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A Review of Risk Factors for Predicting Urinary Incontinence after Benign Prostatic Hyperplasia

Feng Guo, Ying Xiong*, Jun Li, Chen Gong, Hao Huang, Qi Zhao, Xiaowu Pi

First Affiliated Hospital of Yangtze University, Jingzhou, China

Email: 1240846780@qq.com, *31350266@qq.com, 2608756731@qq.com, xl500@163.com, 601444097@qq.com, 1365857990@qq.com, 1264096785@qq.com

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Abstract

Benign prostatic hyperplasia (BPH) is one of the common diseases in middle-aged and elderly men, and its clinical symptoms include storage symptoms, voiding symptoms and post-urination symptoms. Surgery is an important treatment method for benign prostatic hyperplasia. It is suitable for BPH patients with moderate to severe LUTS (Lower Urinary Tract Symptoms) and has significantly affected the quality of life. The surgical methods include transurethral resection of the prostate and transurethral holmium laser enucleation of the prostate. While offering a high chance of cure, it also brings some complications, including postoperative urinary incontinence. This article mainly reviews the urinary incontinence after transurethral prostate surgery in recent years and analyzes its risk factors, and summarizes the experience for further prediction and reduction of the incidence of urinary incontinence.

Keywords

Urinary Incontinence, Benign Prostatic Hyperplasia, Surgery, Risk Factors

1. Introduction

Benign prostatic hyperplasia (BPH) is a non-malignant growth or enlargement of prostate tissue and is a common cause of lower urinary tract symptoms in men. Disease prevalence has been shown to increase with age. In fact, the histological prevalence of BPH at autopsy ranges from 50 to 60 percent in men in their 60s and increases to 80 to 90 percent in men in their 70s [1]. At present, surgery is still an important treatment method for benign prostatic hyperplasia,

*Corresponding author.

and it is suitable for BPH patients with moderate to severe LUTS and has significantly affected the quality of life [2]. The main surgical methods are transurethral resection of the prostate (Transurethral resection of the prostate, TURP), transurethral holmium laser enucleation of the prostate (Transurethral holmium laser prostatic enucleation, HoLEP) [3]. No significant differences in functional outcomes and complications were found between the two surgical modalities [4]. Occasional complications after prostatectomy are mostly postoperative bleeding, and some patients may experience urinary incontinence, dysuria, and occasionally bladder spasm, recurrent urinary tract infections, acute testicular epididymitis, and acute pulmonary embolism, etc. [5]. Although incontinence is defined differently in the different literature, which is one of the limitations when comparing incontinence, most studies define postoperative incontinence as involuntary leakage of urine requiring the use of a pad [6]. Urinary incontinence can be caused by a variety of causes, including bladder and urethral dysfunction, intraoperative injury to the external urethral sphincter, prolonged indwelling catheterization, local infection or edema of the prostatic fossa and urethra [6] [7]. It has a great relationship with the patient's age, physical condition, underlying disease, disease course, prostate volume, operator's experience and technical level, perioperative management and other factors. After retrieving relevant literature in recent years and analyzing the risk factors of urinary incontinence after prostate surgery, the summary is as follows.

2. Risk Factors and Predictors Associated with Postoperative Urinary Incontinence

Several similar and different risk factors have been identified in recent studies to increase the risk of urinary incontinence after BPH. In terms of urinary incontinence, such as prostate volume, duration of surgery, surgical approach, preoperative catheterization, and preoperative drug use were all associated with higher rates of postoperative urinary incontinence. Combining effective lifestyle and medical interventions can significantly reduce the risk of urinary incontinence. Age, ethnicity, membranous urethral length (MUL), diabetes mellitus, and time to treatment initiation are all non-modifiable risk factors that also play a role in the development of postoperative urinary incontinence. Understanding these modifiable and unmodifiable risk factors and in-depth assessment of predictors is critical for improving patient outcomes and quality of life. Below, we review some of the major risk factors and predictors associated with postoperative urinary incontinence.

3. Patient Factors

3.1. Age

First of all, benign prostatic hyperplasia (BPH) is one of the common diseases in middle-aged and elderly men, and its incidence is increasing with the aging of the global population. The incidence of benign prostatic hyperplasia increases

with age. At present, it is known that the necessary conditions for benign prostatic hyperplasia include functional testicles and increasing age. In a regression analysis comparing 584 patients with bipolar transurethral enucleation performed by the same physician, the mean (±SE) age was 69.6 ± 0.26 years, and found that in a multivariate analysis Among them, age (hazard ratio 1.07, P value = 0.0034) was an independent risk factor for transient urinary incontinence after prostate surgery [6]. Similarly, in the retrospective multi-center study of Veni Houxin, it was shown that patient characteristics, namely age, is one of the risk factors [8], and Ning, X. *et al.* found that age ≥ 70 years was significantly associated with SUI through multivariate analysis [9], Nam, J.K., *et al.* found that age (odds ratio [OR] = 3.494; 95% confidence interval [CI] = 1.565 - 7.803; p = 0.002) over 65 years was often associated with the occurrence of postoperative transient urinary incontinence (TUI) [10].

However, in a retrospective analysis of 949 consecutive patients who underwent holmium laser enucleation of the prostate by a single surgeon, Elmansi, H.M. *et al.* were not associated with postoperative stress urinary incontinence [11].

3.2. Prostate Volume

The normal prostate volume is small, and the left and right, anterior and posterior diameters of the prostate are measured by transrectal ultrasound; the prostate volume can be calculated according to the spherical volume calculation formula. Elmansi, H.M. *et al.* suggested that a prostate volume greater than 81 mg was associated with postoperative stress urinary incontinence [11]. Yosuke, H. *et al.* found that the prostate volume was 54.7 ± 0.91 cm^3 and the prostate specimen weight was 30.6 ± 0.69 g. The prostate volume (hazard ratio 1.03, P value < 0.0001) was an independent risk factor for postoperative transient urinary incontinence [6]. Li, X.H. *et al.* showed that the prostate volume of transrectal ultrasonography was ≥75 ml (3.61, 2.13 - 6.16, P < 0.001) [12], and Ning, X. *et al.* found that the prostate volume was ≥90 ml (OR: 15.390; 95% CI 8.077 - 29.326; P < 0.001) is an important factor in the occurrence of SUI after PKEP [9].

In addition, the multivariate analysis of Jiang, J.Z. *et al.* showed that the prostate volume in the transition zone (odds ratio [OR], 5.354; 95% confidence interval [CI], 1.911 - 14.999; P = 0.001) was significantly associated with early recovery of SUI [13].

3.3. Diabetes

Studies have shown that diabetes can significantly increase the risk of benign prostatic hyperplasia and lower urinary tract symptoms, and insulin is an independent risk factor and promoter of BPH. Insulin resistance may alter the risk of BPH through several biological pathways [14]. So whether the presence of diabetes can affect the occurrence of urinary incontinence after BPH? Elmansi,

H.M. *et al.* showed that the presence of diabetes was significantly associated with a higher incidence of stress urinary incontinence ($p < 0.001$) [11]. Winnie Hussin observed through research that diabetes mellitus (OR = 1.7 [1.03 - 2.78]) was significantly correlated with UI at 6 months after BPH [8].

3.4. BMI

Previous studies have shown that higher BMI is associated with an increased risk of UI and nocturia in men [15]. In the multivariate analysis at 3 months of Venihausen, elevated BMI (OR/SD = 1.23 [1.09 - 1.38]) was significantly associated with UI. Increased BMI at 6 months (OR per SD = 1.25 [1.03 - 1.5]) was significantly associated with UI [8]. Ye, H., Codas, R., *et al.* BMI > 30 (OR, 4.69; 95% CI, 1.51 - 14.52; $p = 0.007$) was identified as an independent risk factor for 1-month SUI [16]. A summary of the relevant literature on the statistical analysis indicators of patient factors is shown in **Table 1**.

4. Perioperative Factors

4.1. Preoperative IPSS Score

The International Prostate Symptom Score (IPSS) is one of the commonly used questionnaires to assess LUTS severity and LUTS-specific HRQOL in male patients. This questionnaire was originally developed by the American Urological Association [17]. The questionnaire is reliable, valid, sensitive, and responsive [18]. The World Health Organization subsequently proposed that IPSS is an important tool to assess BPH [19]. Zhang, D.X. *et al.* divided 263 patients who received TURP into two groups: 55 in the incontinence group and 208 in the non-incontinence group. Results the preoperative IPSS score was (23.25 ± 3.56) in the urinary incontinence group and (18.34 ± 4.05) in the control group. The analysis showed that a high preoperative IPSS score was the main factor leading to postoperative urinary incontinence [20].

4.2. Operation Time

Univariate analysis by Kobayashi, S. *et al.* showed that enucleation time > 100 minutes ($p = 0.043$) was significantly associated with postoperative UI [21].

Table 1. Patient factors associated with postoperative urinary incontinence.

Patient factors	Age	Prostate volume	Diabetes	BMI	references
Mean ± SD	69.6 ± 0.26	30.6 ± 0.69	-	-	6
OR/SD	1.3 [1.14 - 1.48]	-	-	1.23 [1.09 - 1.38]	8
Mean ± SD	68.6 ± 7.3 (53 - 88)	70.1 ± 32.1 (29.1 - 240.0)	-	-	9
OR	3.494	-	-	-	10
95% CI	-	78.84 - 87.32;	1.02 - 1.06	-	11
95% CI	-	1.911 - 14.999		-	13
95% CI	-	-	-	1.51 - 14.52	16

The total operation time of Jong Kil Nam (OR = 3.849; 95%CI = 1.613 - 9.185; p = 0.002) was a factor that had a significant impact on the occurrence of postoperative TUI. The results showed that the total operation time exceeding 65 minutes was often associated with the occurrence of postoperative TUI [10]. Elmansi, H.M. *et al.* suggested that operative time greater than 96 minutes was significantly associated with stress urinary incontinence [11].

4.3. Weight of Surgical Enucleation

In a multivariate analysis at 3 months, Vinyhousin *et al.* found that increased enucleated tissue weight (ORperSD = 1.29 [1.16 - 1.45]) was significantly associated with UI [8]. Jiang Junzhuo, Gao Juncheng and others believed that the enucleation ratio (OR, 8.253; 95% CI, 1.786 - 38.126; P = 0.007) was significantly related to the early recovery of SUI [13]. Zhang, D.X. *et al.* compared and analyzed the relevant data of the patients in the urinary incontinence group and the non-urinary incontinence group, the difference was statistically significant (t = 8.191, 16.433, P = 0.000) [20].

4.4. Surgical Methods

Conventional surgical procedures include transurethral resection of the prostate (TURP), endoscopic enucleation of the prostate (EEP), holmium laser enucleation of the prostate (HoLEP), and bipolar enucleation of the prostate (BipoLEP) [22]. J Sapetti conducted an observational, analytical, retrospective, single-center study of 171 patients. It is thought that the incidence of urinary incontinence after HoLEP may be related to the surgical technique employed [23]. However, Cornwell, L.B. *et al.* considered that surgical factors had no significant effect on predicting urinary incontinence [24].

4.5. Blood Loss

Kobayashi, S. *et al.* evaluated 127 patients with benign prostatic hyperplasia who received HoLEP. The difference in hemoglobin levels between preoperative and postoperative day 1 was used to estimate blood loss, and univariate analysis showed that blood loss > 2.5 g/dL (p = 0.032) was identified as an important and independent risk factor for postoperative UI [21]. The statistical analysis indicators of perioperative factors in the relevant literature are summarized in Table 2.

5. Discussion and Outlook

Urinary incontinence after benign prostatic hyperplasia is a common complication. Therefore, it is crucial to implement effective and safe interventions to better manage its complications.

Our current review of the literature highlights that risk factors such as patient age, diabetes, BMI increase the risk and severity of postoperative urinary incontinence. Certain predictors such as prostate volume, preoperative IPSS score,

Table 2. Perioperative factors associated with postoperative urinary incontinence.

Perioperative factors	Preoperative IPSS score	Operation time	Weight of surgical enucleation	Surgical methods	Blood loss	references
Mean ± SD	23.25 ± 3.56	-	23.25 ± 3.56	-	-	17
95% CI	-	2.54 (1.03 - 6.30)		-	3.62 (1.12 - 11.99)	21
OR/SD	-	-	1.29 [1.16 - 1.45]	-	-	8
95% CI	-	-	1.786 - 38.126	-	-	13
95% CI	-	98.48 - 107.02	-	-	-	11
95% CI	-	-	-	1.07 (1.01 - 1.16)	-	23

operative time, surgical enucleation weight, surgical approach, and intraoperative blood loss also increase the risk of postoperative urinary incontinence. Some other factors, such as the patient's own urethral membrane length, higher detrusor muscle voiding pressure, and baseline urodynamic parameters also play an important role in postoperative urinary incontinence [14] [25] [26].

A number of studies have shown that by predicting risk factors and giving corresponding measures in advance, the incidence of postoperative urinary incontinence can be reduced. For example, Setta, G. *et al.* measured the following parameters before and after surgery: International Prostate Symptom Score (IPSS), Maximum Flow Rate (Qmax), Post-void residual (PVR) and PSA. The results suggest that early apical-released "EnBloc" HoLEP is a safe technique allowing easier identification of the surgical plane and preservation of the mucosa of the external sphincter to provide lower rates of postoperative stress incontinence and significant functional outcomes. [27]. Lin, C.X., *et al.* retrospectively analyzed 169 consecutive patients who received HoLEP, and compared the original en bloc technique, the en bloc early mucosal dissection technique, and the three horseshoe incision techniques. The incision prevents urethral sphincter injury and the incidence of postoperative TUI is low [28].

After understanding and mastering these risk factors, evaluating each patient with benign prostatic hyperplasia before surgery, and implementing personalized perioperative management for each individual can greatly improve the risk of postoperative urinary incontinence, the occurrence of urinary incontinence, and the symptomatic management after incontinence. For example, Anan, G. *et al.* found in a randomized controlled study that preoperative pelvic floor muscle exercise (PFME) appeared to help improve early urinary incontinence after HoLEP [29]. This provides us with new ideas for formulating patient care plans.

This article can serve as a good primer on recent breakthrough discoveries. Further research is recommended to better understand the causes of urinary incontinence after benign prostatic hyperplasia, improve surgical methods or multi-faceted management, and benefit patients.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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