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ORIGINAL RESEARCH

Concomitant Prostate Needle Biopsy and Laser Vaporization of the Prostate Could Be a Risk of Postoperative Hemoglobin Decline, a Retrospective Study

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Purpose: Contact laser vaporization of the prostate (CVP) for benign prostatic hyperplasia is a widely accepted and safe procedure for elderly patients because of its lower bleeding risks. However, CVP lacks a postoperative pathological examination for prostate cancer. Concomitant prostate biopsy and CVP may complement this disadvantage; however, the risk of bleeding associated with this procedure remains unclear. This study aimed to evaluate the safety of a concomitant prostate biopsy and CVP.

Patients and Methods: This retrospective study included 106 men who had undergone CVP in Nerima General Hospital. Prostate biopsies and CVP were performed simultaneously on 16 patients. We defined the "hemorrhage group" by a >5% decrease in hemoglobin the day after surgery. Preoperative and operative indices were evaluated based on the association with the hemorrhage group.

Results: Participants in the concomitant biopsy group were older ($p = 0.001$), had larger prostates ($p = 0.014$), a lower rate of prostate biopsy history ($p = 0.046$), longer postoperative urinary catheter duration ($p = 0.024$), and a higher rate of decline in hemoglobin levels the day after surgery ($p = 0.023$). Patients in the hemorrhage group ($n = 20$, 18.9%) showed a significantly higher rate of concomitant biopsy and CVP ($p = 0.006$). Multivariate analysis showed that concomitant prostate biopsy ($p = 0.009$, odds ratio = 4.61) was the sole statistically significant predictive factor for hemorrhage.

Conclusion: Concomitant prostate biopsy and CVP of the prostate may increase the risk of bleeding.

Keywords: benign prostatic hyperplasia, contact laser vaporization of the prostate, diode laser, prostate biopsy, vaporization

Introduction

Benign prostatic hyperplasia (BPH) is a common condition among older men, and surgical intervention provides a valuable treatment option for specific patients.[1] Transurethral resection or enucleation of the prostate using a bipolar device or a holmium laser have long been conventional surgical procedures for BPH. However, with the increase in age, the number of patients with cardiac disease and those taking antiplatelet or anticoagulant medications has increased.

Contact laser vaporization of the prostate (CVP) for BPH is an endoscopic laser vaporization technique that uses a 980-nm diode laser. CVP has become popular for BPH treatment because the laser effectively absorbs water and hemoglobin, and it offers excellent ablation capacity along with hemostatic properties.[2–4] Laser vaporization of the prostate is associated with reduced bleeding compared with traditional transurethral surgery and is considered safe, even for patients under antithrombotic therapy.[2,5,6]

Prostate cancer is the second most commonly diagnosed cancer in men.[7] Prostate-specific antigen (PSA) screening test is recommended for early detection of prostate cancer, particularly in elderly men. PSA testing also plays a role in evaluating patients presenting lower urinary tract symptoms.[8] When PSA is elevated, magnetic resonance imaging (MRI) tests, digital rectal examination (DRE), and/or needle biopsy is considered to diagnose prostate cancer. Needle biopsy is

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particularly necessary in diagnosing prostate cancer.[9] However, systematic prostate biopsy based solely on high PSA levels can catch up to be negative in 50–80% of the cases.[10] Many patients undergo nonessential invasive procedures and face potential complications of biopsy, such as pain, infection, bleeding, urinary retention, or sexual dysfunction.[11,12] The PSA follow-up is selected if PSA is mildly elevated but other clinical indicators including MRI, DRE, and PSA density are negative.[13] In practice, transurethral resection or enucleation of the prostate is sometimes performed without strict pretreatment examination to rule out prostate cancer in patients with low likelihood of clinically significant prostate cancer, and it is incidentally detected after the surgery.[14] In such cases, clinicians provide appropriate treatment after the diagnosis of prostate cancer.

In laser vaporization of the prostate, there is a risk of missing incidental prostate cancer due to the inability to perform a subsequent pathological examination.[15] Therefore, we performed concomitant prostate biopsy and CVP in patients with a low likelihood of having clinically significant prostate cancer to examine subsequent pathological diagnosis. However, a concomitant biopsy and CVP may increase the risk of perioperative bleeding and other complications. This study aimed to evaluate the safety of concomitant prostate biopsy and CVP.

Materials and Methods

Patient Selection

We retrospectively reviewed the clinical records of 106 male patients who underwent CVP for BPH at Nerima General Hospital from January 2020 to May 2023. We compared patients who underwent only CVP with those who also underwent concomitant prostate biopsy according to the following preoperative and operative indices: age, body mass index, prostate volume, PSA level, PSA density, preoperative hemoglobin level, continuation of antithrombotic therapy, postvoid residual urine volume, history of urinary retention, preoperative use of urethral catheters, history of prostate biopsy, operative time, laser treatment time, total amount of laser energy, operative use of transurethral bipolar coagulation, hemoglobin level, rate of decline in hemoglobin levels the day after surgery, perioperative blood transfusion, duration of postoperative urethral catheterization, length of hospitalization, and postvoid residual urine volume 3 months after surgery. The indication of concomitant prostate biopsy and CVP surgery was PSA levels exceeding the ordinal cut-off value of 4 ng/mL, yet it demonstrated a low probability of prostate cancer (ie, PSA < 10 ng/mL, PSA density <0.15 ng/mL/mL, negative DRE findings, negative MRI findings if performed, and life expectancy <10 years), and the final decision was depended on the attending physician and the patient. All patients underwent bowel preparation, including oral laxatives the day before surgery and enema on the day of surgery. While the patients were under general anesthesia, the procedure was performed with a 980-nm diode laser (180 W LEONARDO®180 laser system, CeramOptec GmbH, Bonn, Germany) with a Twister LD fiber, using 22.5Fr continuous flow cystoscopy. All prostate biopsies were 12-core systematic biopsies performed via the transperineal approach immediately before CVP, after induction of general anesthesia.

Statistical Considerations

Patient characteristics and operative parameters are presented as number of patients or median and interquartile range. Complications were categorized according to the Common Terminology Criteria for Adverse Events, version 5.0. Preoperative and operative factors between the groups were compared using the chi-square test and Student's *t*-test properly. Among the concomitant biopsy group, we reviewed the characteristics of the patients with prostate cancer.

The hemoglobin levels before and after the surgery were compared; the "hemorrhage group" was defined as patients whose hemoglobin concentration on the first day after surgery decreased by >5% compared to the preoperative concentrations, exceeding the upper limit of the interquartile range of our cohort. We analyzed the association between the rate of change in hemoglobin concentration after surgery and other preoperative and operative factors, which were evaluated by categorizing them based on median values. A multivariate analysis was performed using a multiple logistic regression model.

Statistical analyses were performed using SPSS Statistics (version 27.0; IBM Corporation, Armonk, NY, USA), and *p*-values of <0.05 were considered statistically significant.

Results

At baseline, 106 men had a median age of 73 years, prostate volume of 50 mL, hemoglobin level of 13.7 g/dL, and CVP laser treatment time of 1237 seconds (Table 1). No patients exhibited hematologic disorders or received immunosuppressive therapy. Sixteen patients were maintained on antiplatelet or anticoagulant medications during surgery.

Sixteen patients underwent prostate biopsy and CVP simultaneously and 90 underwent CVP only. The concomitant biopsy group was older ($p = 0.001$), had larger prostates ($p = 0.014$), a lower rate of prostate biopsy history ($p = 0.046$), longer postoperative urinary catheter duration ($p = 0.024$), and a higher rate of hemoglobin decline on the day after surgery ($p = 0.023$) (Table 1). A significant postoperative decline in hemoglobin level was observed in the concomitant biopsy group (paired-samples *t*-test, $p = 0.022$) but not in the CVP-only group (paired-samples *t*-test, $p = 0.114$).

All the postoperative complications are shown in (Table 2). The most common complication was hematuria (13.2%). The incidence of complications of all grades or grade 3 or higher was not significantly different between the two groups. Only one case of postoperative hematuria requiring transurethral bipolar coagulation occurred in the concomitant biopsy group.

From the patients who underwent concomitant biopsy and CVP, we diagnosed two patients with prostate cancer. One patient was 80-years-old man, with a PSA level of 5.7 ng/mL and a prostate volume of 46 mL. Adenocarcinoma was diagnosed in accordance with a Gleason score of 3 + 3 and was treated with hormonal therapy. The other patient was 75-years-old man, with

Table 1 Patient Characteristics

	All patients (n = 106)	CVP + biopsy (n = 16)	CVP (n = 90)	P-value
Age, yr (IQR)	73 (66–80)	80 (75–84)	71 (66–79)	0.001
Body mass index, kg/m^2 (IQR)	23.8 (21.3–25.8)	22.4 (21.0–25.8)	24.0 (21.5–25.7)	0.694
Prostate volume, mL (IQR)	50 (35–75)	67 (48–85)	45 (31–70)	0.014
PSA level, ng/mL (IQR)	4.17 (1.59–6.19)	6.67 (5.42–10.95)	3.68 (1.49–5.68)	0.468
PSA density, ng/mL/mL (IQR)	0.07 (0.04–0.12)	0.11 (0.07–0.17)	0.07 (0.03–0.12)	0.948
Preoperative hemoglobin level, g/dL (IQR)	13.7 (13.0–14.7)	13.4 (13.0–14.6)	13.8 (13.0–14.7)	0.854
Continuance of antithrombotic therapy, n (%)	16 (15.1)	2 (12.5)	14 (15.6)	1.000
Preoperative postvoid residual urine volume, cc (IQR)	98 (50–226)	247 (68–700)	90 (46–166)	0.158
History of urinary retention, n (%)	46 (43.4)	7 (43.8)	39 (43.3)	0.975
Preoperative usage of urethral catheter, n (%)	25 (23.6)	5 (31.2)	20 (22.2)	0.523
History of prostate biopsy, n (%)	39 (36.8)	2 (12.5)	37 (41.1)	0.046
Operative time, min (IQR)	41 (27–56)	43 (35–63)	39 (27–56)	0.464
Laser treatment time, sec (IQR)	1237 (898–1852)	1285 (1051–1788)	1198 (849–1933)	0.902
Total laser energy, kJ (IQR)	138 (84–243)	171 (116–248)	131 (81–239)	0.760
Operative use of transurethral bipolar coagulation, n (%)	14 (13.2)	3 (18.8)	11 (12.2)	0.082
Hemoglobin level at postoperative day one, g/dL (IQR)	13.5 (12.5–14.2)	13.1 (12.0–13.9)	13.8 (12.7–14.3)	0.112
Rate of hemoglobin decline at postoperative day one, (IQR)	0.02 (0.00–0.05)	0.05 (−0.01–0.09)	0.02 (0.00–0.05)	0.023
Perioperative blood transfusion, n (%)	0 (0)	0 (0)	0 (0)	0.440
Length of postoperative urethral catheterization, day (IQR)	3 (3–4)	4 (3–5)	3 (3–4)	0.024
Length of hospitalization, day (IQR)	6 (6–7)	6 (6–7)	6 (6–7)	0.895
Postvoid residual urine volume at three months after the operation, cc (IQR)	46 (27–89)	56 (25–181)	46 (26–84)	0.198
Positive for cancer, n (%)	2 (1.9)	2 (12.5)	–	

Abbreviations: CVP, contact laser vaporization of the prostate; IQR, interquartile range; PSA, prostate-specific antigen.

Table 2 Complications after Surgery

	All patients (n = 106)	CVP + biopsy (n = 16)	CVP (n = 90)	P-value
All grades, n (%)	40 (37.7)	5 (31.2)	35 (38.9)	0.470
Hematuria, n (%)	14 (13.2)	2 (12.5)	12 (13.3)	0.627
Urinary retention, n (%)	13 (12.2)	0 (0)	13 (14.4)	0.120
Urinary tract infection, n (%)	6 (5.7)	2 (12.5)	4 (4.4)	0.200
Urinary tract obstruction, n (%)	4 (3.8)	1 (6.3)	3 (3.3)	0.462
Stress urinary incontinence, n (%)	2 (1.9)	0 (0)	2 (2.2)	0.736
Aspiration, n (%)	1 (0.9)	0 (0)	1 (1.1)	0.858
Grade 3 or above, n (%)	11 (10.4)	2 (12.5)	9 (10.0)	0.483
Hematuria, n (%)	6 (5.7)	2 (12.5)	4 (4.4)	0.200
Urinary tract obstruction, n (%)	3 (2.8)	0 (0)	3 (3.3)	0.630
Urinary tract infection, n (%)	1 (0.9)	0 (0)	1 (1.1)	0.858
Aspiration, n (%)	1 (0.9)	0 (0)	1 (1.1)	0.858

Abbreviation: CVP, contact laser vaporization of the prostate.

a PSA level of 5.1 ng/mL and a prostate volume of 41 mL. Adenocarcinoma was diagnosed in accordance with a Gleason score of 4 + 3, with no metastasis, and was treated with hormonal therapy.

Twenty patients showed a postoperative hemoglobin decrease of >5% (hemorrhage group). Patients in the hemorrhage group were older ($p = 0.047$), had higher PSA levels ($p = 0.019$), higher preoperative hemoglobin levels ($p = 0.012$), and a significantly higher rate of concomitant biopsy ($p = 0.006$) than those in the control group. The prostate volume and continuation rate of antithrombotic therapy were not significantly different between the two groups. Multivariate analysis showed that only concomitant prostate biopsy ($p = 0.009$, odds ratio [OR] = 4.61; 95% confidence interval, 1.46–14.5) was a significant predictor in the hemorrhage group (Table 3).

Table 3 Multivariate Analysis for Factors Associated with Hemoglobin Decline of More Than 5% on Postoperative Day One

	Hemoglobin decline		Univariate	Multivariate	
	≤5% (n = 86)	>5% (n = 20)	p-value	p-value	Odds ratio (95% CI)
Concomitant biopsy, n (%)	9 (10.5)	7 (35.0)	0.006	0.009	4.61 (1.46–14.5)
Age > 73 years, n (%)	47 (54.7)	6 (30.0)	0.047		
Body mass index > 23.7 kg/m^2, n (%)	43 (50.0)	10 (50.0)	1.000		
Prostate volume > 50 mL, n (%)	38 (44.2)	12 (60.0)	0.638		
PSA level > 4.17 ng/mL, n (%)	40 (46.5)	15 (75.0)	0.019		
PSA density > 0.07 ng/mL/mL, n (%)	41 (47.7)	11 (55.0)	0.555		
Preoperative hemoglobin level > 13.7 g/dL, n (%)	36 (41.9)	15 (75.0)	0.012		
Continuation of antithrombotic therapy, n (%)	13 (15.1)	3 (15.0)	0.647		
Operative time > 41 min, n (%)	41 (47.7)	10 (50.0)	0.851		
Laser treatment time > 1237 sec, n (%)	39 (45.3)	13 (65.0)	0.255		
Total laser energy > 138 kJ, n (%)	41 (47.7)	12 (60.0)	0.321		

Abbreviations: CI, confidence interval; IQR, interquartile range; PSA, prostate-specific antigen.

Discussion

CVP and other endoscopic laser vaporization procedures can be safely performed even in patients under antithrombotic therapy because of reduced bleeding compared with traditional transurethral surgery.[2,5,6] As patients undergoing surgery for BPH are aging, the number of patients receiving antithrombotic therapy has increased, and laser vaporization techniques have gained popularity as a treatment for BPH.[16,17] Among patients for whom laser vaporization of the prostate is considered, a certain number of patients have slightly elevated PSA levels but a low likelihood of prostate cancer. The disadvantage of laser vaporization alone is that the tissue cannot be examined pathologically; therefore, a pathological diagnosis is not possible. Hence, simultaneous prostate biopsy and laser vaporization may enable post-operative pathological tissue diagnosis. However, no studies have addressed the safety of concomitant prostate biopsy and laser vaporization for BPH, although the safety of concomitant prostate biopsy and transurethral resection of the prostate has been reported in some studies.[18,19]

In this study, patients who underwent CVP only were compared with those who underwent CVP and prostate biopsy, and there were significant differences in several factors. Among such factors, it is natural that the rate of history of prostate biopsy was low in the concomitant biopsy group because patients who had already ruled out prostate cancer by past prostate biopsy were included in the CVP only group. Patients in the concomitant biopsy group were older; this could be because younger patients who had a longer life expectancy were more willing to undergo biopsy before surgery for BPH. The larger prostate volume observed in the concomitant biopsy group may be attributed to our tendency to preliminarily classify larger prostates, that is, lower PSA density, as less likely to be prostate cancer, thereby allowing the omission of preoperative biopsies.

In this study, we evaluated the safety of concomitant prostate biopsy and CVP. We observed no significant differences in complication rates. In terms of the occurrence of infection, a common complication following prostate needle biopsy, its low incidence may be attributed to the transperineal approach.[20] The rate of hematuria was also not significantly different between the groups. However, the rate of change in hemoglobin levels after surgery in the concomitant biopsy group was significantly higher than that in the control group ($p = 0.023$). A significant postoperative decline in hemoglobin level was also observed exclusively in the concomitant biopsy group (paired-samples t-test, $p = 0.022$). Multivariate analysis identified concomitant biopsy as an independent predictive factor for hemoglobin decline (OR = 4.61). These findings suggest a potential association between concomitant biopsy and perioperative bleeding.

After prostate needle biopsy, intraglandular hemorrhage is known to occur in the majority of patients, which can be easily detected by MRI imaging.[21] Postprocedural hemorrhage in the prostate tissue following biopsy sometimes causes hematuria regardless of whether the biopsy was done through the rectum or perineum; however, bleeding is not clinically significant and is seldom troublesome.[20] This is possibly because the prostate is an elastic solid organ, and hemorrhages in the prostate after a simple biopsy are usually confined and localized in the prostate tissue. However, if CVP is performed immediately after biopsy, bleeding in the deep layer of the prostate after the biopsy may become apparent when the surface is vaporized by CVP, and some blood may be lost in the irrigation fluid until hemostasis is achieved by the laser.

Laser coagulation has been reported to be unsuitable for hemostasis of large vessels (>500 μm in diameter), possibly because of its shear stress and flow velocity.[22] A 980-nm wavelength diode laser, which is used in CVP, has good absorption of hemoglobin and water and can simultaneously cause evaporation of prostate tissue and form a coagulation layer on the vascular end, which enables vaporization of the prostate without blood loss, but may not be useful in stopping high-flow bleeding from large vessels. Concomitant prostate biopsy and CVP may compromise the advantages of CVP as it provides surgery with a lower risk of bleeding.

As an additional note, no significant difference was observed in prostate volume between the hemorrhage and control groups. A large prostate gland is typically considered a predictor of perioperative blood loss during endoscopic surgery for BPH; however, our results suggest otherwise.[23] Although the interquartile range of the prostate volume in our cohort was 35–75 cc and the instances of prostate volume >80 cc were limited, these findings indicate that CVP is generally safe in terms of bleeding risk.

This study had several limitations. The nature of the study was retrospective, with a small sample size and a single-center design. Validation of these findings in a large cohort and prospective study is required. Moreover, the clinical importance of a >5% decrease in hemoglobin levels may be controversial. However, to the best of our knowledge, this study is the first to examine the safety of concomitant prostate biopsy and CVP, and our results show that simultaneous

biopsy and CVP could entail a risk of bleeding. This finding would make surgeons predict bleeding in concomitant cases and guide clinicians in obtaining an appropriate preoperative informed consent from the patients.

Conclusion

Concomitant prostate biopsy may increase the risk of bleeding associated with CVP. Therefore, educating patients about this risk while planning a simultaneous prostate biopsy and CVP for subsequent pathological examinations is important.

Ethics

This study was approved by the Ethics Committee of the Nerima General Hospital (20220712-1). It also conforms to the ethical principles of the Declaration of Helsinki.

Informed Consent

Obtained via an opt-out approach.

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Author Contributions

All authors made a significant contribution to the study, whether in its conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave the final approval of the version to be published; agreed on the journal to which the article has been submitted; and agreed to be accountable for all aspects of the work.

Disclosure

The authors have no conflicts of interest.

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