Sexual Dysfunction in Patients With Urinary Bladder Stones but no Bladder Outlet Obstruction

Zhi-Cheng Gong¹,²†, Zhi-Liang Wu¹,³†, Yao-An Wen¹,⁴†, Jie-Peng Zou¹, Xisheng Wang⁶, Xiaoyan Leng⁶, Anthony J. Bleyer⁷, Chunhua Deng⁸, Michael P. Feloney⁹, Yuanyuan Zhang¹⁰* and Shan-Chao Zhao¹¹,¹*

¹ Department of Urology, Nanfang Hospital, The First School of Clinical Medicine, Southern Medical University, Guangzhou, China, ² Department of Urology, Xiang’er Hospital of Xiamen University, Xiamen, China, ³ Department of Urology, Dongfeng Zhongshan People’s Hospital, Zhongshan, China, ⁴ Department of Urology, Fujian Medical University Union Hospital, Fuzhou, China, ⁵ Department of Urology, Shenzhen Longhua New District Central Hospital, Shenzhen, China, ⁶ Public Health Sciences, Department of Biostatistics, Wake Forest University School of Medicine, Winston-Salem, NC, United States, ⁷ Section on Nephrology, Wake Forest University School of Medicine, Winston-Salem, NC, United States, ⁸ Department of Urology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou, China, ⁹ Department of Urology, School of Medicine, Creighton University, Omaha, NE, United States, ¹⁰ Wake Forest Institute for Regenerative Medicine, Wake Forest University School of Medicine, Winston-Salem, NC, United States, ¹¹ Department of Urology, The Third Affiliated Hospital, Southern Medical University, Guangzhou, China

Objective: To explore the correlates of sexual dysfunction and lower urinary tract symptoms (LUTS) in male patients with urinary bladder stones and to determine the effect of stone extraction on recovery of sexual function.

Materials and Methods: A total of 87 male patients with primary bladder stones were studied from January 2015 to May 2016. All patients underwent pneumatic lithotripsy for bladder stones. Sexual dysfunction was assessed based on sexual function assessment scales. The relationship of bladder stones with sexual dysfunction or LUTS was assessed using a two-sample t-test. Postoperative improvement of sexual function was assessed by repeated measures Analysis of Variance (ANOVA).

Results: Forty-one patients had primary bladder stones and 46 had secondary stones from the kidneys. Eighty-three of 87 patients (95%) had sexual dysfunction; 79 patients (91%) had both sexual dysfunction and LUTS. There was a significant association between bladder stones and sexual dysfunction, between sexual dysfunction and LUTS, and between bladder stone and LUTS (p < 0.05). There was no significant association between the course of illness, size and number of bladder stones, or urinary tract infection with sexual function (p > 0.05). In addition, among 83 patients with both bladder stone and sexual dysfunction, 61 patients (73%) had benign prostatic hyperplasia (BPH) and 22 patients (27%) had no BPH. On postoperative evaluation at 3 months, sexual dysfunction scores were significantly improved in 77 patients (88.5%).

Conclusion: Patients with bladder stones have a high incidence of sexual dysfunction, particularly those with co-existing LUTS and BPH. About 1/3 patients without BPH had sexual dysfunction and surgical removal of bladder stones significantly improved sexual function and LUTS.

Keywords: sexual dysfunction, bladder stones, lower urinary tract symptoms, surgical treatment, benign prostatic hyperplasia
TAKE HOME MESSAGE

Patients with bladder stones have a high incidence of sexual dysfunction, particularly those with co-existing LUTS and BPH. About 1/3 patients without BPH had sexual dysfunction. Surgical removal of bladder stones significantly improved sexual function and LUTS.

INTRODUCTION

Bladder stones are common in the patients with bladder outlet obstruction, either from mechanical obstruction, as in older male patients with benign prostatic hyperplasia (BPH), or functional obstruction, as in patients with a neurogenic bladder. The risk factors for bladder stone include recurrent bladder infections, presence of a foreign body in the bladder, kidney stones, congenital abnormalities of the urinary tract and dehydration (1). Typical symptoms of bladder stones include intermittent painful micturition, terminal hematuria, and lower urinary tract symptoms (LUTS). Common complications of bladder stones include chronic bladder dysfunction and urinary tract infections. However, few studies have evaluated sexual dysfunction in patients with bladder stones. The purpose of this study was to characterize the presence of sexual dysfunction in men with bladder stones. In addition, we assessed the correlates of sexual dysfunction and LUTS in patients with lower urinary tract stones and evaluated the beneficial effects of stone removal on improvement of sexual dysfunction.

MATERIALS AND METHODS

This longitudinal prospective observational cohort study was conducted from January 2015 to May 2016. Collection of patient information in this study was approved by Nanfang Hospital at the Southern Medical University Institutional Review Board. All male patients with a diagnosis of bladder stones were enrolled after obtaining written informed consent. All enrolled patients underwent a comprehensive clinical examination prior to surgery, including measurement of blood pressure, heart rate, weight, height, urinalysis, and routine clinical blood measurements. All patients underwent pneumatic lithotripsy for bladder stones and were followed-up at 3, 6, and 12 months after surgery.

The number and size of bladder stones were evaluated preoperatively using ultrasound, computed tomography (CT), or cystoscopy, and then determined by postoperative analysis (Figure 1). Urinary tract infection was defined as the presence of ≥3 white blood cells per high-power field under a conventional bright field microscope and urine bacteria count >10^5 per milliliter on urine examination. Urinary frequency, difficulty in micturition, and hematuria were considered as LUTS. All patients underwent endoscopic pneumatic lithotripsy.

Sexual function was evaluated before surgery, and 3, 6, and 12 months after surgery. The International Index of Erectile Function short version (IIEF-5) score, Premature Ejaculation Diagnostic Tool (PEDT) score, and sexual life satisfaction score were used to assess sexual function. The severity of ED was measured with the IIEF short version score (IIEF-5), with a score >21 indicating no ED, ≥21 to <21 mild ED, 12 to <17 mild-moderate ED, 8–11 moderate ED, and <8 severe ED. The PEDT was used to assess premature ejaculation. A score ≥11 is considered diagnostic of premature ejaculation, 9–10 is an indication for further evaluation, and a score <9 suggests that premature ejaculation is unlikely. Sexual life satisfaction (SLS) is a comprehensive measure of sexual function, measuring the degree to which an individual is satisfied or happy with the sexual aspect of his/her health. SLS was assessed with a single question about the extent to which the respondent was satisfied with his sex life in the past 1 month. The responses were recorded using a 5-point Likert scale (1 = very dissatisfied; 2 = dissatisfied; 3 = fair; 4 = satisfied; 5 = very satisfied) (5, 6). Preoperative assessment of sexual function was performed using the preoperative field questionnaire form. Postoperative assessment was performed during outpatient visits or via telephone follow-up or postal correspondence. In addition, data was collected on the presence of other conditions, including benign prostatic hyperplasia (BPH), neurogenic bladder, infection, foreign body in the bladder, kidney stones, or congenital abnormalities in the urinary tract.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software for Macintosh (version 20.0; SPSS, Inc.). Data are presented as mean ± variance or as frequency (percentage), as appropriate. Prior to surgery, the sexual function of patients grouped according to the presence of different conditions was analyzed using the two-sample t-test. All tests were two-sided and P < 0.05 were considered indicative of statistical significance. Preoperative and postoperative sexual function scores at 3, 6, and 12 months were analyzed using repeated measures Analysis of Variance (ANOVA) using a general linear model.

RESULTS

Ninety patients met criteria to participate in the study. Three patients were lost to follow-up after surgery and were not
Bladder stones combined with upper urinary tract stones 52.9% (n = 46)
Bladder stones with BPH 71.3% (n = 62)

Data presented as mean ± standard deviation or as frequency (percentage).
LUTS, lower urinary tract symptoms; Hp, High power microscopic field of view.

No significant difference was noted in preoperative and postoperative sexual function scores between patients with bladder stones and patients with bladder stones combined with BPH (p > 0.05; Table 2).

Patients with LUTS often have sexual dysfunction. In this study, the IIEF-5 scores of patients with urinary symptoms were significantly different from those of patients without urinary symptoms; however, there was no significant difference between the two groups with respect to PEDT and SLS scores. There was no significant difference between patients with and without difficulty in micturition with respect to the IIEF-5, PEDT, and SLS scores (Table 2). Similarly, there was no significant difference between patients with and without hematuria with respect to IIEF5, PEDT, and SLS scores. Although more patients with bladder stones had chronic urinary tract infections (UTI), no significant difference in IIEF-5 and PEDT scores was observed between the UTI and non-UTI groups (p > 0.05; Table 2).

On preoperative evaluation, the mean IIEF-5 score was 14.2 ± 4.3, the mean PEDT score was 12.7 ± 3, and the mean SLS score was 3.8 ± 0.9 in all of 87 patients. On postoperative evaluation at 3 months, the scores were significantly improved in 77 patients (88.5%) compared to the preoperative scores. There was further improvement in scores at 6 months after surgery (p < 0.05). However, there was no significant difference between the 6- and 12-month postoperative evaluation with respect to any of the parameters of sexual function (Figure 3). No significant statistical difference was noted in preoperative and postoperative sexual function scores between patients with bladder stones and
TABLE 2 | Relationship of bladder stones with sexual dysfunction or LUTS.

| Variable                                      | All patients | IIEF-5 (%) | PEDT (%) | SLS (%) |
|-----------------------------------------------|--------------|------------|----------|---------|
| Bladder stones alone                          | 47.1% (n = 41) | 14.8 ± 4.2 | 12.9 ± 3.1 | 3.8 ± 0.8 |
| Bladder stone combined with upper urinary tract stones | 52.9% (n = 46) | 13.7 ± 4.3 | 12.5 ± 3.0 | 3.8 ± 1.0 |
| Bladder stone number                          |              |            |          |         |
| Single                                        | 62.1% (n = 54) | 14.6 ± 4.35 | 13.2 ± 3.02 | 3.9 ± 0.92 |
| multiple                                      | 37.9% (n = 33) | 13.7 ± 4.14 | 11.8 ± 2.83 | 3.7 ± 0.85 |
| Bladder stone size                            |              |            |          |         |
| Small (≤ 3 cm)                                | 70.1% (n = 61) | 13.8 ± 4.14 | 12.9 ± 2.60 | 3.8 ± 0.92 |
| Large (> 3 cm)                                | 29.9% (n = 26) | 15.3 ± 4.49 | 12.1 ± 3.79 | 3.8 ± 0.85 |
| Duration of presence of bladder stones        |              |            |          |         |
| < 1 year                                      | 54.0% (n = 47) | 14.7 ± 4.68 | 12.9 ± 2.96 | 3.9 ± 0.97 |
| ± 1 year                                      | 46.0% (n = 40) | 13.7 ± 3.73 | 12.4 ± 3.09 | 3.8 ± 0.80 |
| Bladder stone combined with BPH               | 71.3% (n = 62) | 17.0 ± 4.54 | 11.6 ± 2.64 | 4.0 ± 0.73 |
| Bladder stone without BPH                     | 28.7% (n = 25) | 13.1 ± 3.65 | 13.1 ± 3.06 | 3.7 ± 0.94 |
| LUTS                                          |              |            |          |         |
| Urinary frequency                             | 74.7% (n = 65) | 13.4 ± 4.2 | 12.8 ± 3.2 | 3.8 ± 1 |
| No urinary frequency                          | 25.3% (n = 22) | 16.9 ± 3.5 | 12.3 ± 2.50 | 3.9 ± 0.7 |
| Difficulty urinating or pain or discomfort in the penis or testicles | 71.3% (n = 62) | 14.2 ± 4.3 | 12.5 ± 3 | 3.9 ± 0.9 |
| No difficulty urinating                       | 28.7% (n = 25) | 14.3 ± 4.4 | 13.1 ± 3 | 3.6 ± 0.9 |
| No LUTS                                       | 3.4% (n = 3) | 16.7 | 14 | 3.3 |
| Hematuria                                     | 41.4% (n = 36) | 13.8 ± 4 | 13.1 ± 2.76 | 3.8 ± 0.9 |
| No hematuria                                  | 58.6% (n = 51) | 14.6 ± 4.5 | 12.4 ± 3.2 | 3.8 ± 0.9 |
| WBCs in urine                                 | 87           |            |          |         |
| < 3/hp                                        | 21.8% (n = 19) | 14.5 ± 4.46 | 13.1 ± 2.81 | 4.6 ± 1.54 |
| ≥ 3/hp                                       | 78.2% (n = 68) | 14.2 ± 4.25 | 12.6 ± 3.07 | 3.8 ± 1.02 |
| Number of bacteria in urine                   | 68           |            |          |         |
| < 10^5/mL                                     | 50.0% (n = 34) | 14.8 ± 4.10 | 12.6 ± 3.62 | 3.8 ± 0.99 |
| ≥ 10^5/mL                                     | 50.0% (n = 34) | 13.3 ± 4.37 | 12.7 ± 2.85 | 3.7 ± 0.83 |

LUTS, lower urinary tract symptoms; IIEF-5, International Index of Erectile Function-5; PEDT, Premature Ejaculation Diagnostic Tool; SLS, Sexual Life Satisfaction Score; WBC, white blood cells; LUTS, lower urinary tract symptoms; IIEF-5, International Index of Erectile Function-5; PEDT, Premature Ejaculation Diagnostic Tool; SLS, Sexual Life Satisfaction Score.

patients with bladder stones combined with BPH (p > 0.05). Importantly, all 25 (28.7%) patients with the bladder stones alone and 62 (71.3%) with bladder stones with BPH had restored sexual function 12 months after stone removal, indicating the bladder stones contribute to sexual dysfunction, and a combination of bladder stones and BPH increases the rate of sexual dysfunction.

DISCUSSION

While many complications of bladder stones are well described, sexual dysfunction in these patients has long been ignored. In this study, we demonstrated that there is high prevalence of sexual dysfunction in bladder stone patients either with or without BPH. Moreover, surgical removal of bladder stones significantly improved sexual function. Sexual dysfunction is common in patients with bladder outlet obstruction due to the increasing age and lack of exercise (7). Advanced age and chronic diseases may cause sexual dysfunction, but compared with other studies of patients in the same age group, the incidence of sexual dysfunction in patients in our study is higher. In a recent study of 3,016 adult men, the prevalence of primary premature ejaculation and secondary premature
ejaculation was 3 and 4.8%, respectively (8). Out of 88 patients with BPH without bladder stones, 70 (80%) patients had ED, and 60 (68.18%) had poor ejaculation (9). In this study, the prevalence of sexual dysfunction in middle-aged men, i.e., ED and premature ejaculation, was 95.4%, and 72.4% in the patients with bladder stones, respectively. In our study, sexual dysfunction occurred in 98% patient with BPH and bladder stones and in 88% of patients with bladder stones alone Sexual function recovery occurred in 88% patients with either bladder stones alone or the combination. This indicates that sexual dysfunction is highly prevalent in patients with bladder stones compared to the healthy male population. Importantly, patients with bladder stones and no BPH have a high incidence of sexual dysfunction while both bladder stones and BPH leads to an higher rate of sexual dysfunction.

Strengths of this study include objective assessment of impotence before and after stone removal with the IIEF-5 score. There are limitations in our study. This initial study draws on data from a single Medical Center with a limited sample size. The small sample size may have affected the reliability of conclusions, masking the statistical significance of significant differences. The large difference in the results from this and the previously mentioned studies may be attributable to differences in study design, methodology, study population, regions, time frame of investigation, or sampling error. In addition, we did not characterize comorbid conditions in this population.

LUTS are traditionally thought to result from bladder outlet obstruction due to benign prostatic hyperplasia, which gradually leads to increasing symptomatology (10, 11). However, some researchers believe that LUTS are not typically associated with the prostate and that bladder dysfunction is often closely related to LUTS, including overactive bladder, urinary tract structure and functional problems, including urinary stones (12). Primary bladder stones are rare and the cause is unknown. Traditionally, it is believed that the causes of secondary bladder stones include upper urinary tract stones, long-term bed rest, bladder foreign bodies, bladder outlet obstruction (BPH) and bladder dysfunction. Among the 87 cases in this study, there were 22 cases of bladder stones without bladder outlet obstruction, most of which were caused by upper urinary tract stones falling into the bladder. The reason why bladder stones were not discharged from the urethra may be related to the hot and humid weather in Southern China area and dehydration caused by insufficient water intake (1). We speculate that due to dehydration, the urine volume is reduced, and the urine is concentrated. The increased urinary concentration and decreased flow leads to the retention of stones and the increase of stone volume. Bladder mucosa is mechanically rubbed by stones, resulting in cell exfoliation and chronic inflammation of bladder mucosa. This leads to long-term irritation of the mucosa of the bladder neck, which leads to LUTS.

Sexual disorders and their effects on patients were shown to be strongly related to both age and the severity degree of LUTS (13, 14). Epidemiological, pathophysiological and interventional studies have shown a strong positive association between LUTS and ED (14–17). About 70% of patients with LUTS have ED (18). In a study by Rosen et al. (13) the incidence of erectile dysfunction in patients with mild, moderate, and severe LUTS was 43.3, 65.8, and 81.9%, respectively. Treatment of ED with tadalafil (a phosphodiesterase-5 inhibitor) was shown to improve LUTS (19). Similarly, studies have shown a close association between LUTS and premature ejaculation (20–23). In one study, 27% of patients with LUTS were found to be affected by premature ejaculation (21). Terazosin, an alpha-blocker, was shown to alleviate both LUTS and premature ejaculation (22).

LUTS prevalence increases with age. In a population-based survey, 61.2 % of respondents reported at least one symptom of LUTS (23). The prevalence of LUTS in patients with bladder stones has rarely been reported. Up to 95% of patients in this study had LUTS, which suggests that bladder stones may be an important risk factor for LUTS. Conversely, patients with LUTS are at an increased risk for secondary bladder infection due to poor function of the urinary tract, which is one of the causes of

![FIGURE 3](image-url)
bladder stones. Prostate volume is an independent risk factor for bladder stones (24). Therefore, BPH and bladder stones are often mentioned together.

BPH may cause primary bladder stones, and both conditions may lead to LUTS. In turn, LUTS is associated with abnormal sexual function. Patients with both BPH and bladder stones are theoretically more likely to experience LUTS and sexual dysfunction, and our findings support this association. For patients with bladder stones without BPH, bladder stones can be secondary to upper urinary tract stones. There is a high sexual dysfunction rate in patients with BPH. A report by Leliefeld et al. suggested that the relation between BPH and sexual dysfunction is coincidental, unless there are severe symptoms or complications (such as bladder stones or urinary retention) (25). However, few studies have reported sexual function in patients with only bladder stones without lower urinary tract symptoms. The incidence of bladder calculi in patients with BPH is closely associated with preoperative positive urine culture and longer intravesical prostatic protrusion (IPP). Furthermore, IPP may be an independent risk factor for the formation of bladder calculi (26). Benign prostatic hyperplasia (BPH) causes LUTS, and approximately 70% of men with LUTS/BPH have coexisting ED. This prevalence ranges from about 35 to 95% and increases with LUTS severity (7). In our study, the incidence of sexual dysfunction in patients with bladder stones alone (88%) was higher than that in the general population and even higher than that in the BPH patient population. However, the bladder stone patients with no BPH also have a higher sexual dysfunction rate. In addition, stone extraction without surgical correction of BPH still significantly improved sexual function. Compared with patients with bladder stones combined with BPH, the sexual function scores were better, although there was no statistically significant difference. These findings indicate that bladder stones are the primary cause of sexual dysfunction in patients with bladder stones. The mechanism may be that bladder stone cause long-term irritation of bladder neck mucosa, which leads to ED.

The presence and severity of LUTS are risk factors for sexual dysfunction. The causes of sexual dysfunction include psychogenic and organic diseases that generally do not directly cause LUTS symptoms or bladder stones. Since almost all patients included in the study had LUTS, we could not determine whether LUTS directly causes sexual dysfunction. However, the prevalence of sexual dysfunction in patients with bladder stones is higher than that in the general population, which indicates a positive correlation between bladder stones and sexual dysfunction. Bladder stones irritate the bladder wall mucosa and may block the flow of urine, causing symptoms and discomfort, which lead to ED. Analysis of preoperative data suggested no significant association of sexual function with the size and number of bladder stones or the duration of presence of bladder stones (p > 0.05 for both). UTI in men may lead to low sexual desire or induce sexual dysfunction (27). However, in this study, the prevalence of sexual dysfunction in patients with chronic UTI was similar to that in patients without UTI. This indicates that although chronic inflammation is more frequent in patients with bladder stones, UTI is not a direct cause of sexual dysfunction in these patients.

In this study, we used endoscopic pneumatic lithotripsy to remove bladder stones. All patients were treated successfully without any serious postoperative complications. In theory, the use of other methods to remove bladder stones may also yield similar results. Indeed, the treatment method should be individualized based on the patient’s characteristics and preferences (28–33).

This was a longitudinal prospective cohort study. To the best of our knowledge, no other study has evaluated the relationship between bladder stones and sexual dysfunction. In addition, no study has evaluated whether patients with sexual dysfunction show improvement after surgery for bladder stones. However, we found that LUTS is very common in patients with bladder stones and many patients suffer from sexual dysfunction. Comparison of IIEF-5, PEDT, and sexual life satisfaction scores before and after surgery revealed that surgical treatment of bladder stones can significantly improve the patient’s sexual function (p < 0.05). This finding indicates that surgical treatment of bladder stones eliminates LUTS or bladder irritation symptoms, importantly improves sexual function. Therefore, we have reason to believe that bladder stones are a risk factor for sexual dysfunction, although they do not directly cause the decline in sexual function. Sexual function assessment should be considered in patients with bladder stones.

**CONCLUSION**

In conclusion, sexual dysfunction in patients with bladder stones has been poorly characterized in the past. This study showed that patients with bladder stones have a high incidence of sexual dysfunction. The mechanism of sexual dysfunction in the patients with bladder stone is unclear but LUTS and bladder stimulation might be involved. Surgical removal of bladder stones significantly improved sexual function and LUTS. The presence of the triad of sexual dysfunction, LUTS, and bladder stones provides important insights for investigation of the pathogenesis and treatment of sexual dysfunction in patients with lower urinary tract stones.

**DATA AVAILABILITY STATEMENT**

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

**AUTHOR CONTRIBUTIONS**

Z-CG, Z-LW, and Y-AW designed, performed most of the investigation, data analysis, and wrote the manuscript. J-PZ, XW, XL, AB, CD, and MF provided technical assistance. S-CZ and YZ contributed to project design, interpretation of the data and analyses. All of the authors have read and approved the manuscript.
