Surgical repair of gynaecological injuries of the ureter *

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In the course of gynaecological surgical procedures, and occasionally during obstetric manoeuvres, the ureter can be compromised in one of the following ways: perforation, section (complete or incomplete), avulsion, denudation, fulguration, ligation, crushing or angulation. As a consequence, a fistula or a stricture will form, greatly jeopardizing renal function and, sometimes, even the life of the patient.

In choosing the treatment for these injuries, many factors are to be taken into consideration, such as the type, the site and the lenght of the lesion, a previous radiotherapy, the presence of an infection, the residual kidney function, the primary disease and the general condition of the patient and also, the time of the diagnosis. From a clinical point of view, we can group, as Weinberg ([14]) does, the treatment of these lesions in two categories: 1° injuries noted during surgery and 2° injuries noted during the post-operative period.

The usual lesions recognized during surgery are sections, complete or incomplete, crushings or, seldom, mass ligatures. The latter require, in most of the cases, only the releasing of the ligature; the surgeon, however, should look carefully for areas of ischemia or necrosis of the ureteral wall and it might be a safe manoeuvre to leave a ureteral splint, passed through a cystoscope, for 10-14 days.

The best remedy for a gynaecological ureteral injury noticed during surgery is usually an end-to-end anastomosis or a ureteroneocystostomy, depending on the location of the lesion and its lenght. In very few cases can other procedure be utilized, such as the end-to-side anastomosis in a double ureter, the transureteroureterostomy or a bowel or cutaneous diversion.

The ligature of the cut end of the ureter, which has been done a few times in the past with the aim to let the kidney die, is a risky and unreliable procedure. In fact, hypertension or, more frequently, an infection in this closed system could develop. Often, the suture can slough off and a urinary fistula can form, even some months after surgery.

Ureteroneocystostomy is the preferred method when dealing with an injury of the lower pelvic ureter. The different techniques of this procedure will be presented later. In the meantime we would like to say a few words about the end-to-end ureteral anastomosis to point out some details which in our opinion, are very important in order to obtain good results.

Working with the ureter, the first rule is to handle the structure very gently, then to free the two stumps sufficiently so that they can be brought together without any tension; at the same time unnecessary freeing should be avoided.

In gynaecological injuries noted during surgery, the ureter is usually of a normal calibre; after removing all injured tissue, the stumps should always be spatu-

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Clinical Experimental Obst. & Gynecology
Vol. IV, nn. 3-4, 1977 pp. 71-77

lated for at least 1 or 1.5 cm, thus creating an oblique line of suture to obtain a wider anastomosis.

Only one layer of interrupted stitches of chromic 50 or 60 catgut on a curved atraumatic needle is applied, taking small bites of the full thickness of the ureteral wall, though with the possible exception of the mucosa. Few stitches, no more than six for a ureter of normal calibre are used and no attempt is made to get a really water-tight anastomosis, but any prolapse of the mucosa is to be avoided. The knots are tired on the outside wall.

Great attention should be given to avoid any torsion of the ureteral segments and the anastomosis should be covered with retroperitoneal fat tissue, or even with the omentum so as to come into direct contact with muscle fibres.

However, it should be pointed out that it is possible to easily gap up to 4-5 cm of ureter, if a greater lenght has been lost, it might be necessary to use one of the procedures described later.

Always the anastomosis of an injured ureter is splinted using a small, soft nasogastric infant tube with multiple holes. This is passed into the bladder and cystoscopically removed 10-14 days later. The splint's function is to drain urine and not to calibrate the anastomosis; therefore, it should not have a tight fitting. According to Hamm *et al.* ([9]), a ureteral vent, 1-2 cm long made above the anastomosis, does not only give the same result as a splint does, but also eliminates the presence of the foreign body which could always create complications; we, personally, have not tried this out.

The last detail to be mentioned here is to make sure that there is always a good extraperitoneal drainage at the level of the anastomosis.

When a patient becomes anuric or oliguric during the immediate postoperative period, the surgeon should not try to explain the anuria on the basis of dehydration and low blood pressure resulting from the extensive surgery, but rather he should suspect the presence of a ureteral lesion. This event calls for a prompt and complete urological work-up (IVP, cystoscopy, retrogade pyelography etc.).

In some cases during cystoscopy, the surgeon could slip a catheter through a partial ligation or uretral angulation up to the kidney. In this case, which is usually very rare, the catheter should be left in situ so as to relieve the urinary obstruction. Besides anuria, the usual finding is a lesion with an impassable obstruction and it is to be debated whether a diverting nephrostomy should be carried out and then wait until the patient's renal status improves ([2,13]), or whether the lesion should be repaired immediately ([6]). Our opinion, though, is that these situations should be analysed individually, reserving one of the diverting procedures for patients in shock or in extremely poor conditions and attempting an immediate repair on those patients in better condition, where prompt investigation permitted an early diagnosis. One of our patients, for example, nephrectomized at the age of 20 underwent at the age of 36 a total hysterectomy with ligature of the ureter. She was opened again six hours after the operation and an end-to-end ureteral anastomosis was carried out. One year and also three years later (Fig. 1), the control IVPs showed good results.

After a ureter has been injured, the complications likely to arise are ureterovaginal or ureterocutaneous fistula or a stricture with or without renal failure. Few of these will not necessarily require any surgical treatment, but only a careful follow-up. As Novak pointed out, 3 weeks after a radical hysterectomy, a 26.7% of hydronephrosis can be observed and an 8.3% is still present even a few months later. A mild lower ureteral stenosis can improve with or without the help of a few dilatations to the point where it will not interfere with the kidney's func-

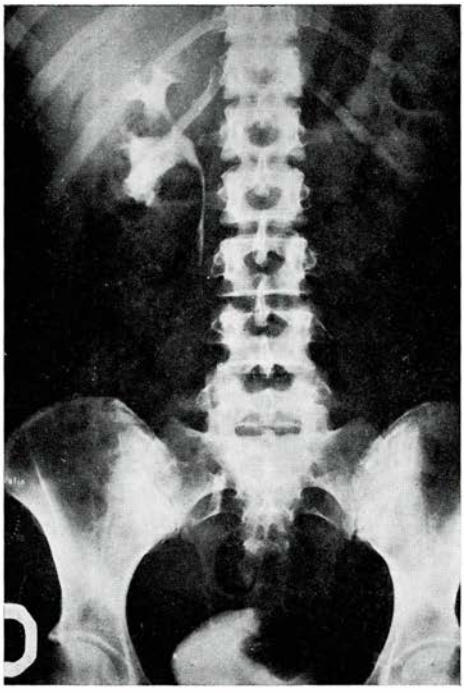

FIG. 1 - IVP three years after an end-to-end anastomosis done 6 hours after ligature of the right ureter.

FIG. 2 - Bilateral uretero-vesico-vaginal fistula with complete destruction of the trigone and lower pelvic ureters.

tioning. Occasionally, a small ureterocutaneous or ureterovaginal fistula can also heal either spontaneously in a few months, or with the help of an indewelling ureteral catheter left for 2-3 weeks. In any case, as we shall discuss later on, it is a good rule to wait at least 4-6 months before planning surgery for a ureteral fistula or stricture.

Nephrectomy should be considered for those patients who have a very damaged kidney or an incurable disease, whereas ligature of the injured ureter or the exposure of the involved kidney to Roentgen therapy are not to be recommended because of the risks and the dubious results.

Urinary diverting surgical procedures, among which the ureterosigmoidostomy has been adopted quite often in the past, have nowadays a very limited indication. Only in one of our patients did we do a bilateral ureterosigmoidostomy, since there was a huge vescicovaginal fistula with complete destruction of both pelvic ureters following a radical hysterectomy and Roentgen therapy (Fig. 2).

Likewise, substituting the ureter with an isolated loop of the ileum ([4]), or another tract of the bowel has limited indications. Still these long and quite complex procedures give pretty satisfactory results: however, we find that in gynaecological injuries of the ureter, the surgeon can always try to perform a reconstructive operation utilizing only the urinary tree, and we believe that the methods of choice are the uretero uretero-anastomosis or the ureteroneocystostomies, modified of cours, accordingly.

The end-to-end anastomosis described before and advocated by us as one of the

Clinical Experimental Obst. & Gynecology
Vol. IV, nn. 3-4, 1977 pp. 71-77

preferable treatments for injuries noted during surgery, can very seldom be utilized for repairing a lesion, especially one of the lower segment. In fact, the usual finding is a proximal ureteral stump embedded in a dense tissue scar which is always longer than it appears to be on the X-ray, and the distal part in most cases is no longer of use. Therefore, even the end-to-end anastomosis suggested by Demel ([7]), which involves mobilizing a flap of the bladder with the stump of the distal ureter, has very limited indications and, in any case, remains a very difficult procedure even for an experienced urologic surgeon.

When a double ureter is present it could be possible to perform an end-to-side anastomosis; if done following all the details described before, it represents an easy and successful procedure. The same can be attained by a transureteroureterostomy ([1]), a technique neglected in the past because the controlateral healthy kidney can be jeopardized in the case of a poor result. On the contrary, we found this to be a very satisfactory method which permits the utilization of the controlateral ureter residuated to a nephrectomy and it can be used with a cutaneous diverting procedure. The injured ureter should be mobilized above the pelvic rim tunnelled underneath the peritoneum and joined to the other ureter with an end-to-side anastomosis which should always be splinted for 10-14 days ([10]). For gynaecological injuries we have done this procedure on a patient who was presented to us 7 years after having undergone a radical hysterectomy followed by Roentgen therapy for a carcinoma of the cervix with a bilateral lower ureteral stenosis and high degree of hydronephrosis, a small incontinent bladder and chronic renal failure; the serum creatinine level was 2.7 (Fig. 3). During transureteroureterostomy, we decided to also do a cutaneous diversion and not an intestinal one because of the status of the kidney. Now, four years later, she does not present any further loss of kidney function (Fig. 4).

Only in special cases can an autotransplantation be taken into consideration; however, this procedure, as also that of the lowering of the insertion of the right renal vein proposed for some cases by Gil Vernet, presents a great deal of difficulty for surgeons not experienced in vascular surgery.

The method of choice for the treatment of these lesions is the ureteroneocystostomy with the various modifications described in the literature. To ensure a good result, the same general principles pointed out for the end-to-end anastomosis should be followed. Moreover, it might be worthwhile mentioning the fact that the ureter always stenotic at its end because of tissue scar, is elongated, tortuous and dilated. The surgeon is helped by these anatomical finding, for they enable him to have ample play when lengthening the ureter; on the other hand he should remember that an excessive freeing of these ureters can very easily endanger the blood supply.

The anastomosis should be done on the posterior or on the lateral wall of the bladder and always with an anti-reflux procedure; in fact, even in adults the vescicoureteral reflux can be very dangerous for the kidney. We use the classical Politano-Laedbetter or the Alexandre techniques according to the site of the anastomosis, the condition of the bladder wall, the necessity of opening the bladder or not, the size of the ureteral stump. To avoid the urinary stasis a ureteroneocystotomy done for repairing a ureteral injury should always be splinted and we use a small-sized, soft, nasogastric infant tube with multiple holes. Avertical ureteral vent can be also utilized.

Depending on the size of the ureter we apply the least possible number of stitches of 40 or 50 chronic catgut; too many sutures, in fact, can interfere with the blood supply of the ureteral end.

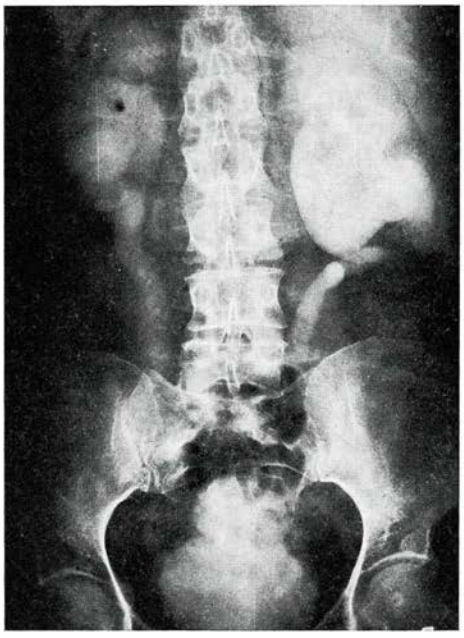

FIG. 3 - Bilateral lower ureteral stenosis with hydronephrosis, chronic renal failure and small incontinent bladder 7 years after radical hysterectomy followed by Roentgen therapy.

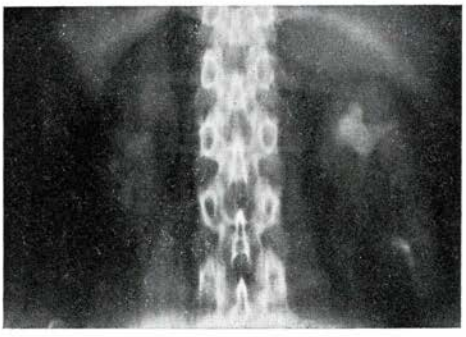

FIG. 4 - The same patient 4 years after a transuretero-ureterostomy and a right cutaneous uretero anastomosis.

To establish a satisfactory drainage, two large-sized Penrose drains are left close to the anastomotic site and brought to the skin extraperitoneally. A simple tubular drain does not give us enough reliability, because of the long time, 10 to 14 days, that it must stay in. For 10 to 14 days also, the bladder is kept at rest by placing a large-sized 22 or 24 Ch Foley catheter.

When it is not possible to do a ureteroneocystostomy on the posterior wall, the surgeon can separate the bladder from the peritoneum, completely mobilizing it, and attach it with a few strong catgut stitches, to the ipsilateral psoas tendon (so-called psoas hitch); this makes it possible to have a higher anastomosis with a fixed part of the bladder wall (Fig. 5).

When an extensive gap exists between the bladder and the stump of the ureter, a tube can be formed using the anterior wall of the organ. We have done this procedure on two occasions following the technique proposed by Boari and Casati ([5]) and modified and codified by Küss (1975). In one case we lost the kidney a few months later because of reflux and recurrent pyelonephritis; so, in the second case, we adopted the anti-reflux method suggested by Gil Vernet ([8]) with a good result (Fig. 6). In bilateral cases, two flaps can be made or the bladder wall bisected, as proposted by Magder ([11]): with this technical trick the bladder wall can easily reach the iliac vessel and a uretero-vescical reimplantation can be carried out at the apex of the bicornuated bladder which is then closed by two longitudinal sutures.

Our casistic is made up by fourteen patients with gynaecologic injuries, treated

Clinical Experimental Obst. & Gynecology
Vol. IV, nn. 3-4, 1977 pp. 71-77

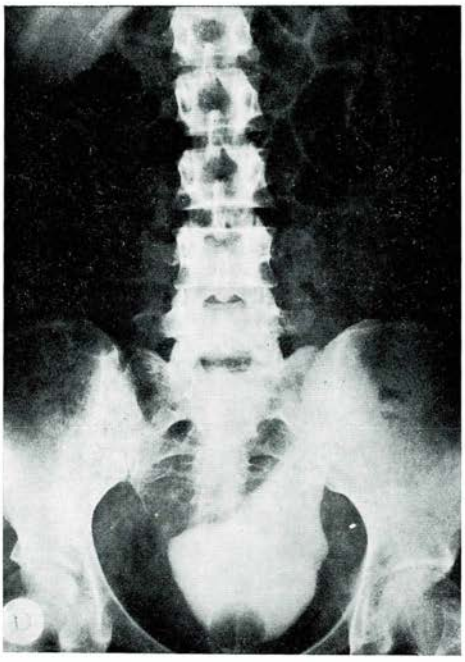

FIG. 5 - Cystografy of a patient 2 years after a left uretero-vaginal fistula repaired with a ureteroneocystostomy and a bladder psoas-hitch.

FIG. 6 - Right ureterovaginal fistula repaired with a Boari-flap and an antireflux procedure.

from June 1972 to May 1976; we calculate 20 ureters because six of the patients had bilateral lesions (Table 1).

Five patients presented a recurrence of the neoplastic disease at surgery and underwent a demolitive or diverting procedure.

In one case, a spontaneous improving of a stricture was seen so that no further surgery was necessary. A very low and small uretero-vaginal fistula healed with the help of an indwelling catheter left for 3 weeks.

Tab. 1. *Treatment of 20 gynaecological ureteral injuries (June '72 - May '76).*

Lesion	Surgical procedure	Result
Section (1)	end to end (1)	good
Ligature (2)	end to end (1)	good
	ureteroneocystostomy (1)	good
Stricture (8)	nephrectomy (1)	—
	nephrostomy (4)	—
	transureteroureterostomy (2)	good
	spontaneous healing (1)	good
Ureterovaginal fistula (9)	ureteral catheter (1)	good
	ureteroneocystostomy (2)	good
	Boari flap (2)	one fair
	psoas hitch (2)	good
	ureterosigmoidostomy (2)	good

Looking at the reconstructive procedures done, one notices that inspite of the small number of cases, a large variety of techniques have been used. We believe that our good results are due to this fact.

Thus, in conclusion, we would like to summarize a few of the important points which should be remembered. When dealing with gynaecological injuries of the ureter, a reconstructive surgery should always be considered, even in cases in which it might be safer to perform a diverting procedure before doing the constructive one. Surgery should not be carried out before having planned it 4-6 months beforehand, because some of the lesions might improve in the meantime and, therefore, no surgery will be required, plus it is always wise to wait until the lesion has stabilized itself.

Furthermore, the surgeon should be acquainted with the different procedures described in literature; each patient presents a very individual lesion which can require a particular procedure. He has to also bear in mind that there is no better substitute for a ureter than a segment of the urinary tree, so he should try to avoid all the diverting intestinal procedures or similar substitutions.

The treatment of the urinary infection is very important both before and after surgery and it should be continued for a long period of time.

The ureter, even if it is dilated and tortuous, is a very delicate strutcture and has particular blood supply that should be respected. In order to avoid stagnation of urine, a vent above the anastomosis should be done or a splint should always be left in up to the time when peristalsis of the ureter will be regained.

A good and satisfactory drainage is very important and should be left in place for a sufficient period of time.

The patient should be followed for many years after surgery so as to prevent any further complications.

SUMMARY

A brief review of the most recent works on surgical repair of gynaecological injuries of the ureters is presented along with the treatment suggested for lesions noted during surgery, in the immediate post-of period and/or arising as late complications.

The Author's casistic of the last 4 years is then given and also the surgical techniques used and the results obtained and discussed.

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