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AN OPERATION FOR THE TREATMENT OF STRESS INCONTINENCE

BY

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Although most cases of stress incontinence are seen in patients who have sustained injury during childbirth, the condition is by no means uncommon in nulliparae and even in young women. Clinically, in the average case the external meatus is patulous and the urethra is prolapsed downwards and forwards, with the result that the external meatus lies below and behind its normal situation.

Anatomical Considerations

Much work has been done by Curtis *et al.* (1939, 1942), and by Von Lüdinghausen (1932), Kalischer (1900), Andina and Hintzche (1946), in particular. The plain muscle sphincter round the internal meatus consists of two series of loops. In one of these, muscle fibres pass behind the internal meatus with the arms of the loops extending upwards and forwards. The other loop passes in front of the meatus with its arms extending posteriorly and with each arm being pierced by the ureter. There is a tendency to describe this sphincter muscle as the "lisso sphincter."

The striated muscle sphincter of the urethra, which is also known as the sphincter urethrae, the urogenital sphincter, and, more recently, as the "rhabdo sphincter," is much more complicated. Some of its fibres pass circularly round the urethra. Other fibres pass from an attachment to the back of the symphysis pubis area backwards to form a loop posteriorly round the urethra. A third group of fibres are looped in front of the urethra and then pass backwards laterally, to be attached to the lateral wall of the vagina. In another group the fibres are looped in front of the urethra to interlace between the urethra and vagina and subsequently merge into the vaginal wall.

There is some evidence that those cases of stress incontinence which develop after anterior colporrhaphy are caused by the division of the nerves which supply the urethral sphincter. My own view of the aetiology of stress incontinence is that most cases are due primarily to damage or to loss of tone of the condensation of endopelvic fascia which lies between the urethra and the anterior vaginal wall, which I have called the post-urethral ligament. This condensation consists of plain muscle tissue and is attached to the pubic rami on each side and to the neck of the bladder above. It forms a firm supporting shelf of tissue. The ligament cannot be displayed at operation except in cases of cystocele of slight degree, for if any form of prolapse of the anterior vaginal wall is well marked the tissues of the ligament are inconspicuous. It is because of this weakness of the ligament that the prolapse develops. In my view the main cause of stress incontinence is weakness of this ligament, although damage to the urethral sphincter or to its nerve supply is a contributory factor. The radiographic findings of downward displacement of the urethra and the neck of the bladder in cases of stress incontinence can be explained in this way.

Surgical Methods

Surgical treatment by the vaginal route has the object of forming a shelf of the para-urethral tissues beneath the urethra, and numerous modifications of this technique are employed. Kelly's method of introducing mattress sutures into the neck of the bladder gives moderately good results. It is well known that stress incontinence is usually cured if prolapse is treated by vaginal hysterectomy or by the modern modifications of the Fothergill operation.

It is also well known that the vaginal methods are not always successful, and various sling methods have been employed. Stoeckel's modification of Goebel's method, in which longitudinal strips of rectus fascia were brought down behind the symphysis and sutured together below the urethra, did not give satisfactory results. I learnt the method in Vienna some years ago, but the clinical results were unsatisfactory. In 1942 Aldridge employed a method of bringing down transverse strips of fascia taken from the aponeurosis of the oblique abdominal muscles. Millin (1947) introduced a method whereby the operation is performed retropubically, and modifications have been described by Millin and Read (1948), Marshall (1948), and others. Studdiford (1944, 1945) has described modifications of Aldridge's technique. These sling operations are being performed extensively at the present day, and good results are being reported.

In the latter part of 1947 it occurred to me that the problem could be approached in another way, and the idea behind the method which is described below is to replace the weakened post-urethral ligament by a strip of fascia lata taken from the thigh. A preliminary report has already been published (Shaw, 1949).

Selection of Clinical Material.—A very large number of patients suffering from stress incontinence attend the out-patient department of St. Bartholomew's Hospital. It is important to select cases with care, for urgency and frequency of micturition must be distinguished from stress incontinence. The patient should be made to cough when her bladder contains urine, and if the urine can be seen to be discharged from the meatus when the patient coughs stress incontinence is diagnosed. It is also important to exclude neurological causes, and in doubtful cases the patient is referred to a neurologist. Many of the patients have been operated upon on several previous occasions by the vaginal route, and these failures are considered to be particularly suitable for the operation.

Technique

Method of Obtaining the Fascial Strip

The patient lies on her left side with the right knee flexed. An incision 7 in. (17.5 cm.) long is made from the lateral epicondyle of the femur, and the fascia lata is exposed by dissecting the fatty tissues from the fascia. A strip of fascia lata is then taken, not less than 6 in. (15 cm.) and not more than 7 in. long. It is shaped so that it is $1\frac{1}{2}$ in. (3.75 cm.) in diameter in the middle and decreases at each end to a diameter of $\frac{1}{2}$ in. (0.8 cm.) (Fig. 1). The fascial strip is placed upon a gauze pad soaked in warm saline, and the cut edges of the fascia lata are brought together by means of three mattress sutures followed by a long continuous suture. The skin incision is closed with clips. As a general rule

FIG. 1.—The strip of fascia taken from the fascia lata is $1\frac{1}{2}$ in. broad in the middle, tapering to each end, and is 6 in. long.

FIG. 2.—The incisions in the vaginal wall. A midline incision starts about $\frac{1}{4}$ in. away from the urethral meatus. An incision is made on each side from the meatal end of this incision.

FIG. 3.—The lateral flaps are dissected away and the urethra and the neck of the bladder mobilized. The diagram shows the position of the incisions made through the pubo-coccygeus muscle on each side of the urethra.

FIG. 4.—The fascia lata strip sutured into position. The upper margin of the strip is stitched to the circular ring of vaginal wall left near the meatus. The sutures are not passed through the muscle wall of the urethra. At the other side of the fascia lata strip the sutures are introduced between the fascia lata and the front of the cervix. If the bladder cannot be sufficiently mobilized this part of the fascia lata strip is stitched both to the post-urethral ligament and to the anterior vaginal wall.

there are only one or two small vessels to ligate, and the operation can be easily completed within ten minutes. In no case has there been infection of the wound or the development of a haematoma. Most patients complain of pain in the wound for two or three days after the operation, but no patient has complained of inconvenience of any sort after being up and about.

Dissection of the Urethra and Neck of the Bladder

The patient is placed in the lithotomy position and a Sims speculum is introduced into the vagina. In the group of cases operated upon the cervix could only rarely be pulled down as far as the vaginal orifice. Consequently the following procedure was adopted.

Lane's tissue forceps are placed on the anterior vaginal wall in the midline, about $\frac{1}{4}$ in. (0.3 cm.) above the meatus, and another Lane tissue forceps is attached to the anterior vaginal wall, again in the midline, as high as possible above the neck of the bladder. A midline incision is now made, extending from a point about $\frac{1}{4}$ in. above the meatus to the Lane tissue forceps placed on the upper part of the anterior vaginal wall (Fig. 2). On each side a lateral incision is then made at the end of the incision near the meatus, and the lateral incisions extend outwards towards the pubic rami. The next step is to dissect away the two triangular flaps marked out by these incisions. The dissection must be made with a scalpel, except laterally, where the separation can be made with the help of a piece of gauze wrapped round the finger. If the correct plane of cleavage is reached it is rare for severe haemorrhage to be encountered. The haemorrhage can be controlled to some extent by injecting oxytocin into the tissues in the neighbourhood of the crura of the clitoris. The dissec-

tion exposes the urethra along the whole of its length together with the neck and base of the bladder (Fig. 3).

Fixation of the Fascial Strip to the Urethra

The fascial strip is now held transversely. The middle of the upper margin of the strip is then sutured to the ring of vaginal wall, $\frac{1}{4}$ in. thick, which remains around the external meatus (Fig. 4). It is customary to introduce three sutures. At no time is the sling sutured to the muscle tissue of the urethra itself. Next, the posterior edge of the sling is sutured to the neck of the bladder, to the upper margin of the post-urethral ligament, and in some cases to the vaginal wall as high up in the vagina as possible. This part of the operation is of fundamental importance, for it is intended that the sling shall support the urethra along the whole of its length, together with the neck of the bladder. If it is found possible to mobilize the bladder from the front of the cervix the upper edge of the sling is sutured to the cervix itself.

Attachment of the Lateral Ends of the Fascial Strip

Much preliminary work was carried out on the anatomy of the symphysis pubis area, and plaster models of the bones were made. It seemed that the most suitable inclination of the sling would be obtained if holes were drilled in the pubic bones just below the attachment of the adductor longus tendons. The method of suturing the ends of the sling to the rectus muscles above the pubis, following the course described by Price (1933), was discarded. The next question to consider was the method of approach to the bones. Initially, a curved incision was made through the skin of the mons with its convexity directed upwards to enclose the clitoris. It was found to be a simple matter to incise the soft tissues down to the level of the tendinous tissues attached to the bones; but haemorrhage was found to be troublesome, and it was necessary to divide the suspensory ligament of the clitoris. Nevertheless, an excellent approach is obtained by this method. There are, however, certain disadvantages. Complete haemostasis may be almost impossible, and it was found necessary to leave a small rubber drain when this incision was made. Another disadvantage is that the lymphatic drainage of the vulva is cut off so that the lower flap becomes swollen, and this happens particularly often in elderly patients.

Another method which was employed on one occasion was to make an arched incision below the clitoris through the tissues which lie internal to the labia minora. The exposure obtained is unsatisfactory, although the operation is relatively bloodless. This method of approach was not repeated.

A third method of approach is to make curved incisions on the outer side of the labia majora at a level which allows the drill-holes to be made just below the attachment of the adductor longus tendon. It is found in practice that there is much variation in the development and vascularity of the adductor muscles which are attached below the level of the adductor longus. The incision through these muscles should be made transversely. It is, however, by no means easy always to expose the pubic bone sufficiently medially to allow the drill-holes to be made near the symphysis pubis.

The fourth method of approach is to make the skin incisions on the inner sides of the labia majora. This method of approach is the one being practised at the moment. It has the obvious disadvantage that a considerable thickness of tissue must be cut through before the bone is exposed. It has, however, so many other advantages that it is the method which is recommended.

One of the most important parts of the operation is to open up the retropubic space on each side lateral to the urethra. It is possible to separate the pubo-coccygeus muscles from their attachment to the pubic bones with the finger, but the method should be regarded with disfavour. It is essential to cut through the pubo-coccygeus muscle near its anterior attachment with a scalpel. The scalpel should be introduced lateral to the urethra and a vertical incision about $\frac{1}{4}$ in. (1.25 cm.) long made through the pubo-coccygeus tendon. As the patient is lying in the lithotomy position there is no risk of injury to the bladder, and troublesome haemorrhage is rarely seen if a scalpel is used. A finger is now introduced through the scalpel incision and the retropubic space opened up. The

vertical incision is then made through the skin of the labium majus. The incision through the skin is carried down until the tendinous and muscular tissues are reached. These latter tissues are cut through transversely until the bone is exposed. An assistant now introduces his finger into the retropubic space and a drill-hole is made through the pubic bone with a Hudson brace and drill. It is important to use a drill nearly $\frac{1}{2}$ in. in diameter. It is possible to determine with a fair amount of precision the degree to which the bone has been drilled, and the assistant says at once when the drill emerges into the retropubic space. There seems to be little risk of bladder injury if ordinary care is taken. A special pair of curved forceps is now introduced into the skin incision, passed through the drill-hole, and then made to appear through the incision in the pubo-coccygeus tendon. The appropriate end of the fascial sling is now introduced into the end of the forceps and the forceps withdrawn so that the end of the sling appears through the skin incision in the labium majus.

At this stage it is necessary to introduce a self-retaining catheter, because the external meatus is drawn upwards as soon as the other end of the sling is passed through the drill-hole of its appropriate side, after which there may be great difficulty in finding the external meatus.

The next step is to incise the pubo-coccygeus of the opposite side, to open up the retropubic space, to make a corresponding skin incision through the labium majus, and to make a drill-hole as before. The free end of the sling is now drawn through the drill-hole. If the two ends of the sling are pulled outwards it can be seen how the broad supporting hammock of the sling draws up the urethra and also brings the urethra forwards towards the symphysis pubis (Fig. 5). The amount of tension required is relatively easy to determine, for the catheter in the urethra indicates the direction in which the urethra is lying.

FIG. 5.—Showing the mode of action of the strip of fascia lata. It pulls the urethra and the neck of the bladder forwards, and at the same time draws up the meatal end of the urethra.

The next stage of the operation is to repair the anterior vaginal wall. It may be necessary to excise redundant vaginal tissue, and it is not always easy to obtain good apposition in the area around the external meatus. The final steps of the operation consist in suturing the ends of the sling with catgut sutures to the tendinous tissues in the vicinity of the bore-holes. Subsequently the redundant ends of the sling are excised, the tissues exposed in each of the skin incisions impregnated with a powder of penicillin and sulphathiazole, and the skin incisions closed with catgut sutures.

Critical Analysis of the Technique

The method would probably not have been employed before the discovery of antibiotics and the sulphonamides, for the risk of the operation is clearly the development of osteomyelitis. Every effort has been taken to ensure asepsis. Penicillin powder is distributed liberally over raw surfaces before the incisions are closed, and all patients have been subjected to penicillin therapy prophylactically for three days after the completion of the operation. No case of osteomyelitis has developed. Nevertheless, probably because of failure to ensure complete haemostasis, three cases of mild suppuration in the pubic wounds arose. Unless haemostasis seems to be absolute a small rubber drain should always be introduced into the skin incision.

It may be argued that the fascial strip acts as a foreign body and may be a source of persistent sepsis if the area becomes infected. This has not happened. It may also be argued that the fascial strip becomes replaced by fibrous tissue so that in time the supporting effect of the sling is weakened. This has not happened in any case, although the first operation was performed more than a year ago.

Similar remarks apply to the other sling operations, for it is difficult to believe that the end of the fascial strip of the Aldridge operation receives any blood supply from its abdominal attachment. Moreover, there is good reason to believe that the tissues of the fascia lata sling act as an organizer to the replacing fibroblasts, which themselves become similar to the cells of tendinous tissue. In favourable cases the whole operation can be completed in forty-five minutes, and none of the patients has developed shock and in no case has there been severe bleeding.

Nevertheless, modifications have been tried. It was found to be an extremely simple procedure to expose the obturator foramen and to introduce the special curved forceps through the foramen to appear through the vaginal wound, and this obturator approach was used in a series of cases. The theoretical advantage is that there is no risk of osteomyelitis in this method. The supporting angle of the sling is, however, unsatisfactory on theoretical grounds. In fifteen cases the obturator approach was made. In twelve cases complete cure of the stress incontinence was obtained, but in three cases the symptom was not completely relieved.

An obvious objection to my method is that a separate incision is made along the thigh. On the other hand, a scar along the thigh does not compare unfavourably with the abdominal scar of the Aldridge operation. To meet this objection slings of tantalum gauze were used in two cases. The end-results were extremely satisfactory, but it was found difficult to pass the ends of the tantalum gauze through the obturator foramen, and the method has not been repeated.

One of the great advantages of the operation is that there is no risk of injury either to the bladder or to the urethra, so that there has been no case of bladder or urethral fistula. Nor, indeed, has there been any haematuria in any of the cases. The wide hammock-like support of the fascia lata strip seems to be theoretically sound. Cases of persistent retention have not been seen, although two or three patients had difficulty in passing urine after being up and about. Experience has shown that it is necessary for the self-retaining catheter to be kept in the bladder for ten days after the operation, because patients have great difficulty in passing urine when they are in bed. Consequently it has been the routine practice to give patients sulphamerazine prophylactically. Some cases have developed cystitis, but in most instances the cystitis has cleared up fairly soon. The worst complication is urgency of micturition, which tends to persist in some cases for several months after the operation. Nevertheless, in only one or two cases have patients been distressed by this symptom.

Results

So far 51 cases have been operated upon. Unfortunately, one patient died. The case history is as follows.

The patient, aged 60, had been married for 44 years, and had had 11 children. She had complained of stress incontinence for four years. Her general condition was fairly good except that her blood pressure was 200/110. A fascial sling operation was performed on July 30, 1948, using the obturator foramen approach, without technical difficulty. It was noticed that the patient was abnormally quiet during the first few days after the operation. On Aug. 5 she became stuporous early in the morning, her tongue was furred, sugar was found in the urine, but Rothera's test was negative. Blood chemistry showed: blood urea 65 mg., blood chlorides 595 mg., and blood sugar 650 mg. per 100 ml. Rothera's test now became weakly positive. She was seen by a general physician and a neurologist, who formed the opinion that the coma was due to a cerebral vascular accident rather than to diabetes, in view of the very high sugar content and the disproportionately low ketosis. The patient died at 3 o'clock that afternoon. A

post-mortem examination was performed by Dr. H. I. Coombs. The signs were regarded as those of diabetes. The operation area was clean, without sepsis or haematoma and with no evidence of injury to the bladder or urethra. The patient would not have died if she had not been operated upon, but there is no reason to believe that the especial character of the operation was the dominant cause of the development of diabetic coma. This fatal case is not included in the series.

Of the other 50 cases, 15 have been operated upon by the obturator foramen approach for the attachment of the ends of the sling, and 35 have been operated upon using bore-holes through the pubic bones. Of the obturator foramen cases, three have not been completely cured of symptoms. The other cases of this group have been cured of their stress incontinence, but in view of the three partial failures the obturator foramen method has been abandoned. Nevertheless, 12 of the 15 cases can be regarded as completely cured, and the three cases that were not completely cured were greatly relieved. The tantalum-mesh cases belong to this group of 15. In both cases an excellent result was obtained, the patients being completely cured.

Of the 35 cases in which drill-holes have been made the results have been satisfactory. One patient, aged 60, developed a stroke six months after the operation, since when she has been incontinent, although at times before she had the stroke she was not completely free from stress incontinence. There is no doubt that this patient was a bad subject for operation, and it was always difficult to decide from the history whether she was suffering from stress incontinence, urgency, or frequency.

In one case the approach to the pubic bones was made by means of a curved incision below the clitoris. This led to the bore-holes being placed low down, and subsequently, although the urethra was well supported by the sling, a slight degree of cystocele developed above this level. Nevertheless, the patient was cured of stress incontinence although she suffered much from urgency. The case is of some interest because there is a tendency to maintain that failure to support the neck of the bladder is the cause of stress incontinence (Muellner, 1949). Except for the patient who subsequently developed a stroke, the 35 patients were all cured of stress incontinence. It was found that the younger patients were completely cured of all their urinary symptoms. The older patients, however, suffered from frequency and urgency for some time after the operation, although these symptoms gradually improved with time.

It is perhaps of some interest to record that the technical problem which caused most difficulty was to decide upon the best method of approach through the skin of the vulva to reach the pubic bones. Each method of approach that was tried had certain advantages, and it was only after very careful consideration that the incisions on the inner sides of the labia majora were selected as the most satisfactory.

In my view the operation should be regarded as an excellent method of treating stress incontinence, particularly in those patients in whom vaginal methods have failed. The technical difficulties are not very great and there seems to be no risk of injury either to the bladder or to the urethra. At first thought the operation of drilling holes in the pubic bones seems to be severe, but in practice it is simple to carry out. Preliminary work with models had shown that the correct inclination of the sling can be obtained only if the pubic bones are drilled. It was felt from the beginning that the inclination of the sling was not the best possible if the ends of the sling were brought through the obturator foramina, but as the first few patients operated upon in this way were relieved of their symptoms the method was employed for a small series of cases. The results, however, were not satisfactory in all cases and the method has been abandoned.

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STEATORRHOEA AND GLOSSITIS AFTER ILEOCOLOSTOMY

EFFECT OF SYNTHETIC VITAMINS OF B COMPLEX, AUTOLYSED YEAST, AND LIVER EXTRACT

BY

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Pantothenic acid and inositol have for many years been recognized as members of the vitamin B complex. The former has been shown to be an essential factor for many animal species, in some of which deficiency is associated with ectodermal defects, such as dermatitis and greying of the hair, and with reduced alimentary motility. Inositol is a normal constituent of all animal and plant tissues. The little that is known of its role in animal nutrition suggests that it also is related to the maintenance of ectodermal tissues. The role of both these substances in human nutrition is still unknown.

The case is here described of a man who had an ileocolostomy performed for what was most probably regional ileitis. He later developed steatorrhea and signs of avitaminoses. His symptoms were predominantly alimentary, and the opportunity was taken to observe the effect on them of pantothenic acid and inositol as well as of other synthetic vitamins and vitamin preparations.

Case Report

The patient had apparently been healthy until September, 1935, when, at the age of 21, he developed pain in the right iliac fossa. Laparotomy revealed a swollen terminal ileum and dense adhesions in this region and around the caecum. The appendix was normal. Anastomosis was performed between the lower ileum and the first part of the transverse colon. The exact length of ileum by-passed in this procedure was not recorded, but from subsequent radiological examination it was estimated to be about 24–36 in. (61–91 cm.). He had no symptoms thereafter until about twelve months later he suffered from diarrhoea, nausea, vomiting, anorexia, and abdominal discomfort over a period of about two weeks. Six months afterwards he complained for the first time of a sore tongue, and his mouth felt raw where it was irritated by his dentures. During the next five years, although abdominal symptoms never amounted to more than occasional mild discomfort across the lower abdomen, the glossitis was constantly troublesome, relieved only by repeated injections of liver extract.

Clinical and Laboratory Findings.—When I first saw the patient on July 21, 1945, he was in good general health. His tongue, however, showed general atrophy of moderate degree and was a fiery red at the tip and edges. No significant abnormality was detected in the abdomen. Blood examination revealed: red cells, 4,230,000; haemoglobin, 11.8 g.%; M.C.V., 96 μ^3 ; M.C.H.C., 29%; white cells, 7,600. A test meal showed free HCl. The fat content of the faeces was 46% of dry matter, and balance experiments revealed that he absorbed only 67%