proximal end to the skin, closing its distal end.

The dog lived 13 days without expelling any fæces through the rectum. We supposed that the anastomosis had not acted. At the post-mortem, we found a stomach containing intestinal fluid, the efferent portion of the intestine being empty, and numerous adhesions at the point of the anastomosis. The fluid introduced into the stomach passed with much difficulty through the mouth.

Dog 2.—Gastro-enterostomy between the initial portion of small

intestine and the fundus of the stomach. Thirty-seven days later, the dog is vomiting intestinal liquid and shows all the symptoms of intestinal obstruction. Next day we gave it 300 gr. of milk and half an hour later we killed it. At the post-mortem the stomach contained a yellowish fluid of fecal odor with clots of milk. This did not pass either into the duodenum, nor into the jejunum. The mouth was anatomically in good condition but obliterated by a bone which was impacted in its aperture and obstructed, on the other hand, the intestine. The intestine was distended by the liquid reaching the point of anastomosis and was contracted just behind the anastomosis.

Dog 3.—Gastro-enterostomy between the initial portion of the jejunum and pyloric antrum. Forty-four days after the operation the intestine is cut just above the anastomosis. The end in connection with the anastomosis is closed and the duodenal end is fixed to the skin.

The next day a meal composed of milk and hashed meat is given to the dog, which it eats with good appetite. After 7 or 8 minutes some bile is coming out of the duodenojejunal opening and 15 minutes afterwards a few small curds of milk mixed with the bile. Half an hour after the meal the dog is killed. In the duodenum some bile and a few curds of milk are found representing what has passed through the pylorus. In the jejunum, at a distance of about 65 to 70 cm. one perceives a quantity of clots of milk and some particles of meat, showing what has passed through the gastro-intestinal mouth, which is normal, the pylorus likewise.

Dog 4.—Gastro-enterostomy between the initial portion of the jejunum and the pyloric antrum. Forty-six days after the operation, the intestine was cut above the anastomosis, exactly as in the former cases, the end attached to the stomach was closed, and the duodenum fixed to the skin.

After 3 days, 400 gr. of milk were given, 10 minutes later, a small quantity of milk was flowing through the duodenal fistula. The animal was killed 20 minutes later. In the duodenum we found some curds of milk which had passed through the pylorus. In the jejunum, for a distance of more than 1 metre, the intestine was full of curds of milk. Artificial opening and pylorus both normal.

Dog 5.—Gastro-enterostomy between the jejunum and fundus of the stomach. After a month, section of the intestine above the anastomosis, closing the gastric end and fixing the duodenal end to the skin.

The next day 400 gr. of milk and hashed meat is given to the dog. After two minutes and a half, milk begins to flow abundantly through the duodenal opening, mixed with a few particles of meat. Ten minutes later about 150 gr. of milk are flowing. The animal is killed 10 minutes after the meal. We find in the duodenum a great quantity of milk and particles of meat which passed through the pylorus. In the jejunum at about a distance of 10 to 20 cm. we see some clots of milk and some particles of meat, representing all that had passed through the anastomosis. Artificial opening and pylorus both normal.

Dog 6.—Gastro-enterostomy between the initial portion of the jejunum and the fundus of the stomach. Thirty days after the operation,

after having removed an adhesion, which united the anterior part of the stomach with a point of the efferent part of the jejunum, situated 9 cm. below the anastomosis, we cut the intestine across above the anastomosis, closing the gastric end and suturing the duodenal end to the skin.

The next day a meal of milk and hashed meat was given to the dog. Seven minutes later, the milk and some particles of meat were passing through the duodenal aperture. The dog was killed half an hour after the meal. The duodenum contained some curds of milk and some particles of meat; the jejunum contained milk and meat in its first centimeter. Gastro-anastomosis and pylorus both normal.

Dog 7.—Gastro-enterostomy between the initial portion of the jejunum and the pyloric antrum. Two hundred and twenty-three days after the operation, second operation (June 22, 1912). Section of the jejunum above the anastomosis, closing the gastric end and suturing the duodenal end of the skin. 20 cm. below the anastomosis, the jejunum is cut through a second time, closing the distal end and fixing the proximal to the skin.

The next day, 100 gr. of milk is given to the dog; 1 minute later liquid begins to flow through the jejunal fistula (corresponding to the anastomosis); 2 minutes and a half later a large amount of bile is flowing through the duodenal fistula. These liquids are collected and preserved. About a quarter of an hour later, the liquid coming from the jejunal fistula is no longer clear, a fresh sample is put aside. These different liquids are analyzed by W. Fabre. During the first quarter of an hour, bile flowed through the duodenal fistula and acid liquid through the jejunal fistula. After a second quarter of an hour, bile was coming through the duodenal fistula, the jejunal fistula giving a liquid containing ozazone (specific of lactose) which W. Fabre could not find in the bile coming through the duodenal fistula. Next day half a pint of milk is given to the dog. It is killed an hour later. The stomach contains an almost clear liquid with some curds of milk; the duodenum is full of bile and some few curds of milk. The piece of jejunum connected with the gastric mouth is full of curds of milk. The mouth is normal, so is the pylorus.

In none of these experiments did we find the mouth obliterated, nor thickened, even after having kept the dog alive during a long time, 223 days in one case.

As for the functions of the mouth, we may leave aside the experiments 1 and 2. In the first, function was prevented by adhesions and angulation; in the second, the dog died the thirty-seventh day in consequence of an intestinal occlusion produced by a bone obstructing the mouth and the intestine just in front of it.

In 2 cases, in which the mouth was made on the fundus, the gastric contents passed at the same time through the mouth

and through the pylorus, but the greatest quantity through the latter.

In 3 cases, in which the anastomosis was made on the antrum, 44, 50 and 223 days after the operation, the gastric contents (milk and meat) passed through the artificial mouth almost entirely.

These experiments show that the evacuation is done principally through the anastomosis if it is situated on the pyloric antrum, through the pylorus if it is situated on the fundus of the stomach.

If previous experimentators saw the gastric contents passing almost altogether through the pylorus, it was probably because of their having made the anastomosis on the fundus of the stomach. It is the fundus which presents when opening the abdomen of a dog, and it is this part of the stomach which is brought out. Therefore, it is the natural portion used for anastomosis. The pyloric antrum, on the contrary, is situated deep under the liver and it is necessary to pull it out to bring it to light. It is, therefore, only when one has the fixed intention of making the anastomosis on this part that one is at all likely to do so.

Most probably Kelling, Delbet and Tuffier operated on the cardiac part of the stomach. As for Tuffier,³⁴ we are quite sure of it. He says: "I remind you how easy it is to observe on a dog, making use of X-rays, that everything passes through the pylorus, because we know, when operating on a dog, that the new pylorus can only be placed at a distance of 25 cm. from the normal pylorus and not less."

In the experiments on cats of Cannon and Blake, 8 times gastric contents was forced out naturally by peristaltic waves through the pylorus; only 2 exceptions were observed, food leaving by both exits; in one of these two cases the stoma was in the posterior wall of the antrum close to the pylorus, in the other about half-way between the two ends of the stomach.

Calabrene, who paid attention to place the mouth near the pylorus, notes that the contents of the stomach pass through the anastomosis.

These different modes of evacuation of the gastric contents, according to the position of the artificial opening, find their explanation in the differences of the muscular contractions in the different zones of the stomach. In order that the gastric contents may pass from the stomach into the intestine, the pressure to which it is subjected must be greater than that of the intestinal contents.

Experiments show us that the pressure, which is very weak in the fundus, gets stronger in the antrum and that even in the latter it is subjected to considerable variations, getting considerably stronger at the very moment of the gastric contractions. Von Pfungen, in 1887, measured intragastric pressure on a boy with a gastric fistula. The pressure in the fundus varied only from 5 to 10 mm.; in the region of the pylorus, the pressure was greatly increased and varied from 40 to 80 mm. mercury, in connection with its peristaltic contractions.

Hofmeister and Schutz had observed likewise a very great difference in the form of contractions of the two parts of the stomach, in their experiments on dogs. Moritz has seen, in his observations on men, that as far as the left part of the stomach was concerned, he observed only very rare and slight variations of pressure, from 2 to 6 cm. of water, meanwhile, he found that in the pyloric region the energetic contractions of the gastric muscle were very frequent, and capable of making the water rise up to 50 cm.

All the investigations agree to make us consider, with Gray and others, that the stomach consists of two parts, the cardiac part acting as a reservoir and the pyloric part as a motor.

One understands, therefore, that the juxtapyloric anastomosis works actively even when the pylorus is normal, and that the anastomosis on the cardiac part is functionless in cases of a permeable pylorus.

Radiological Examinations (in collaboration with Dr. Maingot, radiographer of the Loumec Hospital and Wolfram, junior demonstrator in anatomy).—The radiological examina-

tions on man have confirmed the results of the experiments on dogs. Our anastomoses have almost always been placed on the lowest part of the pyloric antrum. In consequence, we observed that the evacuation of the gastric contents takes place partly through the anastomosis, partly through the pylorus.

To be quite certain of the exact point of passage of the bismuth, the examination of a skiagram is insufficient. In cases where the bismuth has passed through the pylorus, it happens that the skiagram shows a loop leaving the greater curvature and giving the illusion of a passage through a gastro-intestinal anastomosis, whereas this appearance is due to the fact that the initial portion of the duodenum is overshadowed by the stomach, the jejunal shadow only separating from that of the stomach below the greater curvature. It is indispensable to make a skiascopic examination. One then sees the bismuth pouring into the stomach and passing through the anastomosis before reaching the pylorus. In this way it is impossible to mistake the evacuation through the anastomosis for an evacuation through the pylorus.

The evacuation through the anastomosis does not always take place in the same way: On 19 of our patients without a sign of gastric stasis before the operation and no sign of pyloric stenosis during the operation, we observed after intervals varying from 1 to 11 years:

Once, everything passed through the pylorus; 11 times everything passed through the anastomosis; 7 times the bismuth passed both through the anastomosis and the pylorus.

Sometimes, the passage was almost immediate; in other cases the passage took place by instalments, succeeding each other at short or long intervals; in some cases the evacuation began with a gush and continued by repeated instalments.

The results of radioscopic examinations are therefore in accordance with the results of the experiments and show that, in opposition to the general opinion, the gastro-intestinal anastomosis may work even in cases where the pylorus is patulous.

We have found these results interesting enough to draw your attention to them even if they have not considerable practical importance and if they do not prevent many surgeons from continuing to exclude in many cases the pylorus.

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