STRESS INCONTINENCE OF URINE IN THE FEMALE

By TERENCE MILLIN, M.Ch., F.R.C.S.,

and

CHARLES D. READ, M.B. F.R.C.S.(E), F.R.A.C.S., F.R.C.O.G.

London

PART 2

MILLIN'S SLING OPERATION

General Considerations

In Part 1 of this study we offered radiological evidence that the basic lesion in these cases of stress incontinence is a descent of the bladder neck on raising the intra-abdominal pressure, and that consequently the rational operative cure should aim at, and succeed in, preventing this descent. The sling operation devised by one of us (T.M.) some four years ago, which appears to accomplish this simply and with satisfactory results, is the subject of this communication. It is a purely abdominal operation, and effects the suspension of the bladder neck and upper urethra by means of an aponeurotic sling or hammock, which has the particular merit of being elastic, having a muscular pedicle at each extremity. Moreover, by virtue of its disposition, the sling actually tightens when the intra-abdominal pressure rises and bulges out the lower abdominal wall, so elevating the vesical neck under those very conditions which, pre-operatively, caused the descent of this structure and so allowed urinary leakage.

Recently, McIntosh Marshall of Liverpool, working independently has come to a similar conclusion, namely that adequate support of the bladder neck is the all-important factor in urinary control in the female. He employs a somewhat similar sling type of operation, but his sling is sometimes formed of a free aponeurotic strap. In a personal communication he endorses the claims made for such a procedure as the sling operation herewith described.

The Operation

After a full vulval shave, the abdomen is prepared as for any routine abdominal operation. After anaesthetization, with full aseptic precautions on the operating table, a No. 20 Ch. Malecot or Foley catheter is passed into the bladder on a stilet. The bladder is allowed to

empty and the catheter then gently withdrawn until the expanded head of the Malecot, or the distended 5 c.c. balloon of the Foley catheter is felt to impinge on the vesical neck. If desired, a light pack may be placed in the vagina. The patient is then placed in the full Trendelenburg position and suitably draped. A generous transverse incision is made at the level of the anterior superior iliac spines slightly convex downwards in the line of the skin creases. The incision is carefully deepened throughout its length to expose the aponeurosis of the anterior abdominal wall. The flaps are undermined upwards, downwards and laterally, and accurate haemostasis effected by ligature or diathermic coagulation. The anterior sheath of each rectus muscle is now incised in the line of the skin cut, and, by passing the closed blades of a pair of long-angled scissors laterally through this incision and then gently opening them, the aponeuroses of the two oblique muscles are freed from the underlying transversalis on each side. The incision previously made in the anterior rectus sheath is now continued laterally through the two oblique aponeuroses to within 2 cm. of the anterior superior spine on each side. Both aponeurotic flaps are then freely undermined, and from the inferior one a full-length strap, 1 cm. wide, is cut, pedicled on the right (Fig. 1). A second similar strap is next cut based on the left (Fig. 2). If the straps have been correctly fashioned it will be noted that about 3 cm. of the base of each is muscular, and so they will have an elasticity not otherwise obtainable. Each strap, 15-18 cm. in length, is now wrapped in a warm saline swab. The recti muscles are then separated in the mid-line, care being taken to avoid opening the peritoneum, and the retropubic space gently opened up by drawing the pre-peritoneal fat upwards. By passing a pair of curved Kocher's forceps from within outwards at the outer border

of each rectus, the end of the corresponding strap is seized and drawn through (Fig. 3), and again wrapped in a warm saline swab. A suitable self-retaining retractor (Millin or Gosset type) is inserted into the wound, and the recti spread. The retropubic space is thus visualized. The bladder neck and upper urethra are gently pushed away from the posterior aspect of the pubis, the attachments being loose and avascular. The expanded end of the catheter will usually be seen, and always felt, so identifying the level of the bladder neck. With finger and thumb, the urethra, with its contained catheter, is traced downwards and gently freed from the underlying vagina on each side (Fig. 4). No attempt should be made to isolate the urethra in its entire circumference, or it will probably be torn. Dense adhesions are usually present in the mid-line on its under-surface, especially after previous vaginal operations. Elevating the proximal urethra with the thumb and forefinger of the left hand, the specially-devised curved forceps (Fig. 5) are now forced through the tough urethro-vaginal septum described above, about 2 cm. below the bladder neck, passing the instrument from right to left. By slowly opening the blades of these forceps an adequate tunnel is made to permit the passage of the two straps. The end of the left strap is guided down to the opened jaws of the forceps (Fig. 6), seized, and drawn through. The end of the strap is held with Kocher's forceps and elevated. This manoeuvre delineates the sub-urethral tunnel. Grasping the end of the right-hand strap in the special forceps these are again passed through the tunnel from right to left (Fig. 7), and the end of this strap seized with Kocher's forceps. The special forceps are withdrawn. A pair of Kocher's is then passed through the mid-rectus on each side and the end of the corresponding strap drawn through (Fig. 8). The ends of the straps are then sutured to each other with 5 N nylon, care being taken that the bladder neck is not unduly elevated, so angulating the urethra (Fig. 9). Two nylon sutures are used for security. This manoeuvre approximates the recti and minimizes the risk of divarication. The sling has now, moreover, a point of muscular suspension in the mid-line in addition to its lateral muscular pedicle.

The above is the technique devised and utilized by the urological author. It is obviously open to variations, and the gynaecological author has modified it in a few minor details. He draws the straps through the mid-recti in preference to the outer borders, and does not bring the ends of the straps superficial to these muscles again after passing them under the proximal urethra, but contents himself with suturing the extremity of each strap to its opposite number as shown in Fig. 10. This

simplifies the procedure in that shorter straps will suffice. The central muscle support is derived from the outer half of each rectus. The disadvantage would appear to be the deeper situation of the unabsorbable nylon sutures in case of sepsis, and the more oblique support to the bladder neck with loss of mechanical efficiency. There appears to be little difference in the end-results.

Occasionally venous haemorrhage of a moderate degree of severity is encountered whilst dissecting the peri-urethral area close to the bladder neck. This is due to damage to the friable deep vein of the clitoris or its tributaries entering the neighbouring plexus, and will usually cease with gauze pressure. Occasionally ligature, or preferably diathermic coagulation, will be necessary.

After the straps have been suitably placed and sutured in position, the retropubic space is swabbed free of clots and dusted with sulphanilamide powder. A small stab wound is made in the inferior flap and a corrugated drain placed down to the retropubic space. If the second technique has been employed it will be desirable to approximate the bellies of the recti with a few interrupted catgut sutures loosely tied. (In the first technique the sutured straps approximate the recti sufficiently.) The upper and lower aponeurotic leaves are now united with interrupted sutures of No. 2 chromicized catgut. In some cases the leaves only come together in the mid-line under tension, and it is desirable to straighten out the table and flex the thighs to reduce the tension. The skin and subcutaneous tissues are approximated with silkworm gut and Michel clips. It is a good plan also to insert a small rubber drain at each extremity of the wound into the subcutaneous tissues to prevent the formation of a haematoma. A pressure dressing is applied. The catheter is irrigated gently to ensure that the bladder drainage is free and may require an advancement of 2-3 cm. into the bladder.

Post-operative Care

The patient is nursed sitting up in bed; early movements are enjoined. The catheter is connected by sterile tubing to a bedside 'Winchester.' Irrigations are employed only if the drainage should be faulty. A prophylactic course of sulphadiazine $\frac{1}{2}$ -1 gm. every six hours is given, and a copious fluid intake insisted upon. A variable amount of sanguineous discharge will escape through the stab wound during the first 24-48 hours, necessitating a change of dressings. The small subcutaneous drains are removed at the end of 24 hours. The catheter is usually removed on the fifth post-operative day, but if there is suspicion of injury to bladder neck or urethra it may be advantageously left in for ten days. The retro-

FIG. 1.—Cutting of first aponeurotic strap.

FIG. 2.—Both aponeurotic straps fashioned. Note muscular pedicle.

FIG. 3.—Straps passed through outer border of recti into prevesical space.

FIG. 4.—Liberation of upper urethra from underlying vagina. (Diagrammatic—urethra lies at greater depth.)

FIG. 5.—Millin-Read special forceps. Note projection of lower jaw to simplify perforation of urethrovaginal septum.

FIG. 6.—Sub-urethral tunnel established. Left-hand strap about to be drawn through. (Elevation of urethra shown grossly exaggerated for clarity.)

FIG. 7.—Right-hand strap passed through tunnel.

FIG. 8.—Disposition of sling. End of straps drawn through mid-recti.

FIG. 9.—Final suturing of strap ends with nylon.

FIG. 10.—Alternative method of strap fixation.

pubic drain is removed on the third or fourth day, and the patient allowed out of bed on the seventh day. She is usually ready to go home on the 14th or 16th day.

In a small proportion of cases a post-operative suprapubic urinary leak will occur when the catheter is removed. This will necessitate the reinsertion of the catheter for a further few days. With increasing experience we seldom see this complication. It is of little moment, but will prolong the hospital stay. Not infrequently on removing the catheter some vesical irritability is noted, but this usually soon passes off. Only rarely is any difficulty of micturition noted after withdrawing the catheter, but we make it a rule that if urine has not been voided four hours later, the catheter is reinserted. In one early case where this rule was not observed the retention was only discovered many hours later, by which time extreme vesical distention had led to marked tautening of the straps. Urethral catheterization proved impossible, and suprapubic cystotomy was carried out. In such an emergency, a suprapubic puncture would relieve the tension, and a catheter could then be passed. The above case proceeded to a complete cure without further trouble.

Operative Difficulties

These are seldom of moment.

Haemorrhage.—The tearing of the deep vein of the clitoris or the associated plexus may cause a troublesome venous ooze, but this, as mentioned above, will usually respond quickly to gauze pressure. Ligature or coagulation may be required.

Previous Abdominal Operations.—Many of our cases had mid-line sub-umbilical scars, and apart from the necessity of a careful dissection of the aponeurotic leaves from the scar, little difficulty was met. In one case where a large ventral hernia existed especial care was required. In five cases a previous suprapubic cystotomy had been made, and here dense adhesions between the anterior wall of the bladder and the parietes were encountered. They respond to careful sharp dissection, and the Cavum Retzii will be found to open up readily. The only case in the series in which the operation proved impossible was where a previous gangrenous typhoid cystitis with evident suppurative pericystitis had led to a complete sealing off of the retropubic space. It was necessary to abandon the sling technique and to effect a cure, happily lasting, by means of an intravesical sphincteric tautening.

Previous Vaginal Repairs.—In more than 90 per cent. of our cases one or more vaginal repair operations had preceded the sling (in two cases there had been five previous attempts!). The

adhesions binding the under-surface of the urethra and bladder neck to the vagina are of necessity denser after vaginal interventions than in those in whom no such operation has been carried out, but yield readily to puncture with the special forceps (Fig. 6) designed for the purpose. Most operators undertaking the sling procedure for the first time find the chief difficulty in defining the plane between the urethra and vagina, and are surprised at the force sometimes necessary to perforate the dense bands connecting these structures, especially where several vaginal operations have previously been carried out.

Operations Combined With the Sling Technique

On two occasions one of us (C.D.R.) has performed a total hysterectomy, on two occasions a sub-total hysterectomy and on three occasions a shortening of the round ligaments in association with the sling technique. This, of course, involves a deliberate opening of the peritoneum, the performance of the intra-abdominal procedure, careful closure of the peritoneum and a subsequent sling operation.

Complications

Post-operative Obstruction. In our early cases a desire to make certain of a cure of this distressing complaint tended to encourage over-correction of the bladder descent, and an unduly tight sling resulted. Following this error in technique a few patients complained of difficulty of micturition, usually shortly after leaving hospital. On endoscopic examination they were found to have, as expected, a transverse ridge at the bladder neck analogous to the median bar obstruction found in the male. In the lesser degrees this will respond to dilatation with a Kollmann's instrument, or backward traction to stretch the straps, using a sound *in situ*. In severer cases (three in our series) a per-urethral resection of the bar was carried out with complete relief of symptoms. Obviously care must be taken in carrying out this resection to avoid complete severance of the straps, especially in early post-operative days (at a later date the bladder neck has probably become fixed in its high position by adhesions) and of course, to avoid perforation of the vagina and so cause a vesico- or urethro-vaginal fistula.

Early post-operative difficulty of urination on removal of the catheter has already been mentioned.

Sepsis. This has occurred in two cases. One was an ex-prisoner-of-war in Japan, and had suffered from extreme privations. In retrospect, it is obvious that a longer time should have been allowed to elapse before counselling operation. As

in many of these unfortunates, marked avitaminosis was present, and there was little resistance to infection. A diffuse cellulitis developed in the second week which proceeded to pus formation necessitating suprapubic incision for its evacuation. The patient shed her nylon sutures, but 18 months have elapsed since the operation, and she remains completely cured. In the second case, with a patulous urethra, the catheter slipped from the bladder during the operative manipulations. An attendant nurse was asked to replace it. At the conclusion of the operation it was found that the catheter was in the vagina, and the straps passing under it had traversed this structure. Probably little harm would have resulted had a foul cervical discharge not been present. Retro-pubic sepsis followed, and the patient left hospital with little improvement in her urinary control, but four months later she reported virtually cured.

Post-operative Urinary Leakage. This will occur in a small proportion of cases, but with decreasing frequency as experience grows. On removing the catheter on the fifth post-operative day urinary leakage may occur from the stab wound. This indicates that the bladder neck or urethra has been damaged and merely requires the reinsertion of the catheter for a further few days. In no case has a fistula persisted more than 20 days.

Results

We have now carried out this operation more than 140 times. One patient with an excessively poor myocardium died on the third post-operative day from an acute pulmonary oedema.

The first sling operation was carried out more than ten years ago, it was combined with an intra-vesical sphincteric tautening as we then believed that this latter procedure was necessary. Ribbon gut was used to elevate the bladder neck. Subsequently a silk suspension of the outlet, as now advocated by Perrin of Lyons was employed, but for the past $3\frac{1}{2}$ years the sling as described above has been the operation of choice. We can therefore claim that the procedure has been subjected to a reasonable experience, moreover the functional results have been eminently satisfactory. It has not yet been possible to engage in a complete follow-up, but we have been aware of only one unsuccessful result. This patient had previously undergone two vaginal interventions and a trans-vesical operation all without benefit. A sling gave an immediate good result, but the condition quickly relapsed. Some suspicion was entertained

as to the possibility of a neurological etiology, but efforts to induce her to submit to further investigation have proved unavailing. In a very few other cases, who regard themselves as cured, there is a slight loss of urine on severe exertion. In one poorly-selected patient, in whom almost the whole urethral floor had sloughed following two vaginal plastic procedures, a sling was performed. The incontinence was cured but a severe stricture followed, ultimately requiring a uretero-intestinal transplantation.

Pregnancy After Cure of Stress Incontinence by the Sling Technique

There would appear to be no contraindication to subsequent pregnancies, but we believe that delivery by Caesarean section is indicated in such cases because of the risk of damage to the sling and bladder neck by a subsequent vaginal delivery.

Indications for the Sling Technique

1. Persistence, recurrence, or development of stress incontinence after an adequately performed vaginal repair.
2. Nullipara developing stress incontinence the presence of an apparently intact perineum.

Contraindications to the Sling Technique

1. Lack of urinary control due to a neurological cause, e.g., spina bifida, tabes, etc.
2. The presence of marked genital prolapse. This calls for a vaginal repair, though it is problematical whether an aponeurotic sling should be combined with it when severe incontinence is present.

Conclusions

A radiological study has been presented of the condition of stress incontinence in the female. It is suggested that the basic lesion is a descent of the bladder neck, due to faulty support when the intra-abdominal pressure is raised.

Operations designed for the relief of this malady should aim at elevating and permanently supporting the bladder neck. Those based on angulating or compressing the urethra or bladder neck appear to us to be based on a false conception of the underlying pathological condition.

The 'Millin sling' technique is presented and confidently supported as being a rational and successful procedure for the cure of stress incontinence where the orthodox vaginal repairs have either failed or do not appear to be indicated owing to the absence of demonstrable genital prolapse.