Laser Treatment of Benign Prostatic Hyperplasia

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With the increasing longevity of the population, the incidence of symptomatic bladder outlet obstruction due to benign prostatic hyperplasia (BPH) is expected to increase. Transurethral resection of the prostate (TURP) is currently considered the standard surgical treatment for this disease. However, TURP is an invasive procedure associated with some morbidity and, rarely, mortality. During the past several years, several alternative treatments for BPH have emerged. Visual laser ablation of the prostate (VLAP) is one of the more attractive choices among these alternatives.

The use of laser energy to treat BPH has several advantages over TURP. Laser energy causes coagulation of the blood vessels, thus minimizing blood loss and fluid absorption. VLAP is an outpatient procedure performed under direct vision utilizing a standard or continuous-flow cystoscope. The technique of VLAP is relatively easily learned and has a much shorter learning curve than that of TURP.

To date, clinical trials have confirmed the efficacy and safety of VLAP and the minimal associated morbidity. In the short-term follow-up, improvement in both subjective (symptom score) and objective (urinary flow rate) factors is similar to that after TURP. Although the results obtained with this laser technology are exciting and encouraging, further study and long-term follow-up are needed to confirm the durability of these results.

Benign prostatic hyperplasia (BPH) is a nonmalignant neoplasm that results in enlargement of the prostate gland. Although growth is increased in both stromal and epithelial tissue, in humans this enlargement is primarily of stromal origin.[1] Although BPH is rare at ages younger than 40 years, histologically identifiable BPH has been found in 10% of males younger than 30 years, and the rate increases to more than 50% by age 60 years and to 90% by age 85 years.[2] In an excellent review of seven autopsy series from six different countries, Isaacs and Coffey[3] found that the age-specific prevalence of microscopic BPH was similar in all countries. It is estimated that up to one-third of all men in the United States who have BPH will have significant clinical symptoms of bladder outlet obstruction necessitating treatment by the time they reach 80 years of age.[4]

Conceivably, transurethral surgical treatment of symptomatic BPH dates back to the 17th century, when early lithotomists incidentally may have removed some fragments of hyperplastic prostate tissue. The modern transurethral approach for the treatment of obstructive BPH was developed by Hugh Hampton Young in 1909, when he introduced a "punch-type" endoscopic instrument for the removal of an obstructing prostatic median lobe. Later, this instrument underwent further modifications by Young and then by Braasch at the Mayo Clinic and Caulk. In 1926, the wire-loop electrocautery resectoscope was developed by Stern. And still later, in 1931, McCarthy[5] introduced the first modern-type resectoscope combining forward vision and an antegrade cutting motion utilizing the loop electrocautery. Both the "punch-type" resectoscope of Braasch and the electroresectoscope of Stern-McCarthy have survived to the present day; they have undergone some refinements but no basic changes. Today, transurethral resection of the prostate (TURP) has become the surgical treatment of choice for most cases of symptomatic bladder outlet obstruction caused by BPH and is often regarded as the standard by which the outcomes of all other treatment options are measured.

Its acceptance as the standard, however, does not imply that TURP is not without complications. Although unquestionably it is an effective treatment in most men with bladder outlet obstruction, a recent study indicated that approximately 20% of patients do not achieve satisfactory resolution of their voiding symptoms.[6] TURP is relatively free of life-threatening complications—the mortality rate is 0.2%; however, it is not without some morbidity. A large cooperative study done at 13 institutions reviewed 3,885 consecutive cases of TURP and found an immediate postoperative morbidity rate of 18%.[7] This morbidity included blood transfusions in 6.4% of patients, urinary tract infections in 2.3%, excessive absorption of irrigating fluids, causing what is commonly known as the TURP syndrome, with attendant confusion, nausea, hypertension, seizures, or coma in 2%, and myocardial dysrhythmia or infarction in approximately 2%. That study also found that the late sequelae of TURP included bladder neck contracture or urethral stricture in more than 5% of patients and also mild or severe stress incontinence in 1.2% and 0.5%, respectively. Although the occurrence of impotence after TURP has been difficult to ascertain, a rate of 3.5% to 10% has been reported.[8] Currently, after a standard TURP, approximately 90% of patients experience retrograde ejaculation.[7] Finally, several authors have reported the need for a second TURP in 5% to 20% of patients within 5 to 10 years after the initial TURP.[9,10,11]

For a man who reaches 50 years of age, the probability of having a prostatectomy for relief of clinical BPH in his lifetime is approximately 25%.[12] Therefore, it is estimated that nearly 400,000 transurethral prostatectomies are performed each year in the United States. Thus, TURP is the major surgical procedure performed by urologists today, second only to cataract surgery as the most common operation performed in the United States.[13] As a result, it was estimated that Medicare expenditures for TURP alone in 1991 were in excess of $1 billion.[14] Currently, the overall annual cost to all parties concerned is an estimated $5 billion. During the next two decades, the aging population and increasing longevity in the United States undoubtedly will multiply the number of patients afflicted with symptomatic BPH, and this expenditure will increase further.

Throughout the past decade, interest in finding alternatives to treatment of BPH has been increasing. This interest has been spurred on by multiple factors and influences: the urologic community, in its constant effort to provide effective treatment with less morbidity; the federal government, in its effort to control the rising costs of health care; and, most importantly, the patients themselves, who are seeking an effective, long-lasting remedy with minimal morbidity and an opportunity to return to work and daily activities as soon as possible.

As a result of this interest, several alternative therapies have been evaluated, including watchful waiting, medical management (with androgen suppression, 5α-reductase inhibitors, or α blockers), insertion of prostatic stents or coils, focused ultrasound, cryotherapy, balloon dilation, prostatic hyperthermia, and transurethral incision of the prostate. Many of these methods are new or experimental, and thus their long-term efficacy is yet to be established. A newer alternative to traditional TURP which has demonstrated equivalent short-term efficacy in the treatment of bladder outlet obstruction caused by BPH is the use of laser energy to ablate the obstructive tissue.

Lasers

Laser is an acronym for *l*ight *a*mplification by *s*timulated *e*mission of *r*adiation.It is a powerful beam of monochromatic, coherent photons traveling in the same direction. Laser energy interacts with tissue in one of four possible ways. It is absorbed, reflected, refracted, or transmitted. When absorbed, it is converted to heat energy that results in destruction of the tissue. Vaporization typically occurs at the surface, and coagulation necrosis occurs in the deeper tissue areas. Vaporization results in immediate loss of tissue, and coagulation results in cell death and subsequent sloughing of the necrotic tissue, which can take weeks to months to resolve. The actual amount of tissue destroyed is dependent on the wavelength of the laser, the amount of energy delivered, and the characteristics of the tissue being treated.[15]

The amount of energy delivered to tissue by a laser is determined by the power setting (watts) and the duration of the beam (seconds). The product of these factors is the energy delivered and is expressed as joules (watts x seconds). Clearly, the same amount of energy (joules) can be delivered in several different ways and result in very different effects on the same tissue. For example, 60 joules can be delivered as 10 watts for 6 seconds or 60 watts for 1 second. As a general rule, low power and long duration result in deep, penetrating coagulation necrosis, and high power and short duration result in more vaporization and more shallow necrosis.

Until recently, the use of lasers in urology had been limited to cutaneous lesions such as penile condyloma and carcinoma, bladder tumors, or renal calculi.[15] Now, with the advent of lateral-firing delivery devices, lasers are being evaluated as a treatment option for BPH. Two types of lasers for the treatment of BPH have been used: the neodymium:yttrium-aluminum-garnet (Nd:YAG) and the potassium-titanyl phosphate (KTP). Both can be delivered through small quartz fibers and so are suitable for endoscopic use. The Nd:YAG laser has certain advantages for the transurethral treatment of BPH. The Nd:YAG beam has the deepest depth of tissue penetration and is selectively absorbed by tissue proteins to cause deep thermal necrosis and resulting tissue ablation. With the destruction of prostatic tissue by coagulation necrosis, prostatic blood vessels and also prostatic venous sinuses are not opened, and thereby both significant bleeding and the absorption of irrigation fluids are eliminated. The wavelength of the Nd:YAG laser (1,064 nm) allows it to pass through water, urine, and hemoglobin with minimal diminution in energy; thus it adapts well to use in endoscopy. Likewise, the KTP laser has certain properties that make it useful for treatment of the prostate. Because its wavelength (532 nm) is absorbed by hemoglobin and it has a shallower depth of penetration, it is useful for "sculpting" the prostatic fossa. In addition, it allows for transurethral incision of the prostate or the bladder neck by its vaporization/cutting properties with a minimal amount of bleeding and little likelihood of subsequent scar formation.

Until recently, the use of lasers in the treatment of BPH was limited. For prostatic lateral lobe tissue to be treated effectively, laser energy needs to be delivered at a right angle to the axis of the urethra. The first laser fiber that could be fired at a right angle was developed by Dr. Ross Everette, an Oklahoma gynecologist.[16] Dr. Douglas Johnson and colleagues then used this fiber to investigate the feasibility of lasing the prostate. Their initial studies were done on the potato, which has optical properties similar to those of the prostate gland. They found that if the potato was treated with Nd:YAG laser energy in four quadrants, a spherical area of coagulation necrosis measuring 2.7 cm in diameter resulted. They concluded that 60 watts in each of the four quadrants produced the greatest coagulation and necrotic effect for the least amount of energy. They then began animal investigations on a canine model and found that when the canine prostate was exposed to Nd:YAG laser energy at 60 watts of power for 60 seconds at the 2-, 5-, 8-, and 11-o'clock positions, the prostate underwent thermal damage with a significant coagulation effect. Examination of the prostate at intervals ranging from 1 hour to 7 weeks after lasing revealed a remarkably consistent sphere of thermal damage measuring approximately 2.7 cm in diameter. The coagulation area subsequently became necrotic and was sloughed off with urine flow over a period of several weeks. The ectatic cavity left in the prostatic urethra reepithelialized with urothelium at 20 weeks postoperatively. It was postulated that this thermal ring sealed the vasculature and thus prevented hemorrhage or absorption of irrigation fluids.[17] In 1990, the first clinical trial evaluating laser treatment of symptomatic BPH with a side-firing laser probe was begun. This preliminary study of 17 patients reported that it was relatively simple, fast, and not associated with any significant blood loss.[17,18]

Currently, two principal transurethral noncontact laser delivery systems are being evaluated for the treatment of symptomatic BPH. These are transurethral ultrasound-guided laser-induced prostatectomy (TULIP) and visual laser ablation of the prostate (VLAP).

TRANSURETHRAL ULTRASOUND-GUIDED LASER-INDUCED PROSTATECTOMY

The TULIP procedure uses transurethral ultrasound to monitor the delivery of Nd:YAG laser energy to the prostate. The ultrasound transducer and the Nd:YAG laser are located together in a 22-French probe. The construction of the probe allows the surgeon to visualize the prostate in real-time ultrasound at a 90° angle to the probe and a depth of 5 cm. The Nd:YAG laser is utilized at a 90° angle to the probe also. A 36-French or 48-French balloon surrounds the probe. This water-filled balloon allows the transmission of ultrasound waves and laser energy with minimal distortion. After the balloon is positioned in the prostatic urethra, it is inflated to compress the prostatic parenchyma and parenchymal blood vessels. This inflation also allows for a uniform-sized prostatic lumen and a predictable depth of laser penetration.[19] Under continuous real-time ultrasound imaging of the prostate, the laser is activated and slowly drawn through the prostatic urethra. A typical prostatectomy requires 8 to 10 passes of the probe at various locations within the prostatic urethra to ensure adequate treatment.

Initial canine studies demonstrated significant tissue ablation with a twofold to fourfold increase in the size of the prostatic lumen at 3 months of follow-up. Bleeding was minimal, and none of the animals required postoperative catheterization.[20] The efficacy and safety of TULIP for the treatment of symptomatic BPH in men are currently being studied. Preliminary results from a large, nonrandomized, multicenter, prospective study in the United States were recently presented.[21] These short-term results indicate that relief of symptoms after TULIP is analogous to that with TURP. However, mean peak or maximal urinary flow rate after TULIP has been suggested to be less than that after TURP.[22]

VISUAL LASER ABLATION OF THE PROSTATE

VLAP is the other principal method of delivering laser energy to the prostate to perform a prostatectomy. The operative technique involved in this procedure has been developed and refined during more than 3 years of clinical experience.

Patients with prostate malignancy, except for those who need only conservative management of bladder outlet obstruction, are not appropriate candidates for VLAP. Unlike TURP, no tissue is removed during VLAP for pathologic examination. As such, given the high prevalence of prostatic adenocarcinoma in the age group of patients who have obstructive prostates, it is imperative to evaluate thoroughly each patient preoperatively and identify those patients who have overt or occult prostatic malignancy. At our institution, this determination is made with a serum prostate-specific antigen determination, a digital rectal examination, and prostatic ultrasonography. If the results of any of these tests are abnormal, transrectal ultrasound-guided biopsy of the prostate is done. In addition, each patient who has symptoms of prostatism is evaluated according to the American Urologic Association (AUA) symptom index, has the urinary flow rate determined, and undergoes a cystoscopic examination to evaluate the bladder and to ascertain the degree of bladder outlet obstruction and the size and configuration of the prostate.

The equipment required to perform VLAP is readily available in most hospitals. A standard laser source that provides high-power Nd:YAG laser energy is required. In addition, a clock to time the duration of laser application and several gauze sponges to clean the end of the laser probe between laser applications are needed. If tissue is allowed to build up on the end of the probe during the prostatectomy, superheating and melting of the laser probe can occur.

A standard 21- or 23-French cystoscope utilizing both a 12° and a 30° lens for performing the VLAP may be used. A Straight Probe Director, which was developed by us and which is a long, narrow tube 6 French in diameter, to guide the laser probe may be used to facilitate the procedure.[23] The lateral-firing laser probe fits snugly through the guide (different sizes of guides can be used for different probes); therefore, the firing port of the laser probe can be precisely located within the narrowed lumen of an obstructive prostatic urethra (Figure 1). We have found that the larger size of and better water flow through the 23-French cystoscope sheath allow for greater dilation and separation of the obstructing prostatic lobes than the 21-French sheath, and, thus, the 23-French cystoscope allows for a greater degree of precision in the delivery of laser energy to large obstructive prostates. Alternatively, a continuous-flow laser cystoscope utilizing our Probe Director marketed by Surgical Lasers Inc., may be used.

The Laserscope Angled Delivery Device (ADD) is the lateral-firing laser probe currently used at our institution. This probe measures 35.5 cm in length and is attached to 2 m of fiberoptic cord. The outer diameter of the probe is 1.0 mm, its fiber size is 400 μm, and it provides laser energy in a beam oriented at a 70° (± 10°) angle to the fiber axis.

After the patient is brought to the operating suite, a suitable anesthesia is induced. Most of our VLAP procedures have been performed with the patient under general anesthesia, although spinal anesthesia has been used also. Patients experience pain during VLAP, and attempts at intravenous analgesia alone have been unsuccessful. Leach et al.[24] showed that VLAP can be performed with the patient under extensive pudendal and periprostatic local anesthetic infiltration accompanied by light intravenous sedation.

Before the induction of anesthesia, it is important to ensure that proper laser safety precautions are enforced. All members of the operating room personnel, the surgeon, and the patient should have proper eye protection designed specifically for the 1,064-nm wavelength of the Nd:YAG laser or the 532-nm wavelength of the KTP laser, depending on the type of laser used. Windows should be covered and all doors closed. Proper warning signs should be posted indicating that the Nd:YAG or KTP laser is in use. Both the Nd:YAG and KTP laser can cause serious burns and irreparable retinal injuries; thus, extreme caution and eye protection are mandatory in any operating theater in which laser energy is used.

After the induction of anesthesia, the patient is sterilely prepared and draped in the dorsal lithotomy position. Cystoscopic examination is then performed to ascertain the exact prostatic anatomy from the bladder neck to the veru montanum. In addition, any median lobe hypertrophy is evaluated. The Straight Probe Director mounted on the 12° foreoblique lens and the bridge is inserted. The laser probe is then inserted through the bridge port of the Straight Probe Director and exits at the distal end of the cystoscope sheath. The laser energy is set at 40 or 60 watts in a continuous-fire mode. For safety, the laser should be in the standby mode (shutter closed) until ready to fire. The laser source is operated with a foot pedal similar to the foot pedal used for the Bovie during a standard TURP. The wavelength of the Nd:YAG laser is outside the visible spectrum. As such, laser sources are equipped with a visible low-energy helium:neon red aiming beam to assist in directing the laser application during surgery.

The Nd:YAG laser destroys tissue by coagulation; thus, prostatic venous sinuses are not opened and fluid absorption does not occur. Therefore, sterile water can be used for the irrigation fluid during VLAP. This irrigation serves to cool the laser probe during the procedure, and constant flow must be maintained while the laser is operating. Before each laser application, the bladder needs to be emptied, and the surgeon should clean the end of the laser probe with a gauze sponge. During application of laser energy, small particles of tissue occasionally attach to the end of the laser probe. This buildup of spattered particles can cause superheating of the probe with charring, loss of efficiency, and meltdown, which decrease the probe's effective life span. For the desired effect of maximal tissue ablation, each laser application should be at 40 watts for 90 seconds of continuous application time. Alternatively, 60 watts of power for 60 seconds may be applied.

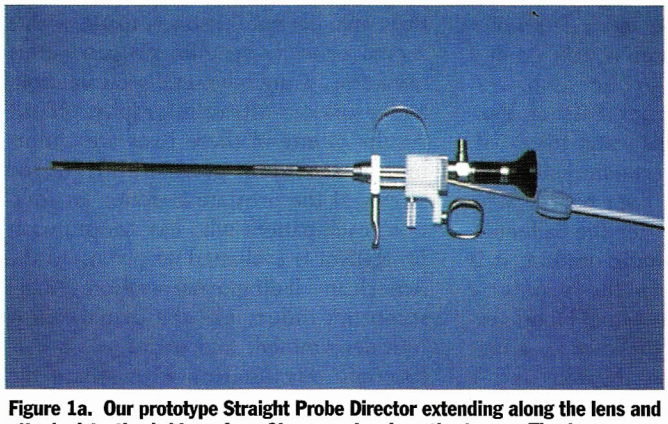

Figure 1a. Our prototype Straight Probe Director extending along the lens and attached to the bridge of an Olympus visual urethrotome. The Laserscope Angled Delivery Device (ADD) runs through the whole assembly.

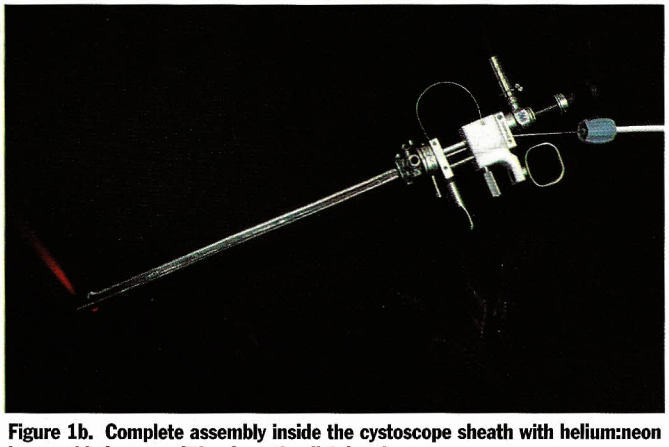

Figure 1b. Complete assembly inside the cystoscope sheath with helium:neon laser guide beam emitting from the distal end.

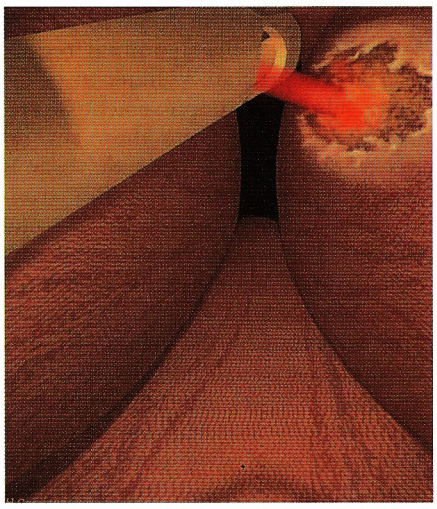

Figure 2a. Lateral lobe application at 2-o'clock position.

This approach produces a zone of tissue coagulation necrosis with a diameter of up to 2 cm from the point of application. "Drifting," or significant movement, of the laser probe during the application produces significantly less tissue necrosis and potentially an ineffective treatment and so should be avoided.

Adequate circumferential tissue ablation is ensured by using a four-quadrant approach to obstructive lateral lobe tissue. Beginning at 1 cm distal to the bladder neck, laserapplications of 40 watts for 90 seconds are applied at the 2-o'clock, 4-o'clock, 8-o'clock, and 10-o'clock positions. The laser beam should be angled upward from the floor of the prostatic urethra into the center of the lateral lobe (approximately 45° from the horizontal) for the 4- and 8-o'clock applications and downward from the roof of the prostatic urethra into the center of the lateral lobe (approximately 45° from the horizontal) for the 2- and 10-o'clock applications (Figure 2). Our current experience shows that this treatment plan provides adequate tissue destruction for the small prostate (5 to 10 g). For larger prostates in which the length from the bladder neck to the veru montanum is more than 2.5 cm, a second series of four-quadrant applications is required, approximately 1 to 1.5 cm distal to the first series of applications. For yet longer glands, these four-quadrant treatment series are repeated every 1 to 1.5 cm until the surgeon has reached an area 0.5

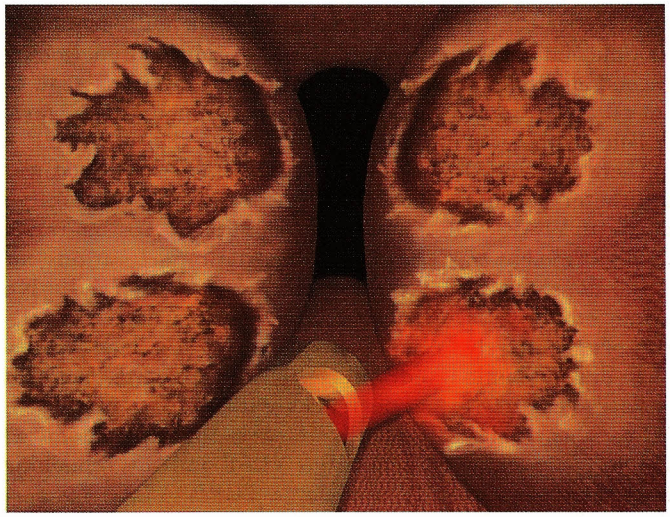

Figure 2b. Lateral lobe application at 4-o'clock position; applications at 2-, 8-, and 10-o'clock positions have been completed.

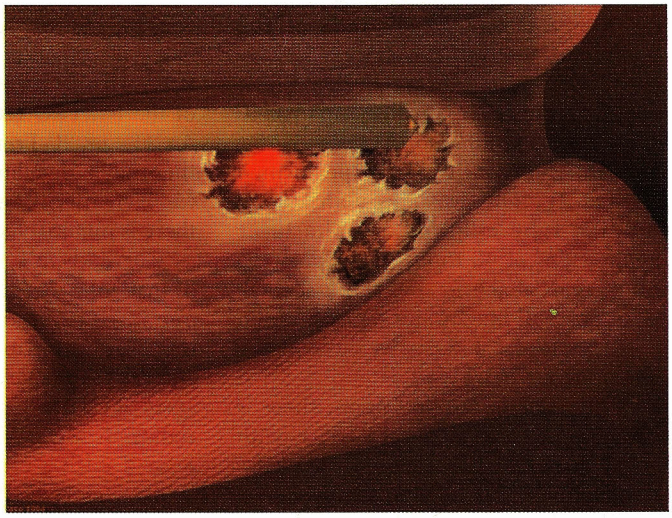

Figure 2c. Side view of right lateral lobe application at 10-o'clock position in mid-prostatic urethra; proximal applications at 8- and 10-o'clock positions have been completed.

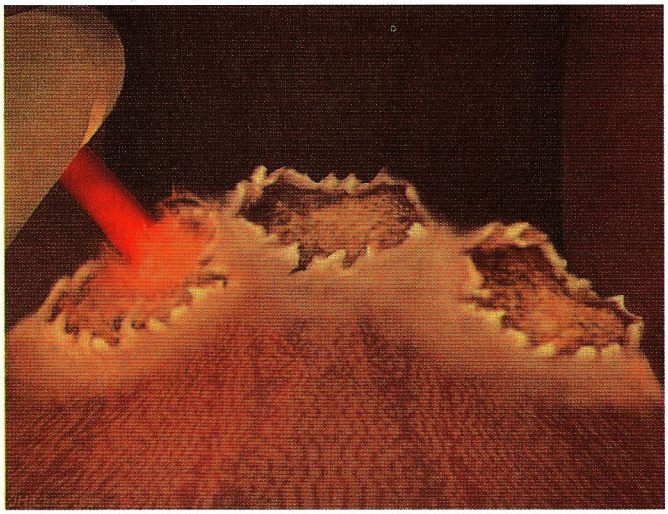

Figure 2d. Median lobe application at 7-o'clock position; applications at 5- and 6-o'clock positions have been completed.

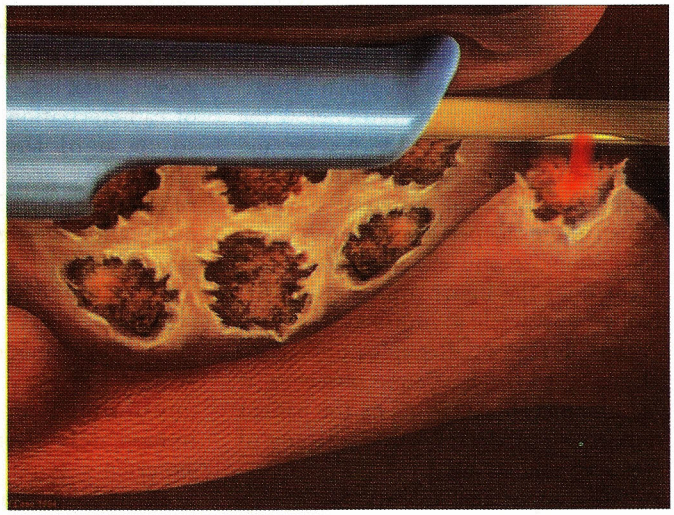

Figure 2e. Side view of median lobe application at 6-o'clock position. Right lateral lobe applications at 8- and 10-o'clock positions in three separate planes have been completed.

Figure 2. Schematic appearance of prostatic urethra during visual laser ablation of the prostate (VLAP) with Laserscope Angled Delivery Device (ADD) emitting neodymium:yttrium-aluminum-garnet (Nd:YAG) laser.

cm proximal to the veru montanum. As the glands increase in size, the anterior-posterior dimension of the prostatic urethra also increases, and additional treatment applications are required at the 3- and 9-o'clock positions. As with standard TURP, we never apply laser energy at the level of or distal to the veru montanum. Likewise, working from proximal o distal helps ensure a free flow of irrigation fluid throughout the application.

After adequate treatment of the lateral lobes, attention is turned to the median lobe. The 12° foreoblique lens is removed, and a 30° lens inserted for better visualization of the intravesical part of the median lobe. If the median lobe is small or there is only a median bar formation, a single laser application of 40 watts for 30 seconds at the 6-o'clock position posteriorly is adequate. For a moderate-sized median lobe, single laser applications of 40 watts for 30 to 60 seconds at the 5-, 6-, and 7-o'clock positions are performed (Figure 2). For prostates with a large median lobe component, the laser applications of 40 to 60 watts for 30 to 60 seconds at the 5-, 6-, and 7-o'clock positions will need to be repeated from proximal to distal in two or three planes along the median lobe.

With each laser application, there is blanching of the mucosal surface with some tissue vaporization and tissue destruction. It is important to remember that these superficial effects do not portray adequately the deep tissue coagulation necrosis required for successful relief of bladder outlet obstruction. One interesting effect encountered with the Nd:YAG laser at 60 watts of power or more is the "popcorn effect." The Nd:YAG laser penetrates below the mucosal surface and is absorbed by, and thus heats, the deeper tissues before vaporization of the mucosal surface. When these deeper tissues are heated, they vaporize and expand with steam formation; the intact overlying mucosa can erupt with a small explosion. Although this small explosion can be alarming to the first-time observer, it has no deleterious effects on the patient and does not decrease the efficacy of the laser application.

After application of Nd:YAG energy to the median lobe, the KTP laser source may then be used for what we refer to as the "sculpting" of the median lobe tissue. The depth of penetration of the KTP laser is less than that with the Nd:YAG laser. Within the prostatic fossa, the KTP laser vaporizes or cuts tissue on contact. This property makes the KTP laser ideal for creating a visible corridor to facilitate passage of urine. With the KTP laser at 34 to 36 watts, a U-shaped groove is created in the median lobe and bladder neck at the 6-o'clock position. Additionally, it is useful to vaporize some of the necrotic lateral lobe tissue to create a cleaner and wider channel through the now edematous and swollen prostatic lumen to facilitate early postoperative voiding.

After treatment of the lateral and median lobes, the prostatic urethra is examined to make certain that there are no gaps in laser treatment. Currently, we tend to deliver nearly 1,000 joules of energy per gram of estimated prostatic weight. An occasional bleeder can be easily identified at this time and coagulated with 5- to 10-second applications of the Nd:YAG laser at 40 or 60 watts. An 18- or 20-French Foley catheter is then left indwelling. There is no need for irrigation of the catheter because there is minimal bleeding with VLAP.

Currently, VLAP is performed as an outpatient procedure, and all patients at our institution are given one dose of intravenous antibiotics preoperatively and are maintained on an oral antibiotic agent until after the urinary catheter is removed. After VLAP, patients are dismissed with a catheter in place and a urinary leg bag. Patients return in 3 to 5 days for removal of the catheter and a voiding trial. If the patient has had urinary retention preoperatively, the catheter is left in place for a longer time (1 to 3 weeks) before removal and voiding trial, or self-intermittent catheterization is started. This extended period of catheterization allows for some dissolution of the necrotic yet still obstructive prostatic tissue and thus reduces the outflow resistance adequately for the debilitated detrusor to effect voiding.

A major difference between the standard TURP and VLAP is the amount of time required postoperatively for patients to experience an improvement in their urinary flow. Immediately after VLAP, all patients experience acute prostatic edema that peaks at approximately 18 hours; thus, urinary catheterization is necessary for 3 to 5 days. After removal of the catheter, most patients do not notice any significant improvement in their urinary stream. Both the patient and the urologist must be prepared to wait several weeks for a significant reduction of the prostate volume to occur and a subsequent improvement in urinary symptoms. Over these several weeks, dissolution of prostatic tissue is usually asymptomatic. However, troublesome dysuria may occur in some patients; it responds to anti-inflammatory agents. Some patients notice the urine has a white, cloudy appearance. This is caused by the release of proteinaceous material from the dissolving prostate. Others may notice the passage of minute material, not unlike the passage of sand after extracorporeal shock wave lithotripsy treatment. In our experience, no significant hematuria has occurred during the period of prostate degeneration after VLAP, except in one patient with agnogenic myeloid dysplasia and malfunctioning platelets. Asymptomatic passage of cloudy urine may occur for several weeks.

To date, many VLAP procedures have been performed in the United States. No significant postoperative morbidity, prostatic perforations, or extravasations have occurred. No postoperative stress urinary incontinence or impotence has been reported. Recently, Kabalin[25] reported his experiences with 25 patients, 13 of whom were prospectively randomized to undergo VLAP and the remaining 12 to undergo TURP. VLAP was performed with Nd:YAG laser energy at 40 watts delivered for 90 seconds in each quadrant. The mean operative time was 59.3 minutes for TURP and 24.2 minutes for VLAP, rectal temperatures were not significantly affected by VLAP, and the mean postoperative decreases in the hematocrit and serum sodium were 2.7 mL/dL and 1.6 mEq/L, respectively, attributed to intravenous hydration of the patient during surgery. After TURP, serum prostate-specific antigen levels returned to baseline levels or lower within 2 to 3 weeks. But, in contrast, after VLAP, serum prostate-specific antigen levels gradually declined over many weeks to baseline levels at approximately 3 months postoperatively. At 6 months after VLAP, nearly 90% of the serum levels were at or below the preoperative levels. At the 6-month follow-up of these 25 men, the mean improvement in peak urinary flow rates was 141% after VLAP and 154% after TURP. The mean decrease

in the AUA six-symptom score was 78% after VLAP and 70% after TURP. Kabalin concluded that the efficacy of VLAP is equivalent to that of TURP at 3 and 6 months of follow-up. Similarly, others have reported favorable initial outcome with VLAP.[26]

Our experience with VLAP has been equally encouraging. Preliminary data were available in 44 men with symptomatic prostatism who were treated with VLAP and followed for up to 14 months. Significant subjective (symptom score) improvement (78%) and objective (flow rate) improvement (97%) were observed. Three of the unimproved patients with large prostates (additional resected weight of 35 to 55 g) required standard TURP subsequently, and in a fourth patient bladder neck contracture developed which was incised with laser. None of the patients treated with VLAP had urinary incontinence or impotence postoperatively. STI

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