Initial Experience with Vaporization of Benign or Cancerous Prostate using 980-nm Diode Laser

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Abstract
Case series describes technique and early 1 month results of initial 10 patients, treated with 150W near-infrared 980 nm diode laser prostate ablation. Among patients, 7 were in retention with long term catheter, of them 4 with prostate cancer. 6 BPH patients were all on 5-alpha reductase treatment. Prostate sizes varied from 23 to 130 ml, median 55. 5 procedures were performed under local anesthesia with cystoscope (“painting technique”) and 5 under anesthesia with continuous flow laser scope “classic technique”. Energy delivered ranged from 78 to 142kJ. No transfusion or hemostasis with other instruments were needed. Complications observed were four fiber tip breakages during the procedure, one reoperation, one grade 3 incontinence and two patients needed short term catheter reinsertion because of irritative symptoms. All patients were free of catheter and with improved flow at one month follow up. Advantages of 980 nm wavelength over 532 nm for prostate ablation are discussed.

Key words: prostate; laser therapy; transurethral resection of prostate; lasers, semiconductor; urinary retention; androgen antagonists.

Introduction
Procedure, marketed as LIFE (laser induced flow enhancement) is actually prostate tissue ablation (evaporation) with the use of 980 nm near-infrared laser energy, delivered with side firing fiber from Biolitec’s Cerelas HPD 150 diode laser. Aim of prostate ablation (in contrast to enucleation) is not in removing maximal amount of prostate tissue, but in resecting a channel which would allow or improve urine flow.
Recent boom in laser prostatectomies [1-2], better affordability of Biolitec laser (compared to Holmium or green light), cheaper fiber (compared to green light), very high power (150W, only recently available for green light) and better ablation function with at least same coagulation in comparison to green light laser (confirmed with in vitro studies [3-4]) have prompted us to test this procedure.

Materials and methods
Patient selection
For first 5 procedures, very strict patient selection was performed. We sought patients in retention, with significant comorbidity, who would not be considered for TURP under general or regional anesthesia or have been recently added to waiting list for TURP and would have to wait with catheter in situ for more than a year. Further, they would have to tolerate procedure under local anesthesia with minimal sedation. Another important problem with laser prostate ablation is lack of tissue samples, therefore recent prostate biopsy and stable PSA were a prerequisite. We have not limited ourselves to BPH treatment, we saw significant opportunity for this procedure also among patients with locally spread prostate cancer, who are waiting for palliative TURP to become at least temporarily free of permanent urinary catheter. Prostate size did not influence our selection.
For the second group of 5 cases, patient selection criteria were eased and we included patients who did not need histology and were waiting for regular or palliative TURP.
Overall, among first 10 patients, there were 4 patients with prostate cancer in retention on long term urinary catheter and laser ablation was performed instead of palliative TURP, and 6 patients with BPH, of them 3 in retention with catheter, one on clean intermittent self-catheterization and 2 who were still able to urinate spontaneously. Patient’s age was between 67 and 77 years (mean and median 72). Prostate sizes ranged from 23 to 130 ml, average 58 ml, median 55 ml. All patients with prostate cancer were on combined androgen blockage (LHRH agonist and antiandronene bicalutamid) from 2 months to 2 years. All BPH patients were on finasteride or dutasteride treatment from 6 months to 5 years.

Anesthesia
First 5 patients were operated under local anesthesia. Before procedure, they received parenteral antiemetic, antibiotic garamycine 240 mg, diazepam 10 mg (Valium, two 5 mg tablets) and extended release oxycodone 10 mg (Oxycontin 10 mg tablet). Xylocain gel was instilled intraurethrally 10 – 20 minutes before procedure. At the beginning of procedure, some
patients also got two times 5 ml of 2% lidocaine injection into lateral prostatic lobes with equipment we use for botulinum toxin bladder injections.

Second 5 patients were operated under general or spinal anesthesia according to anesthetist’s preference.

Operative technique
Caralas HPD 150 diode laser from Biolitec, Germany with side firing “Fusion” fiber (EVOLVE system) and settings between 90 and 125W were used. There are basically two techniques. One uses rotational motion of fiber with two fingers and in a way “paints” prostatic tissue. The other technique (Wolf instrument) locks fiber in the instrument. This technique resembles more classical TURP procedure. Fiber movement is primarily forward and backward with the regular resectoscope mechanism. For rotation, the whole instrument should be turned around.

For the first 5 cases simple Storz 21 French cystoscope and Albarran were used. With this setting, one can easily control turning of fiber with the two fingers, but it is more difficult to guide fiber tip to the selected position in the prostatic fossa or ensure appropriate close-to-contact with the tissue.

For the second 5 cases, Wolf laser scope was used. Continuous flow allowed better visibility and easier procedure, although different technique should be used – one which resembles TURP.

In this series, it was not attempted to remove maximum amount of prostatic tissue, but to produce channel, which would allow or improve urine flow. Therefore, procedure was stopped when it was visually estimated prostatic fossa was wide enough. Further reason for procedure termination was breakage of end part of side-fire laser fiber. This happened on four occasions. On all occasions, this occurred in the last part of procedure, fiber end was washed easily from the bladder, and it was estimated prostatic fossa was already wide enough so no continuation of procedure was deemed necessary.

Postoperative care
On one occasion, patient received three-way catheter after procedure. No tension or bladder wash was necessary and slow irrigation was stopped after one hour. All other patients received regular Foley catheters. There were no early postoperative problems. No patients needed transfusion or had significant increase in creatinine or decrease in sodium.

Patients with local procedure left hospital next day with catheter in situ. They returned for removal after 3-5 days. Patients with general anesthetic stayed in hospital till catheter removal (day 2-4 postop).

Results

Procedure lasted less than 50 minutes on all occasions. All patients were able to tolerate procedure till the end. Patients with local anesthesia complained mostly about feeling of bladder fullness (even with continuous flow instrument) and some also about burning and even strong painful sensations. Sometimes this necessitated more frequent emptying of bladder and therefore prolonged procedure. Availability of spinal or general anesthesia eased preoperative and intraoperative stress on urologist and made experience better for patients.

Laser energy delivered ranged from 78 kJ to 142 kJ, mean 89 kJ, median 81 kJ. Example of view of prostatic cavity before, during and after procedure is presented in Picture 1.

All patients were able to urinate spontaneously after catheter removal. Significant irritation symptoms were reported by 4 patients in the period of 1 to 4 weeks after procedure. Two BPH patients with diabetes, who were on long term catheter (one) or intermittent catheterization (other) before procedure, prostate sizes 55 and 130 ml, returned 1 – 2 weeks after procedure with strong dysuria and fear of retention. Urinary catheter was reintroduced for one week. Cystoscopy was also performed and showed free prostatic urethra, which was still unhealed. After catheter removal, both patients were able to urinate spontaneously. Because all were warned about this possibility and were on permanent catheterization before, they were all very pleased with the procedure.

One month after procedure they showed good flow, no residual.

One patient where procedure was terminated early due to laser fiber breakage and only 78 kJ of energy was delivered, went into retention three days after catheter removal. He was reoperated and some remaining tissue was removed with TURP. During reoperation there was very little bleeding observed and histology showed coagulation necrosis in most prostate chips removed. After catheter removal he was without further problems with very good flow.

One patient who underwent palliative prostate ablation and was in retention before due to local progression of prostate cancer, had grade 3 incontinence one month after procedure and although it was improving, he still needed pads regularly.

One month after the procedure, all patients who were previously in retention were able to urinate freely and empty their bladders till completion. Patients without retention improved their flow rate (initial evaluation,
Discussion and Conclusions

Laser ablation of prostate is not a new kid on the block. It is around for more than a fourth of a century, an article on use of Nd:Yag laser ablation was published already at least 26 years ago [5]. Also, verdict on usefulness of lasers for removal of prostate tissue was issued in review article in 1995 and we still agree with it today: “In our experience, efficacy favors the TURP and safety the laser.” [6]. But under this surface, a lot of things have happened. This is reflected for example in steady increase in number of articles, published and indexed by Medline since 1990 on this issue, which reached more than 100 articles per year in the last few years and is still growing. At first, prostate laser ablation (with Nd:Yag laser) was almost abandoned in favor of Holmium laser prostate enucleation, which is really the most effective procedure and at present represents a gold standard which has in efficacy and safety for patients overcame open prostatectomy [7-9]. However, enucleation is difficult, time consuming, expensive (morcelator, Holmium laser) and not necessarily all people need it [1]. Therefore, search for easier (ablation) and still fancy (laser) prostate procedure continued. As KTP (green) laser appeared main focus turned again to laser ablation [10-12].

Prostate ablation now seems to be easier than enucleation, it is also well advertised by laser factories among potential patients and apparently has become widely accepted as a good method for treatment of BPH, even for big prostates [1, 13].

Apart from mentioned main players (Holmium, KTP) and because availability of lasers for clinical use has significantly increased in recent years, many different machines are competing on the medical laser market. At first thought one would not expect small differences in wavelengths: 1064 vs. 980 vs. 532 vs. 2100 would produce very different tissue effects. But absorption coefficients for water and hemoglobin for different wavelengths are very different. For example, absorption coefficient in water is very high for Holmium and Thulium (27) compared to diode laser 980 nm (0.43), where it is still significant. On the opposite side, Nd-Yag 1064 nm has very low absorption in water (0.12) and for green light laser (532 nm) absorption in water is almost negligible (0.004). Local maximum in water absorption curve at 980 nm explains significant difference between Nd-Yag 1064 nm (0.12) and diode 980 nm (0.43) water absorption. Absorption coefficients for hemoglobin are opposite. There is very high absorption of green light (203), moderate absorption at near-infrared 980 diode laser light (2) and almost nonexistent for Nd-Yag and Holmium lasers [14].

Estimated penetration depths are for holmium 0.4 mm, for green light 1 mm, for diode 980 laser 5 mm and for Nd-Yag 1064 laser 8 mm [14].

Near-infrared 980 nm diode laser has, due to local maximum of water absorption, 4 times higher absorption coefficient in water compared to nearby (according to wavelength) Nd:Yag laser and still significant absorption in hemoglobin. According to those data near-infrared wavelength of 980 nm, with its distinctive position in the middle of all important parameters seems to be most balanced and attractive. Further, it is cheaper to same power holmium, easier for transport, uses less electric power, and one would question why it has not been used already for years. Actually, it was – in other fields and also articles on its use for internal urethrotomy were published already in 2001 [15]. But in the last two years, company Biolitec from Germany with a strong branch in the USA started to produce laser units with 150W power and market them together with side firing fiber, specifically for treatment of BPH. As urologists adopted advances of 980 nm diode laser very quickly, this lead to an interesting situation, where on one side thousands of procedures have already been performed and on the other side European Urology recently published article which questions 980 nm diode laser for human prostate use, claiming it is untested regarding fear of depth of penetration [16]. This claim is unfounded as one would not question use of Nd-Yag laser which penetrates deeper and was used for purpose of prostate ablation already in 1990s. As penetration depth of 980 nm diode laser is lower than Nd-Yag laser’s, there is less risk. Further safety advantage of 980 nm diode laser over green light and Nd-Yag laser is its higher absorption in water. As endo-urological procedures are performed in complete water immersion environment, this represents additional safety feature of 980 nm diode laser compared to Nd-Yag and especially green light laser, where misfired energy is not immediately absorbed and dissipated by water medium, but transferred further to potentially wrong tissues.

Our limited initial experience also confirms usefulness of 980 nm diode laser for ablation of prostate cancer tissue or benign prostate tissue after long term use of 5-alpha reductase inhibitors. This may be further advantage of 980 nm diode laser compared to green light laser, which is more dependent on good tissue perfusion. Although recent study claims green light laser may be used for patients on finasteride and dutasteride, concern still persists [17].

Excluding stones, 980 nm laser is advertised as useful
for many urological (condyloma, bladder tumors, laparoscopic and open surgery), surgical, dermatological or dental applications. Its versatility and ability to use 220V (no need for 380V special electricity supply), its mobility, compact size, quietness (compared to 80W Holmium) will undoubtedly add in its availability in different medical environments in many hospitals.

Observations and complications in our initial 10 patients point towards some issues, which need special attention if one embarks on laser prostate ablation.

Procedure under local anesthesia is feasible, however, it is very stressful and according to our experience we were not able to provide sufficient analgesia and sedation to our patients with this approach. It should be used only in few selected patients.

Laser fiber needs very delicate handling and regular cleaning through tissue brushing (not removing) during procedure, otherwise laser fiber breaks. Careful and limited ablation near colliculus is mandatory otherwise incontinence may occur. Incontinence feature was previously emphasized also for laser enucleation [18]. Re-catheterizations occurred in patients with lowest amount of energy delivered relative to prostate size, therefore enough ablation is necessary, perhaps more than 120 kJ/case.

Our initial results (if confirmed in long term) seem to show 980 nm 150W diode laser system is very useful for prostate tissue ablation. Its role in future “open health market” [19] however, is far from established. According to this experience, it shows improved patient safety and comfort (no need for perfusion, catheter tension, transfusion, less or no creatinine increase, immediate postoperative mobility…) over standard TURP. In this case series, it was very successfully used not only for BPH but also for palliative prostate cancer cases.

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References

14. van Nimwegen SA: Nd:Yag laser in urogenital surgery of the dog and cat. Faculty of Veterinary Medicine. Utrecht, The Nederlands: Utrecht University,
Illustrations

Illustration 1

Picture 1. Prostate ablation with 980 nm diode laser - resectoscope views: A - before beginning; B, C - during procedure (evaporation bubbles are visible) and D - at the end of the procedure, where aim was not to remove maximal amount of tissue, but to create channel which would allow or improve urine flow.
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