**Evaluation of endoscopic laser excision of polypropylene mesh/
sutures following anti-incontinence procedures**

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Abstract

Background

Minimally invasive surgical procedures have gained widespread acceptance for managing stress urinary incontinence (SUI) in female patients. Mesh or suture erosion is a rare complication of anti-incontinence procedures that have traditionally been managed with open surgical approaches.

Objectives

To prospectively follow the largest series of patients that underwent endoscopic laser excision of eroded polypropylene mesh or sutures as complications of previous anti-incontinence procedures.

Intervention

Twelve female patients underwent endoscopic laser excision of suture/mesh erosions in one centre over a 10 year period.

Measurements

Primary outcome variables were requirement for additional endoscopic or open surgery to remove mesh/ sutures. Secondary outcome variables were persistence of urinary symptoms, postoperative complications, continence status and requirement for additional anti-incontinence procedures.

Results and Limitations

Mean interval from previous surgery to erosion was 59.33 (7-144) months and the duration of presenting symptoms ranged from 3-84 (mean: 19.25) months. Ten patients underwent endoscopic excision of the mesh/suture with the Holmium:YAG laser and two underwent excision with the Thulium:YAG laser. Mean operative duration was 19.33 (10-25) minutes and the duration of follow-up was 65.5 (6-134) months. Postoperatively, 6 patients remained asymptomatic and 2 required a rectus

fascial sling for recurrence of SUI. Four patients underwent a second endoscopic excision due to persistence of erosion. One patient ultimately required an open cystotomy to remove the eroded biomaterial. No intraoperative complications were recorded and all patients are currently asymptomatic. A limitation to this study is that a randomised control group was not available for comparative purposes.

Conclusions

Endoscopic laser excision may be an acceptable first-line approach for managing eroded biomaterials due to its high long-term success rate and minimally invasive nature.

1.0 Introduction

Stress urinary incontinence (SUI) is among the top 10 most prevalent medical conditions among adult females (1). Several minimally-invasive surgical procedures for effectively managing SUI have gained widespread acceptance since the introduction of the tension-free vaginal tape (TVT) in 1996 (2). In fact, the popularity of such techniques continues to grow due to decreased morbidity, reduced inpatient stay and cure rates that now approach 95% (3). Although TVT insertion is considered safe due to its relative ease, there are several reports that describe specific procedure related complications such as bladder perforation (2.5-11.7%) and mesh or suture erosion (0.6-5.4%) (1). Bladder perforations are typically recognised intraoperatively with cystourethroscopy and can often be managed without additional therapy apart from prolonged transurethral catheterisation (4). Erosions are less common and are encountered almost exclusively with synthetic biomaterials. An eroded mesh may go unrecognised for several months due to the wide variety of non-specific presenting symptoms that may lead to delays in diagnostic investigations (5).

Initially, erosion into the urinary bladder required an open cystotomy for effective and definitive management (6). Intuitively, less invasive endoscopic approaches with transurethral electroresection or endoscopic scissors were described subsequent to invasive open techniques (4, 7). However, recent studies have used the holmium laser as an alternative tool for excising the eroded material from the lower genitourinary tract. This endoscopic technique was pioneered by our institution in 2005 (5) and has increasing in popularity due to its minimal morbidity and low complication rates. The safety and effectiveness of the holmium laser is reflected by the fact that 95% of its energy is absorbed after traversing 0.5mm underwater. Consequently, its energy is

contained superficially and therefore conveys excellent underwater cutting properties (5, 8-10). To date, studies describing the use of laser therapy for excising an eroded mesh or suture have been limited to case reports and small case series without sufficient long-term follow-up data (11). In this study we present the largest series of patients that underwent endoscopic laser excision of eroded polypropylene mesh or sutures as complications of previous anti-incontinence procedures. We also discuss the long-term clinical outcomes associated with this minimally invasive technique and compare our results with other published studies.

2.0 Materials and Methods

2.1 Patient demographics

Patients with intravesical or urethral exposure to polypropylene mesh and/or sutures after anti-incontinence procedures were followed-up prospectively over a 10 year period at our institution. Their records were retrieved and data extracted. The relevant information gathered included age at presentation and past urological/ gynaecological surgical procedures. The patient's presenting symptoms, their duration and preoperative diagnostic investigations were also recorded. In addition, the time interval between prior urological/ gynaecological procedure and endoscopic laser excision was documented.

2.2 Technique for endoscopic laser excision

All patients were in the lithotomy position under general anaesthesia or sedation and given perioperative intravenous gentamicin (5mg/kg body weight). All procedures were performed as a day procedure by one surgeon (H.F). Cystourethroscopy was performed and the laser fibre advanced through the working channel of the endoscope. Initially, all calcified material was fragmented off the polypropylene with the laser (Fig. 1a). The mesh fibres were then melted with the laser deep to the mucosal surface (Fig. 1b). The resected specimen was then extracted endoscopically. In technically challenging cases the edges of the eroded mesh or suture were grasped with a stent grasper (placed alongside the cystoscope) to stabilise the mesh/ suture by applying tension before deploying the laser (Fig. 1c). All patients were catheterised during the immediate postoperative period for 1-3 days and covered with oral

ofloxacin for 72 hours. The relevant intraoperative data recorded included the location of the exposed/ eroded material, the type of laser fibre deployed, the laser's output settings, the duration of the procedure and any procedure related complications.

2.3 Postoperative follow-up

All patients underwent flexible cystourethroscopy at 3 months follow-up. Patients were then followed up on a 6 monthly outpatient basis thereafter with an interview, physical examination and urinalysis. Any patient that presented with recurrence of their symptoms during the follow-up period underwent urodynamics and repeat cystourethroscopy. The primary outcome variables measured were the requirement for additional endoscopic or open surgery to remove mesh/ sutures. Secondary outcome variables were persistence of urinary symptoms, postoperative complications, continence status and the requirement for additional anti-incontinence procedures.

3.0 Results

3.1 Patient demographics

Between January 2002 and January 2012 twelve female patients were referred to our institution for endoscopic management of suture/mesh erosions after anti-incontinence procedures. Table 1 demonstrates the relevant patient demographics. The mean age at presentation was 54.83 (47-73) years. Ten patients had previously undergone transvaginal-tape (TVT) for the management of SUI, one patient had a history of Burch colposuspension and one patient previously underwent an anterior colporrhaphy and Stamey vesicopexy. The mean interval from surgery to erosion was 59.33 (7-144) months. Presenting symptoms included macro- and microscopic haematuria, recurrent SUI, recurrent UTIs and suprapubic pain. The duration of presenting symptoms ranged from 3-84 (mean: 19.25) months. All intravesical/urethral erosions/ exposures were diagnosed with flexible cystourethroscopy.

3.2 Intraoperative findings

The relevant intraoperative findings are demonstrated in table 2. There were 10 intravesical erosions and 2 erosions into the urethra. Eroded TVT mesh was identified in eight patients and polypropylene sutures were identified in the remaining four. Ten patients underwent endoscopic excision of the mesh/suture with the Holmium:YAG laser (VersaPulse® PowerSuite™) and two underwent excision with the Thulium:YAG laser (RevoLix®). Laser fibre length varied from 200µm to 550µm and output settings varied from 0.8 Joules at 10 Hertz to 1.2 Joules at 10-15 Hertz. The mean operative time was 19.33 (10-25) minutes and there were no intraoperative complications.

3.3 Postoperative follow-up

Table 3 demonstrates the relevant post-operative follow-up data. The mean duration of follow-up was 65.5 (6-134) months. Six patients remained asymptomatic and 2 required a rectus fascial sling for persistence of SUI. Four patients underwent a second endoscopic excision due to persistence of the eroded material. Patients with persistent erosion presented with recurrence of their symptoms within 12 (1-12) months of their initial endoscopic procedure. In one patient, a third endoscopic procedure was required due to persistent mesh erosion at the bladder neck. Ultimately, an open cystotomy was performed on this patient due to persistence of the eroded mesh and the calcified tape was successfully extracted. At present, all patients are continent of urine and remain asymptomatic.

4.0 Discussion

Laser therapy has an established role in endoscopic urology; in particular for the treatment of benign prostatic hyperplasia (BPH) and urolithiasis. Although the holmium:YAG laser has been applied to treat mesh and suture erosions after anti-incontinence procedures, previous reports have been limited to single case studies and small case series without sufficient long-term follow-up data. Therefore urologists may be reluctant to advocate laser therapy as the ‘gold-standard’ surgical tool for excising biomaterials that have eroded into the urinary bladder or urethra. In the current study we present the largest case series of patients undergoing endoscopic laser excision with a mean postoperative follow-up of 65.5 months. Our main finding is that endoscopic laser excision of eroded biomaterials appears to be an effective, swift and minimally invasive solution to this problem.

In our case series the distribution of presenting symptoms varied widely. Recurrent urinary tract infections (UTIs) and intermittent macro-/microscopic haematuria were the most prevalent presenting complaints and were found in 42% (n=5/12) and 58% (n=7/12) of females respectively. These findings are consistent with other studies that describe macro-/microscopic haematuria and recurrent UTIs as predominant symptoms in erosive complications (9, 12-13). Other common presenting symptoms are suprapubic discomfort, recurrent SUI, *de novo* frequency and *de novo* urgency. These irritative symptoms are likely to have developed from direct contact of a foreign body with host urine leading to encrustation and calcification of the eroded biomaterial. Notably, the mean duration of presenting symptoms prior to diagnosis was prolonged at 19.25 months. This finding suggests that clinicians are often misled with erosive complications with resultant diagnostic delays and higher indices of

suspicion should be adopted; particularly in the context of prior anti-incontinence surgery and the aforementioned presenting symptoms.

A number of different hypotheses have been postulated on the pathogenesis of mesh or suture erosion. Trocar perforation is usually recognised intraoperatively, however a lack of familiarity with 70° endoscopes can occasionally lead to unrecognised perforations; particularly if the 11 and 1 o'clock regions of the urinary bladder are not accurately inspected. Furthermore, insufficient distension of bladder tissue at the time of intraoperative inspection may also prohibit direct visualisation of an occult perforation. Another explanation is gradual erosion of the material into the urinary bladder or urethra over time precipitated by submucosal placement of the tape or suture during the initial procedure (4-5). Perhaps, the latter hypothesis is more likely in this study as the mean interval from previous anti-incontinence surgery to erosion was 59.33 months.

Diagnostic cystourethroscopy should be performed on all patients after endoscopic laser excision as the recurrence rate for erosion was 33% (4/12) within 12 months of the initial excision procedure. Re-epithelialisation over the resected defect is more likely to occur if excision is not performed 2-3 mm deep to the mucosal surface. In our study, one patient ultimately required an open cystotomy to retrieve the eroded mesh as resection to the deeper urothelium was not feasible due to technical difficulties with endoscopic accessibility. In addition, two patients required an autologous rectus fascial sling for recurrence of SUI; however both patients are currently dry and continent. Our excision success rate of 92% (11/12) compares favourably with other smaller case series where the success rate for complete

endoscopic excision with laser therapy ranges from 50% to 100% (10, 13). In general, other approaches at erosive excisions are more invasive and involve an open suprapubic, transvaginal or transabdominal approach (12, 14-16). Advantages of the endoscopic laser approach include decreased inpatient stay, decreased catheter duration, low rates of recurrence and good functional outcomes (10).

Notably, our two most recent patients presenting with TVT erosion underwent excision of the tape with the Thulium:YAG laser (RevoLix®, $\lambda = 2,000\text{nm}$) and this feature is unique to our study. Thulium confers a number of potential advantages over the Holmium:YAG (VersaPulse® PowerSuite™, $\lambda=2,140\text{nm}$) laser in this clinical setting. Firstly, thulium's wavelength produces up to four-fold less thermal damage to soft tissue when compared to holmium, thereby reducing the risk of intraoperative bladder perforation or irreversible damage to urethral tissue (17). Additionally, the thulium laser offers greater flexibility for use in flexible cystosurethroscopes permitting improved access to erosions that are in challenging anatomical locations. Also, higher irrigation rates allow for improved visibility and can therefore make technically difficult procedures more feasible (18). Finally, the thulium laser fibre releases a continuous, operator dependent, pulse when deployed and is 5-10 times more efficient than the conventional holmium:YAG laser for vaporizing urinary tract calculi at identical pulse energies. Therefore, this option offers a more cost-effective alternative and may reduce the duration of general anaesthesia (19).

A limitation to this study is that a randomised control group was not available for comparative purposes due to the infrequency of erosive complications after anti-incontinence procedures (1). However, we believe the relatively large number of

cases presented and long-term follow-up data at hand demonstrates that endoscopic laser excision appears to be an acceptable first-line, minimally invasive option for managing intravesical/urethral suture and mesh erosions. We also believe that the thulium:YAG laser may offer an attractive alternative to the holmium:YAG laser in this clinical setting in the near future. It has the potential for improved access to awkwardly located biomaterials that have eroded and may reduce the frequency of intraoperative thermal damage to surrounding tissues. However additional, prospective, randomised trials will be required in the near future to comparatively evaluate both laser types.

5.0 Conclusion

As the TVT procedure continues to increase in popularity, a concomitant increase in erosive complications is likely to occur. In this study, we prospectively followed twelve patients who underwent endoscopic laser excision of an eroded mesh or suture after anti-incontinence procedures. Our results demonstrate that endoscopic laser excision may be an acceptable first-line approach for managing eroded biomaterials due to its high success rate and minimally invasive nature. Information gathered from this study provides important knowledge on the clinical presentation and management strategies for erosive complications after anti-incontinence surgery.

6.0 References

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Patient Number	Age	Previous urological gynaecological procedure(s)	Interval from previous surgery to exposure/erosion (months)	Presenting symptoms	Duration of presenting symptoms (months)
1	49	TVT	66	Frequency Recurrent UTIs Recurrent SUI	3
2	47	TVT	84	Urgency Frank haematuria	3
3	56	TVT	108	Recurrent UTIs Microscopic haematuria	84
4	48	TVT	7	Intermittent frank haematuria	2
5	59	TVT	144	Intermittent frank haematuria	13
6	59	TVT Posterior vaginal prolapse repair	72	Suprapubic pain Recurrent UTIs	36
7	58	Vaginal hysterectomy Urethrosopic fistula repair TVT sling	36	Recurrent SUI	64
8	73	TVT	30	Suprapubic pain radiating to vagina	5
9	57	TVT	24	Urgency Post exercise haematuria	5
10	48	TVT	9	Recurrent UTIs Intermittent frank haematuria	3
11	57	Burch colposuspension	60	Intermittent frank haematuria	1
12	47	Anterior colporrhaphy and Stamey vesicopexy	72	Recurrent UTIs Frequency Urgency	12

Table 1: Demographics of patients presenting with erosions after previous anti-incontinence surgical procedures and their presenting symptoms

Patient Number	Eroded material	Erosion/ Exposure site	Laser type and fibre length	Laser Settings	Duration of procedure (minutes)
1	TVT tape	Urethra: 5mm from bladder neck, 9-11 o'clock	Holmium, 200µm	0.8J at 8 Hz	25
2	TVT tape	Bladder: 2 o'clock, 2cm inside bladder neck	Holmium, 365µm	1J at 10 Hz	10
3	TVT tape	Urethra: 5 o'clock, just distal to sphincter	Thulium, 550µm	0.8J at 10 Hz	15
4	TVT tape	Bladder: left side of dome & right side of dome	Thulium, 550µm	0.8J at 10 Hz	20
5	TVT tape	Bladder: 5 o'clock, 1cm from bladder neck	Holmium, 500µm	1J at 5-10 Hz	18
6	Polypropylene suture	Bladder: Looping through, 1 o'clock, close to bladder neck	Holmium, 365µm	1.2J at 10-15Hz	24
7	Polypropylene suture	Bladder: posterior wall near trigone	Holmium, 365µm	1J at 10 Hz	20
8	TVT tape	Bladder: In and out through right lateral wall (3cm strip)	Holmium, 550µm	1.2J at 10 Hz	20
9	TVT tape	Bladder: 2.5cm strip, heavily calcified, posterior wall	Holmium, 365µm	1J at 10 Hz	20
10	TVT tape	Bladder: left anterolateral bladder wall	Holmium, 365µm	1J at 10 Hz	20
11	Polypropylene suture	Bladder: close to bladder neck on left ant. Wall	Holmium, 365µm	1J at 10 Hz	20
12	Polypropylene suture	Bladder: right ant. Wall close to bladder neck	Holmium, 365µm	1J at 10 Hz	20

Table 2: Intraoperative findings and laser output settings used during the endoscopic excision procedure

Patient Number	Requirement for 2nd laser excision	Requirement for 3 rd laser excision	Duration of follow-up since definitive laser excision	Findings at follow-up
1	No	No	72	Required rectus fascial sling for recurrent SUI Currently dry
2	No	No	72	Dry
3	No	No	24	Dry
4	No	No	6	Dry
5	Yes (Remnant TVT excised 12 months after initial excision: Holmium 365µm; 0.8J at 10 Hz)	No	134	Dry
6	Yes (Remnant suture deep in bladder wall excised 5 weeks after initial excision: Holmium 365µm; 0.8J at 10 Hz)	No	70	Dry
7	No	No	48	Dry
8	Yes (Remnant TVT excised 6 months after initial excision: Holmium: 1.4J at 15 H)	No	60	Dry
9	Yes Remnant TVT excised from bladder neck 12 months after initial excision: Holmium 365µm: 1J at 10 Hz)	Yes (3years after 2 nd excision: Thulium 550 µm: 1J at 10 Hz)	-	1 year after, required open cystotomy and removal of calcified tape. Currently Dry
10	No	No	98	Dry
11	No	No	96	Dry
12	No	No	100	Required rectus fascial sling for recurrent SUI. Currently dry

Table 3: Long-term follow-up data for patients undergoing endoscopic laser excision

of eroded mesh or sutures after previous anti-incontinence surgery

Figure 1: Intraoperative images demonstrating surgical technique for endoscopic laser excision of eroded TVT. The mesh was initially cauterised with the laser fibre (A) and a resection deep to bladder mucosa was performed to remove any residual material (B). For technically challenging cases the edges of the eroded mesh or suture were grasped with a stent grasper to stabilise the mesh by applying tension before deploying the laser (C). Resected specimens were then extracted endoscopically (D).