muscles which receive their nerve supply, partially or wholly, from the third lumbar nerves (Ferrier and Yeo,¹⁰ Paterson¹¹). (4) Although the chart, showing the area of anæsthesia after partial relief of the compression by laminectomy, indicated affection of the third lumbar roots according to Thorburn,⁴ the other facts mentioned above made one inclined to adopt the view of Head⁸ and Starr,¹² according to whom the second lumbar roots would be the lowest involved.

The diagnosis, therefore, made during life was that the lesion, probably of the nature of caries of the spine, implicated the cord by pressure between the level of origin of the eleventh dorsal and second lumbar roots inclusive.

I am indebted to Dr. J. Scott Riddell for having had an opportunity of performing a very partial necropsy. The condition found was as follows:

NECROPSY.

An incision was made over the spine, when a considerable quantity of pus escaped, coming apparently from the lower dorsal region of the spine. The spinal canal was opened upwards and downwards from the site of laminectomy. No irregularity of the spine was noted in the lower dorsal or upper lumbar region. The cord was removed through the whole lumbar region and the greater part of the dorsal region, and it was found that there was marked thickening of the dura mater along the whole length of cord removed. There was no pus within the dura. The bodies of certain vertebrae were in great part destroyed and replaced by old caseous nodules, which, being firmly adherent to the thickened dura, were removed along with the cord and were found to project through the dura, causing depressions in the cord opposite. The mass pressed on the anterior and lateral aspects of the cord as far back as, and including the origin of, the posterior roots, while the dura was very thick and firm over the posterior columns. The extent of cord compressed in this way included the part from above the origin of the eleventh dorsal roots to the level of the origin of the second lumbar roots. The cord showed a marked constriction between the origins of the tenth and eleventh dorsal roots. The lower two dorsal roots were much atrophied, and contrasted forcibly in point of size with the tenth dorsal root, which seemed normal. The nodular mass, when examined microscopically, was found to show beautiful old tubercles.

The probable course of events in this case is interesting. There seems little doubt that J. F. did suffer, many years before, from spinal caries about the region of the sixth dorsal vertebra. This caused the angular curvature, and, although the cord remained compressed as shown at the time of operation, any signs of paralysis that may have been present passed away. The disease at that site became quiescent, but another focus appeared lower down, causing the long-continued root pains, and eventually ending in complete paraplegia. The disease at that site did not cause any obvious irregularity of the spinous processes. The rapid improvement after the operation, performed by Dr. Ogston at the level of the sixth dorsal vertebra, was no doubt due to the fact that removal of pressure at any part of the cord would relieve compression on the cord at any and every other part.

The order of recovery of the conducting functions of the cord was in accordance with what is the general rule in cases of compression of the cord or spinal nerves, that is, sensation first and most, motor power last and least. The relative degree of affection of the various forms of sensation, as shown by the record (see diagram, p. 479) taken soon after the operation, was unusual. As a rule, in organic lesions of the cord or its roots, the loss to touch is less extensive and less definite than the loss to pain, while in J. F. there was a distinct area of anæsthesia (v. diagram) corresponding to the distribution of certain dorsal and lumbar roots, and the sensation of touch was markedly defective on the rest of the legs, whereas painful sensation was appreciated as such everywhere. The degree of affection of the sensations of pain and temperature was also unusually dissimilar. There could be no doubt as to the defect of the power of differentiating heat and cold at places where a painful sensation was acutely felt. It is difficult to say why the various forms of sensation should be affected in different degrees in cases of compression of the cord. Attempts have been made, without much success, to find an explanation in the degree of pressure exerted on the different parts of the cord. Thus it is supposed that pressure on the lateral parts of the cord would affect pain (and temperature) mainly, and pressure on the posterior columns would involve touch. If this were true, there should have been more affection of pain than of touch in the case of J. F., as the caseous mass pressed on the anterior and lateral aspects of the cord, while the posterior columns were intact (except for the thickened dura).

Inferences from individual cases are always uncertain, but

any deduction that may be drawn from the case of J. F., with regard to the sensory distribution of the various spinal roots, would accord with the views of Head rather than of Thorburn. As the eleventh dorsal roots were undoubtedly much compressed, and the upper limit of anæsthesia was well below the umbilicus, the case would indicate that the area supplied by the eleventh dorsal root does not reach so high as the umbilicus, as Thorburn is inclined to believe. Again the area of anæsthesia embraced the region supplied by the third lumbar root according to Thorburn, whereas *post mortem* that root was seen to be free from pressure except that exerted by the thickened dura, which pressed quite as much on the fourth and fifth lumbar roots as on the third.

NOTES AND REFERENCES.

¹ Since these notes were made I have ascertained that there was a distinct tuberculous family history. ² *Diseases of the Nervous System*, second edition, vol. i, p. 241. ³ *Op. cit.*, p. 248. ⁴ *A Contribution to the Surgery of the Spinal Cord*, 1889, p. 69. ⁵ *Brain*, vol. xvi, 1893, pp. 375-381. ⁶ *Brain*, vol. xvi, 1893, pp. 1-133. ⁷ *Brain*, vol. xvi, 1893, p. 368, and *Medical Annual*, 1896, pp. 97-101. ⁸ *Op. cit.*, p. 163. ⁹ *Journal of Anatomy and Physiology*, vol. xxiii, 1889, pp. 341-353. ¹⁰ *Brain*, vol. iv, 1882, p. 226. ¹¹ *Journal of Anatomy and Physiology*, vol. xxviii, 1894, p. 183. ¹² *American Journal of the Medical Sciences*, 1892.

REMARKS

ON

PYLORECTOMY,

WITH NOTES OF TWO CASES, AND A DESCRIPTION OF A NEW METHOD OF ATTACHING THE DIVIDED STOMACH TO THE CUT DUODENUM.

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In January, 1896, I operated on a patient for simple stricture due to cicatricial contraction of the pylorus. When the abdomen was opened the stomach and duodenum appeared to be united by a mere cord, and it was obvious that the ordinary operation of pyloroplasty would not meet the requirements of the case. The operation then performed suggested to me the modification of pylorotomy to be described; and finding that it could be satisfactorily done on corpses, and that its details were in accordance with what I believed should be principles in gastro-intestinal surgery, I described the proposed operation to surgical colleagues in the infirmary here six months before the opportunity of practising it presented itself. Before giving a report of the cases I deem it proper to relate certain points in connection with the operation. In the preparation of the patients, 5 grains of calomel, followed by small, frequently-repeated doses of a saline purgative two days before the operation, thoroughly cleared the gastro-intestinal tract. A rest in bed and a limited diet of equal parts of milk and barley water, with $\frac{3}{4}$ ss of whisky and $\frac{3}{4}$ as of water half an hour before the operation, completed the general preparations. The stomach was not washed out in either. The abdominal wall was prepared in the usual way, by a thorough cleansing and disinfection for several hours with a towel wrung out of a 1 in 1,000 corrosive sublimate solution, and every detail of the operation was conducted with scrupulous antiseptic precautions.

The pylorus was then excised in both cases in the usual way.

The modification I have introduced refers to the method of connecting the remainder of the stomach to the cut duodenum, and will be best understood by a reference to the accompanying diagram (Fig. 3) made by Dr. W. G. Richardson. The opening into the stomach is, as would be expected (and as is shown in the diagram), larger than the opening into the duodenum made by cutting it transversely. In order to overcome the difficulty of uniting the two without the aid of complicated sutures an incision over 1 inch in length was made down the centre of the anterior wall of the already transversely divided duodenum. By spreading the longitudinal cut transversely the duodenal opening was so widened as to correspond approximately with the larger opening in the stomach. All that now remained was to connect the two by a satisfactory suture. Before describing the

Fig. 1.—Portion of human small intestine injected.

form of suture employed I should mention that I regard the purely mechanical advantage of this modification which has been described, though important enough to lay some stress upon, yet as the least satisfactory reason for its adoption.

Fig. 3.

It appears to me that the consideration given by surgeons to stomach and intestinal wounds and operations has been too much limited to the purely mechanical problem of how to secure such close apposition as to make the juncture water tight. This is easy to do with an indefinite number of appliances or sutures on the operation table, but the majority of *post-mortem* examinations show that the death of the patient has arisen from septic peritonitis due to a leak somewhere in the junction line. The faulty union is not found near the mesenteric attachment, as is usually thought, but at or about the convexity of the gut. An examination of the vascular supply of the intestine suggests how this may be brought about, and by what form of operation its occurrence may be made less probable. Fig. 1 is an accurate drawing from a portion of injected human small intestine, prepared for me by Dr. Bolam, of the College of Medicine, Newcastle-on-Tyne. From the mesenteric border the larger vessels will be seen to take an almost directly transverse course over the side of the gut to reach its convexity. Close to their origin,

and for some distance in the wall of the intestine, a free anastomosis exists between the larger trunks.

Further on this intercommunication gradually diminishes until the convexity is reached, when the vascular supply has become so limited that in certain places no visible vessels can be demonstrated. (Fig. 2, a drawing of the same portion of gut as Fig. 1, shows its convexity and illustrates this point.) A similar vascular supply is found throughout the small intestine. It follows that when a transversely-divided duodenum is attached to the stomach by sutures or any apparatus, a watertight juncture being effected, the circulation of the convexity of the gut, at least, is completely arrested, that union can only occur in parts beyond the suture line, and that at the convexity of the gut a certain amount of gangrene must result. The operation suggested so alters the direction of the blood vessels that instead of running transversely on the convexity, they take an oblique course towards the divided duodenal edges, and many of them will escape the strangulating effect of an interrupted suture. It also ensures a vascular supply at and in the neighbourhood of the angle *c* (Fig. 3), because its vessel of supply is not annihilated by a suture at the corresponding portion of the mesentery.

The difficulty of uniting the cut ends satisfactorily has developed a taste for plates, bobbins, buttons, and other mechanical devices. The only advantage (a most important one, however) which can reasonably be claimed for any of them is that by their use the operator is enabled to see and know more or less exactly what he is doing. This is not so easy as it may appear, and in using sutures alone without any systematic scheme it is difficult to avoid getting into confusion, and finishing the operation with the uncomfortable but definite knowledge that the result depends more upon luck than the surgery brought to bear upon it. If, however, the simple plan of inserting temporary sutures, suggested to me first by Mr. Caird, of Edinburgh, be followed (see Fig. 3, *a, b, c*) this difficulty is overcome, and the junction can be made as rapidly and more effectually with sutures alone as with any of the ingenious apparatus employed. The posterior wall of the opening which is to serve as the artificial pylorus is first made. A long catgut suture threaded in an ordinary needle is introduced through all the coats in the position of one of the outer three temporary sutures (see Fig. 3) used to show the exact relation of parts. This suture is securely tied, has its short end clamped in hæmostatic forceps, and takes the place of the temporary suture. The longer threaded end is used as a continuous stitch through all the coats of the

Fig. 2.—Injected small intestine (showing convexity).

stomach and duodenum, and brings their apposed surfaces into firm apposition. The middle temporary suture being reached it is withdrawn, and the continuous stitch travels on to the further temporary one, which it replaces.

The posterior wall is now formed by a continuous catgut suture passed from within outwards through all the coats, and bringing the peritoneal surfaces of stomach and duodenum into firm apposition. The anterior wall is next made in a similar way by a continuous catgut stitch through all the coats, but here the suture cannot be passed from within, and of course does not bring the peritoneal coats into apposition as it does posteriorly. The object of this continuous catgut stitch is to secure a temporary watertight junction between the two viscera. To secure broad permanent adhesion between stomach and duodenum, a ring of fine silk interrupted sutures through peritoneal and muscular coats only, is placed all round the temporary junction effected, and completely buries it.¹ For the purpose of producing permanent adhesions the use of a continuous suture, which necessarily interferes with a proper blood supply to the parts enclosed by it, is to be condemned. Experience has taught me that the combination I have described and introduced several years ago may be relied upon to secure satisfactory union.

CASE I.—J. G., aged 48, was admitted to the Royal Infirmary, Newcastle-on-Tyne, on July 1st, complaining of pain in the stomach, and vomiting. About ten months ago he began to feel pain in the stomach region, which was not aggravated, but if anything relieved, by taking food. It was worse at night, especially when he lay on either side. Eight months ago he began to vomit, and brought up such large quantities "he did not know where it all came from." The vomited matter frothed a little, and was occasionally brown. Latterly the pain had become so severe that sometimes he was obliged to get up and walk about at night groaning. His bowels were much constipated, and required strong medicine to move them. He lost over 2 st. in weight after his illness commenced. Twenty years ago he had an attack of stomach pain, and for three days vomited a quantity of black stuff. Except for this he never had any illness. The patient, a fair-complexioned man, looked thin, but not anæmic. His pulse was 80, and small, and temperature subnormal. Examination of the abdomen by inspection, palpation, percussion, and auscultation of the stomach showed considerable dilatation of the stomach. A fair-sized tumour, difficult to define, could be felt midway between the umbilicus and ensiform cartilage in the middle line. The diagnosis of carcinoma of pylorus with stricture and dilated stomach was made.

Operation, August 3rd, 1897; anæsthetic, chloroform.—The abdomen was opened by an incision extending from below the ensiform cartilage to above the umbilicus, and the pylorus involved in a firm tumour drawn out. No doubt was felt as to the malignant character of the swelling, and the operation of pylorotomy was performed as described, the vertical slit in the duodenum being about $1\frac{1}{2}$ inch long. (When slit up the induration and tumour were found to be inflammatory, and surrounding a typical circular ulcer the size of a shilling on the posterior wall of

the stomach and involving the pylorus.) The abdominal wall was closed with silk sutures, and the patient was sent to bed in good condition.

After-Progress.—For twelve hours nothing was given by the mouth, and rectal enemata of milk and beef tea were administered every four hours. During the next twelve hours he had frequent sips of hot water. On the afternoon of the second day small quantities of milk and barley water were allowed and gradually increased. For the first eight days he progressed without a hitch, the highest temperature recorded being 100° on the evening of the fourth day, and afterwards normal, his pulse continuing between 70 and 80 throughout. By this time he was taking food freely—fish, milk pudding, etc.—and enjoyed everything, as his stomach trouble had entirely disappeared. Then he was troubled with a slight cough. On the tenth day the dressings were removed for the first time and the stitches taken out. The wound had entirely healed by first intention. I did not see him again till August 28th (fourteen days later) I then found that his cough had gradually increased, and he now had free expectoration of muco-purulent matter, with a temperature highly suggestive of pus somewhere. His general condition was good; he could eat, and enjoyed anything, and nothing wrong about the scar or in the abdomen was discoverable. There were a few bronchial rales in his chest, and at his right base a limited dull area, with distant tubular breathing. The following day (August 29th) I inserted a hypodermic syringe into the dull area, and drew out a little pus. The diagnosis made was subdiaphragmatic abscess, but this was not confirmed by my medical colleagues who were called in consultation. On August 30th (a month after pylorotomy) I resected portions of the eighth and ninth ribs in the posterior axillary line, and on dividing the costal pleura found the lung solid from pneumonia (I did not know whether it was lung or liver for some days after) adherent to the chest wall. A hypodermic syringe again found pus, and an opening was made at the spot where this was detected. Not more than 3j in all escaped; but, as further search failed to reveal any other collection, a large drainage tube was inserted. The expectoration continued in spite of a free discharge from the tube, but his cough was easier, and his temperature steadily fell. On September 8th (nine days later), as there had been no discharge from the tube for some days, and his morning and evening temperature were normal, the tube was removed. On September 10th (two days later) his temperature began to rise again, and the cough was more troublesome. On September 15th I made another attempt to find pus, but failed, and by this time the bulk of lung appeared to be solid from pneumonia. On September 21st he died, seven weeks after having pylorotomy performed. No post-mortem examination could be obtained.

CASE II.—J. H., aged 40, was admitted to the Royal Infirmary under my care on October 18th, 1897. She complained of pain in her stomach and vomiting. Five months ago she suffered from an attack of abdominal pain and diarrhoea, which lasted for a day. From this time she had been troubled with pain after food. About two months ago vomiting commenced. The vomited matter was frothy and brown, had an offensive smell, and amounted to more than she took. The sickness was worst at night, and the usual programme was as follows: Either lying on her right side or taking food or drink brought on a "working" in the stomach, which at times would "gather up into a lump," then the pain commenced and got worse, till she vomited, when it was relieved. Her bowels were much constipated, and required enemata to move them. Latterly she had been confined to bed from weakness, and could only take a little milk. After her illness commenced she became very quickly emaciated. She had had no illness of any note hitherto, and no trouble with her stomach previously. The patient was very thin and feeble, foul breath, coated tongue, pulse 84, temperature normal. Red patches on conjunctiva with

slight muco-purulent discharge from sleeping with her eyes open (an ominous sign). On examination of the abdomen the stomach could be seen contracting at intervals, forming a large swelling, and evidently much dilated. At the umbilicus a rounded swelling about the size of a tangerine orange could be seen through the thin abdominal wall, ascending and descending with respiration. This mass on palpation was hard, nodular, freely movable in every direction and nontender. The diagnosis made was malignant growth causing stricture of pylorus.

Operation. October 21st, 1897.—On opening the abdomen above the umbilicus the disease was found to be limited to the pylorus, and the operation of pylorotomy was performed as described. The patient stood the operation well, and appeared to be no worse at the finish than when it was commenced.

After-Progress.—Shortly after being put to bed she became much collapsed, lying with her mouth and eyes open, face and breath cold, shallow breathing, and pulse imperceptible at the wrist. Three pints of normal saline injected into the median basilic vein produced a marked improvement, and from this time her recovery was straightforward, the wound being healed when the dressing was removed on the twelfth day. Three weeks after the operation the patient was shown at the Northumberland and Durham Medical Society meeting. She was then able to eat and enjoy ordinary food, and had so much improved in condition that she was allowed to go home the following day.

February 8th, 1898. This patient recently visited the infirmary to report. She can eat anything; has gained $1\frac{1}{2}$ stone in weight, and feels quite well.

Microscopically the growth was scirrhus carcinoma.

In both cases there was a well marked pyloric obstruction to be seen in the specimens excised.

NOTE.

¹The needles used for this purpose are specially made for me by Messrs. Down Brothers, of London, and are the only good intestinal needles I know.

ON PALPATION AND AUSCULTATORY PERCUSSION.

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In the paper which I published last year in the *Practitioner* (April), I drew attention to palpation as a method of physical examination of the chest and abdomen. On first reading or hearing, it seems impossible that the method should perform all that I claimed for it, and I find that medical men are inclined to discredit the matter until the facts are demonstrated to them, and until they have actually tried the method and found how easy it is of application. Further experience has confirmed my opinion that palpation is for most purposes much more delicate than percussion, and, after a little practice, much more free from fallacies. It must, however, be understood that it does not altogether take the place of percussion. Each will tell something that the other does not, but I maintain that palpation is a very valuable method of examination, and in no way painful to the patient, while percussion, as frequently practised, often is.

If an experienced operator will analyse his thoughts as he examines a patient, he will find that the more he percusses chests, the more he unconsciously relies upon the resistance which is felt by his percussing and percussed finger respectively, and the less he relies upon the sound elicited by the percussion, though the latter is, of course, very valuable. Now if this be so, why should we not estimate the resistance without percussion by simple palpation? In the paper alluded to I gave tracings from the chest showing the outlines of the heart, liver, and spleen, determined by both percussion and palpation, which speak for themselves of the accuracy of palpation; indeed, a small error of percussion was corrected by palpation.

To practise the method it is well at first to press lightly and alternately with the first and second fingers of the right hand upon the part desired, using just a little more pressure than one would employ in testing the eyeball for glaucoma. If this be done there will be found in various parts of the chest wall, ignoring the bony and cartilaginous prominences, many spots in which the resistances vary. In trying the method it is important to throw one's knowledge of anatomy on one side, and approach the matter with a quite open mind. After a little practice, too, it is unnecessary to use the alternate pressure of the fingers described, and it suffices to pass the fingers, pressing lightly, over the chest wall. Try in the former way the first and fourth interspaces of the left side in the parasternal line (one inch and a-half outside the edge of the sternum), and the fourth space will be found to be the harder, from the presence of the heart beneath it. Again,

compare the second and the seventh spaces in the right nipple line, and the liver resistance will be felt in the latter space. One of my colleagues objected that the differences in width of the intercostal spaces might account for this, but the error can be avoided in a simple manner. Press with the ball of the thumb on the upper part of the thorax on the right side, and again on the part below the nipple, and the difference of resistance will be obvious. So far we have only tested the soft parts, but the cartilages show similar signs, as will be perceived when the resistances of the second and the seventh cartilages on the right side are compared.

It is astonishing, but nevertheless true, that differences of resistance can be felt through solid bone like the sternum. Test the resistances of the sternum opposite the first and the fourth intercostal spaces, and the resistance of the heart will be felt in the lower spot, though this requires a little care to detect. A case illustrating the value of this sign occurred to me lately. A man came to my out-patient room complaining of dyspeptic symptoms, but on hearing his voice I at once told the students that he probably had an aneurysm. On that day there happened to be no convenience at hand for examining the larynx, but on examining the chest carefully I could find no trace of aneurysm. On the man's next visit, wishing to demonstrate the method of palpation, I chose him as a subject, thinking that he had a normal chest, but I found that the upper part of the sternum was more, instead of less, resistant than the lower part, and further examination by other methods showed that he really had an aneurysm of the aorta pressing on the recurrent laryngeal nerve and paralysing the left vocal cord, the signs of which had not been developed at his former visit.

Practised as described, palpation can define delicately and more accurately than percussion the areas of the heart, liver, and spleen. We know the dulness of the normal spleen which percussion ought to define. In the mid-axillary line it should extend from the ninth to the eleventh rib; below it should follow the line of the eleventh rib; and anteriorly it should not pass beyond a line representing the junction of the ribs with their cartilages, which is approximately shown by a line drawn from the left sterno-clavicular articulation to the tip of the eleventh rib on the left side. But the results of such percussion are notoriously uncertain, because of the overlapping of the stomach and large intestine. By palpation, however, the resistance can be felt in spite of these. This I have found to be particularly valuable in the early diagnosis of enteric fever, which can be simulated so closely by, among other disorders, intestinal influenza. The addition of enlargement of the spleen to the other symptoms is important. Again, the kidneys can only be defined by the usual methods of percussion, with difficulty and uncertainty, while by palpation the upper border of the left kidney can be felt at the back, a little inside the scapular line, at the level of the eleventh rib and its lower border about 2 or $2\frac{1}{2}$ inches lower. The upper part of the right kidney lies in front of the liver, and therefore cannot be felt from behind, but its lower border can be defined to lie somewhat lower than that of the left kidney. It is a manifest advantage of palpation that it can accurately show the area of the heart, for percussion is here uncertain, and in advanced cases of emphysema gives no reliable results. In the routine examination of the chest it has often occurred to me to find small areas of resistance which have yielded no other physical signs, but the patient has given a history of pleurisy or pneumonia in these spots. Probably the undue resistance was caused by a little thickening of the pleura or of the lung tissue, too small to be otherwise detected. I have tested the method in every possible way, including experiments on the dead body, and strongly recommend its trial by physicians.

Auscultatory percussion is not at all a new method, as has been supposed, for it was used by Laennec and Piorry. It was afterwards revived by Camman and Clark, and is mentioned by Gerhardt, Weil, and Walshe in their textbooks. But it has not received as much attention as it deserves, for it is a method of physical examination which is capable of value, if only it be used with a proper knowledge of its *rationalité*. At the present time it is in danger of falling into disrepute because of having been mistakenly employed to determine the size of the heart, in connection with the Nauheim method of treatment. Let me say at once, then,