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LASER VS OPTICAL URETHROTOMY FOR URETHRAL STRICTURE

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Abstract

This study is to compare the two options of treating urethral stricture; the cold knife and the LASER. The prospective study conducted in the Department of urology of Basrah Teaching Hospital. Patients were divided in two groups, all patients had urethral strictures one group treated with optical urethrotomy and the second group treated with laser urethrotomy. Patients were evaluated both pre and post operatively for flow rate and for symptoms and complications. The number of patients studied was 30, divided in to 15 in each group (cold knife and laser). The mean peak flow rate in laser group was (12.9 ml/min), and the cold knife group was (15.4 ml/min) after 14 days post operatively. Both cold knife and laser urethrotomy improves the peak flow rate significantly two weeks after surgery but the improvement was more noticed in the cold knife group. Bleeding was more (against our expectations), while infection was less, and the operative time was more in the laser group. In conclusion, the cold knife treatment for urethal stricture is more effective with less complications than laser treatment.

Keywords: laser, stricture, urethra, optical

Introduction

A urethral stricture is a scar of the subepithelial tissue of the corpus spongiosum that constricts the urethral lumen. As the constriction increases, obstruction occurs and leads to symptoms which may be related to the obstruction or secondary to it [1] (Figure 1).

The term stricture usually used for constrictions of the anterior urethra. Otherwise in the posterior urethra the terms stenosis or contracture are applied. The site and the age of the patient may give a hint about the cause of the stricture. For example, Meatal strictures may be caused by lichen sclerosis (the most common identifiable cause of anterior urethral stricture in young adults), and instrumentation or poor hygiene at any age [2].

Aim of study

to evaluate the diode laser as a method for treating urethral stricture.The parameters of operative time, intraoperative and postoperative complications were recorded.

Patients & Methods

The present prospective study was conducted in the Department of urology of Basrah teaching hospital. The study was based on two groups. the patients with diagnosed urethral strictures treated with optical urethrotomy and laser were included in this study. Patients were randomized into two groups. In group A (laser group); the patients underwent urethrotomy with laser (figure 4). In group B (Cold knife), cold knife was used for Direct vision internal urethrotomy (DVIU) (figure 5). Patients were assessed by a history , physical examination, blood count, urine analysis, urine culture , renal function tests, uroflowmetry, retrograde urethrogram (figure 6) and urethroscopy(40). A note was made about the possible etiology of the stricture. Any Urinary Tract Infection (UTI) was treated before surgery. Uroflowmetry was done in all patients except those who had suprapubic cystostomy and peak flow rate (PFR) was taken as zero. The site and length of the stricture was noted on urethroscopy. Antibiotic (Ciprofloxacin, 500 mg and Gentamycin) was given just before and after procedure and continued for 5 days. Normal saline was used for irrigation. The cold knife technique The Sachse Urethrotome was introduced per urethra using a 21 F sheath. If required a 5F guide wire was introduced through the side channel to guide the urethrotome. The stricture was then incised using the knife at 12'o clock position while withdrawing the instrument knife, simultaneously. The procedure was repeated till the stricture was adequately opened up. The laser urethrotomy was undertaken using the diode laser. The laser energy

was transmitted to the urethra through a quartz optical fiber 1.5–2m long, with a diameter of 400–600 µm. These fibers are semi-rigid and can pass easily through the catheterization channels of all cystoscopes, including pediatric cystoscopes of 11F.

The urethrotomy was carried out through a 19F cystoscope. The cystoscope was then removed and re-inserted to keep the guidewire outside the sheath of the cystoscope.

The power setting was 18–20W using the continuous mode.

Patients selection: Patients aged (19-66) with short segment urethral stricture (less than 1.5 cm) were included in the trail while patients with long and multiple strictures and patients with Benign prostatic hyperplasia (BPH), Balanitis Xerotica Obliterans (BXO) and neurogenic disease were excluded from the study.

Results

The mean PFR in the laser group is (3.7 ml/min) while in the cold knife is (3.9ml/min) before surgery with no significant difference between the two groups (Table 1).

Table 1 (PFR before surgery)

	N	Minimum	Maximum	Mean	Std. Deviation
Peak Flowrate laser before surgery	15	1.00	8.00	3.7333	1.98086
Peak Flow rate cold before surgery	15	1.00	9.00	3.9333	2.37447

Patient follow up was done at 14 days post procedure to assess the improvement in the symptoms, PFR and the presence of complications such as (infection and hematuria).

The patients were divided to two groups in the study, Laser group of 15 patients mean age (43.2) and cold knife group of 15 patients with mean age (46.9). (Table2)

Table 2 (Age distribution in both groups)

	Number of patients	Minimum age	Maximum age	Mean	Std. Deviation
Laser	15	19.00	66.00	43.2000	15.71260
Cold knife	15	18.00	87.00	46.9333	20.98457

Regarding the cause of stricture, the cause is iatrogenic in 11 patients (either by instrumentation or catheterization), traumatic in 10 patients, infectious in 5 and unknown in 4 patients which were subdivided into two groups without significant difference (Table 3).

Table 3 (ideology of urethral stricture in both laser and DVIU)

cause	DVIU n:15	Laser n:15
traumatic	6	4
iatrogenic	5	6
infectious	2	3
unknown	2	2

With regard to the involved segment of the urethra 18 patients with posterior and 12 patients with anterior urethral stricture (Table 4).

On applying the chi square test there is no significant difference in the distribution between two groups in etiology, the involved segment of the urethra, the PFR or the baseline renal function.

The mean operative time with DVIU (12.4 min) group is lower than the laser group(17.6 min) which is statistically significant .

Table 4 (site of urethral stricture in both arms)

site	DVIU	Laser
Anterior	10	8
posterior	5	7

The mean PFR in laser arm was (12.9 ml/min), on the other arm the DVIU group mean PFR was (15.4 ml/min) after 14 days post operatively (Table 5).

Table 5 (PFR before and after surgery in both groups)

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PFR laser before	3.7333	15	1.98086	.51146
	PFR laser after	12.9333	15	3.03472	.78356
Pair 2	PFR cold before	3.9333	15	2.37447	.61308
	PFR cold after	15.4667	15	2.58752	.66809

So, the mean change in the PFR are (9.2 ml/min) and (11.5 ml/min) in the laser and cold knife respectively (Table 6) with a marked difference in both two groups from baseline (Table 7,8) after 14

Table 6 (mean change in the PFR before and after surgery in both groups)

	Paired Differences		
	Mean	Std. Deviation	Std. Error Mean
Flow laser before – flow laser after	-9.20000	3.36367	.86850
Flow cold before – flow cold after	-11.53333	2.82506	.72943

Table 7 (statistical significance in both groups in change of PFR in both groups)

	N	Correlation	Sig.
Flow laser before & flow laser after	15	.151	.590
Flow cold before & flow cold after	15	.354	.195

Table 8 (the upper and the lower limit of change in the PFR)

	Paired Differences	
	95% Confidence Interval of the Difference	
	Lower	Upper
Flow laser before – flow laser after	-11.06274	-7.33726
Flow cold before – flow cold after	-13.09780	-9.96887

days of surgery, but the DVIU group had the better improvement in the mean PFR than the laser which is statistically significant.

Post-operative Hematuria was observed in the laser group in 13 patients (86.7%) while only 2 patients did not develop hematuria(13.3 %) in cold knife arm group (Table 9).

Table 9 (the incidence of hematuria post operatively in the laser group)

	Frequency	Percent	Valid Percent	Cumulative Percent
No hematuria post. op.	2	13.3	13.3	13.3
Hematuria present post. op.	13	86.7	86.7	100.0
Total	15	100.0	100.0	

In cold knife arm hematuria was developed in 6 patients (40%) while 9 patients did not have hematuria (60 %) (table 10). So, the incidence of hematuria immediately post operatively was observed in the laser group more than the cold knife which is significantly lower in DVIU.

The incidence of infection post operatively in the laser group was only (20%) while it was higher in the DVIU group as it reached (40%) (Table 11,12)

Table 10 (the incidence of hematuria post operatively in the DVIU group)

	Frequency	Percent	Valid Percent	Cumulative Percent
No hematuria post. op.	9	60.0	60.0	60.0
Hematuria present post. op.	6	40.0	40.0	100.0
Total	15	100.0	100.0	

Table 11 (the incidence of infection post operatively in the laser group)

	Frequency	Percent	Valid Percent	Cumulative Percent
infection present post. op.	3	20.0	20.0	20.0
infection absent post. op.	12	80.0	80.0	100.0
Total	15	100.0	100.0	

Table 12 (the incidence of infection post operatively in the DVIU group)

	Frequency	Percent	Valid Percent	Cumulative Percent
Infection absent post. op.	9	60.0	60.0	60.0
infection post. op.	6	40.0	40.0	100.0
Total	15	100.0	100.0	

Protocol

History	Before surgery	After 15 days of surgery
dysuria		
frequency		
urgency		
weak stream urine		
terminal drippling		
incomplete emptying		
retention		
intermittency		
hematuria		

Renal Function	Before surgery	After 15 days of surgery
blood urea		
serum creatinine		

flow rate	Before surgery	After 15 days of surgery

General urine Examination	Before surgery	After 15 days of surgery

Urine culture and sensitivity	Before surgery	After 15 days of surgery

possible complications	Before surgery	After 15 days of surgery
bleeding		
infection		

Figures

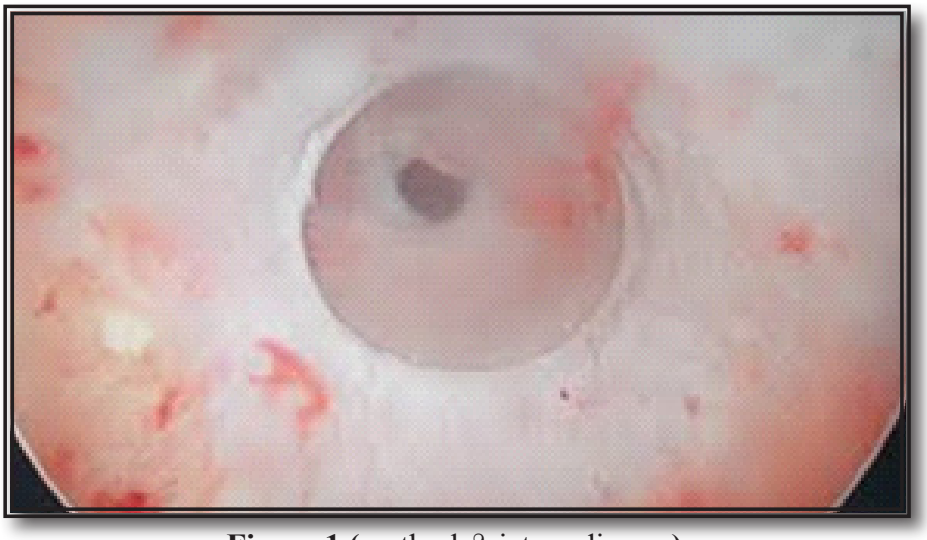

Figure 1 (urethral stricture disease**)**

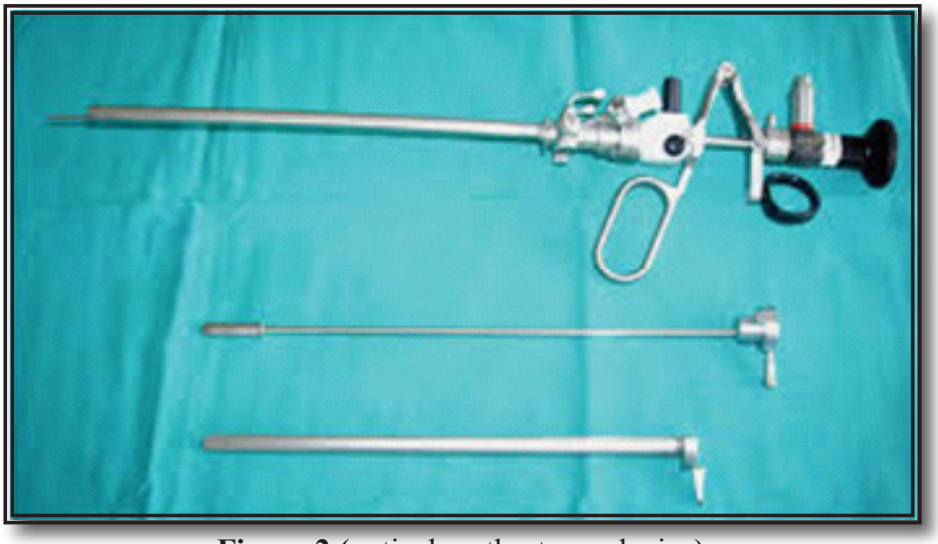

Figure 2 (optical urethrotomy device**)**

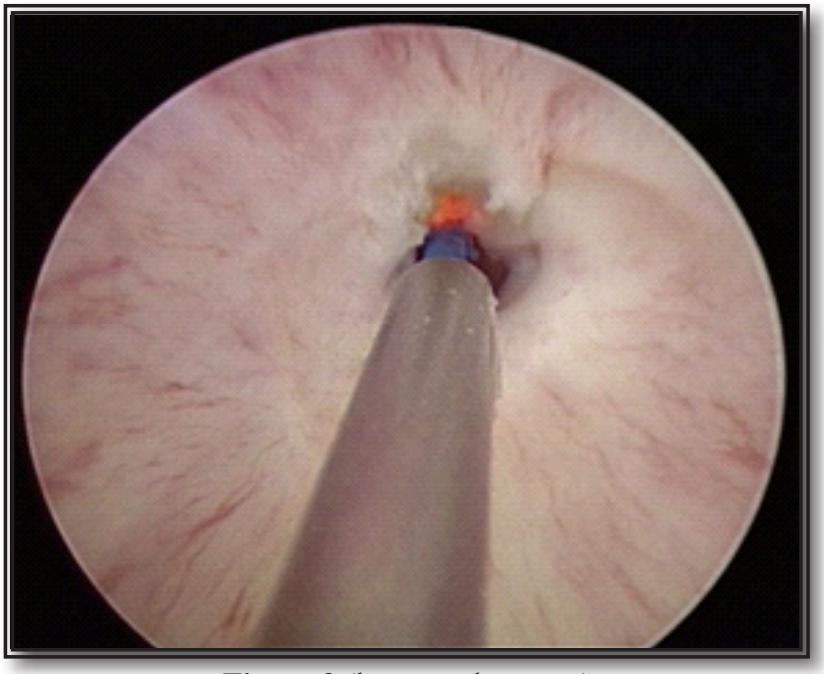

Figure 3 (laser urethrotomy**)**

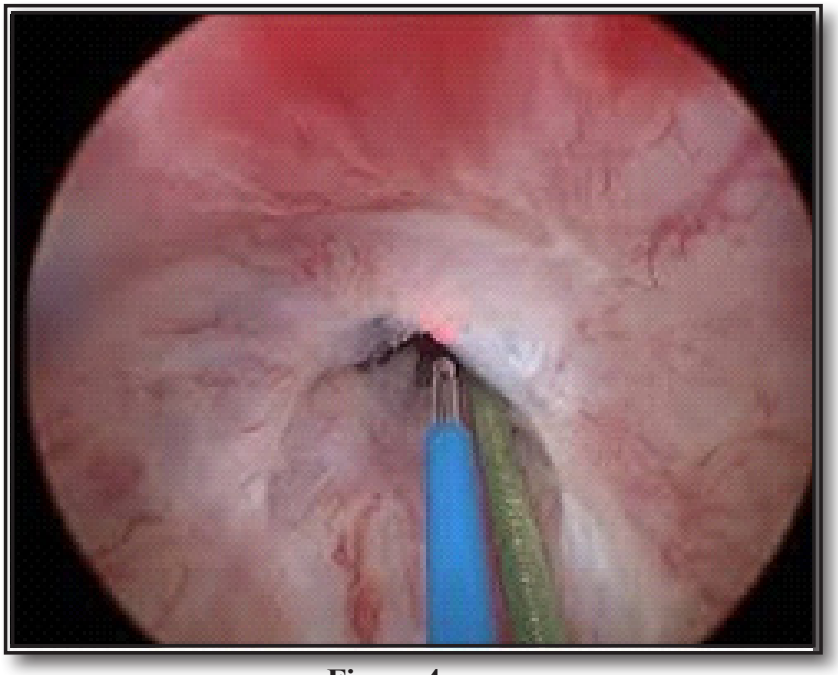

Figure 4

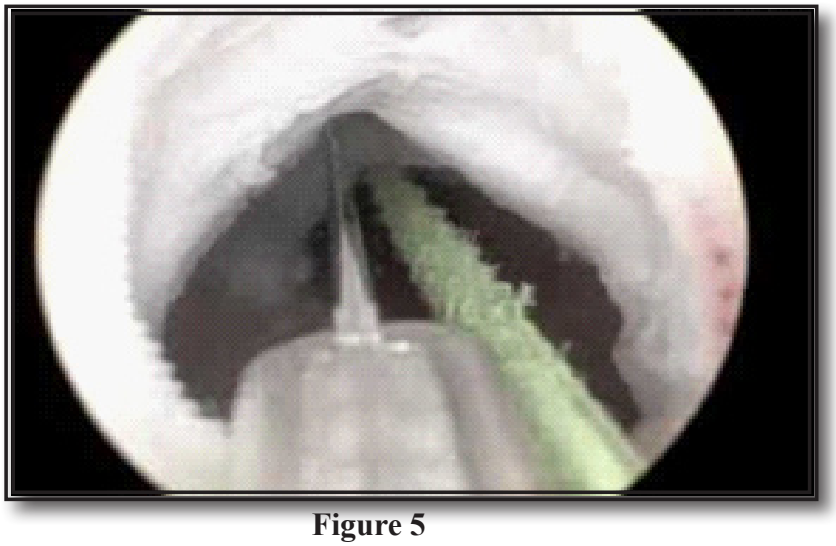

Figure 5

Figure 6 (retrograde urethrogram showing anterior urethral stricture**)**

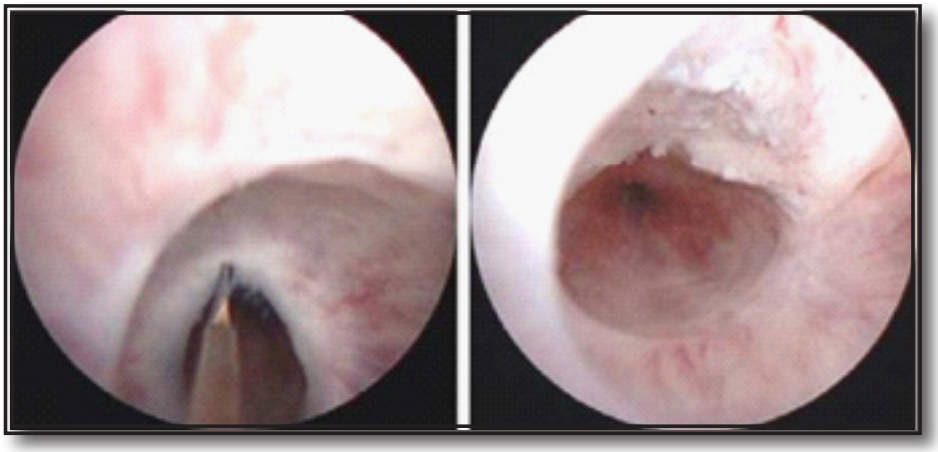

Figure 7 (urethral stricture before and after DVIU**)**

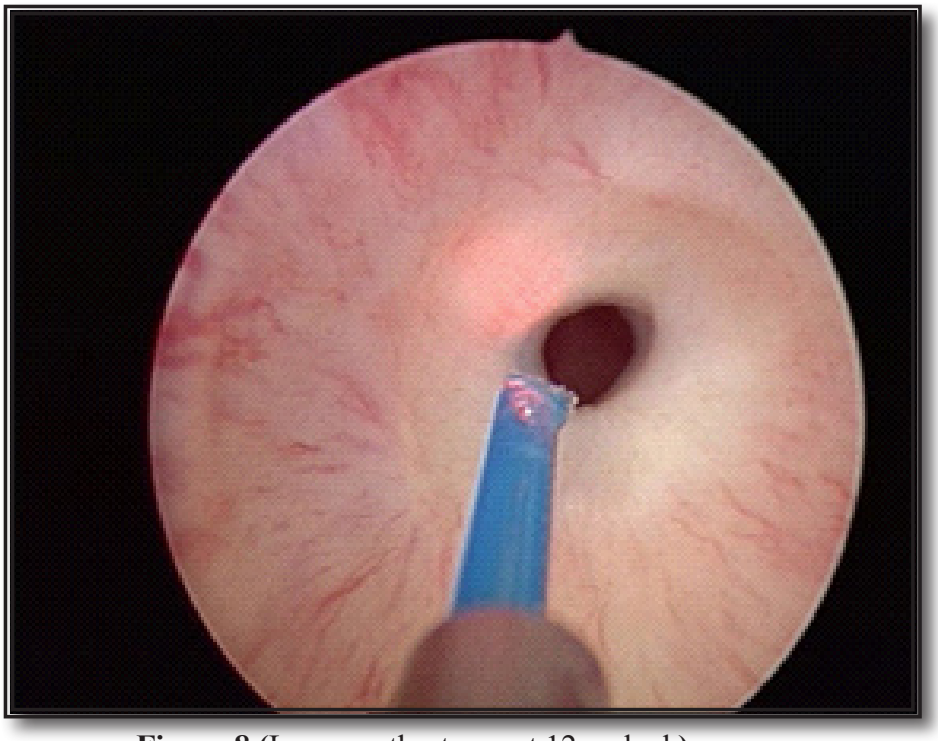

Figure 8 (Laser urethrotomy at 12 o clock**)**

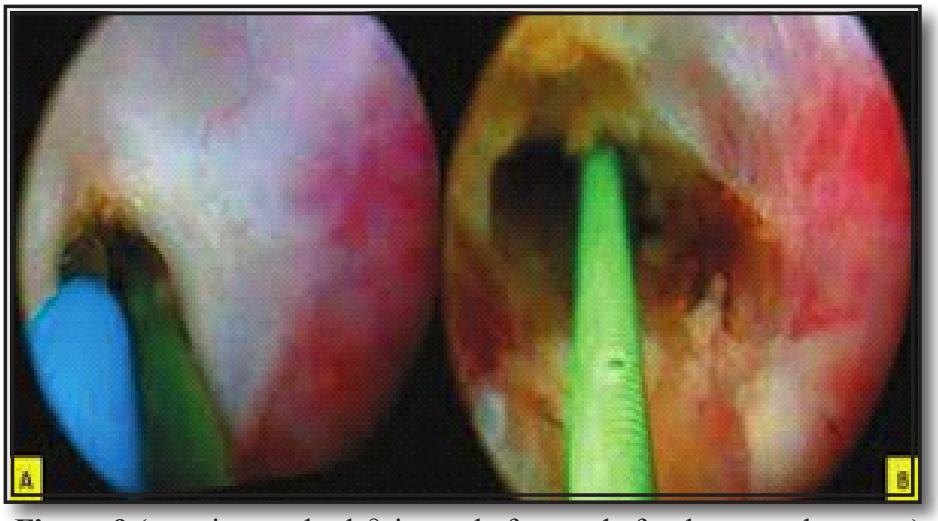

Figure 9 (anterior urethral stricture before and after laser urethrotomy**)**

Discussion

Urethral stricture in male either congenital or acquired, the acquired causes are subdivided to iatrogenic, traumatic, infection and idiopathic with the iatrogenic is the most common etiology seen in the clinical practice [3].

The most detected histopathology is squamous metaplasia (changes from columnar to squamous endothelium) at the stricture site which leads to loss of mucosal barrier and extravasation of urine through mucosa leads to more fibrosis and more stricture formation [4].

Before intervention many factors should be considered such as the site, the length of the stricture and the depth of scar.

The short segment stricture (less than 2 cm) with no deep spongiofibrosis is usually managed endoscopically while the long segment managed by various procedures of open urethroplasties.

So, we will discuss the various types of endoscopic management of short segment stricture.

The gold standard short stricture management is cold knife urethrotomy using the saches knife which is made by 12 o clock incision of stricture site using direct vision then a 12 fr catheter is passed and kept for 3-4 days post operatively [3] (Figure 8).

Other emerged data shows incision in 6 o clock (in addition to 12) or the injection of triamcinolone in the stricture site may improve the outcome or reduce the stricture recurrence but kamps et al showed that these measures not superior to the 12 incision alone [5].The recurrence rate is around (35-60 %) with DVIU and most recurrence within the first year of treatment, so the need for other modality of urethrotomy was required and a various types of laser urethrotomy emerged as an additional option for management. Parsons et al was the first trail which assess the role of the laser in the urethral stricture which was done in the canine urethra [6].

Matsouka et al stated that laser acts by tissue vaporization and may damage the adjacent tissue [7].

Over the past 3 decades, the use of laser in urology advanced and many types of laser were used such as holmium (Ho:yag), KTP, thalium, nydmium (Nd:yag) and Diode laser. Laser urethrotomy is affected by the tissue absorption, wavelength and thermal energy of the laser. The Nd:YAG has the deepest tissue penetration diode lasers (4-5 mm), KTP and argon lasers around (1-3 mm). Ho:YAG laser has less than (0.5 mm). Ho: YAG, as it has low tissue penetration lead to less scarring [8].

During incision with a laser for urethral stricture, scarred tissue will be evaporated, so extirpation of the fibrous tissue by direct contact of the laser fiber could be achieved even when low power energy used.

Laser urethrotomy done at 12 or 6 o clock to reduce the risk of bleeding and to incise the scar tissue and the 18 fr catheter is passed and kept for 3-4 days post operatively (Figure 9) .

The operation time in our trail was more in the laser (17,8 min) compared to the DVIU group (12.4 min) on the other hand another studies(atak et al and jain et al) shows comparable results that the operation time is longer in the laser (jain et al laser op. mean time was 19.8 min while in DVIU was 9.3 min) [9, 10].

But only one trail M.Atak et al(done on 50 patients) which was published in 2011 showed that the operation in the laser group has a mean time (16.4 min) while in DVIU (23.2 min) [11].

So, the result of the operation time may depend on the surgeon experience and the long operation may be due to the less experience with laser urethrotomy.

When we had evaluated the results of PFR, the study revealed that the mean Q max in the DVIU group was (ml/min) with the mean change (11.5 ml/min) post op. from baseline while in laser group the mean Q max was (ml/min) with mean of (9.2 ml/min) improvement so it was significantly better in the DVIU group.

On comparing these results with other trails such as M.Atak et al on 2011 in the DVIU group was 15.4 ml/min while in the laser group 13.2 which is significantly better in the DVIU group an d the study showed a comparable results [9]. Slawomir et al 2011(A retrospective trail on 60 patients) showed that the mean improvement in the PFR were 10.2 mi/min and 11.4 ml/min in DVIU and laser after 7 days post op. respectably and this shows that laser was superior to DVIU in improvement of PFR [12].

Kegham et al 2017(prospective study shows that there is no significant difference in the change of PFR between laser and cold knife groups post operatively and had a comparable result in the two arms [13].

Regarding the incidence of hematuria post operatively, the laser group has higher incidence of hematuria (86.7%) compared to (40%) in the DVIU arm.

When comparing to other trails such as kamps et al which was made on 190 patients the laser group has a significant lower incidence of bleeding post op. (12%) compared to the DVIU group (26%) [5].

Morteza et al stated that laser has less bleeding post op and less catheterization time in comparison to cold knife group [14]. M. Atak et al showed that there is no significant difference in the incidence of hematuria between laser and cold knife group [9].

Regarding the lower tract infection in the the post-operative period in our study which was confirmed by the presence of positive urine culture for uropathgen,the incidence was significantly lower in laser group (20%) than the cold knife group(60%).

Kumar et al 2012 stated that UTI was found in (41.7%) of laser arm patients and (13.2%) of them continue to have positive urine culture despite the use of antimicrobial agents and some of patients had stopped the long term follow up and withdrawn from the trail compared to (27%) incidence of infection in the DVIU group which is significantly lower [11]. Kamal et al used the Diode laser of 400-600 nm by direct contact, reported that the incidence of UTI is slightly more in the laser group as compared to the DVIU [5]. The most widely accepted explanation to the occurrence of UTI with laser is that it may be due to coagulation and necrosis to the tissue caused by laser energy that increase the UTI occurrence.

Becca Gibon and Leparts et al results stated that UTI will affect the long term results and increase the recurrence of urethral stricture so they recommend the use of suprapubic cystostomy for several days pre op. with the use of appropriate antimicrobial agent to decrease the incidence of UTI post op. [15].

Recently, the proper use of antimicrobial agent has a special importance because of high resistance to antimicrobial agents.

Wagenlehnar et al reported that ciprofloxacin resistance may reach (20%) among E.coli, pseudomonas and klebsiela microorganisms, while the resistance is lower to cephalosporins (12%) so they recommend the use of injectable cephalosporins 30 mins before the onset of urethrotomy and continue on cefuroxime post op. to decrease the incidence of UTI [16].

Conclusion

Urethral stricture disease has a significant negative impact on the Quality of life and the health care system.

Both DVIU and laser urethrotomy improves the PFR significantly 2 weeks after surgery but the improvement was more noticed in DVIU mainly because of the use of burning energy leads to more scarring and spongiofibrosis that affect the results.

The mean operative time was longer with the laser group probably due to less experience with laser urethrotomy so needs more time during procedure.

Regarding complications, hematuria was seen more in laser arm while infection was more noticed in DVIU group.

Recommendation

Despite the great development of laser in urology, the cold knife urethrotomy still the gold standard for treatment of short segment urethral stricture disease with good outcomes and less complications and further studies are required to evaluate the outcome of laser urethrotomy.

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