ORIGINAL ARTICLE

The short-term outcome of laser endoureterotomy for ureteric stricture

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SUMMARY

With the advent of new technology, the treatment for ureteric stricture has moved from open surgery to endoscopic procedures. Our goals were to review and determine the prognostic factors for success of laser endoureterotomy for ureteric stricture.

This is a cross sectional study for all cases that underwent laser endoureterotomy in a single centre from 2002 to 2009. Standard treatment in this centre utilizes holmium laser. The fiber used was 365nm, setting as 1J and frequency 8 Hz; power output 8 W. Confirmation of adequacy of incision wss by either visualization of extra-ureteric fat or extravasations of contrast on fluoroscopic imaging. Success or recurrence of the endoureterotomy was confirmed objectively with evidence of improvement from imaging. Of these 77 patients, 42 cases (61.8%) of the strictures were from upper ureter. Eight cases (11.7%) of mid-ureteric while lower ureter had 18 cases (26.5%). Length of stricture has been grouped into two groups; Short (<1cm) and long (≥1cm) and their distributions were 47.1% and 26.5% respectively. Follow-up duration ranged from six months to 88 months with an average of 19.6 months. Success rate was 76.5% (52 patients) while 16 patients (23.5%) developed recurrence. Stone disease, positive presenting symptoms and short length of the stricture were identified as variables with good predictor. This study achieved a 76.5% of success rate for this treatment modality for benign ureteric stricture in well-selected patients. Success is more likely if patient is symptomatic (earlier treatment) and previous stone disease present as a risk factor.

KEY WORDS:
Laser endoureterotomy, ureteric stricture

INTRODUCTION

The majority of urological procedures now involve endoscopic or minimally invasive techniques. With the advent of new technology, the treatment for ureteric stricture has moved from open surgery to endoscopic procedures. But there is still no standardized or optimal treatment; options include cold knife incision, balloon dilatation or metallic stent to open surgery such as reimplantation or conduit. Direct comparisons among all the treatment modalities is difficult due to small sample size in all previous studies.

We present our experience with laser endoureterotomy as our centre has been utilizing this technique since 2001 for all of our cases with ureteric stricture. The incidence of ureteric stricture has been reported at 0.5 – 11% after upper tract manipulation[1]. Other causes include: spontaneous passage of stone, chronic inflammatory disease such as tuberculosis, ischaemic causes from any pelvic surgery or radiotherapy. Open surgery like ureteric reimplantation remains the gold standard for cases with severe and long stenosis; outcomes are usually favorable. Laser endoureterotomy should only be attempted in tertiary centers with sufficient experience and resources.

To our knowledge, our study with 68 patients is currently one of the larger data bases on this subject and our goal was to review and determine the outcome and the prognostic factors for success of laser endoureterotomy for ureteric strictures.

MATERIALS AND METHODS

This was a cohort study analyzing all cases that underwent laser endoureterotomy in the Department of Urology, Hospital Selayang, Malaysia from 2002 to 2009. Standard treatment of laser endoureterotomy in our centre utilizes holmium laser (Ho:YAG). All cases were pre-stented (about 2-4 weeks) and the procedure was performed with a rigid ureteroscope. The fiber used was 365nm, standard setting as 1J and frequency 8 Hz; power output 8 W. The incision was carried out on the postero-lateral wall with proximal ureteric strictures, but in the middle and distal ureter the incision was antero-medial. The technique of incision used is based on the anatomy of ureteral blood supply; as the nutrient advential vascular plexus supplying the ureter travels on the medial part of upper ureter (from aorta, common iliac artery and gonadal artery) and crosses to the lateral part in the mid and lower ureter (from internal iliac artery) usually around pelvic brim. The incision was carried both proximally and distally for 0.5 to 1cm. Confirmation of adequacy of incision was by either visualization of extra-ureteric fat or extravasations of contrast on fluoroscopic imaging. Stent was left for about six to eight weeks; using either stent size of 6Fr or 7Fr.

Success or recurrence of the endoureterotomy was confirmed objectively with evidence of improvement from imaging studies. The imaging choices included CT scan, IVU, radioisotope study and retrograde pyelogram. Recurrence is defined as persistence of the stricture; success is defined by resolution of the stricture or in some cases where narrowing still persists but IVU or DTPA showed contrast washout after intravenous frusemide thereby confirming the non-obstructive nature of the lesion. First imaging was done three

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months post-operation and subsequent imaging if clinically warranted (for example, redevelopment of symptoms again). The follow-up was three monthly during first year, six monthly and 12 monthly during subsequent follow-up. The exclusion criteria were endopyelotomy cases for PUJ stricture, malignant or multiple strictures (for example inflammatory cause such as tuberculosis) and acute ureteric injury from iatrogenic causes such as during pelvic surgery (but cases were included if patient had previous pelvic surgery but no documented ureteric injury). There were no major complications in all of the case discussed above.

Statistical method

Categorical and numerical data were presented in number with percentage and mean with standard deviation. Appropriate statistical test such as Independent sample t-test and Chi-square test was used for univariate analysis. For multivariate approach, Binary logistic regression was used to determine the prognostic factors. The analysis was carried out using PASW (version 18.0; Chicago IL).

RESULTS

There are 77 patients eligible for the study. However nine were excluded (one was a case of presumed stricture but turned out to be malignant lesion instead, two were excluded due to suspected tuberculosis infection, six because of the incomplete documentation or the patient failed to return for follow-up). Follow-up duration ranged from six months to 88 months with average of 19.6 months.

Therefore there were 68 patients analyzed (see Table I), the majority were female (48 patients, 70.6%). The following racial distribution was noted: Malay 32 (47.1%), Chinese 23 (33.8%), Indian 12 (17.7%), and Others 1 (1.5%). The mean age was 50.7years (±13.6). Among all patients, 61.8% of the strictures were from the upper ureter (42 cases), 11.7% (8 cases) of mid-ureteric while lower ureter had 18 cases (26.5%). The location is defined as being above, overlying or below the sacroiliac joint.

Length of stricture has been grouped into two groups; Short (<1cm) and long (≥1cm) and their distributions were 47.1% and 26.5% respectively. Unfortunately, there were 18 cases (26.4%) where the length of stricture was not mentioned.

The risk factors were categorized as "Stone disease" if there were previous records of stone disease where the stone was passed spontaneously, or with medical expulsion or ESWL. The "Ureteroscope" group included patients who had prior ureteroscopic procedure for stone or any other diseases. Previous pelvic radiotherapy and previous pelvic surgery (Immediate iatrogenic injury to ureter would not be included) was the next category (the two groups were combined as "Ischaemia" during analysis due to small sample size); and lastly no known risk factors. Most of the cases were stone related (23 cases, 33.8%), 20 cases (29.4%) had previous ureteroscopic procedures; 9 cases (13.2%) were ischemic in origin (two previous pelvic surgery or seven post-radiotherapy) while 16 cases (23.5%) had no obvious risk factors.

There were 38 cases who presented with symptoms (most commonly pain), 17 had no symptoms while the presentation history was not clearly stated in 13 cases.

The overall success rate was 76.5% (52 patients) while 16 patients (23.5%) developed recurrence (see Table I). Age, gender, race, laterality and site of stricture had no impact on outcome as shown in Table II.

Longer strictures showed a trend of poorer outcome but was not statistically significant; dividing into just short and long group showed a p-value of 0.068. In the univariate analysis, symptoms and risks appeared to be a good indicator for successful treatment.

Relapse usually occurred in three to nine months. Ten cases of recurrence were detected in the first imaging review (three months), four more cases in six months and the last two recurrences in 9 months. For the patients with recurrence, 10 out of 16 were treated with repeat laser endoureterotomy and six were successful (60% success rate); the remaining patients were treated either surgically (reimplantation) or conservatively (patient's preference).

Table I: Profile demographic of patients and their clinical features

Risks factors	n (%)
Profile	
Age[a]	50.7 (13.6)
Gender	
• Male	20 (29.4)
• Female	48 (70.6)
Race	
• Malay	32 (47.1)
• Chinese	23 (33.8)
• Indian	12 (17.6)
• Others	1 (1.5)
Clinical features	
Risk	
• No risk	16 (23.5)
• Stone disease	23 (33.8)
• Ischemia	9 (13.2)
• Ureteroscopy	20 (29.4)
Symptomb	
• Symptomatic	38 (69.1)
• Asymptomatic	17 (30.9)
Laterality	
• Right	32 (47.1)
• Left	36 (52.9)
Site	
• Upper ureter	42 (61.8)
• Mid ureter	8 (11.8)
• Lower ureter	18 (26.5)
Lengthc	
• Short	32 (64.0)
• Long	18 (36.0)
Recurrence status	
• Recurrence	16 (23.5)
• No recurrence	52 (76.5)

[a]Reported in mean (SD)
[b]Symptom had 13 missing values
[c]Length had 18 missing values

Table II: Profile demographic of patients and their clinical features versus status of recurrence

Risks factors	Recurrence n (%)	No recurrence n (%)	P-value
Profile			
Age[a]	54.1 (12.8)	49.6 (13.7)	0.256
Gender			0.854
• Male	15 (75.0)	5 (25.0)	
• Female	37 (77.1)	11 (22.9)	
Race			0.778[b]
• Malay	24 (75.0)	8 (25.0)	
• Chinese	19 (82.6)	4 (17.4)	
• Indian	9 (75.0)	3 (25.0)	
• Others	0 (0.0)	1 (100.0)	
Clinical features			
Risk			0.047c
• No risk	3 (18.8)	13 (25.0)	
• Stone disease	2 (12.5)	21 (40.4)	
• Ischemia	2 (12.5)	7 (13.5)	
• Ureteroscopy	9 (56.3)	11 (21.2)	
Symptom			0.009
• Symptomatic	4 (36.4)	34 (77.3)	
• Asymptomatic	7 (63.6)	10 (22.7)	
Laterality			0.400
• Right	9 (28.1)	23 (71.9)	
• Left	7 (19.4)	29 (80.6)	
Site			0.697
• Upper ureter	10 (23.8)	32 (76.2)	
• Mid ureter	1 (12.5)	7 (87.5)	
• Lower ureter	5 (27.8)	13 (72.2)	
Length			0.068
• Short	5 (41.7)	27 (71.1)	
• Long	7 (58.3)	11 (28.9)	

aReported in Mean (SD) and associated p value was calculated using independent sample t-test
bP-value after others races was excluded due to only one representative.
cP-value reported using Fisher's exact test

Table III: Result of binary logistic regression of predicting successful outcome of treatment

Predictors	OR	95%CI	P value
Model 1:			
Pre-symptom			
Asymptomatic		ref	
Symptomatic	3.5	0.7, 18.3	0.137
Risk			
No risk	9.2	0.8, 101.4	0.069
Stone	12.4	1.1, 135.1	0.039
Ischemia	5.2	0.6, 45.6	0.139
Ureteroscopy		ref	
Length			
Short	3.5	0.6, 19.1	0.150
Long		ref	
Model 2			
Pre-symptom			
Asymptomatic		ref	
Symptomatic	5.9	1.5, 23.2	0.010
Risk			
No risk	4.3	0.8, 22.9	0.084
Stone	8.6	1.4, 51.6	0.019
Ischemia	3.1	0.4, 21.6	0.255
Ureteroscopy		ref	

Table IV: Reported of success rate in previous studies

Study	Patient sample (n)	Success rate (%)	Power setting	Follow-up (months)
Sanjay, 2005 [1]	17	75	1.2J, 15 Hz	40.8
Singal, 1997 [3]	22	76	-	-
Thomas, 1997 [4]	36	80	-	-
Lane BR, 2006 [5]	19	68.4	1J, 10 Hz	36
Gdor, 2008 [6]	13	62	-	21
Mazo, 2008 [7]	23	88	-	-
Lin, 2009[8]	19	52.6	1.2J, 10 Hz	43
Gnessin, 2009 [9]	35	78.7	-	27
Corcoran, 2009 [10]	34	85	-	25.2

We generated two sets of results by multivariate analysis. For the first model, three predictors such as symptoms, risks and length were included and for the second model, only symptoms and risks were included. Out of 68 patients, 60.3% were included in the multivariate logistic regression due to missing data. From the results in Table III for first model, only the risk category for those with stone was significant (OR=12.4 with 95%CI=1.1, 135.1, P value=0.010). Presence of symptom had a sizable odds ratio (OR=3.5 with 95%CI=0.7, 18.3, P value=0.137) but the result was not significant. In the second model (without length), we found presence of symptom was significant (OR=5.9 with 95%CI=1.5, 23.2, P value=0.010). It indicated that those with symptoms were almost 6 times more likely not to have recurrence compared to those who were asymptomatic. Besides that those in the "stones" category (OR=8.6 with 95%CI=1.4, 51.6, P value=0.010) were almost 9 times more likely to have a successful outcome compare with those in the "ureteroscope" category.

DISCUSSION

The principles of successful endoureterotomy are based on the work by Davis *et al*[2] in 1948 who were the first to describe the ability of an incised ureteric stricture to regenerate and reepithelialize. After a longitudinal incision the area is covered within days by urothelium and reinforced by a growing muscular layer that, in effect, replaces the scarred region.

As shown in Table IV, this study compares favorably with other available studies[1,3-10] in terms of its success rate. From most other studies, the most important factor in determining outcome is the length of the stricture; although this was not reflected significantly in our study, we agree with this, and our study did showed a positive correlation. Gdor *et. al*[6] stated that length was not a factor but a history of stone impaction was important. The definition of success in this study is the objective resolution from imaging studies whereas some other studies include resolution of symptoms as success of the procedure.

Patients with previous ureteroscopy for stone have a significantly greater risk for failure after treatment. This is logical when assume that these patients have more severe stone impaction compared to patient with only simple stone disease. Therefore, they are more likely to have recurrence. Renal function is found to have significant association with treatment outcome. The exact mechanism and degree of correlation is not known. Several hypotheses have been put forward but none conclusive. Wolf *et al*[11] reported the failure of endoureterotomy in all patients with ureteric strictures in renal units with <25% of total renal function.

In the current study, we were not able to analyze the correlation between renal function and treatment due to incomplete data. Ideally, all patients should have functional imaging; hopefully future studies can address this issue. In our series if a patient is asymptomatic from his/her stricture, endoscopic treatment are more likely to recur (six times more likely). Symptoms may signify a more acute presentation and therefore earlier treatment during this early stage of disease may be the reason for a better outcome. Most of the recurrences are reported within three to nine months after the endoscopic procedures. As there is still no standardized follow-up protocol, this finding suggests that the follow-up interval may be longer if no recurrence is detected within one year.

Laser endouretotomy is an excellent treatment modality for benign ureteric stricture in well-selected patients[12]. On the issue of attempting second endoureterotomy after the failure of the first procedure, these should be assessed in a case-by-case situation; we did achieve a 60% success rate from our data. Factors that need to be considered are patient's age, medical condition, symptoms, expectation, function of the affected kidney, benefit and complication form both open and minimally invasive surgery.

LIMITATION

This is a retrospective and a cross sectional study where some data were not available. There were six cases excluded due to incomplete data or failure to comply follow-up. This may have had a significant impact in this study with a relatively small sample size. Not all patients received functional imaging which could have provided a better predictor for the outcome. We lack a follow-up imaging protocol after the first imaging, and there may be undetected strictures recurrence as subsequent imaging is only ordered if they are symptomatic.

CONCLUSION

This study achieved a 76.5% of success rate for treatment of benign ureteric strictures in well-selected patients. Success is more likely if patient is symptomatic (earlier treatment) and previous stone disease as risk factor.

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