



Original Article

The effect of prostatic inflammation on clinical outcomes in patients with benign prostate hyperplasia

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ABSTRACT

Background: To investigate the effect of asymptomatic inflammatory prostatitis on clinical outcomes of patients undergoing trans urethral resection of prostate due to benign prostatic hyperplasia.**Materials and methods:** A total of 514 patients were enrolled in the study. Clinical parameters and pathological results were compared before and one year after surgery.**Results:** Of the patients 310 were diagnosed with purely benign prostatic hyperplasia and the others were diagnosed with both prostatic inflammation (category IV) and benign prostatic hyperplasia. No statistical significance was observed between two groups among the parameters including age, prostate volume and post voiding residue ($P > 0.05$). Patients with prostate inflammation presented higher preoperative International Prostate Symptom Score and lower Qmax values when compared to those without inflammation before trans urethral resection of prostate.**Conclusion:** Asymptomatic prostate inflammation can lead to worsen lower urinary tract symptoms and urinary flow rate in patients with benign prostatic hyperplasia. Furthermore, the improvement of the complaints after surgery was worse in patients with asymptomatic prostate inflammation. Further well designed prospective-randomised studies are needed to support our findings.© 2018 Asian Pacific Prostate Society, Published by Elsevier Korea LLC. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Benign prostatic hyperplasia (BPH), which is defined as hyperplasia in stroma and glands of prostate histologically, is a common benign neoplasm in men after the age of 50 years.¹ It is characterized by the lower urinary tract symptoms (LUTS) and bladder outlet obstruction. LUTS result from several diseases but benign prostatic enlargement is the leading cause and more than 50% of men aged above 50 years are believed to experience LUTS secondary to an enlarged prostate gland.^{2–4}

Although BPH/LUTS are likely to cause an even heavier burden on health-care systems, the pathogenesis of this condition is still largely unknown. Many factors are likely to be involved in the development and progression of prostate enlargement. Epidemiological and histopathological studies have indicated the possible role of prostate inflammation in the pathogenesis of LUTS and BPH.⁵

Histological evidence of prostatic inflammation is investigated in patients with BPH who do not have symptoms of prostatitis. Asymptomatic prostate inflammation is acknowledged in the National Institute of Health (NIH) classification of prostatitis (category IV) and has been detected in 43–98% of surgically resected prostatic tissues removed for BPH.⁶ The standardized classification system of chronic prostatitis and chronic pelvic pain syndrome which was proposed by Nickel et al in 2001 can be used in the evaluation of prostatic inflammation in prostate biopsies, transurethral resected prostatic tissues, or prostatectomy specimens.⁷ The purpose of the present study was to compare the effect of prostatic inflammation on the outcomes of clinical parameters of the patients undergoing transurethral resection of the prostate (TURP) due to BPH.

2. Materials and methods

After receiving approval of an Ethics Committee of the Okmeydani Training and Research Hospital, Istanbul, Turkey, the records of patients who underwent TURP due to BPH were examined

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retrospectively between 2013 and 2015. After scanning the data of the patients, a total of 514 patients were included in the study along with clinical information and histopathological results.

Inclusion criteria were identified as follows: patients with LUTS due to BPH admitted to urology clinic, over the age of 50 years, with no previous urologic surgery. Patients were excluded from the study if they had positive urine culture, chronic pelvic pain syndrome diagnosed according to the NIH classification (category III prostatitis), acute and chronic bacterial prostatitis bladder or prostate cancer, bladder stone, urethral stenosis, and neurological diseases. After the medical data screening conducted according to these criteria, 514 patients were defined as BPH. Among them 86 patients (17%) underwent catheterization due to acute urinary retention, and 204 patients (40%) had prostatic inflammation (category IV prostatitis). BPH was diagnosed with digital rectal examination, micturition symptoms, and transrectal guided ultrasound. All patients received alpha-blocker therapy for at least 3 months before TURP except those with a urethral catheter.

Information of the patients, such as weight, height, blood pressure, medical history of hypertension, diabetes, serum prostate specific antigen (PSA) levels, maximal urine flow (Qmax), and post voiding residue (PVR), was collected when the patients were admitted to the urology clinic. Prostate volume was calculated by transrectal ultrasonography. International Prostate Symptom Score (IPSS) had been surveyed by questionnaire before TURP and 1 year after TURP, respectively.⁸

Prostate inflammation was determined by evaluation the samples obtained from TURP. Inflammatory cells infiltration within BPH tissue was defined according to the histopathological classification system of prostatic inflammation reported by Nickel et al which evaluated prostatic inflammation for location (glandular, periglandular, and stromal), extent (focal, multifocal, and diffuse) and grade (mild, moderate, and severe).⁷

2.1. Statistical analysis

The normality test was performed using Kolmogorov–Smirnov test. Mann–Whitney U or Student *t* test was performed comparing continuous variables between the two groups according to normality test. χ^2 test was performed for categorical variables. All analyses were performed using SPSS, version 19 (SPSS Inc., Chicago, IL, USA). All demographic values were presented as means with standard deviations. All tests for statistical significance were 2-tailed, and $P < 0.5$ was deemed significant.

3. Results

Overall 514 patients were retrospectively enrolled. All patients underwent TURP. Of the participants, 310 were diagnosed with BPH alone, and the others were diagnosed with both prostatic

inflammation (category IV) and BPH. A urethral catheter was inserted into 36 patients with BPH alone (7%) and 50 patients with prostatic inflammation/BPH (10%), respectively.

The age range of patients was between 50 and 81 years (median 68 years); the average of the prostate volume was 59 ml (33–90). Patients' characteristics such as age, PVR, prostate volume, and PSA are summarized in Table 1. All patients were treated with TURP. The mean operation time was 64.3 ± 24.5 minute, and the average catheterization time was 3.6 ± 1.2 days. Thirty-three patients had postoperative complications (transient hematuria in 14 patients, urinary retention resolved by recatheterizations in 11 patients and urinary tract infections in 8 patients). No conversion to open surgery in any case and no TURP-related death was recorded during the study period.

Patients were divided into two groups depending on whether they were catheterized preoperatively or not. Then, both groups were divided into two in itself according to the presence of prostatic inflammation or not. No statistical significance was observed among the patients in terms of age, prostate volume, and PVR ($P > 0.05$). However, PSA level of the BPH/prostatic inflammations group was significantly higher than the BPH alone group: 3.8 ± 4.4 ng/dl (0.16–7.2) versus 2.5 ± 1.8 ng/dl (0.25–6.2), $P = 0.001$, before TURP. Patients with prostate inflammation presented higher preoperative urethral catheterization rate when compared to those without inflammation (50 of 204 patients with BPH/prostate inflammation vs. 36 of 310 patients with BPH alone, 11.6%, 24.5%, respectively, $P < 0.05$) (Table 1).

Overall, 310 of 514 patients (60.3%) showed no sign of prostate inflammation at the histology report, whereas 204 of 510 patients (39.7%) presented an inflammatory infiltrate. Inflammation was mild in 107 of 204 (52.5%) patients, moderate in 82 of 204 (40.2%) patients, and severe in 15 of 204 (7.1%) patients according to the histopathological classification system. Anatomic location of prostate inflammation occurred within stromal (47.4%), glandular (21.4%), and periglandular (31.1). Regarding inflammatory infiltration extent, focal region infiltration occurred in 101 patients (49.3%), multifocal zone infiltration took place in 57 patients (27.9%), and diffuse area infiltration occurred in 46 patients (22.7%) (Table 3).

Patients with prostate inflammation presented higher (worse) preoperative IPSS and lower Qmax scores when compared to those without inflammation before TURP (29.9 ± 9 , five vs. 23 ± 5.3 and 6.2 ± 1.9 vs. 8.4 ± 1.9 , respectively, $P < 0.05$). In the same way, statistically significant differences in total IPSS scores and Qmax scores were found 1 year after TURP ($P < 0.05$) (Table 2). No differences were observed between patients with mild and moderate-to-severe inflammation.

4. Discussion

In the last few years, several studies have examined the relationship between BPH and prostate inflammation. Epidemiological

Table 1
Baseline patient characteristics before and 1 year after TURP

Total (n = 514)	BPH*	BPH/prostatic inflammation (category IV)*	P
Before TURP	(n = 274)	(n = 154)	
Age (year)	65.9 ± 6.7	67.1 ± 7.4	0.81
Serum PSA level (ng/dl)	2.5 ± 1.8	3.8 ± 4.4	0.001
Prostate volume (cm ³)	57.5 ± 11.3	57.1 ± 6.8	0.75
Post voiding residue (ml)	65.3 (35.1–92.4)	71.9 (36.0–100.3)	0.48
1 year after TURP	(n = 274)	(n = 154)	
Prostate volume (cm ³)	23.6 ± 9.5	25.4 ± 6.3	0.64
Post voiding residue (ml)	12.7 ± 4.3	14.0 ± 5.2	0.67
Catheterization/acute urinary retention	n = 36/310 (%11.6)	n = 50/154 (24.5%)	0.0002

BPH, benign prostatic hyperplasia; SD, standard deviation; TURP, transurethral resection of the prostate. Data are presented as mean ± SD or median interquartile range (IQR).

*Patients with urethral catheter were not included in statistical analysis.

Table 2
Comparison of IPSS and Qmax scores between two groups

IPSS and Qmax scores (n = 428)	BPH	BPH/chronic prostatitis (category IV)	P
Before TURP			
Total scores (IPSS) ^{a)}	23 ± 5,3	29,9 ± 9,5	0,001
Qmax (ml/s)	8,4 ± 1,9	6,2 ± 1,9	0,001
1 year after TURP			
Decrease of IPSS (Δ value)	18,2 ± 4,9	15,4 ± 4,8	0,001
Increase of Qmax (ml/s) (Δ value)	11,6 ± 3,7	8,8 ± 2,5	0,001
	n = 274	n = 154	

BPH, benign prostatic hyperplasia; IPSS, International Prostate Symptom Score; SD, standard deviation; TURP, transurethral resection of the prostate; Qmax, maximal urine flow.

Data are presented as mean ± SD.

^{a)} Patients with urethral catheter were not included in statistical analysis.

Table 3
Histopathological characteristics of prostatic inflammation

Characteristics	BPH/prostate inflammation (category IV) (n = 204)
Anatomical location	
Glandular	43 (%21,4)
Periglandular	64 (%31,1)
Stromal	73 (%47,4)
Extent	
Focal	101 (%49,3)
Multifocal	57 (%27,9)
Diffuse	46 (%22,7)
Grade	
Mild	107 (%52,5)
Moderate	82 (%40,2)
Severe	15 (%7,1)

BPH, benign prostatic hyperplasia.

Data are present as mean %.

and histopathological studies have indicated that prostate inflammation is not only a common finding in BPH but also plays a primary role in prostatic cells overgrowth, and a direct relationship exists between the degrees of inflammation and LUTS.^{8–10}

In a previous study, although men with chronic prostatitis routinely receive antiinflammatory and antimicrobial therapy, they found that leukocytes and bacterial counts as they defined them do not correlate with severity of symptoms.¹¹ It is the reason why not to detect prostate inflammation by counting white blood cells. However, in another study, inflammatory cells and proinflammatory cytokines such as interferon-mRNA, interleukins (IL-2, IL-4, IL-6, IL-7, IL-8 IL-15, IL-17) and tumor necrosis factor-alpha (TNF-a) have been detected on histopathology of resected specimens of BPH.¹² Engelhardt et al showed that a direct association between asymptomatic inflammatory prostatitis NIH category IV, a high incidence of prostatic calcification, and significantly greater TNF-a expression in patients with obstructive BPH.¹³ In the present study, we diagnosed inflammation by analyzing inflammatory cells in resected specimens of BPH.

The present study showed that no statistical significance was observed among the patients in terms of prostate volume unlike recently published study by Nickel et al. In that study, chronic prostatic inflammation was detected at a rate of 77.6% in a large cohort of patients (Reduction by Dutasteride of prostate Cancer Events (REDUCE), n = 8824). Inflammation was associated with higher prostate volume (46.5 cm³ vs. 43.4 cm³; P < 0.0001) and higher IPSS score (8.8 vs. 8.2; P < 0.05).¹⁴ Another study published by Hu et al showed that patients in the BPH/asymptomatic inflammatory prostate group had typically larger prostate volumes than the BPH alone group. They also concluded that neither Qmax rate nor serum PSA density showed a significant difference between the two groups.¹ In the present study, PSA density, Qmax,

and total IPSS scores showed a significant difference between BPH/prostate inflammation and BPH separate groups.

Our study confirmed that prostatic inflammation is frequently found in patients with BPH (204 of 514; 40%), and significant differences regarding baseline and 1 year after postoperative total IPSS and Qmax score were observed between patients with and without prostate inflammation. The present study also showed that patients with BPH/prostate inflammation had higher preoperative urinary catheterization rate compared with BPH alone group. It may be due to the secretion of cytokines from inflammatory cells, and these cells continue to release inflammatory cytokines from the residual prostate tissue after TURP which may cause the bladder neck and detrusor muscle disorders.

We evaluated the prostate tissue obtained from TURP according to the grade, extent, and anatomical location of the histopathological classification system. The result obtained from the study showed that inflammation was mostly observed in the stromal area (47.4%), focal extent (41.3%), and mild grade (52,5%) which was confirmed by Hu et al.¹ They found that mild, focal, and stromal prostatic inflammation had accounted for the majority. Furthermore, Nickel et al demonstrated that periglandular inflammation was the most common pattern, and it constituted 0.5% of all glandular volume in surgical specimens of 100 patients who underwent to TURP without clinical prostatitis.¹⁵

PSA level increases in patients with symptomatic prostatitis.¹⁶ However, the effect of inflammatory prostatitis on serum PSA level is under debate. Nickel et al reported that there was no correlation between inflammation pattern, prostate volume, and serum PSA level.¹⁵ Furthermore, Morote et al did not observe any statistically significant difference in serum PSA levels between the patients with and without prostate inflammatory.¹⁷ Similarly, Okada et al reported that serum PSA levels were high in patients with polymorphonuclear leucocytes predominance in infiltration (acute histological prostatitis), and serum PSA levels were normal in patients with mononuclear cell predominance (chronic histological prostatitis).¹⁸ In contrast, Simard et al reported that the extension of the inflammatory process was directly related to elevations of serum PSA levels in asymptomatic patients.¹⁹ The study published by Ozden et al also showed that high serum PSA levels in BPH patients could correlate with high inflammatory aggressiveness score in asymptomatic inflammatory prostatitis.²⁰ Our data demonstrated that PSA level was greater in the group of patients with histological prostatic inflammation at baseline compared with those with no inflammation. The differences were small but statistically significant.

There are several limitations to this study. First, we evaluated prostatic inflammation in resected prostatic tissue merely histologically. Inflammation markers, cytokines in extraprostatic secretions could be included in the analysis to enhance the robustness of the analysis. Additionally, the production of reactive oxygen species commonly produced from inflammatory cells through either

endogenous or exogenous insult might play a significant role in age-related diseases including BPH. They should also be included in the evaluation. Last, though we did not find a significant difference between groups for prostate volume, the resected prostate volume should also be compared. However taking into account the similarity of average prostate volume in two groups and that of the surgeon's skills and experience, we may postulate that the resected prostatic tissue was comparable between groups.

The results of our study suggest that prostate inflammation may lead to worse IPSS and Qmax scores in the patients with BPH. Furthermore, it can cause slightly higher PSA levels in patients with BPH/prostate inflammation. However, we did not see significant differences between two groups regarding prostate volume. We think that this situation can help us to understand the effect of prostatic inflammation on the worse IPSS and Qmax scores independent of prostate volume. But it is still unclear how the inflammation causes symptoms of the urinary tract such as acute urinary retention, higher IPSS score, and lower flow rate. We need further studies about the inflammatory pathways and inflammatory mediators to support our findings in the future.

Conflicts of interest

No conflict of interest was declared.

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