KTP Photoselective Laser Vaporization of the Prostate: Indications, Procedure, and Nursing Implications

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Laser technology has evolved rapidly in the field of urology. Over the past decade, there has been a concerted effort to surgically relieve bladder outlet obstructive symptoms in men with benign prostatic hypertrophy (BPH) by using a laser. Recent improvements in laser technology have led to the development of promising new treatment modalities. The potassium-titanyl-phosphate photoselective laser vaporization of the prostate procedure effectively vaporizes the obstructing prostatic adenoma in a 1-day surgery procedure. Current results show that this procedure provides a feasible option for men seeking long-term relief of bladder outlet obstructive symptoms due to BPH.

Over the past decade, there has been a concerted effort to surgically relieve the bladder outlet obstructive symptoms in men with benign prostatic hypertrophy (BPH) by using a laser. Recent improvements in laser technology have led to the development of promising new treatment modalities. The potassium-titanyl-phosphate photoselective laser vaporization of the prostate procedure effectively vaporizes the obstructing prostatic adenoma in a 1-day surgery procedure. Current results show that this procedure provides a feasible option for men seeking long-term relief of bladder outlet obstructive symptoms due to BPH.

Laser Physics

The acronym LASER stands for Light Amplification by Stimulated Emission of Radiation. In this process, light energy is converted into thermal energy. The light is emitted as a photon that travels in waves. Laser light differs from ordinary light by three distinguishing characteristics: it is monochromatic, collimated, and coherent. Laser light comprises photons that are all the same wavelength, thus it is monochromatic. Collimated means that the waves are all parallel to each other and do not diverge significantly as they travel outward. This property minimizes the loss of power as the laser light travels. Finally, the laser light is coherent, meaning the waves travel in phases and in the same direction. This property is extremely important in generating power.

The degree of thermal damage to tissue from laser light depends on the temperature to which the laser energy heats the tissue. There is warming of tissue from 0 to 60
degrees Centigrade. From 60 to 100 degrees Centigrade a process called coagulation occurs. This refers to a process of protein denaturation and structural alteration of the blood, resulting in a change of consistency and slowing or stoppage of flow. Tissue dehydration and sloughage then follow. Above 100 degrees Centigrade vaporization of tissue occurs. This results in the conversion of liquid or solid components of tissue to vapor. The vaporized tissue is immediately removed, creating a cavity (Mueller, 2000).

The optical penetration depth of laser light depends strongly on the wavelength of the laser light (O’Boyle & Carter, 2001). And certain tissue chromophores (a chemical group that gives rise to color in a molecule) have different absorptive characteristics of light. Thus, laser light can be targeted to certain tissue chromophores like oxyhemoglobin, melanin, and water. The KTP laser emits visible green light at 532 nm wavelength that targets the chromophore hemoglobin and penetrates tissue to a depth of only 0.8 mm. Because of its high absorption in blood and its shallow penetration depth, the thermal energy is confined in a shallow tissue depth. The superficial tissue is rapidly vaporized, and only a 1 to 2 mm rim of coagulated tissue remains (Laserscope, 2003). This leads to minimal bleeding during the procedure and fewer irritating symptoms postoperatively. And due to the fact that the KTP laser beam targets hemoglobin, the patient can remain on ASA and/or other anticoagulants such as clopidogrel (Plavix®) and warfarin (Coumadin®) during the procedure. This is an extremely valuable attribute of the KTP laser since some patients needing a prostatectomy are unable to discontinue these medications for even a short period of time without risking serious complications.

Laser Safety

Knowledge of laser safety is essential for the surgeon and operating room staff. Appropriate training is critical and should include general laser principles and also cover the particular laser system that is being used. Lasers have inherent hazards. These include electrical shock, fire, and eye injury (Childs, 1993). The most common injuries from the use of lasers are usually electrical, thus only trained personnel should open, adjust, or work on the laser at any time. The laser should always be unplugged when work is being done on the laser, and power cables and the laser fiber should be handled with dry hands to avoid a shock.

Two types of fire are associated with lasers. The first type is an electrical fire that occurs when the electrical components of the laser catch fire. If this should occur, the nurse should immediately disconnect the power cable from the receptacle to extinguish the fire. The second type of fire that is possible with lasers is igniting the surgical drapes. Towels, sponges, and other draping materials should remain moist during the entire procedure.

The eyes are especially susceptible to laser injury because even minor trauma to the optical surfaces can lead to significant morbidity. The laser energy can severely damage the cornea and/or retina. Therefore, when the laser is in operation, protective eyewear must be worn by all personnel. However, protective eyewear for lasers is not interchangeable. It is specific for the laser wavelength being used. Eye injury with laser exposure is related to the type of wavelength used. Because of their high absorption in water, CO2 lasers will create a corneal abrasive type of injury. KTP light is not absorbed by water, and therefore it can penetrate the vitreous humor affecting the retina (Laserscope, 2003). Eyewear is labeled accordingly. The wavelength being used must be listed on the eyewear. The nurse must ensure that the patient also has appropriate eye protection when the laser is in operation. This may include moist sponges, moist towels, or eyewear specific for the wavelength used. Figure 1 highlights practical hints for laser safety in the operating room.

Surgical Considerations

The PVP procedure vaporizes the obstructing adenoma with minimal to no bleeding. There is essentially no fluid absorption and therefore, no risk of TUR syndrome. This eliminates the two serious potential complications of electrocautery TURP in large prostates. Thus, all patients, regardless of prostate size, are potential candidates for the KTP photoselective vaporization of the prostate. Nurses must remember that the larger the prostate, the longer the OR/anesthesia time.

The operating time is dependent on several factors. First, and probably most important, is the experience of the operating surgeon. It takes approximately 10 normal-size prostate cases to become proficient with the surgery. A mean operative time of 36 minutes was reported for treating a mean gland size of 55 cc (Malek & Nahen, 2004). For the most efficient vaporization, the laser should be 0.5 mm from the tissue. As the tissue vaporizes, it moves away from the laser fiber, and the distance between the fiber and tissue increases. This leads to less-efficient vaporization and can even cause coagulation. As more skill is acquired, the surgeon learns to continually advance the tip of the laser fiber toward the vaporizing tissue to maintain the 0.5 mm distance.

The second important factor in operating time is the vascularity of the tissue. Because the
Practical Hints for Laser Safety

1. Eye wear is a must! It is impossible to move out of the way or turn the head quickly enough to avoid eye injury from a Class IV laser.
2. Ensure that the patient has appropriate eye protection too. This may include moist sponges, moist towels, or eye wear specific for the laser being used.
3. Use the aiming beam when operating the KTP laser. This avoids patient injury to tissues not targeted for vaporization.
4. Examine the laser fiber carefully for cracks before using. If it is cracked, or accidentally dropped, immediately dispose of it.
5. Handle power cables and laser fibers with dry hands to avoid shock.
6. Give laser commands loudly and clearly, such as “Laser On,” “Standby,” “Blue Line,” and “Laser Off.”

chromophore for the laser is hemoglobin, a highly vascular gland will vaporize quickly. Prostates that are less vascular will vaporize much slower and consequently, the operating time increases. This is the case in transurethral microwave thermotherapy (TUMT) or transureteral needle ablation (TUNA) failures, or in men who have had external beam radiation for prostate cancer.

Finally, the size of the prostate, as previously mentioned, affects the length of the operating time. The size of the prostate correlates directly to the operating time. As would be expected in a study of men with large prostates, the operating time increased. In men with an average preoperative prostate volume of 161 cc, the mean OR time was 121 minutes (Sandhu, Casey, Gonzalez, Kaplan, & Te, 2004).

A concern with the PVP procedure is the lack of tissue for pathologic evaluation and the possibility of missing a prostate cancer. Therefore, it is imperative that each patient in whom prostate cancer is a reasonable concern should have a normal digital rectal examination (DRE) and serum prostate-specific antigen test (PSA) prior to the procedure. If there is any question, a transrectal ultrasound and biopsy of the prostate should be performed. If the results are negative, the patient is a candidate for the procedure.

Preoperative Preparation

Lasers still hold a certain mystique to patients. Because the laser procedure generates immediate results, patient expectations during the postoperative period may be unrealistic. The nurse should counsel the patient regarding the procedure as well as postoperative instructions (see Figure 2). Addressing realistic expectations and the patient’s individual concern will ensure fewer problems in the postoperative period (Carney et al., 1995).

The procedure is performed under general or spinal anesthesia. Accordingly, the patient should restrict activity for the first 48 hours after surgery. Some of the patient’s preoperative BPH symptoms (such as frequency, urgency, and nocturia) may continue or even increase for a short time after surgery. Usually, these symptoms respond well to anticholinergic medications and nonsteroidal anti-inflammatory medications, and will resolve within the first 4 to 6 weeks after surgery. Discussing this with the patient prior to surgery helps ensure a better understanding.

Erectile dysfunction is an infrequent occurrence following surgery. Conversely, retrograde ejaculation occurs in most men after a TURP. Patients need to know that the absence of antegrade ejaculation will not lessen the ability to achieve or maintain erection or experience orgasm. Possible surgical complications must also be discussed with the patient. Although rare, these include ureteral obstruction, bladder neck contracture, urethral stricture, and incontinence. It is important to assure the patient that someone will be available to talk to him during the postoperative period to answer questions or concerns.

Case Presentation

Mr. Smith is a 67-year-old real estate agent who has been followed for progressive bladder outlet obstructive symptoms for the past 10 years. He has been on various medical therapies and is now on a combination of doxazosin and finasteride. Mr. Smith states that while the medications do help, he continues to have symptoms of frequency and urgency. He relates that this often creates embarrassing situations when he is with clients and does not have ready access to a bathroom. He gets up three times during the night to urinate. His International Prostate Symptom Score (I-PPS) is 25/35. Mr. Smith is frustrated spending money on medical therapies yet continuing to experience irritative BPH symptoms. He wants relief. His past medical history is significant in that the patient has mitral valve prolapse and a family history of coronary artery disease. He is on 81 mg of ASA daily.

Uroflow has a volume of 303 ml with a peak flow rate of 11 cc per second and an average flow rate of 7 ml per second with a 150 cc post void residual urine (see Figure 3). On DRE, there is a large, smooth, nontender prostate. Cystoscopy reveals trilobar hyper-
plasia with a 3.5 cm prostatic fossa and visual obstruction from the verumontanum. Bladder shows 2+ trabeculations but no cellules. PSA is 0.9 ng/ml.

The PVP procedure is scheduled, and details of the surgery are discussed with Mr. Smith. Since the procedure is relatively new, most patients do not know what to expect. Mr. Smith watches a video of the procedure, is given a brochure with a description of the laser procedure, and the nurse reviews written postoperative instructions/expectations with him (see Figure 2). Although most patients are discharged the same day as the procedure, Mr. Smith is prepared to spend 1 night (23 hours) at the hospital if needed. Mr. Smith's cardiologist is notified of the surgery and advises that the ASA be continued to prevent deep vein thrombosis.

The surgery. Mr. Smith is admitted to the day surgery unit of the hospital. After preparation in the preoperative area, including a prophylactic long-acting IV antibiotic, he proceeds to the operating room. Following the induction of general anesthesia he is placed in the dorsal lithotomy position, and prepped and draped in the usual sterile manner. The urethra is lubricated with K-Y® jelly and the 22F laser-scopes inserted without difficulty into the bladder. Panendoscopy is performed and the ureteral orifices are identified well back from the bladder neck. The verumontanum is identified and the obstruction is visualized (see Figure 4). The laser is set at 80 watts and the bladder neck tissue is vaporized to capsular fibers as far laterally as possible. The left and right lateral lobes are vaporized from the bladder neck to the verumontanum bilaterally by sweeping the laser beam across the prostatic adenoma. Each pass vaporizes a 0.8 mm depth of tissue. By slowly sweeping the laser beam over the tissue and slowly...
moving the beam toward the verumontanum, the lateral lobes are slowly vaporized from the bladder neck to the verumontanum. If any bleeding is encountered the laser is backed off the bleeding vessel and activated, thus coagulating the bleeding vessel and stopping the bleeding. At the end of the procedure the prostatic fossa is wide open and when viewed from the verumontanum no tissue can be seen (see Figure 5). The urethra is once again lubricated with K-Y jelly and an 18F 3-way Foley catheter is inserted into the bladder and connected to normal saline irrigation. The patient is transported to the recovery room, and then to the ward. Mr. Smith is maintained on catheter drainage for 3 hours to allow the bladder to recover from the anesthesia and to regain enough tone to contract and empty. After this period, the catheter is plugged and the bladder filled with 300 cc of normal saline irrigant through the continuous irrigation port. The Foley catheter is then removed, and after he urinates, Mr. Smith is discharged to home the afternoon of surgery.

Postoperative period. The following afternoon, the nurse calls Mr. Smith at home. He is experiencing some mild urgency; otherwise he is voiding without difficulty. At the end of the first month Mr. Smith returns for his postoperative appointment. A urinalysis is done and his postoperative uroflow reveals significant improvement (see Figure 6). He is very happy with the procedure and all bladder outlet obstructive symptoms are gone.

Nursing Implications
At present, a tremendous amount of information about BPH is available to the public. The advice obtained from the Internet, lay literature, and family and friends can be overwhelming to the patient. One of the important roles of the nurse is that of educator. The nurse can help the patient sort through the available information, providing clarification and education regarding the disease process as well as the available therapies for BPH. Even the many types of lasers used to treat BPH can be confusing to the patient when trying to make a treatment decision. The PVP procedure is a relatively new treatment, and taking the time to discuss the procedure and the pre and postoperative instructions is very important (Laserscope, 2004).

A second and equally important role of the nurse is that of providing patient support. Sometimes a patient thinks that because the results of the laser treatment are immediate, he will require no postoperative recuperation period. Even though the patient has been counseled before surgery, he may seem surprised when he experiences postoperative symptoms. Providing a listening ear and reinforcing realistic expectations can positively influence the patient’s perception of his surgical experience.

Results
PVP laser prostatectomy produces rapid, safe, and effective relief of the bladder outlet obstructive symptoms of benign prostatic hypertrophy (Malek, Kuntzman, & Barrett, 2000; Malek, Barrett, & Kuntzman 1998). In a long-term study by Dr. Reza Malek from the Mayo Clinic in Rochester, Minnesota, pre and postoperative I-PPS symptom scores, mean peak flow rate and post-void residual urines were evaluated out to 3 years postoperatively. The I-PPS score decreased from an average of 22.0 preoperatively to 5.4 at 3 months and remained stable at 3 years. The mean peak flow rate increased from a preoperative average of 7.8 cc/sec to an average of 27.8 cc/sec at 3 months postoperatively and remained stable at 3 years. The post-void residual urine averaged 154 cc preoperatively and decreased to an average of 44 cc at 3 months postoperatively and also remained stable at 3 years (Malek, Kuntzman, & Barrett, 2003).

Conclusion
Recent improvements in laser technology have led to the development of promising new treatment modalities. The PVP procedure effectively vaporizes the obstructing prostatic adenoma in a 1-day surgery procedure. The patient experiences almost no bleeding and most men are able to return to normal activity within 48 hours. Further studies are needed to address the issue of irritable symptoms some men experience in the first 4 to 6 weeks following surgery. Current results
show that this procedure provides a feasible option for men seeking long-term relief of the bladder outlet obstructive symptoms due to BPH. Longer term followup studies are now in progress.

References