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

Thesis

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By

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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

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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, Qmax <10 mL/s (with a voided volume >150 mL).

And according to distensibility:

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

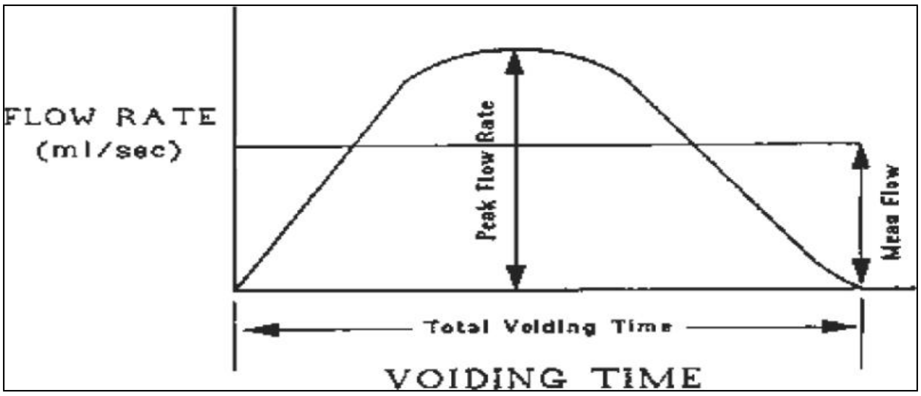

Figure 1: Typical hyperbolic, bell-shaped urinary flow rate curve of a normal, unobstructed urethra

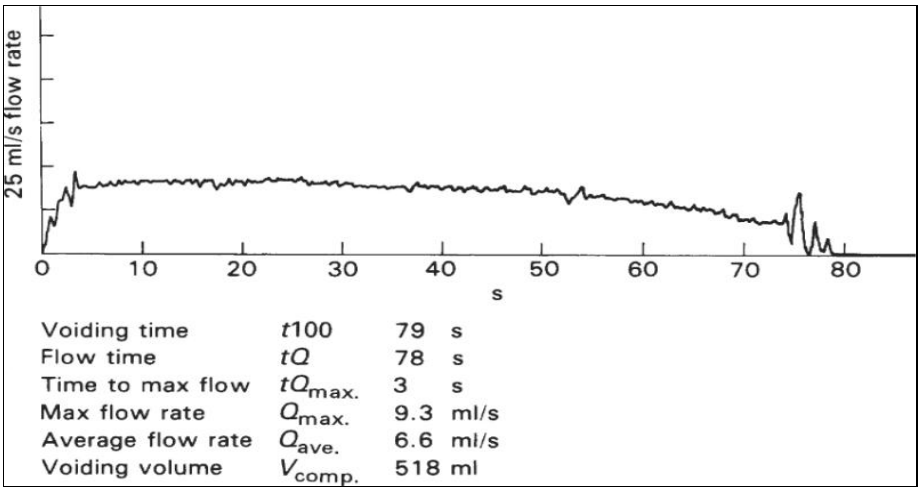

Figure 2: Typical flat, box-shaped flow rate tracing in the presence of a urethral stricture (from Blandy JP, Fowler C. Urethra and Penis Inflammation. In Urology. Blackwell Science, Oxford (1996).

Definitions of successful stricture treatment are the following:

1. Q_{max} ≥15 mL/s with a normal urethrogram[9].
2. Q_{max} ≥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} ≥15 mL/s[11].
5. Satisfactory voiding, normal retrograde urethrogram and VCUG, and Q_{max} ≥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 ultrsound[14].

Treatment of stricture urethra is either by internal urethrotomy or uretheral 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