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Original Article

The association of benign prostatic hyperplasia with lower urinary tract stones in adult men: A retrospective multicenter study

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Abstract *Objective:* To examine the relationship between benign prostatic hypertrophy (BPH) and the presence of lower urinary tract stones.
Methods: We retrospectively reviewed the records of men with lower urinary tract stones who presented to three clinical centers in Korea over a 4-year period. We divided the patients into two groups based on the location of urinary stones: Group 1 (bladder calculi) and Group 2 (urethral calculi). We compared the characteristics of both groups and performed univariate and multivariate analyses with a logistic regression model to investigate the relationship between BPH and lower urinary tract stones.
Results: Of 221 patients, 194 (87.8%) had bladder calculi and 27 (12.2%) had urethral calculi. The mean age of Group 1 was higher than that of Group 2 (68.96 ± 12.11 years *vs.* 55.74 ± 14.20 years, $p < 0.001$). The mean prostate volume of Group 1 was higher than that of Group 2 (44.47 ± 27.14 mL *vs.* 24.70 ± 6.41 mL, respectively, $p < 0.001$). Multivariate

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logistic regression showed that age (OR = 1.075, 95%CI: 1.023–1.129) and prostate volume (OR = 1.069, 95%CI: 1.017–1.123) were independently associated with increased risk for bladder calculi. Upper urinary tract stones and/or hydronephrosis conferred a 3-fold risk for urethral calculi (OR = 3.468, 95%CI: 1.093–10.999).

Conclusion: Age and prostate volume are independent risk factors for bladder calculi. In addition, men with upper urinary tract disease are at greater risk for urethral calculi, which may migrate from the upper urinary tract rather than from the bladder.

1. Introduction

Q1 Benign prostatic hyperplasia (BPH) is highly prevalent in elderly men and affects approximately 50% of all men between 60 and 70 years old [1]. Twenty-five percent to 50% of those with BPH have lower urinary tract symptoms (LUTS), such as flow impedance and sensations of incomplete emptying, related to bladder outlet obstruction (BOO). Furthermore, BPH is associated with additional complications such as acute urinary retention, hematuria, urinary tract infection, and urinary stones [1,2].

Historically, lower urinary tract stones have been associated with a variety of disorders of the lower urinary tract, such as neurogenic bladder, BPH, and urethral stricture [3]. These disorders are known to cause urinary stasis and infection. Bladder and urethral stones are two common types of lower urinary tract stones and account for 5% and 0.3% of all urinary stone diseases, respectively [3,4]. Bladder calculi are commonly found in elderly men with lower urinary tract obstruction, such as BPH [5,6]. Although urethral calculi primarily arise in association with urethral foreign bodies or anatomical anomalies such as urethral strictures or diverticula, the bladder is considered to be a primary source of urethral calculi in adults [3,4].

Although BPH is assumed to be associated with BOO and urinary stasis, the role of the prostate in the pathogenesis of lower urinary tract stones has not been well explored. In this study, we compared the characteristics of men with two types of lower urinary tract stones to help elucidate the role of BPH in the formation of lower urinary tract stones.

2. Materials and methods

We retrospectively identified men with lower urinary tract stones who presented consecutively to three clinical centers in Korea (Eulji University Daejeon Hospital, Konkuk University Chungju Hospital, and Yonsei University Wonju Severance Christian Hospital) between May 2010 and May 2014. Two hundred and thirty-five patients were identified. We collected data from men over the age of 19 years old to exclude the patients with lower urinary tract stones associated with an anatomic abnormality such as a urethral stricture or diverticulum that were common in childhood. Bladder and urethral calculi were confirmed by computed tomography (CT) or cystoscopy. Urethral calculi were defined as any calculi in urethra from the meatus through to the bladder neck. Two patients were below the age of 19 years and were excluded. The medical records of 12 additional patients were not available for review. We reviewed the medical records of the remaining 221 patients. The Institutional Review Board of the Yonsei University Wonju College of Medicine approved this study (YWMR-15-5-059).

We divided the patients into two groups based on the location of the urinary stones: Group 1 (bladder calculi) and Group 2 (urethral calculi). The demographic and clinical data collected included patient age, medical history, clinical manifestations, laboratory findings, and radiologic findings. All 221 patients had undergone CT to investigate the presence and location of lower urinary tract stones, congenital abnormalities, and/or associated upper urinary tract pathology. Upper urinary tract pathologies included concurrent renal or upper urinary tract stone and unilateral hydronephrosis. We calculated prostate volume (PV) using a previously described method and ellipsoid formula ($PV = \pi/6 \times$ [width (cm) $\times$ thickness (cm) $\times$ length (cm)]) [7]. We estimated width (right–left) and thickness (anterior–posterior) on axial CT images, and we estimated length (cranial–caudal) on a coronal CT images.

We used the independent *t*-test, the Fisher exact test, and the chi-square test to compare the baseline characteristics of the two groups of patients. We performed univariate and multivariate analyses with a logistic regression model to examine the relationships between several independent variables and the two types of lower urinary tract stones. We performed all analyses with the IBM SPSS Statistics software, Version 20.0 (IBM, Armonk, NY, USA). We considered two-tailed *p* values of less than 0.05 statistically significant.

3. Results

Of the 221 patients, 194 (87.8%) had bladder calculi and 27 (12.2%) had urethral calculi. All of urethral calculi were found in prostatic or bulbar urethra. As shown in Table 1, the most common symptoms of bladder calculi were hematuria (37.1%) and voiding dysfunction (32.5%). Five patients (2.6%) with bladder calculi presented acute urinary retention, however it might result from BPH or bladder calculi, itself. Urethral calculi were commonly associated with voiding dysfunction (63.0%) and acute urinary retention (18.5%) secondary to urinary tract obstruction. All of

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