

Lasers in Urology

Changes in Serum Prostate-Specific Antigen Levels after Potassium-Titanyl-Phosphate (KTP) Laser Vaporization of the Prostate

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Purpose: The prostate-specific antigen (PSA) level decreases after transurethral resection of the prostate (TURP). However, changes in the PSA level after potassium-titanyl-phosphate (KTP) laser vaporization of the prostate are not well known. The aim of this study was to investigate the effect of KTP laser vaporization of the prostate on PSA levels in patients with benign prostatic hyperplasia (BPH).

Materials and Methods: Serum PSA levels were checked before and 1, 3, 6, and 12 months after the procedure in patients who underwent KTP laser vaporization between October 2004 and August 2008. Patients with prostate cancer, a history of urinary retention, or prostatitis during the follow-up period were excluded. The results for 278 patients were studied.

Results: The mean age of the patients was 69.0 ± 6.7 years (range, 50-91 years) and the mean preoperative PSA level was 2.72 ± 2.93 ng/ml. The PSA level tended to be increased at 1 month after the operation (3.18 ± 3.23 ng/ml, $p=0.032$) but decreased within 3 months and became stabilized after 6 months at 1.79 ± 1.82 ng/ml ($p < 0.001$).

Conclusions: PSA levels may increase after KTP laser vaporization for a certain period of time, but eventually decrease and become stabilized after 6 months. Therefore, it may be appropriate to wait up to 3 months if the PSA level rises after the procedure, and further investigation should be considered if the PSA level still remains high after 6 months.

Key Words: Prostate-specific antigen; Potassium titanyl-phosphate; Prostatic hyperplasia

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INTRODUCTION

Since prostate-specific antigen (PSA) was demonstrated in prostatic tissue in 1970, measurement of the serum PSA level has become widely used for the early diagnosis and management of prostate cancer [1]. However, it is well known that an increased serum PSA level does not always indicate the existence of prostate cancer [2,3]. The serum PSA level can also be increased in patients with benign prostatic hyperplasia (BPH), in patients with prostatitis, and after interventions such as prostate biopsy and transurethral resection of the prostate (TURP) [2,3]. Especially in patients with mildly increased serum PSA (4-10 ng/ml), the single most common cause of serum PSA elevation is known to be BPH, rather than prostate cancer. Other benign prostatic diseases that can cause elevation of the se-

rum PSA level include acute urinary retention, acute prostatitis, and prostatic ischemia [4]. Moreover, it has been reported that the serum PSA level has a tendency to increase temporarily for 20 days after TURP and will decrease afterwards [2]. Therefore, it is difficult to distinguish prostate cancer from benign prostatic conditions in patients who have undergone interventions on the prostate. One report on this issue suggested that 3% of patients who have undergone surgeries for BPH will actually develop prostate cancer during the follow-up period [5]; thus, establishment of clinical guidelines for follow-up strategies for such patients is necessary.

It is now well understood from several reports on changes in the serum PSA level after TURP that the serum PSA level decreases after TURP [2,6]. By contrast, reports on changes in the serum PSA level after potassium-titanyl-

phosphate (KTP) laser vaporization of the prostate based on the analysis of large populations are rare.

Treatment of patients with BPH by 80 W high-power KTP laser vaporization was first introduced in clinical practice in 2000 and is now accepted as an effective minimally invasive treatment modality. This method eliminates prostatic tissues that cause obstruction through vaporization, which occurs when hemoglobin selectively absorbs the KTP laser that generates heat energy [7].

KTP laser vaporization has gained considerable attention among many urologists recently because this treatment modality is less invasive while offering treatment results similar to those of conventional TURP [8,9]. Hwang et al reported that patients who underwent KTP laser vaporization demonstrated significant improvements in International Prostate Symptom Score (IPSS), maximal flow rate (Qmax), quality of life (QoL), and residual urine 3 months after the operation [9].

Because the use of KTP laser vaporization is expected to increase, a need exists for establishing patterns in changes in the serum PSA level after the operation. The elucidation of such patterns might offer useful clinical information on appropriate management and follow-up strategies.

MATERIALS AND METHODS

A total of 662 patients underwent KTP laser vaporization of the prostate for BPH between October 2004 and August 2008. Among these patients, those with prostate cancer, prostatitis, a history of urinary retention, or use of anti-androgen medication, all of which can influence serum PSA levels, were excluded. Also excluded were patients for whom insufficient data were available or who were lost to follow-up. Therefore, 278 patients were included in the prospective analysis of serial serum PSA levels.

Careful history taking, digital rectal examination (DRE), IPSS, urinalysis/urine culture, transrectal ultrasound (TRUS), Qmax, postvoiding residual urine (PVR), and serum PSA levels were checked in every enrolled patient and evaluated to determine whether to perform KTP laser vaporization. Patients with abnormal DRE findings or a serum PSA value of 4.0 ng/ml or higher underwent TRUS-guided 12-core prostate biopsy to detect and exclude prostate cancer. Prostate volume was estimated by TRUS,

first by measuring length (L), width (W), and height (H) and then by calculating volume by use of a prolate ellipsoid formula ($L \times W \times H \times \pi / 6$).

Either epidural or subarachnoid anesthesia was used for the operations, and the vaporization was carried out by use of an 80 W KTP laser system (GreenLight[®] PVTM; Laser-scope, San Jose, CA) that uses a 6 Fr side-deflecting optical fiber emitting laser at a wavelength of 532 nm, which is delivered through a 23 Fr, 30° continuous flow cystoscope connected to videoendoscopy. The distance from the probe to the prostatic tissue was kept closer than 2 mm, and normal saline was used as the irrigation fluid. The vaporization was performed until the tissues that caused the obstruction were completely removed, resulting in the formation of an appropriately sized cavity. A Foley catheter (16 or 18 Fr) was inserted right after the procedure and was removed one day later.

Serum PSA levels were measured in every patient before the operation and 1, 3, 6, and 12 months after the operation to analyze patterns of change. In addition, serum PSA levels at 24 months after the operation were also checked in 183 patients. The mixed linear model in SPSS (version 12.0, SPSS Inc) was used for statistical analysis of the changes in the serum PSA level, and statistical significance was defined as a p-value of less than 0.05.

RESULTS

The mean age of the patients was 69.0 years (range, 50-91 years). The mean serum PSA value was 2.72 ± 2.93 ng/ml, and mean prostate volume estimated by TRUS was 35.7 ± 15.5 cc (Table 1).

The serum PSA level temporarily increased and reached

TABLE 1. Baseline variables

Variables	Mean±SD	Range
Age (years)	69.0±6.7	50-91
Preoperative PSA (ng/ml)	2.72±2.93	0.1-19.4
Prostate volume (cc)	35.7±15.5	12-102
Energy applied (kJ)	161.9±112.0	11.7-486.6
Operation time (min)	46.5±13.9	25-97

PSA: prostate-specific antigen, SD: standard deviation

TABLE 2. Changes in postoperative follow-up PSA

Time	Mean PSA (ng/ml)	PSA changed (ng/ml)	95% CI	p-value ^a
Preoperative	2.72		1.29-1.50	
1 month after	3.18	+0.46	2.08-2.95	0.032
3 months after	1.92	-0.80	0.95-1.23	<0.001
6 months after	1.79	-0.93	0.89-1.17	<0.001
12 months after	1.70	-1.02	0.76-1.01	<0.001
24 months after ^b	1.71	-1.01	0.64-1.32	0.041

PSA: prostate-specific antigen, CI: confidence interval, ^a: p-value of changes compare to preoperative PSA, ^b: measured in only 183 patients among the enrolled patients

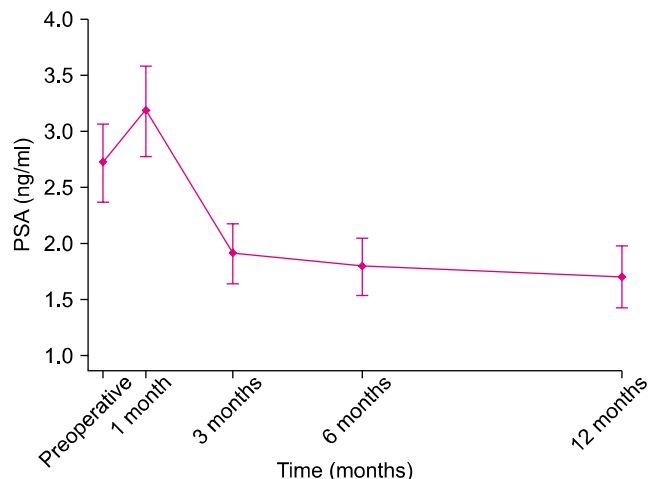


FIG. 1. Patterns of change in the PSA level before and after KTP laser vaporization of the prostate. PSA: prostate-specific antigen, KTP: potassium-titanyl-phosphate.

3.18 ± 3.23 ng/ml at 1 month after the operation ($p=0.032$). However, levels began to decrease continuously afterward and decreased to 1.92 ± 2.26 ng/ml in 3 months ($p < 0.001$) and 1.79 ± 1.82 ng/ml in 6 months ($p < 0.001$). Within 12 months, the serum PSA level was 1.70 ± 2.25 ng/ml ($p < 0.001$), thus demonstrating a decreasing pattern of stabilization (Table 2, Fig. 1). The decreasing pattern showed its greatest value between 1 month and 6 months (Fig. 1). The serum PSA level at 24 months after the operation was not checked in all patients, but it also was shown to decrease and stabilize (Table 2). As a result, the serum PSA level had decreased by 37.5% by 12 months after the operation compared with the preoperative level.

DISCUSSION

BPH is a common disease in older men; 40% to 70% of men over the age of 60 years are suspected of having BPH, and it is still on the rise along with increasing life expectancy and westernized diets [10,11]. TURP is accepted as the standard surgical method for treating the lower urinary tract symptoms of BPH, although several other treatment options have been developed to date. However, complications of TURP such as bleeding, TUR syndrome, urethral stricture, retrograde ejaculation, and urinary incontinence are still among the side effects of this procedure and have not decreased significantly despite developments in techniques and instruments. Accordingly, less invasive surgical options have been investigated [8].

KTP laser vaporization of the prostate was introduced in the 1990s but was not widely accepted as an effective treatment option because it was performed with a low-power (20 W, 34 W) KTP laser in the early years and required a relatively longer surgical time than conventional TURP. More recently, however, the 80 W high-power KTP laser was developed to improve vaporization speed, and as a result, KTP laser vaporization has become an effective treat-

ment modality. Malek et al proved its efficacy by reporting that patients with prostates over 45 cc who underwent 80 W KTP laser vaporization showed significant improvements in IPSS, QoL, Qmax, and PVR within 5 years of follow-up [12]. Therefore, KTP vaporization is now widely practiced in many institutes because of its efficacy and reduced invasiveness, even though some controversy remains concerning its complication rates compared with conventional TURP [13-15].

KTP laser vaporization cannot eradicate prostate cancer that originates in the peripheral zone, however, because it only eliminates tissues at the transitional zone of the prostate [6,16]. Marks et al reported that among 82 patients who underwent TURP to treat lower urinary tract symptoms, prostate cancer had developed in 6 patients within 5 years of follow-up [6]. With KTP laser vaporization in particular, possible pathologic diagnosis of prostate cancer could be missed because it is impossible to obtain a prostate specimen from the operation, which is possible in conventional TURP. Therefore, it would be useful to establish clinical guidelines by serum PSA follow-up after the operation to detect coexisting prostate malignancy with BPH. To date, however, only limited reports on serum PSA changes after KTP laser vaporization of the prostate were available.

It is widely known that serum PSA levels generally increase after interventions on the prostate for a certain period of time and decrease afterward [2,17]. Temporary elevation of the serum PSA level occurs as a result of PSA leakage to the systemic circulation due to damage to the blood-prostate barrier during manipulations [18]. In addition, prostatic inflammation after the manipulation can also facilitate increases in the serum PSA level [2]. There are several different reports on the length of time it takes for the serum PSA level to decrease after a procedure. Volkan et al reported that the serum PSA level increased immediately after KTP laser vaporization, but eventually decreased and returned to its preoperative level within 15 days after the operation [19]. In our series, the serum PSA level increased for up to 1 month and then decreased significantly over the next 3 months. It is not possible to clearly explain this variability in the length of time for which the serum PSA level is increased. Further investigation of the probable responsible factors, such as differences in prostate volume, the preoperative serum PSA level, operating time, and devices, are necessary to clarify this matter.

Aus et al analyzed the serum PSA level of 190 patients who underwent TURP and reported that the serum PSA level was reduced by 70% compared with its preoperative level [20]. They also reported that the serum PSA level became lower than 4 ng/ml in 90% of those patients. Wolff et al also reported that the serum PSA level became stabilized at 2 ng/ml or higher in patients who were diagnosed with prostate cancer after TURP [21]. Therefore, similar to patients who undergo TURP, the possible existence of prostate cancer should also be considered in patients who demonstrate a serum PSA level that remains high or increases constantly after KTP laser vaporization. In our study, the

serum PSA level decreased significantly within 3 months after the operation and showed only a slight decrease from 6 to 12 months, which might mean that the levels stabilize after 6 months.

In the present study, we were able to accurately analyze the changes in the serum PSA level after KTP laser vaporization by frequently checking the postoperative serum PSA level in a relatively large population for more than 1 year. Our results might provide valuable guidelines for clinical practice.

CONCLUSIONS

The serum PSA level may be temporarily increased after KTP laser vaporization for a certain period of time, but values will show a decreasing pattern within 3 months and will eventually become stabilized between 6 and 12 months. Therefore, it may be appropriate to wait for 3 months if the serum PSA level rises after the procedure. However, if the serum PSA level remains high even after 6 months, close follow-up or further investigation should be considered.

Conflicts of Interest

The authors have nothing to disclose.

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