



PEDIATRIC UROLOGY CASE REPORTS

ISSN 2148-2969

<http://www.pediatricurologycasereports.com>

Diagnosis of Primary Bladder Neck Dysfunction in a Child with Refractory Urinary Symptoms

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Received: 01-Apr-2025, Manuscript No. PUCR-25-172100; **Editor assigned:** 03-Apr-2025, PreQC No. PUCR-25-172100 (PQ); **Reviewed:** 17-Apr-2025, QC No. PUCR-25-172100; **Revised:** 24-Apr-2025, Manuscript No. PUCR-25-172100 (R); **Published:** 01-May-2025, DOI: 10.14534/j-pucr.20222675696

Description

Primary Bladder Neck Dysfunction (PBNB) in children is a lesser-known but clinically significant functional abnormality that can lead to persistent Lower Urinary Tract Symptoms (LUTS) when more common urological conditions have been ruled out. PBNB is characterized by a failure of the bladder neck to open adequately during voiding, resulting in bladder outlet obstruction despite the absence of any anatomical obstruction such as posterior urethral valves, urethral strictures, or neurogenic bladder. Diagnosing this condition can be challenging, particularly in pediatric populations, where cooperation with diagnostic procedures may be limited and the overlap of symptoms with other common disorders can obscure clinical judgment.

Children with PBNB typically present with a variety of refractory urinary symptoms that persist despite standard management. These symptoms may include urinary frequency, urgency, hesitancy, weak urinary stream, incomplete emptying, daytime incontinence, and in some cases, recurrent Urinary Tract Infections (UTIs). Nocturnal enuresis may also be a feature.

The pathophysiology of PBNB involves a failure of coordination between the detrusor muscle and bladder neck during micturition. In a normal voiding cycle, detrusor contraction is accompanied by a simultaneous relaxation of the bladder neck and external urethral sphincter to allow for smooth and complete emptying. In PBNB, the bladder neck does not relax appropriately, causing a functional obstruction that leads to increased voiding pressures, incomplete emptying, and elevated residual urine volumes. Over time, this can contribute to secondary bladder changes such as detrusor overactivity, hypertrophy, or decreased compliance, and may even affect upper tract function if left unrecognized.

Initial investigations typically include a renal and bladder ultrasound, which may show a thickened bladder wall or increased Post-Void Residual (PVR) urine volume. However, these findings are nonspecific and can be present in a range of voiding disorders. A voiding diary can be helpful in tracking frequency, volumes, and episodes of incontinence. Uroflowmetry with Electromyography (EMG) is a key non-invasive diagnostic tool that can provide clues to underlying dysfunction. In PBNB, the typical uroflowmetry pattern is that of a staccato or interrupted flow curve with a prolonged voiding time and high post-void residual volume, reflecting inadequate bladder neck opening. EMG may show coordinated sphincter relaxation, distinguishing PBNB from dysfunctional voiding, where the external sphincter contracts during voiding.

The gold standard for diagnosing PBNB remains Video Urodynamic Studies (VUDS), which combine pressure-flow measurements with fluoroscopic imaging of the bladder and urethra during filling and voiding phases.

VUDS allows direct visualization of the bladder neck during the voiding phase. In children with PBND, the detrusor pressure rises during attempted voiding, but the bladder neck remains closed or opens late and inadequately, with a narrow funnel shape on fluoroscopy. The EMG tracing typically shows a relaxed external sphincter, confirming that the obstruction is at the level of the bladder neck rather than the distal urethra. This finding helps differentiate PBND from other conditions such as dysfunctional voiding, underactive bladder, or anatomical obstruction.

The diagnosis of PBND can be frustrating for families and clinicians alike due to the subtlety of findings and the lack of standardized diagnostic criteria in children. However, accurate diagnosis is essential for guiding appropriate treatment and preventing long-term sequelae. Left untreated, PBND can result in chronic bladder dysfunction, persistent infections, vesicoureteral reflux, or even renal impairment in severe cases. Children with PBND may also experience social difficulties and reduced quality of life due to persistent incontinence or urinary urgency, particularly in school-aged children.

Once the diagnosis is established, management of PBND involves both non-pharmacological and pharmacological strategies. Timed voiding, biofeedback therapy, and pelvic floor retraining may be beneficial in select cases, although these interventions are more effective in dysfunctional voiding than in PBND. Alpha-adrenergic blockers such as doxazosin or tamsulosin are commonly used in the medical management of PBND.

These medications act by relaxing smooth muscle at the bladder neck, facilitating more complete opening during voiding and reducing outlet resistance. Studies have shown that alpha-blockers can significantly improve uroflowmetry parameters and reduce residual urine volumes in children with PBND. They are generally well tolerated, although careful dose titration and monitoring for side effects such as hypotension or dizziness are important, particularly in smaller children.

Surgical intervention, such as Bladder Neck Incision (BNI), is reserved for the most severe and refractory cases. BNI involves endoscopic incision of the bladder neck to relieve the functional obstruction. This procedure carries a higher risk of complications, including incontinence, and is used cautiously in children. Surgical intervention is typically considered only after failure of medical therapy and confirmation of PBND through comprehensive urodynamic evaluation.

Conclusion

Primary bladder neck dysfunction is an underdiagnosed cause of refractory lower urinary tract symptoms in children. Accurate diagnosis requires a combination of clinical suspicion, functional testing, and fluoroscopic imaging to differentiate PBND from other voiding disorders. Recognition of this condition is critical to prevent long-term complications and to tailor effective management strategies. Advances in diagnostic techniques and therapeutic options have improved outcomes for children with PBND, but awareness among clinicians remains key to timely diagnosis and intervention.