linea alba. After about fifteen months, however, the sensory loss becomes negligible, as far as ordinary testing can determine, probably owing to regeneration of nerve fibres.

In all these cases there was a marked loss of function of that part of the rectus muscle lying between the point where the fibres were split and the mid-line. This may be fairly extensive or confined to one segment of the muscle, depending on how many nerves have been divided. It is present from the outset and persists for a considerable period. In a few cases there was a slight bulge on coughing, but for the most part the loss of muscle function could only be detected when the patient raised the head and shoulders from the couch. The functional results from the patient's point of view were excellent, and after secure suture and healing by first intention no disability was apparent from the abdominal scar. As a typical example may be quoted the case of a brewer's drayman who, nine months after such an operation, was lifting barrels of beer daily without difficulty or discomfort. It appears that after careful suture of the aponeurosis the risk of hernia is very slight in the absence of sepsis and drainage.

We next followed up the results obtained by the paramedian or rectus slide incision with outward displacement of the muscle and its nerves. In these cases, for some reason not readily explained, the sensory loss is insignificant from the start. We found that in this group the rectus muscle on the side of the scar functions normally throughout, and there is no weakness discoverable after this operation.

Our inquiries show that in the absence of infection the functional result is so good that no special advantage attaches to either incision, but for accessibility the muscle-splitting incision has certain points in its favour. In the presence of infection, however, we have seen a number of post-operative herniae after the muscle-splitting incision. Infection interferes with the healing of the aponeurosis, which has but a poor blood supply, and this is further complicated by the sacrifice of a segment of muscle. With the rectus slide incision the muscle itself is uninjured and falls back to its natural position, forming an additional barrier against subsequent weakness. Further, when the wound heals without complication it is probable that the regeneration of nerve fibres occurs normally and the muscle function is quickly restored. Should infection be incurred this process may fail, owing to the barrier of fibrous tissue, through which the nerve fibres cannot penetrate, causing atrophy of the muscle and thus allowing a hernia to develop.

We have also occasionally seen patients who complain of painful areas in the scar after division of nerves, probably owing to involvement of the severed nerve fibres in fibrous tissue. Most of us must have met with the somewhat analogous condition where the ilio-inguinal, a highly sensitive nerve, has been damaged in hernia operations, leaving the patient with a painful and tender scar. Such unpleasant sequelae are fortunately seldom observed, but none the less they are too frequent, and it is important that we should take all possible precautions to avoid their occurrence.

In urgent operations on the upper abdomen the quickest and easiest approach is by a muscle-splitting incision passing through the inner third of the rectus muscle. This affords good access in cases of perforated gastric or duodenal ulcer and in acute cholecystitis, and avoids injury to the nerve trunks at the lateral border of the rectus. I recently published¹ a follow-up of 41 cases of perforated gastric and duodenal ulcer approached by this route, and when seen subsequently all possessed a satisfactory abdominal wall.

I have confined my remarks to those abdominal incisions which are in most general use. It is only by a careful study of our results and a more accurate follow-up of cases that reliable conclusions can be obtained, and any discussion of our methods on these lines with a view to their improvement must surely be of value.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, 1922, vol. i, p. 556.

THE ABDOMINAL INCISION IN PELVIC SURGERY.*

BY

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My personal experience of gynaecological surgery dates from the time when all abdominal incisions were made in the middle line and were closed with through-and-through silkworm-gut sutures. Incisional hernia must have been fairly common in those days, as it was usual for every patient whose abdomen had been opened to wear a belt for the rest of her life. Then we began suture in layers, first with silk, and later with catgut. Gradually the use of the belt was found to be unnecessary, and was dropped except in special cases.

After suturing in layers had come into use, I omitted silkworm-gut stitches altogether for a considerable period, uniting the peritoneum, fascia, and skin separately, but putting no stitches through the muscle. The results were very good; but in a few cases serum oozed from the wound, wetted the dressing, and kept the skin moist and sodden for a few days. This was apt to permit superficial infection, which delayed and impaired perfect healing of the skin edges. I therefore sought a means of applying pressure sufficient to keep the wounds dry, and found that this could be done by inserting five or six silkworm-gut sutures through the skin, fat, and fascia after uniting the peritoneum. The silkworm-gut sutures are left untied until the fascia and the skin have been stitched with catgut. A roll of gauze about an inch in diameter is then laid over the sutured wound, and the silkworm sutures are tied over it, compressing gauze, skin, fat, and fascia. This anchored dressing gives moderate uniform pressure along the course of the incision. It is left untouched for a fortnight, when it is removed to reveal a firmly healed linear scar. There is no moisture of the wound, no cutting of the skin and no stitch abscess. There is no dressing of the wound, no taking out of clips, and no need to use little rubber tubes to cover the silkworm sutures. The method must be distinguished from that in which sutures are tied first over the skin and then again over the gauze, giving a form of anchored dressing that has no great advantage over a loose one. I have used my own method in every case during some fifteen years. It has spared me worry and lessened the work of my nurses, while it has saved my patients much discomfort if nothing worse.

The mid-line incision sutured in layers leaves the abdominal wall as good as it was before the operation. But many of the women treated in a gynaecological ward have, before operation, very defective and inefficient abdominal walls. In most parous women there is considerable separation of the recti, and in a large proportion of these the injury is considerable and even extreme. In other cases the trouble is due to stretching by large tumours.

While this parietal defect would not alone justify surgical interference, it seems a pity, if the abdomen has to be opened for some other purpose, to close it again without taking steps to secure for the patient a better abdominal wall than that she possessed before her operation. With this object I have long made it my rule to open the sheaths of the rectus muscles on both sides throughout the whole length of the incision. When this has been done the inner edges of the recti come together and lie in direct contact as the wound is closed, and this without any injury to their nerves or to their blood supply. The union secured is muscle to muscle, and the so-called linea alba is done away with. This end is gained with very little trouble. If the primary incision through the fascia opens one muscle sheath, then the fascia must be dissected up until the other muscle is freely exposed. If the primary incision goes between the recti and exposes neither of them, then the fascia must be lifted on both sides until both muscles are bared freely throughout the length of the incision.

* Read before the Manchester Surgical Society, February 19th, 1924.

Two details may be mentioned. First, the dissection should be done as the incision is made and not at the end of the operation; for some bleeding may be caused, and if this occurs at the beginning of the operation it will have stopped long before the end. But if fresh bleeding is brought on just before suturing it may cause delay or even lead to the formation of haematoma in the wound. Again, if there is much fat just outside the peritoneum, this should be torn or clipped away. If it is not removed this fat may intervene between the edges of the recti when the wound is closed, so preventing direct muscle-to-muscle union.

When closing the wound, the spare peritoneum, freed from fat, is bunched together in the mid-line with a continuous catgut suture. The silkworm-gut sutures for anchoring the dressing are next put in through skin, fat, and fascia. They perforate the fascia outside the redundant portion of the fascia—namely, close to the edge of the exposed rectus muscle. These are left untied and the fascia is united with catgut so that its edges do not merely meet, but overlap or are bunched up sufficiently to draw the rectus muscles into contact in the mid-line. The skin edges are next drawn together with a subcutaneous catgut suture, the roll of gauze is placed over the incision, and the silkworm-gut sutures are tied over it. When this method is used, not only does the abdominal incision do no harm, but the parietes of the average woman are very much improved. She leaves hospital, in short, with one central rectus muscle below the umbilicus instead of two lateral ones with a gap between them.

The position of the umbilicus varies very considerably, and sometimes an incision below it will not permit the delivery of a fibroid or ovarian growth. In these cases, if the abdominal wall is a bad one, the best course is probably to excise the umbilicus completely and unite muscle to muscle throughout the length of the incision required for the extraction of the growth. No doubt a certain aesthetic loss is involved when the umbilicus is removed. But our mother Eve is presumed to have had no navel, and her daughters can afford to dispense with this adornment in exchange for a sound abdominal wall.

The books of the Manchester Royal Infirmary and the St. Mary's Hospitals show that out of the last 1,725 patients whose abdomens I have opened only 12 have returned for repair of the incision. This shows a percentage of 0.7 defective scars. In several of the cases drainage had been used, in a few there was a history of chronic bronchitis, but the chief cause of failure was, I think, the intrusion of portions of extraperitoneal fat between the edges of the recti. There are two women on whom I have refused to operate for a third time; for no sooner are they up and about than their tissues stretch and give forthwith, in spite of the use of good belts. On the other hand, there is one patient whom I have delivered five times by Caesarean section. Her abdominal wall, stretched five times by the growth of large children, required considerable trimming and repairing on the last occasion. But it remains sound and efficient, for the patient still earns her living as a stage dancer. Taking these figures for what they are worth, I believe that less than 1 per cent. of the patients are any the worse for the median incision; but the point I wish to emphasize is that, since I began opening both muscle sheaths, the majority are not only no worse but are much better, as to the abdominal wall, than they were before operation.

Of transverse incisions I have not much experience. I used them nineteen times some years ago and found that making the incision and closing it occupied, on the average, seven minutes longer than using the median incision. It was generally necessary to tie two arteries. Access to the pelvis was fair, but it was not good for other parts of the lower abdomen, or for the removal of growths of any size. Large areas of connective tissue are rawed, and in certain cases might be infected, with serious consequences—as, for instance, if drainage should be necessary. The only obvious advantage is the aesthetic—namely, that the scar is partly concealed by the pubic hair. Judging by the number of these scars that I see, the transverse incision is not popular at present in this country. On the other hand, I see a very large number of lateral scars. In some of these cases the result is good, but in

many there is pronounced atrophy of the rectus muscle between the incision and the mid-line of the body. It would appear that the lateral wound does not give good access, for I could give a long list of lesions I have found in patients whose abdomens had previously been explored through incisions that must have been either too small or too far from the middle line. But the main defect of the lateral incision is that it does not improve the abdominal wall of the woman with separated recti. It leaves her with her parietes as bad as before, if no worse.

I think the incision in the mid-line below the umbilicus is the best for gynaecological work, and that it might be used with advantage by general surgeons when the diagnosis is not clear—as, for example, in cases of appendicitis and diverticulitis complicated by the results of infection of the pelvic organs—for the median incision cannot injure the muscle or the fascia as the lateral incision may do. It gives better access to both sides of the lower abdomen, and it can be extended upward as may be desired. Further, it gives the opportunity for improving the patient's abdominal wall in all women whose recti lie far apart.

EFFECT OF INSULIN ON THE SUGAR CONTENT OF ARTERIAL AND VENOUS BLOOD IN DIABETES.

(Preliminary Communication.)

BY

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THIS investigation was undertaken primarily in the hope of gaining more evidence on the precise place of action of insulin in the body. A large amount of research has already been done on the subject, and it is known that the action does not take place to any great extent in the blood itself. The liver and muscles have been mainly credited with the utilization of sugar and the disappearance caused by insulin. It appeared that the part played by the muscles and general tissues might be further investigated by comparing the sugar content of blood going to and coming from these tissues—that is, arterial and venous blood.

Recent work by Foster¹ has shown that a difference between arterial and venous blood sugar concentration does exist in normal individuals, but no comparison seems to have been made on diabetics. Accordingly it was determined to estimate simultaneously the arterial and venous blood sugar in diabetics to see if the normal difference were present, and to compare this before and after insulin. If any variation in difference were found in diabetics after insulin, it could be inferred that this was directly due to the action of insulin on the muscles and general tissues which lay between the arterial and venous blood.

Methods Used.

As frequent arterial punctures are impracticable, and Foster has shown in the dog that blood from a paw prick and direct from an artery give readings identical within the range of experimental error, capillary blood drawn directly from the ear into a 0.2 c.cm. pipette has been used as representing arterial blood throughout this investigation. Venous blood was obtained from the arm veins by a fine syringe and transferred to a Wassermann tube containing a trace of oxalate, from which the required amount was immediately measured, the whole process being completed within two minutes of bleeding the ear. Cole's method of blood sugar estimation was used, and gave very satisfactory duplicates.

Normal Persons.

A few control experiments on normal students at King's College Hospital confirmed the results obtained by Foster on the difference between arterial and venous blood sugars in normal individuals. He found that the fasting levels of venous and arterial blood were practically identical, but that after the ingestion of 100 or 200 grams of glucose the arterial exceeded the venous on an average by 20 to