influence of that kind, and even on inspection alone the tonic muscular contraction may readily be appreciated, if we observe the limitation of respiratory movements in the lower rectus muscle.

The peritoneo-cutaneous radiation is best appreciated by a consideration of the shoulder-tip pain resulting from stimulation of the parietal peritoneum lining the under-surface of the diaphragm. In some observations on this shoulder-tip pain¹ I have drawn attention to the fact that whenever the sensory terminations of the phrenic nerve under the diaphragm are stimulated, either mechanically or by inflammatory exudate, a pain is felt over the corresponding shoulder in the area supplied by the third and fourth cervical nerves. This shoulder-tip pain is of special interest as proving a peritoneo-cutaneous reflection or radiation of the painful stimulus. By the descent of the diaphragm in the embryo this area of parietal peritoneum becomes widely separated from its corresponding skin area, and thus an embryological event, dependent on the development of the lungs, enables us to observe the working of the pain-producing mechanism. While I have proved the invariability of shoulder-tip pain where the diaphragm is stimulated, I have not found the same constancy of cutaneous hyperalgesia as tested by light pinching over the acromion process. In some cases the patients describe the pain as akin to rheumatism in the shoulder, and deny any tenderness on light pinching or deep pressure. In some instances tenderness is felt, but only on deep pressure on to the acromion process, while in others definite hyperalgesia is felt on light pinching.

It cannot be doubted that a similar radiation or spreading of painful stimuli from the parietal peritoneum to the skin overlying it via the spinal cord occurs in the anterior abdominal wall, though the proximity of skin to peritoneum has prevented its recognition. When the under-surface of the diaphragm in a patient under spinal anaesthesia is stimulated by the insertion of a gauze swab between the liver and the diaphragm, the patient complains of pain in the shoulder-tip area, but feels no pain locally. So, when the parietal peritoneum is stimulated I believe that the pain is felt in the skin and subcutaneous tissue alone. The exact position in the nervous system of the synapses necessary to produce this radiation is uncertain. The teaching of Mackenzie and Ross would lead us to expect to find it in the grey matter of the posterior horn of the cord, but there would appear to be a greater probability that it lies in the posterior root ganglia. (Fig. 2.)

If I have succeeded in proving my contention that the muscular rigidity in acute appendicitis is a reflex result of peritoneal stimulation alone, the diagnosis of acute appendicitis becomes a far simpler clinical problem. Mackenzie himself, obsessed by his theory of a visceromotor reflex, taught that it was impossible to separate the symptoms produced by the inflamed appendix from those produced by the inflamed parietal peritoneum. From my experience in teaching students I am sure that the widespread acceptance of Mackenzie's doctrine has introduced an unnecessary difficulty into the diagnosis of abdominal lesions. The student, picturing muscular rigidity as a reflex from the inflamed organ through the splanchnic afferent nerves, and conscious that peritonitis produces a similar effect, finds a hopeless impossibility in the task of distinguishing between the two processes, and is apt to regard abdominal diagnosis as very largely guesswork. But if he can be taught that true reflex involuntary rigidity is the result of stimulation of the parietal peritoneum, and of that alone, and that the only true pain felt in the gastro-intestinal tract is a splanchnic pain due to increased tension and exaggerated peristalsis, the investigation of a case of acute abdominal disease becomes relatively straightforward.

A BIOLOGICAL CONSIDERATION OF ABDOMINAL PAIN.

I will finally sketch in briefest outline what I conceive to be the biological or evolutionary aspect of abdominal pain. With the development of the alimentary tract and the peritoneal cavity a great responsibility for the protection of the abdominal viscera was laid upon the parietal peritoneum. To guard against bacterial invasion of the peritoneal cavity from without by penetrating wounds, or

from within by perforation of a hollow viscus, the parietal peritoneum was endowed with nerves of exquisite sensitivity to mechanical or chemical insult. Stimulation of this layer produced reflex guarding of the overlying muscles, with pain felt in the skin and on the surface of those muscles. At the same time another reflex—not dealt with in this paper, but also originating in the parietal peritoneum, the splanchnic inhibitory reflex—was provided to secure rest to the intestinal tract and so to avoid the diffusion of septic material by peristalsis.

Against the danger of intestinal obstruction another mechanism had to be elaborated. Violent peristaltic efforts of myogenic origin attempted to overcome the obstructing force, and their occurrence was registered by painful afferent stimuli through the splanchnic nerves, appreciated by the brain as spasmodic in character, and vaguely localized in the centre of the abdomen. This splanchnic pain would seem to be the more primitive in order of evolution. It is akin to protopathic pain in its dull character and in the absence of precise localization. Moreover, a considerable stimulus is needed before consciousness of pain is produced.

SUMMARY.

1. The evolution of our knowledge of the mechanism of abdominal pain is summarized.

2. The initial central pain in acute appendicitis is a true splanchnic pain, due to increased intra-appendicular tension.

3. The localized right-sided pain is due to irritation of the parietal peritoneum.

4. Cutaneous hyperalgesia is too variable in its incidence to be of value in the diagnosis of acute appendicitis.

5. The mode of production of cutaneous hyperalgesia is discussed. Mackenzie's viscerosensory reflex theory is criticized.

6. The mechanism of reflex muscular rigidity and the associated deep tenderness is discussed. Mackenzie's visceromotor reflex theory is criticized, and the role of the parietal peritoneum emphasized, protective muscular rigidity being ascribed to a peritoneo-muscular reflex.

I am indebted to Professor J. S. B. Stopford, M.D., F.R.S., for his kindness in drawing the diagrams illustrating this paper.

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AN OPERATION FOR THE CURE OF PROLAPSE OF THE RECTUM IN THE FEMALE.*

BY

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THE aim of the operation herein described is to restore the muscular retentive mechanism which prevents the bowel prolapsing after each act of defaecation.

In July, 1913, a single woman, aged 51, came to see me; she had undergone an operation for rectal prolapse four years previously, the prolapsed portion of the bowel being excised. The operation was, unfortunately, a failure. The bowel still prolapsed for nearly two inches and the anal orifice surrounded by scar tissue admitted three fingers. She had complete incontinence of faeces, and was unable to earn her living as a nurse. Her condition was deplorable, and her nervous system had suffered considerably in consequence. She was reluctant to undergo another operation, but ultimately yielded to persuasion.

The bowel was returned and the patient was placed in the elevated lithotomy position; an incision was then made around the anal orifice anteriorly and laterally for three-fourths of its circumference. The perineum was incised in the middle line from the fourchette to the anal orifice; this incision was further prolonged anteriorly into the labium of each side for about an inch and a half. The lower end of the rectum was freed by dissection anteriorly and laterally, exposing the levator ani on either side, whilst the lower portion of the posterior vaginal wall was dissected upwards for about two inches. A V-shaped piece was then cut out

* Abstract of a paper read before the Subsection of Proctology, February 8th, 1928. *Proc. Roy. Soc. Med.*, vol. xxi, No. 5, p. 891, March, 1928.

of the anterior rectal wall and the anterior margin of the anal orifice. The cut edges were united by catgut sutures, after tying the bleeding vessels. The scar tissue surrounding the anus was dissected out, and the anal orifice reconstructed to the requisite size by a series of catgut sutures passed so as to take a grip of the sphincter ani and to avoid the mucosa of the bowel. A V-shaped piece was next removed from the posterior vaginal wall, followed by the suture of the levatores ani muscles in front of the lower end of the rectum. The cut edges of the posterior vaginal wall were then sutured together by catgut sutures, which were passed through the united levatores ani muscles, and when tied brought the latter in close apposition with the posterior vaginal wall. Silkworm-gut sutures were passed through the perineal tissues to coapt the divided perineal body, and further to coapt the already sutured levatores ani muscles. The skin edges were finally united with catgut, whilst a special silkworm-gut suture was inserted to prevent the anal orifice falling backwards.

The patient made a smooth recovery and regained complete control of her anal sphincter. She has, moreover, remained well up to the present date, and has expressed herself as being completely cured. She has been enabled to discharge her duties as a nurse and to lead a life of unusual activity. The result of this operation satisfies the time test, for the patient has remained perfectly well up to the present date—that is, for thirteen years.

On thinking over this operation I concluded that it was unnecessary to excise a portion of the rectal wall and anal margin (as that procedure only led to scar formation) instead of building up and strengthening the anal sphincter, which could be done much better without

and had her last confinement twenty-nine years previously. She had had slight rectal prolapse and loss of control ever since her last child was born. When she presented herself for examination the rectum protruded for four inches, and she informed me that the amount of rectal prolapse had

been gradually increasing. There was no evidence of ulceration.

It is essential that such patients should have a preliminary period of rest in bed, not only for purposes of local cleansing, but because congestion is diminished in those who have struggled to be about. The prolapsed bowel should be returned, and if possible retained, which still further diminishes local congestion.

During the operation the elevated lithotomy position is employed in order to diminish the tendency to protrusion of the rectum. An incision is made around the dilated anal orifice anteriorly and laterally for three-quarters of its circumference. A mesial incision is then made from the anal orifice

FIG. 2.—Levatores ani exposed together with the sphincter ani. The vaginal flap has been reflected upwards. A, Levator ani. B, Sphincter ani. C, Vaginal flap.

FIG. 1.—The smaller diagram shows the prolapse of the rectum. The larger diagram shows the line of the incision after the prolapse has been returned.

to the fourchette, which, when deepened, splits the perineal body (Fig. 1). This incision is prolonged at its anterior extremity outwards and forwards into each labium. The anal sphincter and the lower end of the rectum are exposed by dissecting away the superjacent tissues, and the posterior vaginal wall is dissected upwards for about two inches (Fig. 2). Catgut sutures are now introduced grasping the sphincter ani, being passed on one side from within outwards under the sphincter muscle and avoiding the mucosa, and in the reverse order on the opposite side, and are then tied. A sufficient number of these sutures are introduced to restore the anal orifice to the normal size, and when a good grip of the sphincter muscle is taken by the sutures this muscle is strengthened and tightened, and a normal anal aperture is constructed. Sutures of catgut are further used to tighten the stretched

FIG. 3.—Sutures in position, V-shaped piece excised from vaginal flap. A, First of a series of catgut sutures to reconstruct anal orifice. B, Silkworm-gut sutures passed deeply through the levator ani and skin on each side. C, Fascial sutures of catgut. The levatores ani are further united with catgut.

removing any portion of the bowel; and although the functional result had been so good, yet I believed that avoiding a scar would be even better. I was able to put my ideas into practice when this patient brought her sister to me in October, 1924, and the operation I performed on her appears to be suitable for the majority of cases. This woman was 65 years of age, the mother of three children,

FIG. 4.—Operation completed. Silkworm-gut sutures tied through small pieces of india-rubber tubing.

or torn fascia over the lower end of the rectum and to reinforce any weak spots.

A sufficient number of silkworm-gut sutures are next inserted; these pass inwards through the skin and levator ani muscle on one side and outwards through muscle and skin on the opposite side. The levatores ani muscles are then united by catgut sutures. A V-shaped piece is excised from the posterior vaginal wall, and the edges united by catgut sutures, which, when passed, also take a grip of

the levatores ani muscles, in order to bring these muscles and the posterior vaginal wall into close apposition (Fig. 3). The skin edges are next united with interrupted catgut sutures and the silkworm-gut sutures tied through small pieces of india-rubber tubing, thus completing the operation (Fig. 4). The last or most posterior silkworm-gut suture is passed so as to prevent the anal orifice falling backwards, which is not infrequent after operations for complete rupture of the perineum. Catgut may also be employed for this suture.

A "sacral anus" is a complication which should not be encountered where the necessary precautions have been taken during the operation to restore the anal canal. After this operation I believe it is best to refrain from administering purgatives at least for some days in order that healing may remain undisturbed. Should the patient be uncomfortable in consequence of the bowel not acting, warm olive oil should be run into the rectum through a small india-rubber tube, and a dose of castor oil given by the mouth. The bowels should afterwards be kept acting by a gentle laxative.

The result of the operation described was completely satisfactory, the wounds healed well, and there was complete sphincteric control. The patient has been enabled to be about and lead an active life, whereas formerly she was more or less of an invalid, spending most of her time either in bed or on a couch, and being forced to give up her business in consequence of her physical suffering.

When writing this paper I received unexpectedly a letter from this patient, in which she states:

"I am writing to tell you the operation has proved a perfect success. It was some time before the bowels acted naturally, but now I am like another woman. I was a long time making up my mind to the operation, but I am glad I did, and I am very grateful to you for your care and skill. I only wish other sufferers knew the benefit."

Although this type of operation remedies the anatomical defects which seem to accompany this variety of prolapse, yet congenital predisposition is an etiological factor which cannot be overlooked, for these two women were sisters, and I am informed that another sister and two cousins suffer from rectal prolapse. Exercises to cause contraction of the levatores ani muscles and sphincter ani should be practised after this operation, and such exercises are still more necessary in the presence of congenital muscular weakness. Finally, this operation offers a prospect of cure, not merely to the surgical derelicts cast adrift because of the failure of other methods, but to those who bear their suffering not knowing that anything can be done for their relief, as well as to those who from knowledge of failures have lost faith in modern surgery.

SPIRIT AND BIPP TREATMENT.

BY

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PROFESSOR RUTHERFORD MORISON's bipp treatment is not, I think, always clearly understood, and if employed haphazardly and without attention to detail may be disappointing. The following case, which recalls that of Dr. Monica Bell and Professor Morison (December 10th, 1927, p. 1077), shows a remarkable result obtained by the use of this procedure.

On December 7th, 1927, a feeble old lady of 77 was knocked down by a motor lorry and sustained a severe compound comminuted fracture of the lower end of the right tibia and fibula, involving the ankle-joint. She was brought into the Barry Surgical Hospital suffering from shock and haemorrhage. Although a rough tourniquet had been tied round the leg the wound was still bleeding, and there was evidence from the saturation of her clothes that the haemorrhage had been profuse. A large dose of morphine and atropine was administered, and a more efficient tourniquet applied. At the end of about one hour she was sufficiently recovered from the initial shock to justify operation.

Under gas and oxygen the wound was freely opened up and the bleeding points secured. The bone was found to be badly comminuted, and many completely detached loose pieces were removed; other fragments showing a reasonable attachment to the periosteum were left. Attention was now directed to the rest of the wound. The skin edges were excised, and badly lacerated portions of muscle and fascia were removed. Fortunately it was possible to save the anterior tibial nerve; this had been completely

stripped by the violence of the injury, but remained in continuity. The wound was now freely swabbed out with methylated spirit, after which it was carefully dried, one or two additional bleeding points being secured at the same time. (There is always a fair amount of bleeding after the application of spirit.) The wound was temporarily packed with dry gauze during the changing of the gloves and towels. On resuming, a small quantity of bipp was introduced into the cavity, and thoroughly rubbed into every available nook and cranny. Lengths of thick linen thread were carefully bipped, and by their means the skin edges were roughly approximated; owing to the loss of tissue accurate apposition without tension was not possible or desirable. The dressing consisted of long pads of gauze freely soaked in spirit, each pad being liberally sprinkled with boric powder. The pads were laid along the wound and did not encircle the limb. A top dressing of wool was temporarily held in position by a bandage.

The plasters were applied as follows. The first plaster extended from above the wound to above the knee—the knee being slightly flexed during the application. The plaster was reinforced with thin laths of wood. The second plaster encircled the foot below the wound. Traction was now made on the foot by means of a weight and pulley, and when alignment of the foot was perfect the intervening space was rapidly filled in with the third plaster. Before the plasters were firmly set a large window was cut out over the wound, and the whole case was divided longitudinally from top to bottom. This division was continued through the wool and bandages until the skin was exposed. This step was an important one in view of the possibility of subsequent swelling, and the very real danger of gangrene in a patient of this age.

The patient stood the operation well, and returned to bed in a fair condition. Before leaving the theatre 500 units of antitetanic serum were injected. I would now also employ anti-gas gangrene serum, but I did not have a stock in readiness at the time.

Prognosis.—The prognosis given to the relations was a bad one. Apart from the immediate dangers of shock and haemorrhage, there remained the possibility of gangrene, and later of severe sepsis with osteomyelitis. At best only healing by granulation could be hoped for, and a very poor functional result.

Progress.—The old lady remained very feeble and debilitated, but no special pain was felt in the foot, and the temperature caused no alarm. There was some trouble with the bladder and bowels. On the seventh day—more from curiosity than necessity—I removed the dressing. The wound was quite dry. The skin was healthy right up to the cut edges, between which lay a hard dry mass of coagulated blood. I took out the stitches and dressed the wound with spirit gauze and powder. A week later a similar dressing was applied. From start to finish not a bead of pus or even serous oozing occurred. At the end of a month the splint was removed daily for massage, and a fortnight later discarded altogether. At the present time she can bend her knee to a right angle, and can voluntarily move the foot through 30 degrees. The wound is healed and the fracture firmly united.

Comments.

The technique used in this case was almost identical with that instituted by Professor Morison at the Northumberland War Hospital. Points to notice are:

1. The full excision of the wound.
2. The liberal use of spirit.
3. The small quantity of bipp required. This must be well rubbed into the exposed surfaces and no excess left.
4. The use of bipped sutures; this prevents infection of the needle holes and the spread of sepsis from the skin to the deeper structures.
5. The dressing with spirit and boric powder.
6. The absence of any encircling bands round the limb.
7. The infrequent dressing of the wound.

The last requires courage, but is most essential if secondary infections are to be avoided.

AN ATYPICAL CASE OF HYPERGLYCAEMIA IN GENERAL ANAESTHESIA.*

BY

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THE unusual extent of the increase in the blood sugar during general anaesthesia in the following case, combined with the absence of glycosuria or of any untoward symptoms, make it worthy of record.

A woman, aged 50 years, was the subject of a major operation on account of gastric ulcer, hour-glass stomach, and chronic appendicitis. She was prepared for operation in the normal manner, having no food on the morning of operation, and receiving 1/4 grain morphine and 1/100 grain atropine about an hour previous to the administration of the anaesthetic.

* This case is one of a series in a research towards the expenses of which a grant has been made by the British Medical Association.