

Comparison of Holmium Laser Treatment of Urethral Strictures in Male Patients with Cold Knife Endoscopic Incision

Thesis

Submitted for Partial Fulfillment of MD Degree in
Urology

By

Waseem Mohamed Nabil Aboul Ela
(M.Sc., faculty of medicine, Cairo University)

Under Supervision of

Dr. Hesham Abdl Hamid Badawy
Professor of urology
Faculty of medicine, Cairo University

Dr. Mostafa Abdl Mohsen Mohamed
Professor of urology
Faculty of medicine, Cairo University

Dr. Hany Abdl Raouf Morsi
Professor of urology
Faculty of medicine, Cairo University

Faculty of medicine
Cairo University

2014

ACKNOWLEDGMENT

*First and foremost, all the thanks to **ALLAH** the most beneficial and merciful.*

*I would like to express my deepest gratitude to **Prof. Dr. Hesham Abd El Hamid Badawy**, Professor of urology, Cairo University, I had the honor to proceed with this work under his instructive supervision, and guidance to enrich my study with his experience and knowledge throughout the steps of this work,*

*I would like to express my profound thanks to **Prof. Dr. Mostafa Abd Mohsen Mohamed** , Professor of urology, Cairo University, for his supervision of this work, step by step in all its stages, for his constant encouragement and support.*

*I am very grateful to **Prof. Dr. Hany Abd Raof Morsi** , Professor of urology, Cairo University, for his help and his valuable supervision throughout the practical part of this work,*

I would like to thank my family; who helped me a lot to perform this work, I owe to them every success I have ever achieved.

No words can express my feelings of gratitude to my wife for her endless help and support. My special dedication to my son Yassin and my daughter Zeina.

ABSTRACT

Objective: To assess the effectiveness of visual laser ablation treatment with holmium:yttrium-aluminum-garnet (Ho:YAG) laser in pediatrics with urethral strictures and to compare the results with those obtained in patients treated with visual internal urethrotomy(VIU) urethrotomy.

Materials and Methods: From January 2010 to January 2013, 32 male patients aged 2 to 70 years (mean age 10.2) with primary urethral strictures 0.5 to 1.5 cm long qualified for the study. 19 cases with the stricture length less than 1 cm and in 13 cases the length was more than 1.0 cm .17 cases with the stricture in anterior urethra and 15 cases with the stricture in posterior urethra The patients were treated using visual laser ablation of urethral strictures (VLASU) with holmium:YAG laser. All the patients were investigated preoperatively by uroflowmetry and ascending cystourethrogram with micturating urethrogrm and were followed up postoperatively with uroflowmetry and ascending cystourethrogram at 3 months and 6 months. Urethrotomy was made at the 12 o'clock position by retrograde vaporization of the scarred tissue through the total length of the stricture with the aid of a metal guidewire.

Results: At 6-month follow-up, 21 cases (65.6%) did not require repetition of the procedure. The mean operation time was 30.8 minutes (range 20–45 minutes). The mean peak urinary flow rate (Qmax) was 6.41 ± 1.78 l/s. the mean Qmax postoperative at 3 months was 17.26 ± 5.9 and at 6 months postoperative was 15.7 ± 7.21

Conclusion: VLASU can be used as a method of treatment of this disorder. It is an effective, modern, low-invasive, and repeatable technique and is technically simple and easy to master with results comparable to those of conventional urethrotomy.

Keywords: stricture urethra, holmium: YAG laser, visual internal urethrotomy

CONTENTS

	<i>Pages</i>
INTRODUCTION	1
REVIEW OF LITERATURE:	
▪ CHAPTER I: Anatomy of penis and male urethra	5
▪ CHAPTER II: Lasers in Urology	17
▪ CHAPTER III: Urethral stricture	29
PATIENTS AND METHODS	63
RESULTS	71
DISCUSSION	88
SUMMARY	106
CONCLUSION & RECOMMENDATIONS	109
REFERENCES	110
ARABIC SUMMARY.....	

LIST OF TABLES

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
1.	Types of laser, their characteristics and applications	25
2.	Baseline Data of the studied cases	64
3.	Baseline data of iatrogenic cases	64
4.	Comparison between preoperative, 3 and 6 months postoperative flowmeter	72
5.	Comparison between results according to length of stricture at 3 and 6 months	74
6.	Comparison between preoperative, 3 and 6 months uroflowmeter according to length of stricture	76
7.	Comparison between results according to site of stricture at 3 and 6 months	77
8.	Comparison between preoperative, 3 and 6 months uroflowmeter according to site of stricture	79
9.	Comparison between preoperative, 3 and 6 months uroflowmeter according to medical history	81
10.	Percent changes between preoperative flowmeter, postoperative 3 month flowmeter and between preoperative, postoperative 6 month flowmeter and between postoperative 3 months and 6 months flowmeter according to length of stricture	83
11.	Percent changes between preoperative flowmeter, postoperative 3 month flowmeter and between preoperative , postoperative 6 month flowmeter and between postoperative 3 months and 6 months flowmeter according to site of stricture	85
12.	Percent changes between preoperative flowmeter, postoperative 3 month flowmeter and between preoperative, postoperative 6 month flowmeter and between postoperative 3 months and 6 months flowmeter according to medical history	86
13.	Follow up after 3 and 6 months	87
14.	Comparison of results of visual laser urethrotomy according to different authors	94

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
15.	Comparison between own study and Jablonowski et al study	96
16.	Comparison between kamp et al study and own study	99
17.	Comparison between maximum flow rate preoperative, 3 months and 6 months postoperatively	100
18.	Comparison between Slawomir et al study and Own study	101
19.	Comparison between Mustafa et al study and Own study	102
20.	Comparison between success rates in different studies after VIU	104

LIST OF FIGURES

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
1.	Typical hyperbolic, bell-shaped urinary flow rate curve of a normal, unobstructed urethra	2
2.	Typical flat, box-shaped flow rate tracing in the presence of a urethral stricture	2
3.	Cross section of the penis near the mid-shaft demonstrating the corpora and their overlying fascias.	6
4.	Diagram of the arterial blood supply to the penis	8
5.	Diagram of the superficial arteries and veins of the penile skin which runs within the dartos fascia.	10
6.	Male bladder and urethra: longitudinal section of the male penis, prostate, and bladder.	13
7.	Sagittal section of the penis and perineum enumerating the divisions of the urethra: 1) glanular 2) pendulous (penile) 3) bulbous 4) membranous and 5) prostatic.(from Gil Vernet S: Morphology and function of vesicocprostatourethral musculature	16
8.	Complete laser system, showing elements responsible for energy input, amplification, and output	19
9.	Retrograde urethrography (RUG)	35
10.	Combination of RUG and VCUG	37
11.	Urethral ultrasound	38
12.	MRI of pelvic floor (adapted from Campbell's Urology)	40
13.	Metal (Lister's) dilators	50
14.	Filiform dilators — leaders and followers	51
15.	Otis urethrotome	52
16.	Sachse urethrotome	53

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
17.a	Mobilization of the bulbar urethra and spatulation for tension-free anastomosis	62
17.b	Approximation of the bulbar to the distal prostatic urethra with interrupted absorbable suture	62
18.	Comparison between preoperative, 3 and 6 months postoperative flowmeter	67
19.	Comparison between results according to length of stricture at 3 and 6 months	67
20.	Comparison between preoperative, 3 and 6 months uroflowmeter according to length of stricture	69
21.	Comparison between preoperative, 3 and 6 months postoperative flowmeter	72
22.	Comparison between results according to length of stricture at 3 and 6 months	74
23.	Comparison between preoperative, 3 and 6 months uroflowmeter according to length of stricture	76
24.	Comparison between results according to site of stricture at 3 and 6 months	78
25.	Comparison between preoperative, 3 and 6 months uroflowmeter according to site of stricture	79
26.	Comparison between results according to medical history at 3 and 6 months	80
27.	Comparison between preoperative, 3 and 6 months uroflowmeter according to medical history	81
28.	Percent changes according to length of stricture	83
29.	Percent changes according to site of stricture	85
30.	Percent changes according to medical history	86
31.	Follow up after 3 and 6 months	87

List of Abbreviations

BPH	: Benign prostatic hyperplasia
CISC	: Clean intermittent self-catheterization
Co2	: Carbon dioxide
CTU	: Core- through urethrotomy
DVIU	: Direct vision internal urethrotomy
EM	: Electromagnetic
EMCU	: Excretion micturation cystourethrography
ESWL	: Extracorporeal shock wave lithotripsy
F	: French
Ho: YAG	: Holmium:yttrium-aluminum-garnet
IU	: Internal urethrotomy
KTP: YAG	: Potassium titanyl phosphate: yttrium-aluminum-garnet
MMC	: Mitomycin-c
MRI	: Magnetic resonance imaging
Nd: YAG	: Neodymium:yttrium-aluminum-garnet
OIU	: Optical internal urethrotomy
PUV	: Posterior urethral valve
Qmax	: Peak urine flow rate
RUG	: Retrograde urethrography
SD	: Standard deviation
SIS	: Small intestinal submucosa
TUR	: Transurethral resection
TURP	: transurethral resection of prostate
VCUG	: Voiding cystourethrography
VLASU	: Visual laser ablation of stricture urethra

INTRODUCTION

Urethral stricture refers to scarring process involving the spongy erectile tissue of the corpus spongiosum (spongiofibrosis). The spongy erectile tissue of the corpus spongiosum underlies the urethral epithelium, and in some cases, the scarring process extends through the tissues of the corpus spongiosum and into adjacent tissues. Contraction of this scar reduces the urethral lumen (anterior urethral disease).

In contrast, posterior urethral “strictures” are not included in the common definition of urethral stricture. Posterior urethral stricture is an obliterative process in the posterior urethra that has resulted in fibrosis and is generally the effect of distraction in that area⁽¹⁾.

Stricture definitions in different studies are according to flow:

1. Patient symptomatic and peak urine flow rate ($Q_{\max}$) <6 mL/s (2).
2. $Q_{\max} <15$ mL/s⁽³⁾.
3. $Q_{\max} <10$ mL/s (with a micturition volume greater than 100 mL) and a characteristic flow curve⁽⁴⁾.
4. Obstructive symptoms, $Q_{\max} <10$ mL/s (with a voided volume >150 mL).

And according to distensibility:

1. Urethra not permitting the passage of a 21-French (F) cystoscope⁽³⁾.
2. Inability to pass an 18F catheter into the bladder⁽⁵⁻⁷⁾.
3. Obstructive urine flow pattern, and/ or impossible dilation⁽⁸⁾.

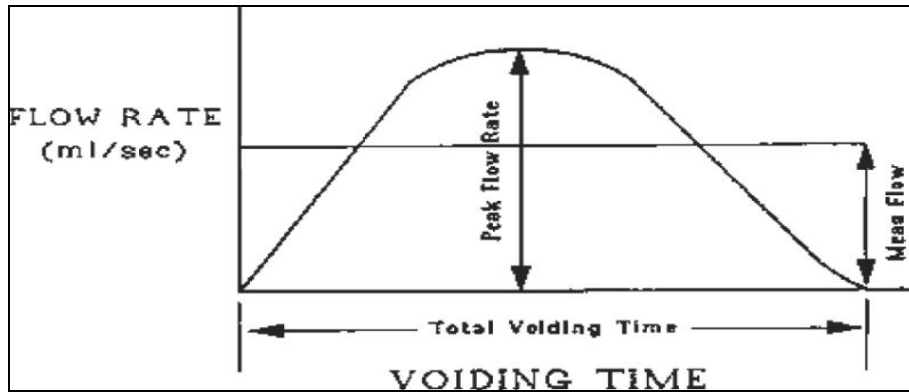


Figure 1: Typical hyperbolic, bell-shaped urinary flow rate curve of a normal, unobstructed urethra

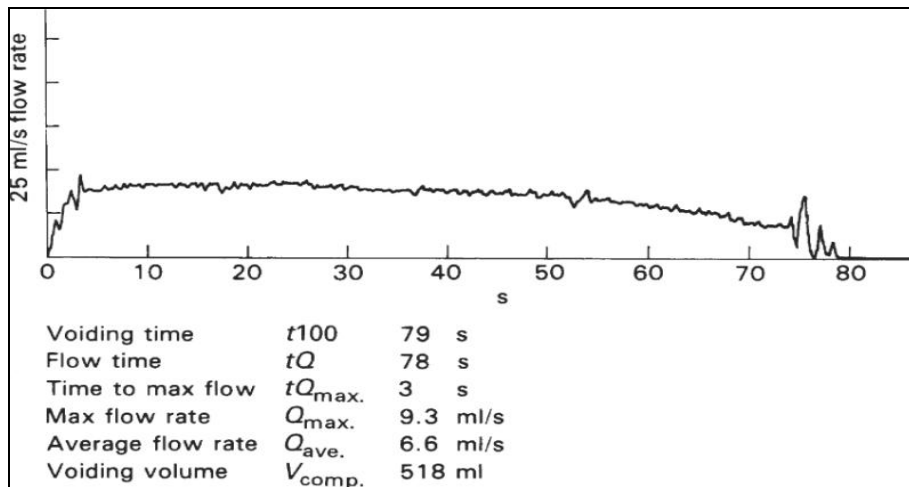


Figure 2: Typical flat, box-shaped flow rate tracing in the presence of a urethral stricture (from Blandy JP, Fowler C. Urethra and Penis Inflammation. In Urology. Blackwell Science, Oxford (1996).

Definitions of successful stricture treatment are the following:

1. $Q_{\max} \geq 15$ mL/s with a normal urethrogram⁽⁹⁾.
2. $Q_{\max} \geq 15$ mL/s, voiding urethrogram normal and urine sterile⁽¹⁰⁾.
3. Patient satisfied and $Q_{\max} > 10$ mL/s⁽³⁾.
4. No clinical symptoms and $Q_{\max} \geq 15$ mL/s⁽¹¹⁾.
5. Satisfactory voiding, normal retrograde urethrogram and VCUG, and $Q_{\max} \geq 15$ mL/s⁽¹²⁾.

Any process that injures the urethral epithelium or the underlying corpus spongiosum to the point that healing results in a scar can cause an anterior urethral stricture. Most urethral strictures are the result of trauma (usually saddle trauma or pelvic fracture). This trauma to the urethra often goes unrecognized until the patient presents with voiding symptoms resulting from the obstruction of the stricture or scar⁽¹³⁾.

Inflammatory strictures associated with gonorrhea were the most commonly seen in the past and are less common now. There is a definite association between the development of an inflammatory stricture and lichen sclerosus–balanitis xerotica obliterans. No clear association between nonspecific urethritis and the development of anterior urethral stricture has been established⁽¹³⁾.

For an appropriate treatment plan to be devised, it is important to determine the location, length, depth, and density of the stricture (spongiofibrosis). The length and location of the stricture can be determined with radiography, urethroscopy, and ultrasonography. The

depth and density of the scar in the spongy tissue can be deduced from the physical examination, the appearance of the urethra in contrast-enhanced studies, and the amount of elasticity noted on urethroscopy and transurethral ultrasound⁽¹⁴⁾.

Treatment of stricture urethra is either by internal urethrotomy or urethral stents or laser urethrotomy and finally open urethroplasty. Types of lasers that have been used for the treatment of urethral stricture disease include carbon dioxide (co2), argon, potassium titanyl phosphate:YAG (KTP:YAG), neodymium:yttrium-aluminum-garnet (Nd:YAG), holmium:yttrium-aluminum-garnet (Ho:YAG), and excimer lasers.

CHAPTER I

Anatomy of Penis and Male Urethra

The penis:

The penis consists of the urethra and three erectile bodies: two corpora cavernosa and the single corpus spongiosum, each within their enveloping fascial layers and the skin (*Figure 3*). All of these structures continue into the perineum. The dorsally located corpora cavernosa make up the bulk of the penis. They contain erectile tissue within a compliant sheath of connective tissue, the tunica albuginea, which is composed of an inner circular and outer longitudinal layer of elastic fibers. Though often depicted as two separate tubular structures, the corpora cavernosa in the shaft of the penis comprise a single blood space with free communication through a midline septum composed of multiple strands of elastic tissue similar to that making up the tunica albuginea. At their attachment in the midline dorsally and ventrally, the fibers of the septal strands fan out and are interwoven with the fibers of the inner circular layer of the tunica albuginea. The septum becomes more complete at the tip of the penis and toward the penile hilum where the corpora cavernosa become independent as they split to form the crura, each of which is attached to the corresponding inferior ramus of the pubis and ischium within its encompassing fascia⁽¹⁵⁾.

The erectile tissue consisting of arteries, venous sinusoids lined with flat endothelial cells, veins, nerves, muscle fibers, and trabeculae arising from the tunica albuginea fill the space of the corpora cavernosa making their cut surface look like the cut surface of a sponge. This tissue