

# Dilemmas and Breakthroughs in the Treatment of Benign Prostatic Hyperplasia in China

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## Abstract

Benign prostatic hyperplasia (BPH) is a common urologic disease in elderly men, which seriously affects patients' quality of life. Current treatments mainly include medication and surgery, but both have their own limitations. In recent years, Prostatic Urethral Dilation (PUD), as a new non-resectable mechanical dilatation technique, has gradually become a hot spot for research and clinical application. This article summarizes the current status of BPH treatment in China, the existing dilemmas, and focuses on the technical features and advantages of PUD technology and the latest product, a Ultra-Minimally Invasive Prostate Dilation Catheter (Longevity Bar), with particular attention to its breakthrough in preserving prostate function and reducing postoperative complications, as well as its advantages for high-risk patients based on the innovation of the thermoplastic polyurethane (TPU) material and the precise positioning technology of the double balloon. The clinical appropriateness of the TPU material innovation and double balloon precise positioning technology for the elderly and high-risk patient groups, with a view to providing new treatment ideas for the clinic.

**Keywords:** benign prostatic hyperplasia(BPH), prostatic urethral dilation (PUD), longevity bar, minimally invasive treatment

## 1. Introduction

BPH is a common male urological disorder characterized by a progressive, non-malignant enlargement of the prostate gland, which worsens with age(Ng et al., 2025). The primary clinical manifestation of BPH is lower urinary tract symptoms (LUTS), which include urinary frequency, urgency, hesitancy, weak stream, nocturia, and incomplete bladder emptying(Cannarella et al., 2021). These symptoms significantly impact patients' quality of life by causing discomfort, sleep disturbances, and, in severe cases, urinary retention, which may require medical intervention such as catheterization or surgery(Gulur et al., 2011).

With the increasing aging population in China, the incidence of BPH has risen correspondingly(Wang et al., 2015). In recent years, there has been a noticeable trend toward an earlier onset of BPH, with younger men increasingly affected. Epidemiological studies suggest that the histological prevalence of BPH in Chinese men over the age of 40 is steadily rising, while the clinical incidence reaches approximately 50% in men over 60 years old and exceeds 60% in men over 80 years old(Wang et al., 2015). The condition not only imposes a significant healthcare burden but also affects daily activities, work productivity, and psychological well-being.

The pathophysiology of BPH is complex and involves hormonal imbalances, aging-related cellular changes, and chronic inflammation(Bizimana Rukundo). Androgens, particularly dihydrotestosterone (DHT), play a crucial role in prostate growth by stimulating stromal and epithelial cell proliferation(Carson III & Rittmaster, 2003). Additionally, increased estrogen-to-androgen ratios in aging men may contribute to prostatic tissue remodeling and fibrosis(Nicholson, 2015). Chronic inflammation and oxidative stress are also implicated in disease progression, leading to extracellular matrix deposition and tissue hyperplasia(Antar et al., 2023).

Current management strategies for BPH focus on symptom relief and improving quality of life. First-line medical treatments include  $\alpha 1$ -adrenergic receptor antagonists (e.g., tamsulosin, silodosin) to relax prostatic smooth muscle and  $5\alpha$ -reductase inhibitors (e.g., finasteride, dutasteride) to reduce prostate volume by inhibiting DHT production(Antar et al., 2023). However, long-term medication can bring about a variety of drug side effects such as dizziness, postural hypotension, sexual dysfunction, and even an increased risk of developing certain malignancies (testicular cancer)(Leung & McNeill, 2006). The search for an extremely minimally invasive and safe treatment is urgent for the BPH patients.

## 2. BPH Treatment Dilemma

Traditional treatments for BPH mainly include medication and surgery. Although medication can relieve urinary tract symptoms to a certain extent, its efficacy is limited and long-term use may be accompanied by side effects, such as sexual dysfunction, low blood pressure, dizziness, etc.(Leung & McNeill, 2006) . Although traditional surgical methods such as transurethral resection of the prostate (TURP) are considered to be the "gold standard" for the treatment of BPH, they are associated with shortcomings such as intraoperative bleeding, various postoperative complications, and prolonged operation and hospitalization of the patient(Rassweiler et al., 2006) . In recent years, Minimally Invasive Surgical Techniques (MIST), such as Transurethral Laser Prostatectomy (TULP)(Hoffman et al., 2003) and Bipolar Plasma Kinetic Vaporization of the Prostate (BPKVP) have been gaining attention for their advantages of less invasiveness and faster recovery(Tsai et al., 2018). In patients with moderate to severe symptoms unresponsive to medical therapy, minimally invasive surgical techniques such as prostatic artery embolization (PAE), transurethral resection of the prostate (TURP), and newer technologies like prostatic urethral lift (PUL) and laser enucleation offer effective alternatives. However, the principle of all current surgical approaches is to remove the hyperplastic glandular tissue and is not applicable to patients who wish to preserve the function of the prostate organ or who are poorly tolerant or unwilling to undergo conventional surgery and anesthesia(Rassweiler et al., 2006). Transurethral Dilatation of the Prostate (TUDP) is a micro-innovative technique for the treatment of BPH in recent years(Huang et al., 2020). The balloon catheter of TUDP has evolved from oval, wedge, and gourd shaped, and at present, China's Zhejiang Tongxuan Medical Technology Co, Ltd. independently developed the Longevity Bar and the novel surgical method of Prostatic Urethral Dilatation (PUD), which is based on the improvement of the TUDP(Huang et al., 2020). PUD has gained more and more attention in clinical practice due to its non-excisional and mechanical dilatation characteristics. In particular, new dilatation catheters, represented by the Longevity Bar, have further improved the safety and efficacy of this procedure.

## 3. History of Development

Transurethral columnar balloon dilatation (TUDP) originated in the 1980s and became popular because of its simplicity and minimal invasiveness, but the long-term efficacy of early products was inconsistent(Huang et al., 2015). In recent years, with advances in catheter design, biomaterials, and precision guidance techniques, PUD technology is now a hot topic of clinical research. Compared with the early TUDP, PUD technology emphasizes more on precision and stability, especially suitable for patients with high age or high risk of anesthesia. Tongxuan has independently developed an innovative Ultra-Minimally Invasive Prostate Expansion Catheter (Longevity Bar) through in-depth research on this technology and by improving various aspects of the columnar balloon catheter and standardizing the expansion process, which has obvious clinical advantages and good long-term therapeutic effects.

## 4. Technical Principles

Voiding obstruction due to BPH involves many complex factors, the most important of which is mechanical, often due to an imbalance between the force of contraction of the forced urethra muscle and the resistance of the bladder outlet resulting in an imbalance between the patient's voiding and the maximal urethral closure pressure[7] . If the urethral closure pressure can be effective, the problem of urinary tract obstruction will be solved[8] . After PUD surgery, the urethral pressure is in the lowest impedance state, the exclusive innovation of anterior and posterior balloon design to achieve sub-millimeter positioning, the front capsule precise positioning and targeting dilatation, and the posterior capsule dilatation synchronized with the compression of the hemostasis, the urinary tract obstruction can be improved in a long-term and effective way. The world's first TPU (Thermoplastic Urethane) material, with excellent biocompatibility and mechanical properties(Gu et al., 2023) , effective dilatation while preserving organs and protecting functions. PUD use no electrical heat or lasers, relying purely on mechanical force to widen the prostate envelope so as not to damage the erectile nerves around the prostate due to heat and it is the first trial in the field of urology that minimally invasive prostate dilatation also achieves perfect relief of obstruction, urinary control, and sexual function protection, making it a trifecta of BPH treatment.

## 5. BPH Treatment Breakthrough

As a new generation of PUD catheter, Longevity Bar's main technological breakthroughs include anterior and posterior balloon structure design, the world's first TPU material and minimally invasive characteristics. Comparative analysis with traditional medication, surgical treatment and TUDP Compared with traditional medication, PUD and Longevity Bar technology has obvious advantages in quickly relieving urinary tract obstruction symptoms and does not require long-term medication to maintain, avoiding the side effects of medication[10]. Compared with traditional surgical methods (e.g. TURP and laser vaporization(Reich & Seitz, 2008)), PUD is significantly less invasive, with no tissue removal and very low risk of bleeding; postoperative

recovery is rapid, with the majority of patients resuming their daily activities within 24 hours of surgery. Moreover, through the optimized double balloon design, new TPU material and minimally invasive characteristics, the Longevity Bar achieves uniform distribution of dilatation pressure during the operation and avoids the problem of uneven pressure of the traditional single-balloon technique. As showed in Fig.1(A), the Single balloon tends to dilate unevenly and showed in Fig.1(B), Columnar balloon tends to slide and bleed. In Fig.1(C) Dual anterior and posterior balloons (Longevity Bar) allow for full dilatation while minimizing slippage and bleeding. The anterior balloon expanding the bladder neck and stabilizing the position of the catheter, and the posterior balloon being responsible for the dilatation of the membranous urethra and the tip of the prostate, which solves the problems of the inaccurate positioning of the surgical site of the TUDP, the urethral sphincter being easy to be damaged, and the problem of postoperative incontinence(Chang et al., 2018). The stability of the procedure and the long-term postoperative efficacy have been greatly improved, making this technique an important advancement in terms of safety and efficacy.

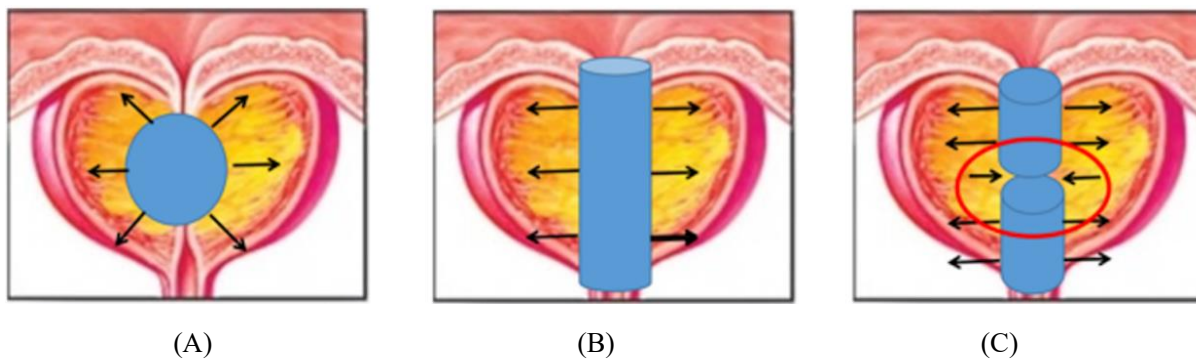


Figure 1. The expansion advantages of the dual-balloon design

Note. (A) Single balloon tends to dilate unevenly. (B) Columnar balloon tends to slide and bleed. (C) Dual anterior and posterior balloons allow for full dilatation while minimizing slippage and bleeding.

## 6. Clinical Applications

The Longevity Bar is a catheter that has been improved through extensive clinical practice. It has a standardized procedure (about 15 minutes/unit), low technical threshold (training cycle  $\leq 3$  cases), and can be out of bed 24 hours after surgery. Clinical observations have revealed that PUD and Longevity Bar have a significant role in improving peak mean urinary flow rate ( $Q_{max}$ ), Post-Void Residual Volume (PVR), baseline quality of life (QoL) scores, and International Prostate Symptom Simulation Score (IPSS)(Huang et al., 2019). In addition, it was significantly better than conventional treatment in terms of bleeding, procedure time, hospitalization time, complication rate and prostate and sexual function protection. Figure 2 showed a patient case from the department of Urology in Xinhua Hospital. The patient is 67 years old and five years ago there was no obvious cause of dysuria, he accompanied by urinary frequency and urgency, increased nocturia, and the symptoms have significantly worsened over the past year. The patient was diagnosed with BPH and he had a  $Q_{max}$  of 9.7 mL/s and a narrowed prostatic portion of the urethra (Fig.2(A)). After the PUD, we can clearly observe under cystoscopy that the prostate and bladder neck are dilated (Fig.2(B)) and the  $Q_{max}$  increased to 13.2 mL/s after 24 hours of PUD. The patient also did not experience postoperative incontinence, suggesting that this surgical approach is very safe for urinary control. In addition, he did not suffer from bleeding during PUD and the hemoglobin values was not different from preoperative. Therefore, PUD and Longevity Bar technology is more suitable for patient groups who have poor results from medication or surgery, do not want to use medication or other surgical treatments, and want to preserve prostate function.

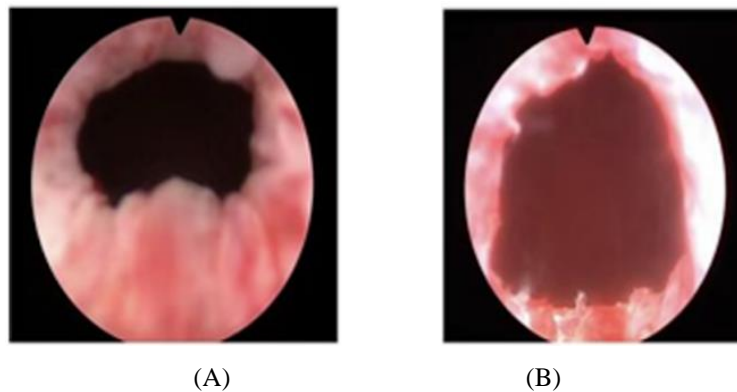


Figure 2. Cryptoscopic observation of the patient's prostate and bladder neck opening before and after the PUD

Note. (A) Preoperative stenosis of the prostatic urethra and bladder neck opening. (B) Significant postoperative enlargement of the prostatic urethra and bladder neck opening.

## 7. Future Developments

Future research directions include personalized and precise treatment plans, development and application of novel biomaterials, and more extensive large-scale multi-center clinical trials. These studies will help to further validate the long-term efficacy and range of indications of PUD and Longevity Bar, and promote the continuous advancement of clinical applications (Madersbacher et al., 2007).

The future diagnosis and treatment model should be centered on “early screening - precise intervention - full management”. Innovative devices such as the Longevity Bar will be deeply integrated with smart technology, screening high-risk groups through AI-assisted early diagnosis (Wasilewski et al., 2024); developing personalized treatment plans by combining genetic testing and imaging genomics (Hariri & Weinberger, 2003); promoting the combination of one-day surgery and PUD to enhance the patient's experience; and relying on telemedicine to achieve long-term post-operative follow-up.

Future medical strategies will evolve along personalized and multimodal treatment models. Multimodal treatment (MDT) with the synergistic application of longevity rods with medication and physical therapy will further preserve organs (Taberna et al., 2020), protect function, and minimize complications, thereby enhancing quality of life. This diagnostic and treatment model and medical strategy will promote the treatment of prostate hyperplasia to be highly efficient and humanized, and ultimately achieve the goal of “one intervention, lifelong benefit”.

## 8. Conclusion

In summary, PUD and Longevity Bar is one of the important advances in the treatment of BPH in recent years, which is characterized by less trauma, fewer complications, and quicker recovery, and is suitable for the majority of patients with BPH, especially for those patients who are not willing to or intolerant of surgery and wish to preserve their organs and functions. Compared with traditional treatments and early TUDP, the Longevity Bar offers a new, safer and more effective clinical option with its latest technological advantages. In the future, with the continuous progress of material science, imaging technology and precision medicine, Tongxuan Medical plans to collaborate with a number of tertiary care hospitals to conduct a series of clinical trials. These trials will not be limited to current applications, but will also explore the potential of Longevity Bar in other indications, such as more complex urological diseases and Bladder neck obstruction (BNO) patients or other related conditions. Through these studies, Tongxuan Medical hopes to provide hundreds of millions of patients around the world with more desirable treatment options to help improve their quality of life and reduce the burden of disease.

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