Trans-Urethral Snare of Bladder Tumor (TUSnBT) with Stone Basket Retrieval: A Novel Time-Saving Technique in the Endoscopic Management of Papillary Bladder Lesions

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**Key Words**
Transurethral snare of bladder tumor • Stone basket retrieval • Novel time-saving technique • Endoscopic management • Papillary bladder lesions

**Abstract**

**Background:** To assess if trans-urethral snare of bladder tumor (TUSnBT) with subsequent stone basket retrieval can be used as an effective, time-saving adjunct resection technique for papillary bladder lesions. **Methods:** Via standard cystoscopy, TUSnBT was performed using a standard endoscopic polypectomy snare with subsequent tumor extraction utilizing a standard stone retrieval basket, when lesions were more than 10 mm in diameter. Smaller lesions were removed with the polypectomy snare. Standard transurethral resection of bladder tumors (TURBT) of the tumor bed was performed post TUSnBT. Histological assessment was performed and assessed separately per session. **Results:** In total, 18 papillary lesions, measuring between 9 and 26 mm, were resected via TUSnBT. Operative TUSnBT time, ranged between 10 and 60 seconds duration per lesion. No significant postoperative morbidity was experienced by patients within this cohort. Histo-pathological assessment revealed adequate muscle representation in 83.3 % of TUSnBT grouped sessions assessed. **Conclusion:** TUSnBT with stone retrieval basket retrieval is a feasible method in selected papillary bladder lesions, and may be coupled with standard TURBT resection techniques. This method is less time consuming and would prove beneficial in select lesions. It may also be beneficial to assist with reducing the resection time or inadvertent bladder perforation encountered during the conventional TURBT.

**Introduction**

“When subsequent chapters are written, we will appear to our successors as inept as do the surgeons prior to 1874 seem to us today.”--- Edwin Beer (1876–1938) [1]

These words are profound, coming from the father of modern day endoscopic therapy of bladder tumors. From the simple fulgurative method, first described by Edwin Beer (1908) himself, to modern day transurethral resection of bladder tumors (TURBT), various innovations have paved the way forward to the expanding options for the “suspicious” bladder lesion [2].
TURBT remains the current gold standard modality for bladder lesions. This procedure is both diagnostic by obtaining specimens for histological staging and therapeutic in cases of non-muscle invasive disease. The traditional resection technique of incising the tumor into several smaller pieces violates the oncological mainstay of treatment, as this resection technique may result in tumor seeding [3].

Furthermore, this traditional TURBT technique has a significant potential for bleeding, which hinders endoscopic visualization, resulting in the possibility of longer operative time, inaccuracy in the base resection, incomplete resection or perforation. Based on the above mentioned factors, this procedure may at times be time-consuming. The TURBT procedure may also be a challenging technique for the surgeon to grasp, with a reported complication rate of 5.8% amongst urological trainees assessed [4].

With the benefits of en-bloc (“sand bunker shot”) resection of bladder tumors being advantageous from a resection and histological standpoint, already well established [5], we aimed to assess if trans-urethral snare of bladder tumor (TUSnBT) could be suitable for en-bloc resection of bladder papillary lesions, with specimen removal using a conventional (large diameter) stone basket for lesions larger than 10 mm in diameter.

We hypothesized that TUSnBT with stone basket retrieval, would result in an acceptable operative time, less bleeding, and better overall visibility when applied for papillary lesions of the bladder.
Methods and Materials

Only papillary bladder lesions were selected for this study. For uniformity, the procedures were performed by a single urologist and specimen reporting was undertaken by a single anatomical pathologist. Institutional Ethics Committee and signed patient consent had been obtained for the purposes of this study (Ethics Clearance Certificate Number M160698).

Between May 2016 and October 2016, 18 papillary lesions were resected en-bloc, using TUSnBT, (SnareMaster Oval, Olympus) with basket extraction method, if the estimated size was greater than 10 mm in diameter. For specimen extraction, large diameter baskets were used including: the Dakota™ Nitinol Stone Retrieval Device with OpenSure™ Handle (Boston Scientific, Marlborough, Massachusetts, USA), DIMENSION® Basket 16 mm (Bard, Murray Hill, New Jersey, USA), and the NCircle® Tipless Stone Extractor (Cook Medical, Bloomington, Indiana, USA).

Surgical Technique (See Figure 1) (Video 1)

The procedure was performed under general anesthesia. Materials utilized for the TUSnBT, was a standard 24 F rigid cystoscope (with 2 working channels, Karl-Storz, Tuttingen, Germany), 7 F monopolar polypectomy snare, ureteric stone basket (as specified above), power supply and cords.

Under cystoscopic vision, the snare was opened and lassoed around the base of the tumor stalk. A 35-watt coagulation power was applied briefly, while the snare was gently closed. The resected base was then observed carefully to assess for bleeding. The resected lesion was removed using a ureteric stone basket. Where necessary a ureteric catheter was utilized to allow a more firm hold of the stone basket, which allowed for easier manipulation during location and cystoscopic removal of the tumor.

Additional resection of the resected base, utilizing the standard TURBT was routinely performed. After the procedure, a 24 F trans-urethral 3-way catheter was inserted and irrigation commenced if necessary. The resected specimens (TUSnBT and TURBT) were labeled and processed separately by the attending pathologist. These lesions were assessed as a group per session of resection.

Outcome Measures

Operative time was measured by reviewing the endoscopic video recordings of the procedure. Intra and postoperative complications were recorded based on the Clavien-Dindo classification [6]. Changes in pre and postoperative hemoglobin were measured. Histopathological assessment was performed in groups of specimen (TUSnBT and TURBT) submitted.

Results

All lesions that were selected for the study were successfully excised using this technique. Lesion sizes ranged from 9 to 26 mm (mean 15.2 mm) in diameter. TUSnBT resection time ranged from 10 to 60 sec (mean 36.8 seconds). These 18 lesions were resected, during a total of 6 sessions, in 4 patients (3 males and 1 female), with 1 patient requiring 2 follow-up resection sessions. Patient mean age was 64.2 years (range 48–74 years) (table 1).

No Clavien-Dindo grade I to V complications [6], were observed during the study (mean follow-up of 6 months).

Histopathological diagnosis of urothelial carcinoma was confirmed in all resected specimens. With almost all TUSnBT specimen groups 83.3% (5/6) having muscle representation within the specimen groups resected. Re-look procedures were performed in patient one as he refused radical cystectomy. After much deliberation, he eventually agreed to undergo definitive surgery, and a laparoscopic radical cystectomy was performed. Histology revealed an invasive urothelial carcinoma with squamous differentiation.

Discussion

The management of the “suspicious” bladder has always posed a challenge for both the urologist and the attending pathologist.

Although the first endoscopic electocoagulation method was described by Edwin Beer (1910), the first resectoscope was pioneered by Stern (1926) [7], with further improvements instituted by McCarthy (1931), and later by Iglesias (1975), who adapted the instrument to the resectoscope of modern times [8].

Traditional TURBT has reported shortcomings; with elevated rates of incomplete resection (15–78%), under staging (34–62%) due to absence of detrusor muscle in 51% of specimens, and tumor recurrence (50–70%) [9]. Added to the above, the operative risks during TURBT include bleeding which impairs the visual field, bladder perforation, urethral orifice damage, irrigation fluid absorption which increases with procedure time, infection and obturator nerve stimulation [10].

Additionally, the TURBT procedure also performs systematic slicing of active tumor, which may result in tumor spreading, seeding and further implantation [3, 9].

From a practical perspective, several resection method modifications have been described in the world literature. Some are employed to allow for an en-bloc resection and others to achieve a more accurate endoscopic sampling (table 2) [4, 9–20].

Complications associated with the conventional TURBT method, were noted in a series of 1,250 patients, where mortality rates (0.8%) and complication rates (9.9%) were reported. Among the complications observed, bladder wall perforation, prostatitis and bleeding.
were the commonest [21].

Bleeding prevents adequate visualization during endoscopic resection and if uncontrolled, this may prolong the resection time, result in bladder perforation due to poor visualization and increase the need for postoperative blood transfusion [20].

Accidental resection of the ureteral orifice may complicate as ureteral obstruction or a refluxing vesicoureteral junction, a devastating complication in the presence of an underlying bladder malignancy [20].

Although bladder perforation may result in intraoperative complications, the occurrence of peritoneal and abdominal wall metastasis after bladder perforation has been reported [4].

Pertinently, the incidence of the complications of bleeding, perforation, poor visualization (listed above) have not been observed in our study and are theoretically much less likely if a snare is employed for the papillary lesion [20].

The use of a snare in urological surgery had been initiated by Leopold von Dittel (1985) when he removed a prostatic lobe with a snare during an open prostatectomy [22]. Although the endoscopic resection of bladder tumors utilizing a snare has recently been described with the mesh net as the retrieval mechanism [9], this study is the first to assess the use of the TUSnBT with a conventional stone basket.

Since, newer, wider diameter ureteric stone baskets are now available and the papillary lesion is soft in consistency, these factors allow for an easy en-bloc removal using the basket after TUSnBT. Where the lesion was difficult to immobilize, the basket was passed through a ureteric catheter into the standard instrument channel within the 24 F cystoscope. Our experience utilizing the TUSnBT method further confirms the feasibility, and convenience of the endoscopic snare in selecting papillary bladder lesions, as was reported in a previous series [9].

It may safely imply that, TUSnBT may be performed in outreach or resource limiting regions and may be coupled with cup biopsies of the bladder base post TUSnBT. The post snare resection cold-cup biopsy was reported to be an adequate histological representation [9]. Furthermore, the endoscopic snare is easily available from most general surgery units, in most regional facilities.

In the pediatric patient with a bladder lesion, techniques utilizing a biopsy gun, passed via the endoscopic channel [11], or a sequential TURBT resection with pro-

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**Table 1.** Demographic details and descriptions of the papillary lesions resected via TUSnBT

| Patient profile/history | Tumor size (mm)/location | TUSnBT time (sec) | Histology (snare)/histology (deep) | Muscle in TUSnBT specimen | Change in pre and postoperation Hb (g/dl) |
|------------------------|--------------------------|------------------|------------------------------------|---------------------------|----------------------------------------|
| Patient 1              | 63-year-old male, 20 pack/year smoking, hematuria, multiple papillary bladder lesions | 14/dome 17/post 16/post 14/left lateral 11/left lateral 10/post | 31 25 42 51 21 42 | TUSnBT: non-invasive papillary urothelial carcinoma, high grade | not visualized |
| Patient 1               |                          |                  |                                    |                           | 1.1                                    |
| Session 1              | patient 1 came for first relook | 9/post 12/post 9/post 17/left lateral | 51 60 20 15 | TUSnBT: high grade infiltrating urothelial carcinoma | yes |
|                        |                          |                  |                                    |                           | 0                                      |
| Session 2              | patient 1 came for second relook, refused cystectomy | 20/right lateral 10/post | 21 10 | TUSnBT: high grade infiltrating urothelial carcinoma, shows focal squamous differentiation. Pathologic staging: TNM Stage II pT2 pNx | yes |
|                        |                          |                  |                                    |                           | 0.1                                    |
| Patient 2              | 49-year-old male with papillary bladder lesions | 13/12 | 32 20 | TUSnBT: non-invasive papillary urothelial carcinoma with low-grade dysplasia | yes |
|                        |                          |                  |                                    |                           | 1.5                                    |
| Patient 3              | 74-year-old male with multiple bladder papillary bladder lesions, smoker | 26/dome | 58 | TUSnBT: an infiltrating urothelial carcinoma with squamous differentiation. TNM: T1 Nx | yes |
|                        |                          |                  |                                    |                           | 0.3                                    |
| Patient 4              | 72-year-old female who has previously been diagnosed with low grade urothelial carcinoma | 20/25/20/post | 55 30 59 | TUSnBT: an infiltrating high grade urothelial carcinoma | yes |
|                        |                          |                  |                                    |                           | 0.7                                    |

**TNM** = Tumor grade, node status, metastatic disease; **Nx** = no nodal involvement.
### Table 2. Tabulation of various endoscopic bladder tumor resection modifications described over the last 25 years

| Author/Ref          | Country (year) | Technique                        | Equipment needed                                      | Resection method                                                                 | Patient/tumor selection | Trans-urethral method of specimen retrieval | Number | Complication | Histology/follow-up           |
|---------------------|----------------|----------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------|------------------------------------------|--------|--------------|-----------------------------|
| Oh Kyung et al. [10]| Korea (2015)   | grasp and bite                   | loop electrode, resectoscope sheath                   | liner resection with tumor held between loop electrode and sheath                | superficial bladder tumor size 0.5-5 cm | NS                                       | 35 patients | none          | 12 Ta patients, 7 T1 patients, 10 G2 patients, 9 G3 patients |
| Lightfoot et al. [11]| USA (2014)     | needle biopsy                    | prostate biopsy needle 18-gauge, 9.5 F pediatric cystoscope, polyectomy snare, mesh net | for bladder biopsy purposes only, to assess histology in children               | 4.3 cm mass at trigone 3 cm polyloid lesion | via biopsy gun | 2 patients | none | NS |
| Maurice et al. [9]  | USA (2012)     | endoscopic snare resection      | resectoscope, grasping forceps, Collins loop          | en-bloc with snare and electro-surgery, snare lassoed around the tumor          | patient with first time diagnosis 2 lesions < 2 cm 6 lesions 2–5 cm 3 lesions > 5 cm | mesh net (small tumors) snare (medium to large tumors) | 9 patients | 11 tumors | none on 2 weeks follow-up 8 papillary urethelial carcinoma, 2 metastatic melanoma, 1 metastatic renal cell carcinoma, mean follow-up 17 months, recurrence 57% |
| Naselli et al. [12] | Italy (2012)   | Collins loop resection and laparoscopic forceps retrieval | laparoscopic grasping forceps, Collins loop          | en-bloc with Collins loop to incise bladder wall around lesion                  | small lesions 0.5–4.5 cm | 5 mm laparoscopic forceps to grasp through a resectoscope up to 4.5 cm specimen | 26 patients | grade 1–2 29% according to Clavien-Dindo classification | 42 papillary 4 papillary/solid |
| Pantuck et al. [13] | USA (2007)     | side to side, lateral rotating motion | resectoscope, disposable cutting loops, sheath       | loop orientated parallel to resectoscope shaft, circular side to side rotation of cutting loop | NS | NS | 38 patients | none | NS |
| Niecker et al. [14] | USA (2005)     | NS                               | NS                                                    | NS cases performed by residents and fellows under supervision                  | NS | NS | 173 patients | 4 hematuria needing transfusion, 6 bladder perforation | NS |
| Lodde et al. [14]  | Italy (2003)   | flat loop                        | flat loop, visual obturator 0 degree, glycine irrigation | en-bloc resection starting with circumferential coagulation 5 mm away from tumor pedicle to the deep muscle layer | papillary tumor < 2.5 cm, only suited for certain locations within the bladder | syringe | 37 patients | 62 lesions | 1 extraperitoneal bladder perforation mean follow-up 14.2 months, recurrence in 12 patients, progression in grade 2 patients, stage pTa 82.3%, pT1 17.7%; Grade G1 69.4%, G2 16.1%, G3 14.5% |
| Saito et al. [15]  | Japan (2001)   | holmium laser                    | holmium laser, 26 F resectoscope                      | en-bloc resection, holmium laser technique or knife electrode to make circular incision around tumor 10 mm away then incision beneath until superficial muscle seen | transitional cell carcinoma size 2–30 mm | loop electrode | 35 patients | none | pTa 44%, pTis 40%, pT1b 12%, pT2 4% |
| Ukai et al. [16]   | Japan (2000)   | J-shaped needle electrode        | 26 F resectoscope, J shaped needle electrode          | en-bloc resection, 5 mm away from tumor edge a circular incision made. Followed by level incisions underneath | superficial papillary lesions size < 2 cm in diameter | biopsy forceps | 88 patients | 108 lesions | pTa, pT1 |
| Abe et al. [17]    | Japan (1998)   | biopsy with aspiration and snare | 24 F Endoscope, 6 F snare forceps, 8 F aspiration    | bladder wall raised by aspiration with syringe, snare forceps lassoed around elevated bladder wall | superficial bladder lesions | syringe | 23 patients | NS | transitional cell carcinoma |
| Herr et al. [18]   | USA (1998)     | cutting loop with closed end "tumor" | A2186 resection electrode                             | the runner levelled the mucosa around the tumor and loop cut through base of the tumor | NS | 226 patients | 140 lesions | none | NS |
| Kawada et al. [19] | Japan (1997)   | archited electrode               | archited resection, alternating the shear from right to left and rotating the archited resec- | 2.5 cm papillary sessile tumor | loop electrode and beak of internal tube | 1 patient | none | grade 2 stage pT1 transitional cell carcinoma |
Elik bulb evacuator in 1 case, rest NS

5 patients

none

NS

1–5 cm in diameter

Chung et al. [20]
USA (1993)
endoscopic snare
modified colonoscopic snare

resectoscope, high frequency wave generator

ion electrode 180 degrees

snare opened to incorporate the bulk of the tumor and then closed. Coagulation and cutting current delivered through snare, followed by cold cup biopsy of the tumor base.

Table 1: A comparison of techniques used for trans-urethral en-bloc resection in papillary bladder tumors and patient and tumor selection

Country (year)
Technique
Equipment needed
Resection method
Patient/tumor selection
Trans-urethral method of specimen retrieval
Number
Complication
Histology/follow-up

NS = Not specified; PBL = papillary bladder lesions (most recent paper to least recent).

Progressive urethral calibration have also been successfully performed [23]. We postulate that the TUSnBT may also be considered in papillary lesions encountered in children, as the snare caliber (7 F), can be easily accommodated in the pediatric lower tract.

Only one out of 6 groups assessed, did not report on the muscle within the specimens retrieved, perhaps due to the "learning curve" effect, as muscle was only absent within the first group of specimens accessed (table 1). The aim of our study was to assess the viability and technicality of this technique to supplement standard TURBT procedure in cases of papillary tumors. It was therefore not intended to completely replace the current endoscopic resection practice, or to compare muscle yield representation within other en-bloc resection techniques. Although our results are still comparable, with an 83% muscle yield in specimens assessed (table 1).

Although the snare is applied to the "stalk" during the TUSnBT procedure, muscle representation should be provided distal to the level of the snare constriction ring, which occurs when deeper tissue is enwrapped within the snare specimen include the "cookie cutter" effect, which occurs when deeper tissue is enwrapped, as muscle is absent when enwrapped within the specimen have been described [9]. Published theories of the possible reasons of muscle representation within the snare specimen include the "cookie cutter" effect, which occurs when deeper tissue is enwrapped, as muscle is absent when enwrapped within the specimen have been described [9].

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We further propose that the use of gentle traction applied via the ureteric stone basket prior to the simultaneous constriction of the snare on the bladder base, may increase the muscle yield in the TUSnBT specimen. Furthermore, the application of suprapubic pressure prior to the construction of the "cookie cutter" effect, which occurs when deeper tissue is enwrapped within the specimen have been described [9]. Published theories of the possible reasons of muscle representation within the snare specimen include the "cookie cutter" effect, which occurs when deeper tissue is enwrapped, as muscle is absent when enwrapped within the specimen have been described [9].

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Another limitation is the lack of the inclusion of larger lesions or pediatric patients. However the larger lesions may be resected via the standard TUSnBT method and subsequently halved with the snare within the bladder. This will allow for an easier basket, mesh net or Elik retrieval with smaller lesions. Another limitation is that the histological assessment of TUSnBT versus TURBT was performed in groups per session of resection, since individual TURBT specimen chip retrievals from the base (post TUSnBT resection) was difficult to isolate for histology, when other lesions are present within the bladder. This TURBT resection “chip” of the TUSnBT base, was removed using an Elik evacuator and thus difficult to isolate per lesion, especially in the presence of multiple tumors.

Conclusion

Our experience with the TUSnBT and basket extraction for papillary bladder lesions is presented. The simplicity of this technique allows for a decrease in the operative time, results in minimal bleeding, better visibility and is easier to perform, replicate and teach.

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