Remarks

ON

THE PREVENTION OF VENTRAL HERNIA AS A SEQUEL TO ABDOMINAL SECTION.

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ALTHOUGH it is fortunately true that in the great majority of instances no hernia follows abdominal section, and that every variety of incision and method of closure can count its successful results by hundreds, yet it is equally true that post-operative ventral hernia does occur at times in a small percentage of cases, and one of the greatest disappointments that can fall to the lot of any abdominal surgeon is to find that after a successful operation upon some of the internal structures, the outer wall of the abdomen, which had apparently perfectly united, yields soon after the subject gets about again, or during the next few years, and his patient returns later with a large ventral hernia. The discomforts arising from this discount heavily the advantages obtained from his work, and unless the primary operation was performed for something which was evidently risking the life of the sufferer, or making that life unbearable, she is apt to consider that the last stage is infinitely worse than the first, and to wish that she had never consulted a surgeon at all. Such an occurrence does much to mar the reputation not only of the operator but of the operation itself, and to dissuade others whose condition requires it from having recourse to the benefits it is otherwise able to confer.

It is difficult to get any clear idea of the relation between successful and unsuccessful cases of union of the abdominal wall. Unsuccessful cases, as Owen says, are apt to be quietly interred, and one hears nothing of them. But my friend, Mr. Rutherford Morison, estimates the number occurring in his own very large practice at about 2 per cent., and in my own list of over 350 abdominal sections I can find 4, a little over 1 per cent. Every abdominal surgeon will, I think, admit that he sees them from time to time. Allow me to mention briefly the details of these cases.

CASE I.

Mrs. H., aged 29, who in 1892 was operated upon in another town by another surgeon, who removed an ovarian cyst. As soon as she began to get strong she suffered from a hard, dry cough, which persisted for a long time. This continued, according to her account, more or less for over two years. No yielding of the scar was noticed until the middle of 1895, about three years and a-half after the first operation. This went on slowly for six months, when she presented herself at Ancoats Hospital. At that time—January, 1896—there was yielding of the lower two-thirds of the scar; there were present two or three openings in the fascia through which the internal contents, consisting chiefly of omentum, could be felt protruding beneath the skin, one slightly to the left and about midway between the pubes and umbilicus being larger than the rest.

On January 23rd the skin was divided by a straight incision parallel to and to the right of the old scar. The patient took the anaesthetic very badly, and the operation was therefore hurried. After freeing and removing the omentum the fascial edges were approximated by buried silkworm-gut sutures, the skin by horsehair. There was continuous vomiting for four days, nevertheless firm union apparently resulted, and the patient was discharged on February 8th, that is, in sixteen days after the operation. She was firmly strapped up.

In March, 1897, that is, fifteen months later, she presented herself again. She said that in the previous June, whilst travelling by train, she was assaulted by some man, and as soon as the train stopped she jumped out of the carriage. In doing so she fell on her knee, and was aware of some yielding of the abdominal wall, which had since increased. She was found to have two medium-sized herniae, rather outside the median line, one above the other, the highest being about 1 in. from the umbilicus. This time she took the anaesthetic better, and both sacs were carefully dissected free from the edges of the openings, and removed with some extruded omentum. The fascial edges were split, after Grieg Smith's method in umbilical herniae, so as to obtain a wider union, and united by buried silkworm gut. She was discharged on March 24th, three weeks after operation, apparently firm. She was again firmly strapped up.

Once more she returned in 1899. This time no apparent reason had existed for the reappearance of the hernia, but again three distinct spaces were to be felt, each more or less in the line of the scar, and each containing omentum. This time frayed-out bands of fascia were found in the coverings of the herniae, partially subdividing them. The whole scar was excised and all the spaces thrown into one. The fascia was very carefully bared above on one side, and below on the other for a distance of 2 to 3 cm. on either side. Mattress silkworm gut sutures were placed in such a way as to draw one layer of fascia over the other

and to fix it there. These sutures were buried and the skin united over all. She was kept on her back for two months. Twelve months later the union was still firm and secure, and, as nothing further has been heard of her, it may be supposed that the hernia has not again recurred. Five years have now elapsed.

CASE II.

Mrs. B., aged 31, a heavy, phlegmatic woman, with great development of fat, enteroptosis, and prolapsus uteri, was operated on for ventri-fication on May 22nd, 1900, apparently successfully, and she was discharged well on June 15th, three weeks after operation.

The next year, February 7th, 1901, she appeared with a large median ventral hernia, which I have operated upon three times since, always without lasting success, and she has now a large hernia, which can only be supported by a heavy belt.

CASE III.

Mrs. K. H., aged 33, in July, 1893, had a parovarian cyst removed, and, as was the custom at that time, a Keith's drainage tube was inserted into Douglas's pouch. The peritoneum was united around this with catgut, and the skin and muscles, including the fascia, by through-and-through sutures of silkworm gut. The tube was removed on the third day, and a small amount of omentum plugged the opening. She recovered apparently completely, and left the hospital with the wall firm two months after operation.

Four years later she returned with two small gaps in the line of incision. Omentum was found adherent to their edges and was freed all around. The edges of the fascia were brought together and united by buried silkworm gut sutures. Two days later, there having been almost persistent vomiting, the abdominal wall gave way, and a loop of intestine could be seen below and between the skin sutures, which were cutting into it. The loop was washed and returned, and the muscular wall re-united by silkworm gut sutures which passed through them, the fascia and the peritoneum; the skin and subcutaneous layer was left open, to permit of free exit to any discharges. Healthy granulations being present seven days later, the outer layers were drawn firmly together by strapping. She left the hospital one month after the operation apparently soundly healed and was seen a month later still, when she was perfectly firm. This was in 1897.

Once more she returned in 1903, that is, six years after the last operation, and ten years after the first. This time there was a large ventral hernia, extending over very nearly the whole extent of the scar. She could give no very definite reason for its reappearance, but said that it had gradually opened up, and had been present for at least a year—it might be more. She was never very clear in her statements. This time the operation took a long time. Adhesions were plentiful and firm, omentum and large intestine were adherent to the edges of the opening, especially near its upper end, and the latter had to be separated with much care. The outlying cavities of peritoneum seemed never ending; when one was cleared out, a small tag of omentum led into another, which in its turn had to be opened up; and when at last the whole tangle was straightened out, and the muscular wall properly united, the patient was much collapsed. Transfusion was done on the table during the operation, 20 minims of liq. strychn. and 10 minims of adrenalin were injected subcutaneously, but the length of exposure and the severity of the operation itself were too much for her, and she died within twenty-four hours.

CASE IV.

H. F., aged 47. A large fibroid uterus was removed by the abdominal route on November 23rd, 1897. The fascia was united by buried silkworm gut mattress sutures. Suppuration occurred around one of these, and a sinus formed. From this, on the 31st, the suture was removed and the sinus healed. She was discharged on January 15th, 1898, seven weeks after the operation. She remained perfectly well until 1902, that is, for four years. She was then nursing a sister; the scar began gradually to yield, and a hernia appeared. This slowly increased, and on her return to hospital in May, 1904, there was a circular opening in the fascia about 2 in. in diameter; through this, bowel and omentum had escaped, and formed two bluntly acuminate masses separated by the firm, thick, skin scar, which stretched like a tough cord above and between them. On operation omentum was found firmly adherent to the edges of the opening and spreading widely in peritoneum-lined cavities above the fascia in the subcutaneous tissues.

It is too early to say anything as to the result in this case, but of the three others it will be seen that one was apparently cured, one is still uncured, and one ended in death. Such occurrences make one, as the French say, furiously to think.

Many abdominal operations are not of a simple kind. A firmly adherent double pyosalpinx cannot be removed safely in a few minutes, whatever the advocates of extreme speed may say. When small and large intestine are adherent above and behind, when adherent omentum covers in the whole mass, when the tubes themselves are tense and thin, separation must, if it is to be safe, also be quietly, slowly, patiently carried out, and such patient work takes time. An intra-ligamentous fibroid cannot be enucleated with safety at express speed. It is therefore inevitable that when all the primary and essential work is done, the patient will be feeling the shock of the operation, and that the surgeon, possibly urged thereto also by remarks from the anaesthetist, will take the readiest means possible of closing the abdominal

wall, and risk the possibility of this not being the one most likely to ensure a satisfactory and permanent union.

So forcibly had this impressed some surgical minds that some years ago there was a strong current in favour of doing all pelvic operations in women by the vaginal route. Incisions in the upper half of the abdominal wall are by no means so likely to be followed by hernia as are those in the lower half. Very rarely indeed are operations upon the gall bladder or stomach succeeded by ventral hernia, and of course this might have been anticipated. The main weight of the abdominal viscera rests upon the lower half of the abdomen; the structures found there—the small intestinal loops—are more movable, and are more likely to undergo variations in size owing to distension, than those found in the upper half, and therefore the internal tension upon this segment alters more rapidly, more frequently, and more forcibly. In the lower segment, moreover, is found the free extremity of the omental curtain, and experience has shown that this structure has a most perverse tendency to insinuate itself into any opening which may have been left, and that when once it has gained an entrance it gradually but persistently tends to widen this, pushing the peritoneum before it, and to burrow amongst and between the superjacent structures.

Any one who has operated upon a few ventral herniae knows how far more extended they are in the subcutaneous fat than was apparent before the skin was divided; that outside the apparently rounded and defined limits of the protrusion as felt through the skin will be found small loculi of peritoneum, each occupied by its own little omental tag, evidently the outposts and pioneers of the ever-invading structure of which they are the extremities. When once this process has gained any ground, nothing appears to stand before it. Peritoneum is expanded, fat is absorbed, muscular fibres pushed aside, even the resistant fascia will be found frayed out over the mass, or with some few more obstinate bands stretched tautly between adjoining lobes. If, then, internal pelvic viscera could be reached and dealt with from the vagina, leaving the abdominal wall intact, much after-misery would be avoided. And, greatly to the satisfaction of workers in this direction, many other advantages have been proved to be gained in surgical work by this route. Shock is very materially lessened, after-recovery is more rapid, peritonitis is evidently not so great a danger, and many more operations turn out to be practicable through this canal than *a priori* would have appeared possible. But some things still remain in treating which it is most convenient and safest to adopt the abdominal route. Ovarian cysts, even if multilocular, may be evacuated and removed through the vagina; but when these are adherent, and no pre-operative signs exist by which the extent of these adhesions can be estimated, it is wiser to attack them from above. Some adhesions, such as those to the lower end of the omentum, can be detached from below, but adhesions to the transverse colon, to the outer borders of the broad ligaments, to the sigmoid flexure, etc., are almost impracticable without a free entry through the abdominal wall. Ectopic pregnancies have been removed through the vagina, but cases are on record where the ovarian artery has slipped from the ligature placed upon it under tension from below, when once that tension has been removed, and rapid and very dangerous haemorrhage has followed. Abdominal section, then, is the only means by which the vessel can be secured, and this has to be carried out immediately under very unfavourable conditions. Fibroid tumours have been frequently removed with or without the uterus per vaginam, but if the tumour is subperitoneal, if it is calcified, if the entire tumour is larger than a child's head, or if it is adherent to any extent, the advantage of being able to see and reach the whole working area afforded by abdominal section, especially when performed in the Trendelenburg position, completely counterbalances by its safety the advantages which belong to the vaginal route.

Surgical opinion, therefore, without denying the force of the manifest arguments in favour of vaginal section, recognizes that abdominal section has, and must continue to have, a distinct place in pelvic surgery, and the problem of how best to reunite the abdominal wall after an abdominal operation presses once more for a solution.

It could scarcely be said until lately that of all the many ways in which this had been done there existed one method which was ideally perfect. Methods which were rapid were not secure, and those which give a demonstrably secure result were not rapid. As has been pointed out above, the temptation to sacrifice all else to rapidity when the operator

had reached the stage at which this had to be done was very great indeed.

Various opinions are held as to the cause of sequent hernia; of these, two appear to be most worthy of consideration. Although nowhere definitely stated, so far as I know, the idea of the importance of the action of the recti muscles would appear to underlie the practice of some surgeons. The incision must not lie in the linea alba; it must separate the muscular bundles of these muscles, or the incision in the skin must not be directly over that in the deeper fascia, whilst that must not coincide with the line of separation of muscular fibre, or the muscle must be dragged to one side, and the deeper incision through the transversalis fascia must be on another plane than that which had opened the muscular sheath. If the muscular fibres are separated they are to be sewn together again. One surgeon makes a crescentic cut through the skin, with its convexity towards the pubes; then turning up the flap thus formed of skin and subcutaneous fat, he makes a vertical incision through the rest of the abdominal wall into the peritoneal cavity. Those who advocate the first three of these plans evidently trust to the presence of the more or less bulky mass of the rectus muscle and to its contractions for a restraining force; those who advocate the last to the support of a flap of skin and subcutaneous fat as a reinforcement to the divided and reunited tissues below.

But any one who will study these cases will readily recognize that these openings increase in size primarily in a lateral direction and not vertically. The muscular fibres of the rectus have a vertical pull; they cannot antagonize to any degree a force acting in a transverse direction. Moreover, it is of little use suturing parallel muscular fibres together. Such fibres never unite to form a resistant scar. It is hardly necessary to point out the futility of relying upon such essentially yielding tissues as skin and subcutaneous fat for the supply of a force sufficient to hold in check the burrowing tendencies of omentum or the pressure of internal abdominal tension.

The alternative opinion would appear to be founded on sounder principles and to offer the really true basis for action.

Surrounding the recti muscles above the fold of Douglas and passing entirely in front of them below this fold is the deep fascia of the abdomen. The name is misleading, since this structure is in no sense a fascia, such, for instance, as is the fascia lata of the thigh. It is a tendon, broad and flattened out: the combined tendon of the external and internal oblique and transversalis muscles. It arises from these muscles on one side, and is inserted at the linea alba into the tendon of the muscles of the opposite side. When this insertion is intact the two opposing sets of muscular fibre antagonize one another. Should the one side only contract it pulls the linea alba—the line of insertion—with the inclosed rectus over towards its own side, but it cannot pull it far owing to the resistance of the opposite set. If both contract they draw the linea alba closer to the spine. If, however, this combined tendon is divided, as it is in ordinary laparotomy in the median line, or in Langenbusch's line on either side, each set of muscles, so far as their tendon is free, pulls its segment further and further away from its fellow of the opposite side until the normal tension is taken off their fibres, so leaving a gap which any further contraction of these fibres still further enlarges. That the true gap through which a hernia escapes is in this layer and formed by this structure can be demonstrated easily in any ventral hernia which will allow of the entrance of a finger. The firm string-like edge of the gap can be traced all round, with no resistance from any other tissue, peritoneum, skin, subcutaneous fat or muscle, except outside this fascial ring. The fingers easily depress all other tissues before them, and enter the abdominal cavity. On operation everything which has escaped from that cavity is found to be within this ring, and not to pass beyond it until having reached the looser tissues above, these intra-abdominal contents spread out widely and apparently without hindrance in the easily-yielding subcutaneous tissues. Although the skin does not give way it stretches enormously, so that on reduction of the hernia once more through the fascial gap, such skin lies in loose redundant folds, and may be largely removed without being missed. The skin and subcutaneous tissue have evidently been no restriction to freedom of escape of the abdominal contents; nor, it is equally demonstrable, have the recti muscles. The rectus of either side has simply been deflected from the middle line and lies outside the edge of the gap. If this edge is divided the recti fibres

will be seen curved around outside. They are never found spread over the hernia itself. The integrity of the recti muscles themselves and their power of contraction have been no bar to the post-operative hernia.

It is, of course, perfectly well known, though practically the importance of the fact would appear to be usually ignored, that normal muscular fibre contracts at once if the tendon to which it is attached is divided, and that if such division is allowed to continue the muscular fibre itself becomes shortened as time elapses. Reunion of the tendon becomes progressively more and more difficult owing to this; if the statements previously made and their obvious corollary be admitted, this is a very strong reason for early interference in any ventral hernia, but, putting this aside for the moment, it naturally follows from what has been said that the most important structure in the abdominal wall from the standpoint of the surgeon is this so-called deep fascia, this tendon of the lateral muscles; and that the risk of or security from post-operative hernia depends entirely upon the thoroughness with which this has been reunited after division.

Although peritoneum will and does yield to a surprising extent when once its outer support has given way, there can be no doubt that a gap in it enables the omentum to find an exit and so to exert its wonderful power of burrowing amongst the tissues of the abdominal wall. Therefore next in importance to the security of the fascial union must rank the importance of complete closure of all gaps in the peritoneum: other reasons, of course, exist for this procedure, but this is from this particular point of view the most important. This closure is in this region usually very easily done. When this is complete and the fascia also firmly united, the muscular fibres of the rectus then assist in the only way they can, by their bulk as a pad between the two, to reinforce the pressure from without, and to fill any dead spaces which might otherwise exist.

The essential thing then is to unite the tendons of the oblique and transversalis muscles in such a complete manner as once more to restore their mutual antagonism and to keep them firmly united long enough for firm organic union to take place between them—a process which, according to Macewen, takes six weeks, but which some observations of my own tend to show is sufficiently firm in a month—by some material which can be trusted to do this, and to remain firm and strong for that period. If at the end of that time all foreign material can be eliminated or removed from the tissues, the ideal method, so far as permanency is concerned, will be attained. If this is not possible the material used should be such as to cause no after-discomfort. It will be seen that this is by no means the simple problem that earlier operators suggest, nor the least important that the surgeon has to consider when planning an abdominal operation.

The ideas which dominate an operator's mind with reference to the structures with which his operation deals can be fairly deduced from the steps of the operation he performs. Judged in this way, the earliest operators must have looked upon the abdominal wall as practically a homogeneous layer of tissue, which, when union of any sort had taken place, would be equally strong in all its parts.

Sutures were introduced through all the tissues, and these were simply drawn and held together for a certain length of time, which appeared mainly to depend upon the time required for the union of the skin. This method even yet is often adopted for the sake of speed. It is no doubt the quickest and readiest method, but it will be seen that the union of the definite layers of this covering must be merely a matter of chance. Peritoneum will unite to anything to which it happens to be apposed—to fat, or muscle, fascia, or connective tissue. In most hernias of any duration, the union between the fascial edge and the peritoneum is very intimate; the thin covering which alone exists between the external world and the peritoneal cavity in an old ventral hernia is composed exclusively of skin and peritoneum, with perhaps a few strands of frayed-out fascia near its periphery.

These unions are not merely useless to prevent escape of intra-abdominal contents, but they are distinctly harmful, as rendering impossible the union of the more resistant structures until they are once more freed. Union of skin to skin is frequently one of the most rapid of all; and it has not been an infrequent experience to find that this skin union has had to be broken through again to permit of the exit of banked-up blood, serum, liquefied fat, or pus which has collected in some space between deeper tissues which have been some distance apart. Such a method stands theoretically and practically

self-condemned from the point of view of permanency, however it may appeal to the surgeon from the point of speed.

Spencer Wells was the first to point out the necessity of union of peritoneal surfaces, but he only laid stress upon this. The importance of such union has been emphasized by other writers since, for other reasons, notably by Clark, on the score of the advisability of once more producing a closed peritoneal cavity, so as to favour peritoneal currents by means of which bacteria and other foreign material in the abdominal cavity may be carried into the lymphatic spaces; and to prevent adhesions between internal viscera and connective tissue outside this layer; but the other structures of the abdominal wall were still treated as though they all were of equal importance.

It is curious to note the swing of the surgical pendulum between this method of "laissez faire" and the opposite extremity in a method lately advocated in some of the surgical journals. In this latter every layer has its own continuous suture. Not only peritoneum, fascia, and skin, but parallel muscular fibres, and even the subcutaneous fat are each united by a contiguous silk thread. It is difficult to see the use of this. Parallel muscular fibres do not unite, however long they are apposed to one another. If they did, every muscle in the body would soon become rigid. As to fat, it is of all tissues the most slowly vitalized; the cells which contain it are most easily crushed, and free fat exudes. The passage of a thread through them opens up a way for the exit of their contents, the thread itself becomes soaked in this oily fluid, now practically dead material, and can then only act as an irritant, sooner or later requiring elimination from the living structures. If the intention is to bring the divided fatty surfaces together, and to prevent dead spaces, this can be done equally well by the pressure of the united more solid structures above and below, owing to the elasticity of the material between, which now will not have been crushed or bruised, nor will it contain any dead foreign substance. A dead space is none the less a dead space because it is filled by dead fluids, such as exuded oil.

It is thus demonstrable that the only tissues as to the union of which the surgeon need interfere are the peritoneum, the fascia, and the skin. If these are secure, all the rest fall naturally into their own place, and are far better left untouched.

The union of peritoneum offers no difficulty. The rapidity of its union and its powers of absorption permit of the use of fine catgut, which is readily eliminated as soon as its work is done—as it is within forty-eight hours—and this has never given rise to any evil results.

The union of the skin is equally simple. Sutures or Michel clamps are readily applied and as easily removed when this layer is united. But the union of the combined tendon of the lateral muscles is by no means such a simple matter. Some material must be used which shall be strong enough to resist not only the natural pull of the three strong muscles attached to this tendon on either side, but any extraordinary strain which may be placed upon them by chloroform or other vomiting, by cough, or by movements of the patient. Incidentally, it will be recognized how futile it is to depend upon the pressure of strapping, binders, or belts, as a counter force to this internal muscular contraction. They are useful for the purpose of keeping external dressings in place, or for the feeling of support and comfort which they undoubtedly supply; but the force they can exert does not, and cannot, effectively act in a contrary direction to the muscular contraction of the obliques and transversales.

And this material must remain strong and firm for a month or six weeks. It is not sufficient to claim for it, as is often done for chromicized gut, that it is not absorbed for that length of time. Long before any material is absorbed it has ceased to have any restraining power. It has become soft, frayed-out, and powerless. It may have held the tissues safely enough for a fortnight, but at the end of that time the patient may cough or strain in urination or defaecation, the lateral muscles contract strongly, perhaps suddenly; the weakened suture stretches or snaps, and the plastic material between the uniting edge of the tendon yields slightly. A repetition of the strain occurs, or several repetitions, and a weak yielding gap between the rigid fascial edges is the result. It needs only some increase in abdominal tension from flatus or other cause to start a small hernia, which will steadily increase from that time onwards.

But any material which will remain strong and firm for six weeks will, on the other hand, probably remain unabsorbed during the life of the patient. Silver wire, bronze aluminium

wire, Pagenstecher's thread, celloidin thread, silkworm gut, are all capable of withstanding the strain, but they are all totally unabsorbable, and sooner or later are almost certain to give evidence of their presence. Pricking, stabbing pains, especially when the recti muscles are in action, slow movement towards the surface, accompanied or not by suppuration around them, have been frequently observed. Buried sutures, therefore, are to be avoided if possible. If, however, a suture must be buried, nothing appears to serve so well as plain silver wire, the ends of these being twisted, and pressed flat against the surface of the fascia.

Since this was written, however, I have had the pleasure and advantage of watching Mr. Rutherford Morison operate on several cases. He uses chromicized catgut of unusual thickness—No. 8 for uniting the fascia—and claims for it that it does remain effective for a sufficient period. I notice, however, that in a very valuable paper contributed by him to the *Edinburgh Medical Journal* this year he says that in a certain percentage of cases ventral hernia is inevitable, and that the evidence of a surgeon who says that he never sees it may safely be put aside, for he does not care for the after-history of his patients. It occurs, he says, most frequently in very fat and very thin persons. I cannot agree that this condition should be deemed inevitable, even in a small percentage. The word itself suggests that surgeons should be content to accept it as such, and to make no effort to eliminate its possibility. It is with a hope of doing something towards so desirable a result that I have brought forward this subject for discussion. Dr. Macnaughton-Jones also uses this material for this purpose, and so doubtless do others. I am very anxious to obtain their evidence as to its reliability.

I have used glass stretchers for preparing gut and silk. When silk or catgut is used after having been sterilized on reels, I have usually found that it is very apt to become entangled or kinked, so that for a long time I have sought for some means by which a perfectly straight thread might be obtained. With these glass stretchers, made for me by Messrs. Woolley, Sons, and Co., of Manchester, I have been able to obtain them. The silk or gut is fastened securely to one end, and then wound upon them so as to obtain only one layer; the opposite end is again securely fastened. Threads of the same material are then tied around, enclosing the sutures at each of the two points where notches have been cut in the uprights, and where the frame has been strengthened by crossbars of glass. If the material is silk, it can easily be boiled, frame and all, in an ordinary sterilizer. If catgut, it requires to be boiled under pressure in cumol or xylol, and must be enclosed in some watertight receptacle, such as the gun-metal cylinders of Mayo Robson. But those cylinders will not take these stretchers, and I have had a rectangular one made by the same firm which supports the glass frame in such a position that the sterilizing fluid can act upon every part of the suture. This is indeed one of the main advantages of using these glass frames. All parts of the suture—that turned to the frame, as well as that outside—are equally exposed. When a suture is wound upon a wooden or glass plate, the side next to the plate is to some extent protected; it is not so in these open stretchers. Glass has been used because it is so easily cleansed, and will itself resist the action of boiling fluids. When sterilization has been done, the threads are cut across at one end of the stretcher, and each double thread can be drawn off from the other end without disturbing the rest. After they have been cut, the advantage of the two cross threads which keep them in place against the stretcher will be appreciated. The stretchers are then kept in wide-mouthed bottles—silk in Bergmann's solution, catgut in absolute alcohol with $\frac{1}{2}$ per cent. sterile glycerine.

The way in which the sutures are placed is of importance. Inasmuch as they have to resist a constant and persistent pull, it is essential that they should not cut through the tissues and so become loose. If applied in the ordinary way this is very likely to happen, especially when the material

used is wire of any kind. Moreover, if the fascial edges only are approximated the area of union is but a thin line, and is consequently stretched or torn through with comparative ease. Noble, whose example I have followed for a considerable time, carefully clears the upper surface of the fascial layer for a distance of 2 to 3 cm. on one side, and the under-surface of its opposite for a similar distance, from all fat, and then places mattress sutures in such a way as to draw one side of the fascia beneath the other and fix it there, so obtaining a broad double union, which is correspondingly stronger, and more likely to be permanent.

But a method which leaves behind foreign material in the living tissues which cannot be absorbed cannot be considered ideal, and it would be a great advantage if at the end of six weeks this could be removed without reopening the wound. Lately, three or four ways in which this may be done have been proposed and carried out with success. In the first the two ends of the wire sutures placed as above described in the fascia have been made to penetrate the skin and superficial fascia above, and have been twisted over the bridge of skin between; or, better still, since such wires tend to cut through the skin, over a pad of gauze placed between them; but in some cases, where the subcutaneous layer of fat is very thick, it is useless to attempt to fix the wire outside, the pressure exerted by the pad being rendered nugatory by the consequent absorption of this layer, the wire loop becoming loose and permitting the fascial layers to separate once more, omentum to insinuate itself between them, and the hernia again to recur. In such cases two courses are open: first, to tighten the loop from time to time; or, secondly, to apply the wire suture in a figure-of-eight fashion, allowing the lower loop simply to grip the fascial layers. Of the two methods the latter is often to be preferred. It seems impossible accurately to gauge the rate of absorption of the fatty layer; the loop may possibly be left too long untightened, and if once omentum has gained a foothold between the fascial edges, it will continue to enlarge the—often minute—opening thus formed.

If the figure-of-eight method is used, the wire is introduced through the skin on one side, penetrating the subcutaneous fatty layer in an oblique manner and emerging in the wound

Fig. 1.

just above the fascia. It is then carried to the opposite side, reversed and made to pierce the fascia of that side from above downwards about a centimetre from its edge. Both layers of fascia have previously been cleared of fat on their lower surface for that distance. Passing beneath this, the needle is carried through the fascia on the original side from below upwards at a point the same distance from its edge. The needle is again reversed, and carried through the subcutaneous tissue and fat obliquely upwards to emerge through the skin at a point corresponding to that by which it first entered but on the opposite side of the wound. By pulling upon both ends of the wire in a direction from the wound,

Fig. 2.

the two fascial under surfaces are brought together and held firmly opposed to one another. The skin edges are then adjusted, a layer of gauze laid over them, and the ends of the wires are brought together over this and twisted together, so closing the skin wound and bringing the divided subcutaneous tissue surfaces in contact. When it is required to remove the wire this is slightly pulled out on one side and

divided close to the skin. A steady pull upon the other end draws it out. Thus in Figs. 1, 2, 3, *c* marks the skin, *d* the subcutaneous fat, *e* the fascia, *f* the rectus muscle, *g* the sub-peritoneal fat, *h* the peritoneum. In Fig. 1 the peritoneum is united; the wire sutures are placed but not drawn up. In Fig. 2 the fascia is drawn together by tightening the loop *a*, by pulling upon both ends of the wire in a direction obliquely from the wound as indicated by the arrows. In Fig. 3 the

Fig. 3.

loop *b* is completed, and by tightening this over the pad *k* the skin and subcutaneous fat are thus approximated. It will be noticed that the tightening of loop *a* has approximated the muscular layer *f* and the transversalis fascia *g*.

With this method it is evident that absorption of the fatty layer enclosed in the loop *b* will have no influence upon loop *a*, which will still remain tight, owing to the rigidity of the silver wire. Silkworm gut is not so effective, as with it the firmness of the loop *a* will depend on the tension in both loops. This method is probably the quickest of all those which permit removal of the foreign material uniting the fascia, and therefore will be preferred by many surgeons, and probably by all in cases where the rapid closure of the abdominal opening is important. But the removal of these wires is sometimes painful, and another method has lately been introduced by Milton of Cairo, which is neater, and renders after-removal less painful. The central idea of his method is the use of the lock-stitch, and he uses it in the following way, which Fig. 4 may help to render clearer. Two threads are

Fig. 4.

used: *a*, the primary thread; and *b*, the secondary thread. In the figure, which represents the wound looked at from above, *c c'* represent the two edges of the fascia which are to be united. A sharp-eyed needle carrying a long silk thread is carried through fascia *c* on one side from above downwards, and through the fascia *c'* on the other side from below upwards; as it protrudes on this side, a loop of silk is pulled out and the needle is withdrawn, still carrying the thread. This is again carried through both layers of fascia in the same way a third of an inch further on, a loop drawn out and so on. Through each loop the secondary thread *b* is passed; when all the loops are placed they are drawn up in turn, so tightening around the secondary thread and approximating the two under surfaces of the fascia. At each end of the wound the respective ends are brought up through the skin, and the end of *a* is tied to the corresponding end of *b*. When it is desired to withdraw the threads, the ends of both are cut through close to the skin at one end of the wound, and the secondary thread *b* is drawn out; this sets free all the loops, and traction upon the end of the primary thread will draw it also out of the wound, leaving in this way no buried suture.

This is a very admirable method, but it has certain drawbacks. I have found that however tightly both ends may be held, during the process of tightening up, the secondary thread is almost unavoidably bent at the points embraced by the primary thread. When the time comes to withdraw the threads, it is evident that if applied as Milton advises the secondary thread must be first removed in order to set free the

other. If the secondary thread is silver wire this is almost impossible; the slight kinking produced is sufficient to render it extremely difficult to release the wire from the bite of the primary thread; if it is of silkworm gut this is apt to break at these points, and so a foreign body is left behind, and the main object of the method—the removal of all buried foreign bodies when deep union is complete—is not obtained. In order to avoid this I have modified the plan in the following way, so as to be able to remove the primary thread first, so setting free the secondary, which can then be easily drawn out.

The secondary thread *b* may be either wire or silkworm gut; the latter, I think, is preferable. The primary thread *a* is interrupted, and made up of several silkworm gut threads introduced as single loops by means of an eyed needle. Each loop is passed through the skin, subcutaneous tissue and fascia of the right side of the wound, emerging in the wound below the fascia of that side; it is carried onwards below the fascia on the left side, and penetrates this layer from below, emerging on its upper surface; the secondary thread is passed through each loop. When all the loops are in place, and the skin wound united by other sutures, the secondary thread is held tight at each end, to prevent kinking, whilst each loop is drawn taut, the two ends of it which emerge from one opening on the right side of the wound are separated, a gauze pad *k* placed between them, and they are then tied over this pad.

The pressure of the secondary thread on one side is thus opposed by the pressure of the pad on the skin above, and the two surfaces of the fascia are drawn together and held in position by them.

Fig. 5.

Fig. 5 shows the position of the wound and threads; looked at from above, *c c'* are the two edges of the divided fascia, *b* the secondary thread, *a a a'* the interrupted loops of silkworm gut. Figs. 6 and 7 represent a vertical section through the abdominal wall, the various layers of which are lettered as before. In Fig. 6 a loop is placed *a a'*, and through its

Fig. 6.

extremity is seen the cut end of the secondary thread *b*. In Fig. 7 it is tightened up, and a pad *k* is placed between the

Fig. 7.

two ends of the looped thread; when tied it brings the two under surfaces of the fascia firmly together.

The same objection holds good with this modification in cases where the fatty layer is thick and may become absorbed, so loosening the grip of the loops. In all such cases it will be advisable to use Milton's original plan of application,

but in cases where this layer is thin I have found the modification easy of performance, and giving a perfect result. The loops should be applied at distances of one-third of an inch from each other, and should so pierce the fascia as to bring together a corresponding width of fascia on both sides. Removal is easy; one thread of each loop is divided close to the skin beside the gauze pad; pulling on the other end quickly releases it, and it is drawn out. When once all the loops are free, the secondary thread is easily withdrawn, whether slightly kinked or not. Care must be taken in all cases to carry the suturing for at least half an inch at each extremity beyond the line of fascial division, so as to produce a fold in the yet undivided tissue.

By the use of one or other of these plans it will be evident that we possess means by which the all-important tendinous expansion known as the deep fascia may be reunited safely and permanently, and that the latter methods also enable us when organic union is firm to remove all foreign material from the interior of the wound.

Something more might be said as to the different behaviour of the tissues in different parts of the abdominal wall; especially as to the difficulty experienced in the reunion of peritoneum near the epigastrium as compared with the ease of this manoeuvre below the umbilicus, and certain modifications which thereby become necessary, but this paper is already too long, and they must be left for future statement.

When a large hernia has to be closed, and the fascial edges are widely separated, the method adopted by both Dr. Macnaughton-Jones and Mr. Rutherford Morison of placing stay sutures so as to embrace the whole rectus muscle, and so obtain a firmer and more comprehensive grip of the tendon on either side, is an admirable one, but does not, in my opinion, dispense with the necessity for obtaining a broad union of the actual opposing portions of this tendon such as is produced by the Noble method. It is an accessory of very great use, but not the primary requisite. Dr. Macnaughton-Jones uses strong silver wire; Mr. Rutherford Morison strong chromicized gut. After all, these are measures for the cure, not for the prevention of post-operative hernia.

A Clinical Demonstration

ON

THE RADICAL CURE OF HERNIA.

Given at the Post graduate College and Polyclinic, London.

By MAYO COLLIER, M.S.Lond., F.R.C.S.Eng.,
Senior Surgeon, North-West London Hospital.

GENTLEMEN,—I have brought for inspection to-day two cases both quite simple of diagnosis, but about which there are many points to discuss and much to say.

RADICAL CURE OF HERNIA.

The patient, as you see, is apparently a strong, healthy fellow, who comes to the hospital with the most absolute belief and faith that I can perform some simple operation on what he says is a rupture in the left groin, so that he will never have to wear a truss again, and never be troubled with a return of his complaint. In short, he wants me to perform the radical cure in the belief that the radical cure will do all for him that he thinks.

This is the general belief among the lay public on the subject of the operations for the relief of rupture. I need hardly tell you that this view is incorrect; and the approximate truth on the subject of the radical cure for hernia I shall endeavour to put before you to-day.

Now, the first question you must be prepared to answer is this, Why an operation at all? Why not a comfortable and well-fitting truss? This question must be answered from several points of view, and first, there are seven classes of cases where a truss cannot be relied upon and an operation is most certainly indicated, namely:

1. Cases of irreducible hernia.
2. Cases of strangulated hernia.
3. Cases where the hernia is not controlled by a truss.
4. Cases of hernia with ectopia testis.
5. Cases where rupture unfits for the public service.
6. Hernias in incompetent and ignorant people.
7. Very large hernias hampering the movements of the patients, and threatening personal comfort seriously.

In all these cases it would be your duty to prefer and advise an operation rather than outside mechanical supports.

In other cases it is quite certain that hundreds of thousands of persons pass through their lives with comfort and safety with the assistance of a well-fitting truss, but I most certainly would not refuse to perform the radical cure for a person who was anxious to be relieved of his truss, and who, from a sentimental point of view, objected to the mechanical support.

Now before you could honestly take upon yourself the responsibility of advising and operating on a patient for the cure of hernia, you must satisfy yourself and your patient in some cases as to the following facts, and you must be prepared with more or less exact knowledge on the subject.

1. And first of all. Can you assure him that the operation is a safe operation so far as his life is concerned, as well as his testicle.

2. Secondly, does the term "radical cure" mean radical cure in the sense of permanency of cure? Is the operation a real cure or only a temporary palliative?

3. Should very young people be operated upon, and if not, at what age should the operation be performed?

4. Should a truss be worn after the operation, and if so, for how long, and if not, should any support or precaution be taken to prevent return?

5. You must satisfy yourself as to the best material for suture, and lastly, but assuredly not least, the best form of operation to perform.

You see from the list of questions that you must either answer to the patient or yourself that the procedure is not quite so simple as the public believe, and not quite so lightly to be undertaken as some would teach.

Safety of the Operation.

I think we may most certainly answer this question in the affirmative and say "the operation is perfectly safe, provided it is done by a skilled, competent operator with experience." Out of 104 cases in one practice there were only 2 deaths, both from zymotic diseases, and in America Dr. Coley lost 1 case out of 160 operations from pneumonia. These are just a few examples illustrating the freedom from trouble after this operation.

Is the Testis in any Danger from the Operation?

It most certainly is in the hands of the unskilled surgeon who endeavours to pull and drag and rend the layers of fascia covering the hernial sac, instead of cutting straight down to the sac and gently peeling it from its nearest covering.

Atrophy of the testis and inflammation with abscess and sloughing have followed this operation in careless hands.

How Far does the Operation bring about a Complete or Radical and Permanent Cure?

Please always safeguard your own reputation and that of surgery in general by telling your patients that many of the best and most promising cases lapse, that the hernia returns and requires a second operation or a truss. Tell your patient that only in some cases does the patient never require further assistance or treatment, but also tell your patient that "an operation will most certainly improve matters, and that after an operation a patient is better off than he was before, and that most certainly it gives immunity to a certain number for a certain time."

As a matter of fact, it is fair to say that in 25 per cent. of the cases operated on the hernia returns and requires a second operation or the assistance of a truss before eight years.

What is the Earliest Age at which an Operation should be Undertaken?

It is a matter of common knowledge that quite a number of male children below 1 year have inguinal hernia, and that quite a large percentage of these get well with the use of properly-fitting trusses. On these grounds a truss should in most cases be recommended in preference to an operation up to, we will say, the 4th year, and in some cases longer. Of course, complicated cases where there are no contraindications should be submitted to operation as early as 2 years.

The Use of a Truss After Operation.

This recommendation will depend not only on the state of the patient before operation, but on his condition and duties after the operation. Speaking generally, favourable cases with small sacs, sound tissues, and well-formed abdominal walls, if allowed to rest for at least two or three months after operation, will not require a truss. *Per contra*, large sacs, weak abdominal walls, pendulous abdomens with much fat