tion will be impossible. Gastric ulcers generally perforate in young anaemic women; duodenal ulcers in men between 30 and 50. But this is by no means constant.

3. Symptoms of acute perforative peritonitis of epigastric origin and spreading down to the right iliac fossa, simulating an acute appendicitis, is frequently seen in duodenal perforation, but very infrequently in gastric perforation. In these cases it can generally be noticed that the early signs are referred to the upper abdomen, the iliac fossa is only secondarily involved. Rigidity at first is in the hypochondriac region, and only later in the iliac region. The initial shock is more intense generally in acute perforative appendicitis, and septic poisoning is seen earlier in the history of the case.

4. An acute appendicitis may travel from the iliac fossa to the right hypochondriac region, and thus simulate a duodenal perforation. The earliest signs here are in the right iliac region, and only secondarily located in the hypochondrium. The similarity of duodenal perforation to acute appendicitis must be borne in mind, and by attention to the onset, the early site of pain, the area of rigidity and the initial higher fever in appendicitis, a correct diagnosis will generally be arrived at.

5. The occurrence or not of haematemesis or melaena should be inquired into. A previous history of melaena only suggests a duodenal perforation.

6. It is easier to exclude other causes of perforative peritonitis than a duodenal ulcer, and by exclusion a perforated duodenal ulcer ought to be more frequently diagnosed.

AFTER-HISTORY.

An interesting point in connexion with perforated duodenal ulcer is the after-history of the patients who recover from operation. Several interesting questions arise. Should symptoms have been present before the operation, do they continue? Should symptoms have been previously absent, do they arise later on, after the successful closure of the perforation? Does perforation ever occur again, and are these patients still in great danger from this catastrophe? Does the treatment stop with the suture of the ulcer, and ought not further surgical means be taken to secure healing of the ulcer?

The after-records of these patients is almost entirely wanting in surgical literature. Occasionally a note after some months is added that some "indigestion still remains," or something to that effect, but there are, as far as I know, no recorded after-histories from which these questions might be answered. I cannot find the records of a case which has perforated a second time. Viewing the question generally from the statistics I have given above it would seem that our treatment should not stop at the successful treatment of the perforation. Duodenal ulcers are very chronic. They show a very little tendency to heal naturally: merely sewing up a hole in the floor of an ulcer, or placing a piece of omentum over it cannot increase this slight tendency towards natural healing. Theoretically the dietetic treatment of the patient after the operation might do so, but we have no evidence to show that it does. The dietetic treatment of a chronic gastric ulcer is very unsatisfactory, and we should expect the same in duodenal ulcer. If we compare chronic gastric ulcers which perforate and are successfully operated upon, and follow these cases afterwards, in many—I should estimate the majority—symptoms of an unhealed ulcer persist. Looking at the question from the statistics of duodenal ulcer, and by comparison with gastric ulcer, in all probability the ulcer remains opened. What is (1) the inconvenience to the patient of this unhealed ulcer, and (2) what is the danger to life? The inconvenience to the patient can only be measured by his symptoms. Should symptoms persist or arise further surgical measures should be undertaken, other things being equal. The danger to life is perforation. Although I can find no evidence of this having occurred twice in the same patient, I see absolutely no reason why it should not. Realizing the serious condition of a patient with a duodenal ulcer, I advocate further interference to secure the closure of the ulcer. With this end in view, after explaining to two of my cases the position, I advised a further operation. Both patients, however, preferred to run the risk, and declined. The third case was so extremely ill from acute bronchitis after the operation that it was not suggested to him.

A word may be said here with regard to the closure of the perforation. In the majority of these cases there is considerable induration around the perforation, and to close by sutures means puckering the wall and consequent narrowing of the lumen of the bowel. A better method, I think,

will be found in an omental graft, if this can be secured, and, failing this, a coil of small intestine. Omentum is perfectly safe; it is easily secured by a few stitches. In fact, probably laying the omentum over the site of perforation and keeping it in position with gauze packing would be sufficient, if time were a great object or for any reason suturing were rendered very difficult. An omental graft would, theoretically, be a more protective barrier against a future perforation than suture.

A duodenal ulcer may perforate, adhesions form, and local suppuration occur. These localized abscesses from duodenal perforation are very rare. Bainbridge in 1903 collected all cases which had been recorded up to then, and found only 26. I have seen one case since. Of the 27 cases, 23 died without a diagnosis being made, in 2 a diagnosis was made at the operation, in 2 a correct diagnosis was made; one of these was operated upon, the after-history is not given, and in the second the condition of the patient prevented any interference. The age of the patients varied from 15 to 56 years, but the majority occurred at the age at which perforated duodenal ulcer is most frequently seen. Analysing the few cases where the previous history is recorded, about 50 per cent. had suffered from gastric trouble, which is mentioned as digestive disturbance, digestive disorders, dyspepsia, or stomach trouble. In one case blood had been passed per rectum a year before, a second case occasionally vomited blood; 6 cases have been operated upon; in 3 cases the abscess was merely opened; and in 3 cases the perforation sutured. Moynihan records a successful case in which he diagnosed the perforation during the operation, closed it, and drained the abscess. Lowson records a case where he diagnosed the condition before operation, sutured the perforation, and drained the abscess. The after-history of the case is not given. A fatal result has attended all the other cases.

The diseases most liable to be confounded with this condition are appendicitis, acute inflammation or perforation of the gall bladder, and suppuration in connexion with the colon. More than once the trouble was thought to have been entirely above the diaphragm. The points in the diagnosis upon which I lay stress are the following:

1. The absence of previous symptoms.
2. If there be a history of previous trouble, its exact nature should be elicited—whether gastric or suggestive of gall stones or appendicitis, or of obstruction from carcinoma of the colon.
3. The exact situation of the early pain. This is usually referred to the right epigastric or hypochondriac region, higher than that of appendicitis.
4. The early rigidity and tenderness over the upper half of the right side of the abdomen.
5. The early tenderness on deep pressure over the lower ribs posteriorly and laterally.
6. The marked increase of pain on deep inspiration in quite the early stages.
7. The frequently observed clinical signs of elevation of the right half of the diaphragm.
8. These abscesses very frequently contain gas, thus differing from those of the gall bladder. Gaseous abscesses originating from the gall bladder are most rare, and in carcinoma of the colon and in appendicitis a detectable quantity of gas in the early stages is most unusual.

THE OPERATION OF GASTRO-DUODENOSTOMY; ESPECIALLY IN REFERENCE TO FINNEY'S OPERATION OF GASTRO-PYLO- DUODENOSTOMY.

By DONALD ARMOUR, M.B., F.R.C.S.,

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THAT the operation of gastro-jejunostomy is the one practically always employed in this country when it is desired to make an anastomosis between the stomach and small intestine for whatever cause, is clear from a search through the literature published upon the subject. In none of the textbooks, save one, is the operation of gastro-duodenostomy mentioned except in connexion with that of pylorotomy; and one goes so far as to say, "gastro-duodenostomy being only employed after a pylorotomy has been performed." That such statements need revision is obvious in the light of recent work published from various clinics abroad.

This is especially true with regard to cases of pyloric stenosis of a non-malignant nature. Stretching of the pylorus, or rupture of its subperitoneal layers, by digital or instrumental means, whether performed by the method of Loreta or Hahn, has proved unsatisfactory owing to immediate risks and remote results, and has been practically abandoned. Pyloroplasty seems to have fallen into disfavour in recent years; partly on account of recurrences following it, but chiefly owing to the improved methods and increased facility of performing gastro-jejunostomy. The especial objections urged against the operation of pyloroplasty have been enumerated by Finney as follows:

1. Its inapplicability in cases of extensive and firm adhesions about the pylorus.
2. Its inapplicability in the presence of still active ulceration.
3. The liability to recurrence of the stricture due to contraction of the scar.
4. The inability to obtain good apposition on account of rigidity of the walls of the stomach and duodenum.
5. The outlet of the stomach is not placed at the most dependent portion, hence in the presence of motor insufficiency the aid of gravity in emptying the stomach is lost.

Theoretically, the ideal operation for pyloric stenosis is pylorotomy. But this must necessarily remain of limited usefulness on account of its greater technical difficulties and increased risks. With rare exceptions, malignant disease is its sole indication.

There remains for discussion the operation for forming an anastomosis between the stomach and small intestine in order to short-circuit the pyloric constriction. This operation of gastro-intestinal anastomosis may be a gastro-duodenostomy or a gastro-jejunostomy. Unfortunately, of late, a loose way of applying to the latter the general term of gastro-enterostomy has arisen, leading to a great deal of confusion.

From a physiological point of view the operation of gastro-duodenostomy presents great advantages over that of gastro-jejunostomy. The stomach contents are conducted into the intestine at, or above, the level of the entrance of the bile and pancreatic juice. The danger of these secretions accumulating in the intestine and being regurgitated into the stomach is done away with. The occurrence of the *circulus viciosus*, which is even now present in a certain percentage of cases of gastro-jejunostomy, will not occur after a gastro-duodenostomy. Bile may be regurgitated in small quantities at first, but its presence in the stomach has been shown to be harmless. Nor can a peptic ulcer occur in the intestine as a result of gastro-duodenostomy, owing to the normal neutralization of the stomach contents on entering the duodenum. That this is a point of great importance is shown by an increasingly large number of such cases being reported from time to time, many of which have been fatal owing to perforation.

Anatomically, the operation of gastro-duodenostomy is not so simple as that of gastro-jejunostomy. But the difficulties of the former have been exaggerated owing to a lack of appreciation of its most important step, namely, the adequate freeing of the duodenum. This done systematically and thoroughly the operation is devoid of any difficulty apart from that connected with intestinal suturing.

Clinically, the chief indication for gastro-duodenostomy is stenosis of the pylorus of a benign nature, whether due to tumour or cicatricial contraction. That it may be employed for malignant stricture as well is shown by a successful case reported by Kocher. But such cases must be of rare occurrence. Adhesions, as suggested by some, are no contra-indication to the operation, as will be seen when discussing Finney's method.

The idea of performing a gastro-duodenostomy for pyloric stricture originated with Jaboulay in 1892. He used a Murphy's button to effect the anastomosis. In 1897 Villard modified the operation, and published three successful cases under the title of Subpyloric Gastro-duodenostomy. Tavel, Henle, de Quervain, Koslowsky, and others have performed Villard's operation, and speak highly of it. Kocher has further elaborated the operation by a more extensive freeing of the duodenum, rendering its descending part, its inferior flexure, and a portion of its transverse part so movable that the parts to be sutured can be brought out and isolated with gauze, thus shutting off the field of operation from the general peritoneal cavity. He designates his method "lateral gastro-duodenostomy," and says of it: "To one who has convinced

himself how easily and securely this lateral gastro-duodenostomy can be performed—provided the duodenum can be rendered sufficiently movable—it will be evident how admirably the operation fulfils the indications for treatment in stenosis of the pylorus." He moreover does not limit the operation to special cases, but regards it as the normal procedure, and thinks that it will take precedence over all previous methods of gastro-enterostomy and pyloroplasty. He proposes to employ this operation in all cases of pyloric stricture.

In 1902 Finney designed and carried out a modification of the method of lateral anastomosis, which he described under the rather misleading title of A New Method of Pyloroplasty. In his operation he really combines a pyloroplasty with a gastro-duodenostomy, and a better term would be that of "gastro-pylo-duodenostomy." Neither adhesions, however firm and extensive, of the pylorus to surrounding structures, abdominal wall, liver, gall bladder, omentum, and colon, nor the thickened walls of the pylorus and stomach have proved a bar to the performance of this operation. With care and perseverance they can be overcome by judicious dissection. Active ulceration would appear to be possibly the only objection to this operation. It is performed as follows: An incision 6 to 8 in. long is made through the right rectus muscle. The adhesions binding the pylorus to the neighbouring structures are divided, and the pyloric end of the stomach and first part of the duodenum are freed as thoroughly as possible. "Upon the thoroughness with which the pylorus, lower end of the stomach, and upper end of the duodenum are freed depends in a large measure the success of the operation and the ease and rapidity of its performance. I wish to emphasize this as one of the most important points in the operation" (Finney). A suture is taken in the upper wall of the pylorus, which is by this means retracted upwards. A second suture is inserted into the anterior wall of the stomach, and a third into the anterior wall of the duodenum, at equidistant points from the suture placed in the upper wall of the pylorus.

These second sutures should be about 12 cm. ($4\frac{1}{2}$ in.) from the latter, and mark the lower ends of the gastric and duodenal incisions respectively. By placing them as low as possible the new pylorus is made amply large, and thus the danger of subsequent contraction is reduced to a minimum. Traction is then made upwards on the pyloric suture, and downwards in the same plane on the gastric and duodenal sutures. By this means the stomach and duodenal walls are kept taut and the placing of the sutures greatly facilitated (see Fig. 1). The peritoneal surfaces of

Fig. 1.

the duodenum and of the stomach along its greater curvature are then sutured together, as far posteriorly as possible (see Fig. 2). Finney recommends a continuous suture for this, as being more easily and quickly applied, and it can be reinforced after incision of the stomach and duodenum.

After the posterior line of sutures has been placed an anterior row of mattress sutures is taken. These are not tied but left long, as shown in Fig. 3. These sutures should

be so placed as to allow ample room for the incision. After they have been placed they are retracted vertically in either direction from the middle of the portion included in the row

Fig. 2.

of sutures (see Fig. 4). When retracted the incision is made in the shape of a horseshoe. The gastric arm of the incision is made through the stomach wall just inside the lowest point of the line of sutures, and is carried up to and through the pylorus and around into the duodenum, down to a corresponding point on the duodenal side (see Fig. 4). Excision of

Fig. 3.

the anterior portion of the thickened pylorus, and if necessary the adjacent portions of the gastric and duodenal walls, lessens the danger of subsequent contraction, and also allows of easy approximation of the two surfaces. Haemorrhage is then stopped. Any redundant edges of mucous membrane are trimmed off with scissors. A continuous catgut suture is now taken through and through all the coats of the intestine on the posterior side of the incision (see Fig. 5). This reinforces the posterior sutures, secures better approximation of the cut edges of the mucous membrane, and prevents the reunion of the divided intestinal walls. The anterior mattress sutures are then straightened out and tied, and the operation is complete (see Fig. 6). A few Lembert sutures may be added if it is thought desirable to reinforce the mattress sutures. The abdomen is closed without drainage. Nothing is given by the mouth for the first thirty-six to forty-eight hours.

Feeding is carried on by nutrient enemata, gradually replace by mouth feeding, beginning on the second or third day.

Fig. 4.

Fig. 5.

Fig. 6.

Three factors of great importance are brought out in this operation:

1. All the stitches are placed and the posterior row tied before the bowel is opened, and it remains open just long enough to control the haemorrhage.
2. The size of the newly-formed pyloric opening is limited only by the mobility of the stomach and duodenum and by the judgement of the operator.
3. Unless the stomach is very much dilated or has descended to an unusual extent, the lower limit of the new outlet is at or near the level of its most dependent portion. Should the stomach be very much dilated, a gastropexy or gastroplication can be performed at the same time.

Clinical Observations

ON A

KIDNEY WHICH CONTAINED MORE THAN FORTY THOUSAND IRIDESCENT CALCULI.

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IN July, 1904, Mr. T. F. Long, Chesham, placed under my care in the Middlesex Hospital a printer, 38 years of age, on account of persistent pain in the right loin. The man was so stout that nothing abnormal could be made out by the fingers. The urine contained microscopic traces of blood and pus cells, and the blood and pus became markedly increased after the patient walked about the garden; exercise of this kind also intensified the pain in the loin. We had no doubt that the kidney contained a calculus, and after two attempts Mr. Mann obtained an excellent skiagraph indicating the presence of a large amount of calculous matter in the kidney.

Fig. 1.—A sacculated kidney with an inadequate ureter. The largest sacculus contained more than 40,000 calculi.

At the operation the kidney was found much enlarged and very movable and its lower half stuffed with calculi. As the organ was completely disorganized it seemed a prudent course to remove it. This presented no difficulty, and the man easily recovered.

The kidney is somewhat noteworthy in itself: during the operation I noticed the ureter to be particularly narrow, and that it exhibited the anatomical peculiarity of which I have described many examples under the name "inadequate ureter." It is well recognized that the junction of the renal

pelvis with the ureter proper is indicated by a marked narrowing of the lumen of the duct, which may conveniently be called the "ureteral strait." Occasionally the ureter from this point downwards is very narrow, and is sometimes even less than one-fourth the average dimensions of an adult ureter. Abnormally narrow ureters of this kind are termed—and not inappropriately—inadequate.

All the calyces of this kidney were widely dilated and sacculated, but the largest sacculus, which constituted more than half the organ, contained a great multitude of stones, which rolled about almost like quicksilver as soon as the sac burst, and a large number of them escaped and could not be recovered.

The calculi require consideration in two groups. Thus, the first consists of ten calculi of varying sizes and shapes. The largest calculus is of the size and shape of a child's astragalus with well-marked facets, indicating that these stones had been subject to considerable pressure. A few had the more regular contour of beans, a further proof of the pressure to which they had been subject (Fig. 2). The remaining concretions are fairly spherical, and all of a bright colour, like old gold. These bodies were carefully dried and measured. The total quantity is 10 drachms, and an average drachm contained 4,120 discrete calculi. The counts were carefully made and controlled, and the total, 40,000, is probably far below the real estimate, without considering the large number unavoidably lost.

Fig. 2.—Separate calculi from the sacculus shown in the preceding drawing.

Fortunately I was able to interest Mr. A. M. Kellas, Lecturer on Chemistry at the Middlesex Hospital, in these concretions, and he has furnished me with an excellent report, of which the following is a summary: Mr. Kellas points out that the larger bean-shaped bodies, whose iridescence he compares with that of stannic sulphide, consist of three parts: (1) A husk consisting in the main of calcium phosphate; (2) a harder part or kernel composed of concentric layers enclosing (3) a small white central body. The laminated portion of the kernel consists mainly of calcium oxalate with traces of calcium phosphate. The central body is almost pure calcium oxalate. The small spherical calculi consist of a thin husk and a nearly white central body. Calcium oxalate and calcium phosphate are present in both portions. Epithelial matter exists in the concretions, but is more abundant in the husk than in the kernel.

The iridescence of these calculi is as remarkable as their great number; those who are interested in this phenomenon will find it considered in a paper of great interest by Mr. S. G. Shattock in the *Transactions of the Pathological Society*, vol. xxxvii, 325, Iridescence in Calculi.

The chief clinical features in the case appear to be these: This man had pain in his right loin for a period of fifteen years. He never remembers to have passed a calculus, yet the small spherical bodies found in his kidney seemed to be made to traverse the ureter. The sac which contained them appeared to communicate with the renal pelvis by a small orifice, barely allowing the passage of a thin bristle. It seems probable that the sacculus which contained this collection of renal stones was of congenital origin, and that for many years urine had slowly filtered among them, and drained away through the minute orifice into the pelvis of the kidney; the retarded flow through the pouch was a means of adding to the number of the concretions, whilst the anatomical conditions of the sacculus hindered their escape.

The only other specimen of this kind with which I am acquainted is a collection of light brown renal calculi in the