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Laser prostatectomy for patients with benign prostatic hyperplasia: a prospective randomized study comparing two different techniques using the Prolase-II fiber

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Summary. Laser prostatectomy for patients with complaints due to benign prostatic hyperplasia is a relatively new treatment option. The most effective procedure for coagulation and vaporization of the prostate is not yet known. In a prospective randomized study of 30 patients, 2 techniques for the delivery of laser energy were compared at 40 W for 90 s. The complications were minimal and antegrade ejaculation was preserved in 15 of 18 potent men. In 24 patients urodynamics evaluation was possible. In both groups a significant reduction in the symptom score was observed. The decrease in detrusor pressure at maximal flow and the increase in flow rate were, however, disappointing. No significant difference in the results was found between the two groups. The power setting needs to be changed in further studies.

The management of benign prostatic hyperplasia (BPH) has been in a state of transition during recent years. Considerable interest has developed in the role of lasers in BPH treatment. Human studies have demonstrated that Nd-YAG laser power delivered to the human prostate will result in significant improvements in subjective symptom scores, uroflowmetry, and postvoid residual urinary volume [5, 7].

Four different techniques of laser energy delivery have been developed: transurethral ultrasound-guided laser-induced prostatectomy (TULIP), visual laser ablation of the prostate (VLAP), interstitial transrectal ultrasound-guided ablation of the prostate (or interstitial thermotherapay, ITT) and contact laser ablation of the prostate (CLAP). All approaches appear to be effective and are relatively bloodless. However, the relief of obstructive symptoms after laser prostatectomy takes (some) time, and the irritative symptoms experienced during the first few weeks after treatment are well known. For VLAP, several side-firing laser fibers can be used; there is a significant difference between fibers with regard to exit angle and beam profile [13], resulting in different spot sizes at the tissue. As the spot size is of major importance for the direct tissue effect and for the clinical results, the optimal application method (and, thus, the clinical protocol) may differ from fiber to fiber.

The short-term outcome of randomized studies comparing TULIP with transurethral resection (TURP) and VLAP with TURP show equivalent results as measured by symptom score, maximal flow rate, and postvoid residual urinary volume [2, 9]. By varying the laser parameters (power setting, wavelength, and spot size on the tissue) and modifying the technique of laser light application, it will hopefully be possible to reduce the early complications and to achieve a result comparable with that of TURP in a shorter postoperative period. Because the result of coagulation or vaporization of prostatic tissue depends on the prostatic vascularity, this parameter must be taken into account as well [12]. Having obtained encouraging results in our first trial of 54 patients treated with the TULIP system [1], we decided to use the VLAP technique in a prospective randomized trial comparing two existing methods of laser application. In one method the tip of the laser probe is held in a fixed position in the prostatic urethra during the application of energy at 40 W for 90 s, and in the other method the laser beam is moved from the bladder neck to the verumontanum during the delivery of 40 W of energy for 90 s (the "painting" method).

In the case of the fixed-position technique, the tissue is not only coagulated but carbonized and vaporized as well due to a large deposition of energy in a specific area. A crater is the result. However, the interval between the onset of coagulation and carbonization is substantial, and as a result of the whitish discoloration of the tissue, during that time a considerable amount of laser energy is reflected back from the tissue into the prostatic urethra. This means a loss of efficiency in laser light delivery. If the fiber is translated over the surface in such a way that immediately after the start of coagulation the fiber is moved to adjacent tissue, laser energy is deposited more efficiently. Because of the fiber movement a larger surface area is affected. Al-

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though the depth of the coagulation is somewhat smaller, the total coagulated volume is larger. The first technique is hereafter referred to as the fixed-position technique and the latter, as the painting technique.

Patients and methods

All men attending the outpatient clinic with micturition complaints are diagnosed in a workup protocol for BPH. With digital rectal examination, determination of prostate-specific antigen (PSA) levels, and transrectal ultrasound (with biopsies of suspect lesions), prostatic carcinoma is excluded. Patients fill in the symptom score (I-PSS) and respond to a question about the quality of life. In all patients a urodynamics examination is carried out (bladder capacity, postvoid residual urinary volume, pressure-flow studies, and bladder instabilities). On the basis of the symptom score (more than ten points) and/or the outflow obstruction as determined with urodynamics, a group of patients is selected for laser prostatectomy.

Patients are randomized for laser prostatectomy using either the fixed-position (FP) technique or the painting technique (PT). In both methods the patients are treated at the 2, 5, 7, and 10 o'clock positions in the prostatic urethra with 40 W of energy for 90 s on each spot (FP) or each stripe (PT), thus using the same total amount of energy. A standard 23-F cystoscope with a 30° viewing telescope is used. The Prolase-II (Cytocare) fiber with an exit angle of 45° and a diameter of 1000 μm is applied. Patients with prostate volumes larger than 40 ml are treated with a double amount of laser energy; patients in the FP group (n = 8) are treated twice at the four clock positions, and in the PT group (n = 7), twice the number of stripes are applied. An Nd:YAG laser is used as the light source. Each patient is treated with a new fiber. A suprapubic tube is placed before the treatment.

A total of 30 patients were randomized. The number of complications, the duration of the suprapubic tube placement, the postoperative symptom scores, and the flow rates were recorded. The urodynamics investigation was repeated at 6 months after the laser prostatectomy. The level of significance *(P)* was calculated with Student's t-test and was set at 0.05. The values of the parameters were expressed as mean values ± SD.

Results

The mean age of the 30 patients was 66 years (range, 50–86 years) and the mean prostate volume was 42 ml (range, 20–80 ml). Before treatment, both groups were comparable with regard to age, prostate volume, symptom and bother score, and urodynamics. In the FP group the suprapubic tube could be removed after 34 days (range, 3–85 days) and in the PT group, after 21 days (range, 2–65 days). The complications encountered are listed in Table 1. Antegrade ejaculation was preserved in 15 of 18 potent men. Most of the men were complaining about urgency and pollakisuria during the first 2–6 weeks after treatment. Of the 30 patients, 6 could not be evaluated; 2 patients in the FP group underwent TURP 2.5 and 4 months later due to unsatisfactory results, 3 patients refused a urodynamics investigation 6 months postoperatively, and in 1 patient a radical prostatectomy was performed as a localized prostatic carcinoma was diagnosed at 4 months after the laser prostatectomy. In the remaining 24 patients (11 in the FP group and 13 in the PT group) a significant reduction ($P < 0.001$) in the symptom score and improvement of the quality of life in both groups was observed. In both treatment groups a decrease in the bladder pressure at maximal flow was noted and the flow rates improved with a mean increase of 3 ml/s. There was no significant difference between the two treatment groups with regard to the results obtained after 6 months (Table 2). The amount of laser energy applied in the two groups was the same (mean, 23,000 J).

Table 1. Complications encountered after laser prostatectomy in the FP group and the PT group

	Patients (n = 30)	FP group	PT group
Slight hematuria	8	5	3
Urinary tract infection	7	3	4
Retrograde ejaculation	3	1	2

Table 2. Results obtained at 6 months after laser prostatectomy in the FP group and the PT group[a]

	FP group (n = 11)		PT group (n = 13)		*P*
Symptom score before treatment	19	(9)	22	(7)	NS
Symptom score after treatment	5	(4)	8	(5)	NS
Quality of life before treatment	3.6	(1.9)	4.0	(1.7)	NS
Quality of life after treatment	1.1	(0.7)	1.5	(1.2)	NS
Detrusor pressure at max. flow before treatment (cmH_2O)	76.6	(27.9)	76.2	(23.8)	NS
Detrusor pressure at max. flow after treatment (cmH_2O)	63.5	(30.7)	59.5	(25.2)	NS
Flow rate before treatment (ml/s)	8.6	(4.4)	8.5	(3.2)	NS
Flow rate after treatment (ml/s)	11.8	(8.4)	9.9	(3.8)	NS

[a] Data represent mean values; standard deviations are given in parentheses. *NS*, Not significant

Discussion

Considerable interest has developed for the use of side-firing fibers coupled to an Nd:YAG laser for BPH treatment. The initial results reported in the literature are promising. The most effective procedure for laser prostatectomy with regard to the power setting, the method of laser application, and the type of side-firing device is not yet known.

By use of the dog prostate model the technique of the four-quandrant pattern was developed [4]. The initial experience in patients treated at 60 W for 60 s in the four-quadrant pattern yielded encouraging results [3]. With regard to the dosimetry in a canine model utilizing a right-angle fiber, Motamedi et al. [8] found that the use of high power settings (50–60 W) for short periods (up to 60 s) resulted in a less pronounced depth of tissue coagulation than did the application of low power (25 W) for a longer period (3 min). Kabalin and Gill [6] concluded from a prostate study of 29 dogs that the mean depth of tissue necrosis obtained at 40 W was more than 30% greater than that achieved at 60 W using the right-angle Urolase fiber, whereas the total energy delivery was held constant. Shanberg et al. [10] compared three different side-firing devices in a study of 50 consecutive patients using different power settings and different procedures (quadrant technique and painting technique). The overall results with regard to the peak flow were comparable. A high dose of laser energy could be used safely. In another study, Shanberg et al. [11] compared a single-spot technique versus whole-tissue photoirradiation with a Prolase-II fiber in 12 patients prior to a planned radical prostatectomy because of stage B prostatic carcinoma. Different power settings were used. The depth of tissue penetration was measured in both histology and gross examinations of the removed specimen. The greatest depth was found after the delivery of 60 W for 60 s.

In our study, two different methods of application of the laser beam were compared at 40 W with the Prolase-II fiber. Although the groups of patients were relatively small, no significant difference in the results was observed. The overall results were less favorable than we expected from our TULIP study. One can question whether a 40-W output from the laser is enough for an efficient treatment. For the Prolase-II fiber a power setting of 60 W would probably be more appropriate. Initial clinical results obtained at our center confirm this. The question as to whether a quadrant technique with the fiber positioned in a fixed position, a painting technique, or a combination of both should be applied remains to be answered.

For clinical relevance the power delivered by the fiber to the tissue is important, not the power coupled into the fiber. Because side-firing fibers need to be used under water and the output power needs to be measured at an angle, a standard power meter cannot be used. Only recently has such a power meter been developed and was the laser power output measured at the fiber tip. These measurements are striking. For most fibers the output power is greatly reduced (over 50%) before the end of the procedure. This reduction in output implies that the power used during the procedure is far less than the "protocol power." Furthermore, it adds another variable to the search for the optimal laser treatment of BPH.

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