

Urethral erosion after suburethral synthetic slings: risk factors, diagnosis, and functional outcome after surgical management

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Abstract Urethral erosion (UE) is an uncommon but potentially severe complication after suburethral synthetic slings. We aimed to identify the risk factors and diagnostic modalities of UE and also functional outcome after UE surgical management. We retrospectively analyzed eight cases of UE managed in our department between 1997 and 2007. The main presumptive risk factors of UE were excessive sling tensioning (six of eight) and postoperative urethral dilation (four of eight). The most frequent symptoms included voiding difficulties (five of eight), storage symptoms (three of eight), pain (three of eight), and recurrent stress incontinence (three of eight). UE diagnosis was accessible to introital ultrasound (five of five) and confirmed by urethroscopy (eight of eight). Surgical management was performed in seven cases and included transvaginal sling removal with urethral repair (two of seven), endoscopic transurethral sling resection (four of seven), and combined approach (one of seven). All the approaches provided good functional outcomes. Transurethral endoscopy is a mini-invasive treatment of UE and should be tried first in selected cases.

Keywords Urethral erosion · Suburethral synthetic sling · Tension-free vaginal tape · Transobturator tape · Complications · Urinary tract injury

Introduction

Stress urinary incontinence (SUI) is a common condition that may affect up to 20% of women [1]. Thereby and because of its negative repercussions on the quality of life, SUI represents a real public health concern [2]. SUI can be treated by various surgical procedures including suburethral sling placement. Although complications have been reported after autologous sling placement, synthetic sling placement has been the source of a higher rate of complications including defective healing and erosions [3, 4].

Transvaginal minimally invasive suburethral sling procedures have become increasingly popular in the past decade. Tension-free vaginal tape (TVT), first described in 1996 by Ulmsten et al. [5], has gained general acceptance and has emerged as the most common anti-incontinence procedure worldwide [6]. Its advantages include short operative time, quick postoperative recovery, low complication rate, and good effectiveness [7]. Nevertheless, because of a blind passage of the needles into the retropubic space, some specific complications, uncommon with the traditional procedures, have been described such as bladder perforation and bowel or vessels injuries [8]. In 2001, Delorme [9] described the transobturator approach that offers similar efficacy with decreasing risk of complications [8].

However, uncommon but serious complications after suburethral synthetic slings have been reported including severe bladder outlet obstruction and urethral erosion (UE). UE has been described in the literature over the last few years. The first case of UE after TVT was published in 2001 [11], and the largest published series numbered only five cases [12, 13]. Clinical presentation seems various and unspecific. Diagnosis is difficult and often delayed. Finally,

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the surgical management of UE is not codified involving either a transvaginal approach with destructive/reconstructive surgery or minimal invasive treatment by endoscopy [15, 21]. To improve the knowledge of this rare complication, we report here our experience with eight cases of UE after suburethral synthetic slings and discuss the relevant literature.

Materials and methods

We reviewed the records of all the patients managed in our department between January 1997 and March 2007 for UE after suburethral synthetic sling placement. UE was defined as the presence of synthetic material within the urethral lumen. Institutional review board approval was obtained for conducting this retrospective review.

Data extracted from records included demographics, past history, details of the suburethral synthetic sling procedure, postoperative adverse events, and specific managements. Presenting symptoms at the time of UE diagnosis, interval between sling placement and UE diagnosis, physical examination details, and specific data from urodynamic study and introital ultrasound were listed. Details of the surgical management of UE (i.e., surgical approach, type of procedure, need of further procedure, and results) were recorded.

The functional outcome was assessed according to the initial symptoms resolution and continence status.

In an attempt to find presumptive explanations for the UE, we carefully analyzed the chronology of the events before the diagnosis of this complication.

The terminology of the International Continence Society was used to describe the lower urinary tract symptoms (LUTS) [10].

Results

Between January 1997 and March 2007, eight patients were diagnosed and managed in our department for UE after suburethral synthetic sling placement. Patients' characteristics, sling procedure details, and postoperative events are given in Table 1. Five sling procedures were performed in our department, and three were performed elsewhere and then referred for further management. Mean age at sling placement was 54.1 years (range 39 to 66). The sling was a TVT® (Gynecare-Ethicon, Somerville, NJ) in four cases, a transobturator tape (TOT) in two cases including one Uratape® (Mentor-Porges, le Plessis-Robinson, France) and one Gynecare® polypropylene sling (Gynecare-Ethicon), a retropubic sling inserted by an abdominal approach in two cases including one Vicryl composite sling (Ethicon, Issy-les-Moulineaux, France) and one Gore-Tex sling (Gore, Evry, France). In patient 8, the posterior wall of the urethra was injured during the insertion of the needle as confirmed by the peroperative urethroscopy. Because the defect was very small (2 mm long), repair was not judged

Table 1 Characteristics of the study population

Case	Age	Patient history	Sling procedure	Peroperative urethroscopy	Postoperative symptoms	First treatment
1	65	Recurrent SUI postcervicocystopexy	Retropubic Vicryl Composite tape	Normal	–	–
2	61	Recurrent SUI postcolposuspension	TVT	Normal	VD	Physical therapy, biofeedback
3	48	De novo SUI	TVT	Normal	VD, urinary retention	Urethral dilation at 9 months
4	66	De novo SUI	TVT	Normal	VD, urinary retention	Tape division and urethral dilation at 3 months
5	44	De novo SUI	Uratape® TOT	–	VD, urinary retention	Urethral dilation at 3 months. Persisting VD and recurrent SUI treated by tape division and polypropylene TOT at 6 months
6	58	Recurrent SUI post TVT	Polypropylene TOT	–	Transient hematuria	–
7	39	De novo SUI	Retropubic Gore-Tex tape	–	VD, urinary retention	Cystocatheter, physical therapy
8	52	De novo SUI	TVT	Posterior urethral wall injury, 2 mm long, not repaired	VD, urinary retention	Urethral dilation at 2 weeks

SUI Stress urinary incontinence, TOT transobturator tape, TVT tension-free vaginal tape, VD voiding difficulties

necessary, and the sling was placed under the urethra without any difficulty. Only one patient out of eight was totally asymptomatic in the initial postoperative period.

Time from sling placement to diagnosis of UE ranged from 2 months to 15 years. Excluding the patient with late transurethral sling migration, mean time from primary procedure to UE diagnosis was 13.1 months (range 2–36). Symptoms of UE included voiding difficulties ($n=5$), storage symptoms ($n=3$), pain ($n=3$), recurrent SUI ($n=3$), and recurrent urinary tract infection ($n=2$; Table 2). Relevant data regarding physical examination, urine culture, urodynamic study, introital ultrasound, and urethroscopy are reported in Table 2. Introital ultrasound was performed in five patients and was able to demonstrate mesh fibers within the urethral lumen in all cases (Fig. 1). In patient 5, who had at the same time a TOT and a TVT in place, the ultrasound was able to distinguish the two slings and to identify which one had penetrated the urethra. In all cases, the ultrasonographic findings were confirmed by the urethroscopy seeing directly sling material within the urethral lumen (Fig. 2).

The characteristics of the surgical management and the functional results are presented in Table 3. Patient 2 refused the proposition of a surgical management of the UE. Two years after, she was dry but still complained of postural voiding difficulties and nocturia. Treatment involved a vaginal approach in two patients (cases 4 and 5), an exclusive endoscopic approach in four patients (cases 1, 6, 7, and 8), and a combined vaginal and endoscopic approach in one patient (case 3).

In patient 4, the procedure began with an inverted U-shaped incision in the anterior vaginal wall. A careful dissection identified the sling entering and passing through the urethra. A midline urethrotomy facilitated complete extraction of the mesh from the urethra. Then, the arms of the sling were dissected toward the endopelvic fascia and transected as high as possible in the retropubic space. Total removal of the sling was performed. The defect in the urethral wall was closed with a 4–0 absorbable suture and covered with a Martius pedicled fat flap and Bologna autologous vaginal tape. At 1 year, the patient was continent and free of symptoms. In patient 5, the attempt failed to dissect and remove the intraurethral part of the mesh via urethroscopy. Because of a severe fibrosis of the surrounding tissue, the eroded mesh could not be removed even partially. A vaginal approach, as detailed above, allowed the removal of both slings present in this patient. The reconstruction involved urethral repair with a 4–0 absorbable suture and Martius pedicled fat flap. At 12 months, all initial symptoms had disappeared excepted SUI. The patient underwent dextranomer/hyaluronic acid (Zuidex®) intraurethral injection leading to a transient improvement of continence but with recurrent SUI after a few months. Then, the patient underwent laparoscopic Burch colposuspension and was dry and asymptomatic at 3 months follow-up. In patient 3, the resection of the transurethral portion of the mesh was performed urethroscopically. A transvaginal periurethral dissection was performed concurrently. Lateral attachments of the mesh were dissected out and removed on both side without

Table 2 Diagnostic evaluation

Case	Presenting symptoms of urethral erosion	Physical examination	Urine culture	Urodynamic study	Introital ultrasound	Urethroscopical findings	Time to diagnosis (months)
1	Recurrent urinary infection, SUI, UUI	Normal	10^5 <i>E. coli</i>	BOO, ISD, USI	–	IL tape and stone	24
2	Postural VD, nocturia	Normal	–	BOO	–	IL tape (distal urethra)	36
3	Postural VD	Normal	–	BOO	–	IL tape (distal urethra)	12
4	VD	Normal	–	BOO	IL tape	IL tape (proximal urethra)	3
5	Perineal pain syndrome, postural VD, SUI, UUI, dyspareunia	Urethral pain	–	BOO, ISD, USI	One TOT IL, other TOT in normal position	IL silicone part of the tape (medial urethra)	7
6	Recurrent SUI at 1 month	Normal	–	–	IL TOT, TVT under the bladder cervix	IL tape (medial urethra)	2
7	Pelvic pain syndrome, hematuria, recurrent urinary infection	Pyuria	10^5 <i>E. coli</i>	–	IL tape	IL tape (medial urethra)	15 years
8	VD, perineal and urethral pain syndrome	Urethral pain	Normal	–	IL tape	IL tape (medial urethra)	8

BOO Bladder outlet obstruction, IL intraluminal, ISD intrinsic sphincter deficiency, SUI stress urinary incontinence, TOT transobturators tape, TVT tension-free vaginal tape, USI urodynamic stress incontinence, UUI urge urinary incontinence, VD voiding difficulties

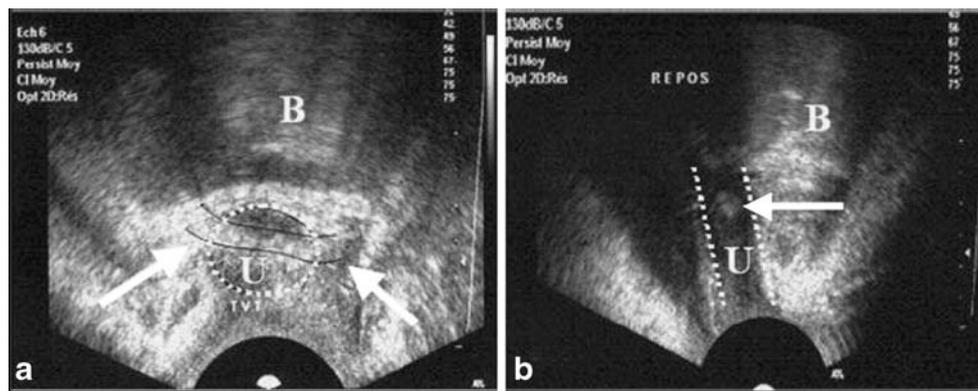


Fig. 1 Intra-urethral ultrasound appearance of an intraurethral placed polypropylene sling: **a** in the transverse angulated plane, the sling, *underlined by black lines* and identified by *arrows*, is seen crossing the lateral urethral walls. The circumference of urethra is indicated by

a dotted circle. **b** In the mid-sagittal plane, the sling, identified by *arrows*, is seen inside the urethral lumen between the anterior and the posterior urethral walls which are indicated by *dotted lines*. *B* Bladder, *U* urethra

opening the urethral wall. The colpotomy was closed with a 2–0 absorbable suture. At 3 months, the patient was continent but complained of persistent voiding difficulties attributable to remnants of synthetic mesh fibers within the urethral lumen. The residual sling was successfully removed through further urethrocystoscopy. One year after, the patient was dry and asymptomatic.

In the four other patients (cases 1, 6, 7, and 8), the treatment involved an exclusive endoscopic approach. We performed each time a transurethral, video-assisted resection of the intraluminal part of the sling, with the endoscopic scissors. To make this procedure easier, the intraurethral mesh was previously grasped with Bengolea forceps, which was introduced along the urethroscope. The remnants of mesh fragments seen at immediate urethroscopic control were excised by cutting the persistent prosthetic fibers one by one until the mesh had totally disappeared. In patient 1, a urethral stone was removed at the time of UE treatment. At 6 months, the patient still complained of persistent SUI but had a significant improvement compared with the preoperative status. She was cured of urgency and urge incontinence. Over the follow-up period, she experienced recurrence of bladder stones because of intravesical-migrated prosthetic tissues. They were removed by repetitive cystoscopy during the 2 succeeding years. One year after the last endoscopy, the patient still had mild SUI. Patient 6 needed two endoscopic procedures to successfully remove all of the intraurethral

extruded mesh. Six months postoperatively, she was still incontinent to stress and underwent dextranomer/hyaluronic acid (Zuidex®) intraurethral injection. One year after, the patient was continent and asymptomatic. Patient 7 had a complete urethral healing after one endoscopic procedure that has been proven by two successive urethrocystoscopies. At 9 months, the patient had a complete resolution of initial symptoms but suffered from recurrent SUI that resolved after TVTO® (Gynecare-Ethicon) placement. One year after this last procedure, the patient was continent and asymptomatic. In patient 8, urethroscopy performed at 1 month follow-up confirmed that the urethral wall has healed very well after a single procedure. Two years postoperatively, patient 8 was continent and asymptomatic.

We identified five possible causal factors of UE: improper excessive tensioning during sling placement ($n=6$), postoperative urethral dilation ($n=4$), misplacement of the sling under the urethra ($n=3$), preoperative direct urethral injury ($n=2$), and mesh material ($n=3$). These factors were associated in six patients (Table 4).

Discussion

We report here a case series of eight UE after suburethral synthetic slings managed during a decade. Medline review of the literature (January 1997–March 2007) using keywords “urethral erosion,” “complication,” “Tension-free

Fig. 2 Urethroscopic diagnosis and treatment of urethral erosion: **a** polypropylene sling penetrating inside the urethral lumen, **b** grasping of the sling with the endoscopic scissors, **c** intraluminal synthetic residue

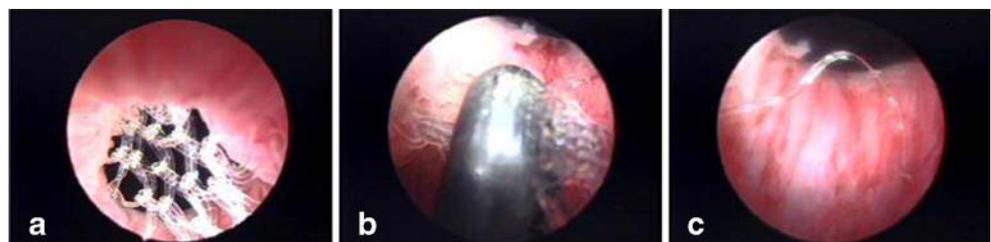


Table 3 Functional outcomes after surgical management

Case	Surgical route	Details of the procedure	Follow-up (months)	Initial symptoms resolution	CO	Further procedure	Final result
1	E	IU sling and stone removal	6	Partial (Residual SUI)	SUI	Repetitive operative cystoscopy	Mild SUI
3	TV and E	Para-urethral and IU sling removal	3	No	Dry	Operative urethroscopy	Continent and asymptomatic
4	TV	Sling excision, urethral repair, Bologna vaginal tapes, Martius flap	12	Yes	Dry	–	Continent and asymptomatic
5	TV	Failure of endoscopic sling removal. Both tapes removal by vaginal route, urethral repair, Martius flap	12	Partial (Residual SU)	SUI	Dextranomer/hyaluronic acid IU injection, laparoscopic Burch colposuspension	Continent and asymptomatic
6	E	IU sling removal by two urethroscopic procedures within the month	6	No	SUI	Dextranomer/hyaluronic acid IU injection	Continent and asymptomatic
7	E	IU sling removal	9	Yes	SUI	Transobturator tape	Continent and asymptomatic
8	E	IU sling removal	24	Yes	Dry	–	Continent and asymptomatic

CO Continence outcome, E endoscopic, IU intraurethral, SUI stress urinary incontinence, TV transvaginal, UE urethral erosion

vaginal tape,” “transobturator tape,” “trans/intra/sub/mid urethral,” “sling,” and “tape” provided 16 published reports containing a total of 26 cases of UE. In all cases, UE followed TVT® insertion [11–26] (Table 5).

The incidence of UE after TVT insertion has been reported to vary from 0.03 to 0.8% [27–29]. However, the frequency of UE after suburethral synthetic slings might depend on surgeon experience and mesh material. Time passed between sling placement and UE is usually difficult to precise. Immediate erosions have been reported after suburethral placement of a monofilament polypropylene sling [18]. In fact, in patients with a neglected peroperative urethral injury, UE occurs shortly after surgery. Nevertheless, the diagnosis of UE is commonly delayed from the initial procedure with a mean time of 13.1 months in our series and 6.7 months in the literature [11–26]. This relative long delay could be explained first by the “physiopathology” of UE and secondarily by an erroneous initial diagnosis and inappropriate first-line treatments. Physiopathology of UE can be divided into three general mechanisms. The first one can be described as the “host” factor. Host factors include vaginal atrophy, scarring, and radiation consequences. The second one involves the iatrogenic factors that can be separated in peroperative (urethral injury, dissection in a plane too close to the urethra, inadequate excessive tensioning) or postoperative iatrogenic factors (secondary urethral dilation to manage outlet bladder obstruction). The last one is the “sling” factor including specific mechanical properties of the mesh

(material, weight, pore size, etc.). Local and peroperative iatrogenic factors mostly result in immediate or shortly delayed UE. Sling factors and postoperative iatrogenic factors are more likely to provide delayed extrusion and erosion. Excessive tensioning at the time of sling placement is always an aggravating factor.

In our series, we identified five different presumptive causal factors of UE, which could play a synergetic role in more than half of cases (Table 4). Among these factors, three were also found to be often implicated in the published reports of UE after TVT insertion [11–26]. These three risk factors are an excessive tensioning of the sling, a peroperative urethral perforation, and one or more postop-

Table 4 Presumptive risk factors

Case	Probable cause(s) of urethral erosion
1	Sling material
2	Sling misplacement, excessive tensioning
3	Sling misplacement, excessive tensioning, postoperative urethral dilation
4	Sling misplacement, excessive tensioning, postoperative urethral dilation
5	Sling material, excessive tensioning, postoperative urethral dilation
6	Peroperative urethral injury
7	Sling material, excessive tensioning
8	Peroperative urethral injury, excessive tensioning, postoperative urethral dilation

Table 5 Published cases of UE: surgical treatment and outcomes

References	Number of cases	Surgical route	Details of the procedure	Initial symptoms resolution	CO	Further procedure	Final CO
Koebl et al. [11]	1	TV	Sling removal, urethral repair	Yes	Dry	–	–
Madjar et al. [16]	1	TV	Sling removal, urethral repair	Yes	UI	–	–
Haferkamp et al. [17]	1	TV	Sling removal, urethral repair	Partial	Dry	–	–
Pit [18]	1	TV	Sling removal, urethral repair, Martius flap, TVT	Yes	UI	–	–
Sweat et al. [14]	1	TV	Sling removal, patch interposition, TVT	Yes	Dry	–	–
	1	TV	Sling removal, urethral repair, Martius flap	Yes	SUI	PVS	Dry
Lieb and Das [19]	1	TV	Sling removal, urethral repair	Yes	SUI	PVS	Dry
	1	TV	Sling removal, urethral repair	?	?	?	?
Vassalo et al. [20]	1	TV	Sling removal, urethral repair	Yes	SUI	Fascia lata	Dry
Werner et al. [21]	1	E	Intraurethral sling resection	Yes	Dry	–	–
Hilton et al. [22]	1	TV	Sling removal, urethral repair, Martius flap	Yes	SUI	–	–
Gerstenbluth and Goldman [23]	1	TV	Slings removal, urethrovaginal fistula repair, Martius flap, PVS	Yes	UI	–	–
Wai et al. [24]	1	E and TV	Sling removal, urethral repair	No	SUI	Bio- feedback	Dry
Tunn et al. [25]	1	TV	Sling removal, urethral repair	Yes	Dry	–	–
McLennan [15]	1	E	Intraurethral sling resection	Yes	Dry	–	–
Bacarat et al. [12]	2	E	Intraurethral sling resection	Yes	Dry	–	–
	3	E	Intraurethral sling resection	Yes	SUI	PVS	Dry
Powers et al. [26]	1	TV	Sling removal, urethral repair	Partial	SUI, UI	–	–
	1	TV	Sling removal, urethral repair, PVS	Yes	SUI	–	–
Starkman et al. [13]	2	TV	Sling removal, urethral repair, PVS	Yes	Dry	–	–
	1	TV	Sling removal, urethral repair, PVS	No	UI	–	–
	1	TV	Sling removal, urethral repair	No	SUI	?	?

? No accurate data, *CO* continence outcome, *E* endoscopic, *PVS* pubovaginal sling, *SUI* stress urinary incontinence, *TV* transvaginal, *TVT* tension-free vaginal tape, *UI* urge urinary incontinence

erative urethral dilations. A wrong plane dissection also appeared to be a very common risk factor in literature series. All these factors could have a worsening cumulative effect. As a matter of fact, no respect for the tension-free rule at the time of sling placement is the most frequent risk factor of UE in our series and in the literature. Other factors such as anatomic variation, twisting of the sling, and tissue weakening by repetitive surgery did not appear as implicated factors in this study but could also be liable to an increased risk of UE. Obviously, above all, technical error during sling placement is the main causal factor of UE. Regarding our experience and the literature, we suggest seven recommendations to avoid UE when performing a suburethral synthetic sling procedure: (1) Careful dissection of the suburethral plan, (2) good spreading out of the sling and placement under the mid-urethra, (3) absolute respect of the “tension-free” original principle of the TVT technique whatever is the route or the sling material, (4) systematic careful urethroscopy to detect lower urinary tract injury, (5) sling removal and procedure aborting in case of urethral injury recognized during the surgery, (6)

avoidance of urethral dilation for the management of late obstructive symptoms. We assume that the suburethral fibrosis is already installed by 7 days after surgery. After this time, the urethral dilation acts like a “cheese wire” on the urethral mucosa. The last recommendation is (7) the prohibition of using synthetic materials that present a high risk of erosion. Currently, it seems that the best material in terms of tolerance and behavior is the large-pore knitted monofilament polypropylene.

Our series and those extracted from the literature [11–26] demonstrate the polymorphism of the clinical presentation of UE after suburethral slings. LUTS are often multiple and unspecific. LUTS are essentially represented by obstructive urinary symptoms, incontinence, pain, storage symptoms, and recurrent urinary tract infection (Table 2). However, voiding difficulty with or without complete urinary retention is the most frequent symptom reported. This is not surprising because this symptom reflects at the same time the cause (initial excessive sling tension) and the consequence of UE (urethral lumen obstruction by the prosthetic material). In this context, the urodynamic study systemat-

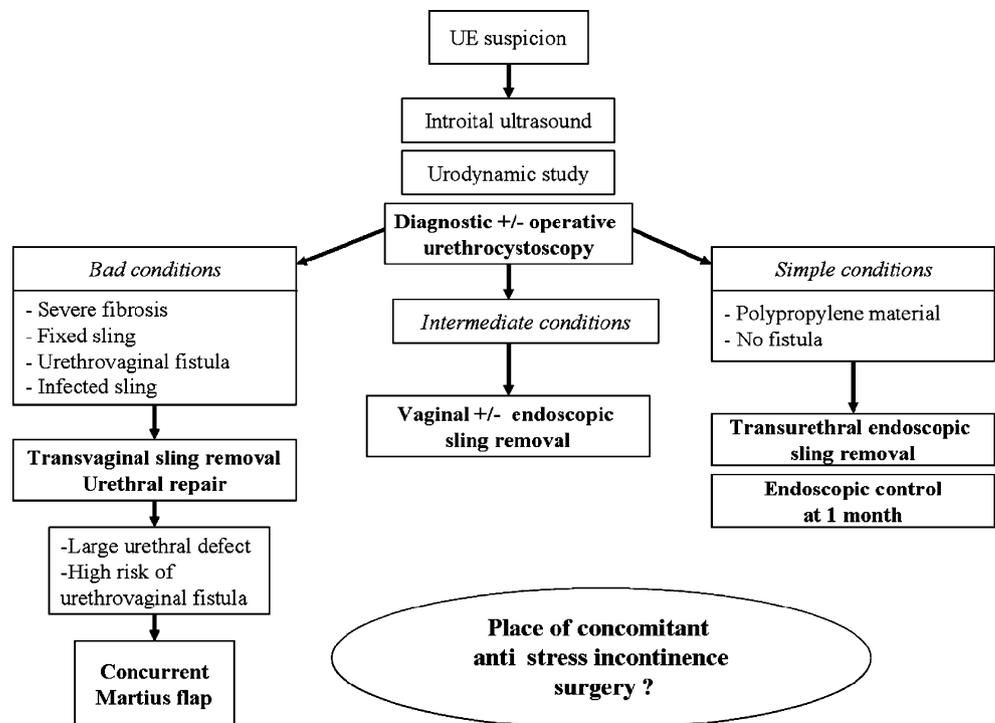
ically found in our experience a bladder outlet obstruction. Physical examination is often poor but can sometimes suggest a urethral damage when the suburethral palpation induces pain or local pyuria. To date, if there is a suspicion of sling complication, ultrasound examination is absolutely necessary. Whereas abdominal ultrasound seems inefficient to diagnose UE in the series of Baracat et al. [12], our experience corroborated by other authors [25] emphasizes the diagnostic role of introital ultrasound. This is a noninvasive exam that is easy to perform, which can be very helpful in hands of a skilled operator.

The management of UE generally depends on symptoms, sling material, sling position inside and outside the urethra, and extent of the local damage. Many authors favor the transvaginal removal of the mesh followed by a layered urethral reconstruction (Table 5). Sling removal needs a careful paraurethral dissection, and urethrotomy is often required resulting in a higher risk of secondary urethrovaginal fistula. This complication is usually prevented by a meticulous urethral repair with multiple-layer closure and interposition of a Martius pedicled fat flap. In the literature series (Table 5), 17 patients were treated by a vaginal approach and had a follow-up. Thirteen patients had complete initial symptoms resolution (76.5%), and four patients had no or partial improvement (23.5%). Six patients were immediately dry (35.3%), whereas 11 patients complained of urinary incontinence (64.7%). Finally, the outcome of the vaginal approach probably depends for a large part on the severity of the initial urethral damage and also on the quality of the reconstruction.

According to some other experts, we advocate the endoluminal endoscopic management [15, 21]. In the literature, we found seven cases of such treatment after TVT® (Table 5). After transurethral sling removal, all patients had initial symptom resolution, and four were immediately dry (57.1%; Table 5). The low rate of recurrent SUI could be explained by the residual support provided by the remnants of the sling and the periurethral fibrosis. The transurethral approach has a low morbidity with good functional outcomes. Recurrent SUI is accessible to further mini-invasive treatment such as periurethral injection or suburethral sling placement. We commonly perform one or more endoscopic controls to check the urethral healing process during the postoperative phase. We only report one failure after endoscopic transurethral management in a patient with recurrent lithiasis that needed additional endoscopic excisions of the remaining sling. In this case, the sling material is directly involved in the failure process. Despite its good feasibility and good success rate, the endoscopic approach is sometimes impossible to perform because of a severe local fibrosis [11, 17]. According to our experience, transurethral endoscopic resection of the mesh appears potentially less harmful for the urethra and should be performed first before embarking on major destructive and reconstructive surgery in the lower urinary tract [21].

We suggest in Fig. 3 an algorithm for the management of UE. In case of urethrolysis, a concurrent SUI procedure to treat or to prevent recurrent SUI is debatable. This option has to be discussed very carefully. At this time of our knowledge, we advocate to treat first the UE without taking

Fig. 3 Strategy for the management of urethral erosion after suburethral synthetic slings



into account the postoperative continence status. When indicated, SUI surgery can be offered easily as a further treatment with good success rates (Table 5).

UE is an uncommon but potentially severe complication of synthetic suburethral slings. The knowledge of the risk factors should lead to basic preventive rules that would minimize the risk of this complication. The diagnosis is accessible to introital ultrasound. The transurethral endoscopic approach is effective and attractive to manage UE and should be suggested as a first-choice treatment in selected cases according to the clinical and urethroscopic findings.

Conflicts of interest None

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