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Evaluation of Correlations Between Bladder Detrusor Overactivity and Lower Urinary Tract Infections

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Abstract

Lower Urinary Tract Infections (LUTIs) are regarded as the most frequent form of bacterial infections and bladder Detrusor Overactivity (DO) are considered to contribute to the urodynamic characteristic of Overactivity Bladder (OAB), including urinary urgency, urinary frequency, with or without Urgency Incontinence (UI), which is common disorder and influences patient's health and quality of life. Since 1960s, studies had focused on whether DO is the etiological factors of recurrent LUTIs or the inverse. Although the definite correlation between DO and LUTIs have not been proved, urinary microbiota may play a role in genesis of DO that was found by mounting evidences using enhanced urine culture technique and pathophysiological variations of bladder detrusor facilitates bacterial colonization in bladder urothelium. In the future, clarification of correlation between DO and LUTIs needs more scheduled studies and more researches that link the urinary microbiota with Central Nervous System (CNS) function to provide accurately information to help us manage the patients more appropriately.

Keywords: Detrusor overactivity; Lower urinary tract infections; Urodynamic; Urine culture; Urinary microbiota

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Introduction

Lower Urinary Tract Infections (LUTIs) are considered as the most common form of bacterial infections. Although several strategies had been proposed to prevent recurrent LUTIs by urology guidelines, the rate of recurrent LUTIs remains high and undoubtedly increases health care burdens. Host and bacterial factors were regarded as the possible mechanisms of recurrent LUTIs and increasing evidences were found in the correlation between Lower Urinary Tract Dysfunction (LUTD) and recurrent LUTIs. Approximately 16% of general population are suffering from Overactivity Bladder (OAB), including urinary urgency, urinary frequency, with or without Urgency Incontinence (UI), which impacts significantly overall quality of life, and the urodynamic traits of OAB is Detrusor Overactivity (DO) (**Figure 1**) [1]. Although high incidence of DO occurred in patients with LUTIs and the inverse, there is not a consensus in correlation between DO and LUTIs. The article aims to review the current evidence exploring whether DO is the etiological factor of recurrent LUTIs or if the bacterial in lower urinary tract contributed to abnormal bladder function.

Since 1960s, there was the hypothesis that ischemia and stasis in the vascular bed of the bladder resulting from elevated intravesical pressure may impair the antibacterial defense mechanisms, which is responsible for the majority of recurrent LUTIs. Walter and associates reviewed retrospectively 579 patients with urodynamically proven Detrusor Hyperreflexia (DH), and found no relationship between the duration and absolute value of maximal intravesical and the incidence of bacteriuria in patients with DH and no previous instrumentation, although patients with higher Residual Urine Volume (RUV) had more significantly frequent LUTIs compared to lower Residual Urinary Volume (RUV) [2]. Due to the fact that it was found unethical to underwent an invasively Urodynamic Studies (UDS) in asymptomatic patients, there was not a control group with urodynamically normal bladder function in the Walter's study, so that it did not draw a conclusion that there was a relationship between DO and LUTIs.

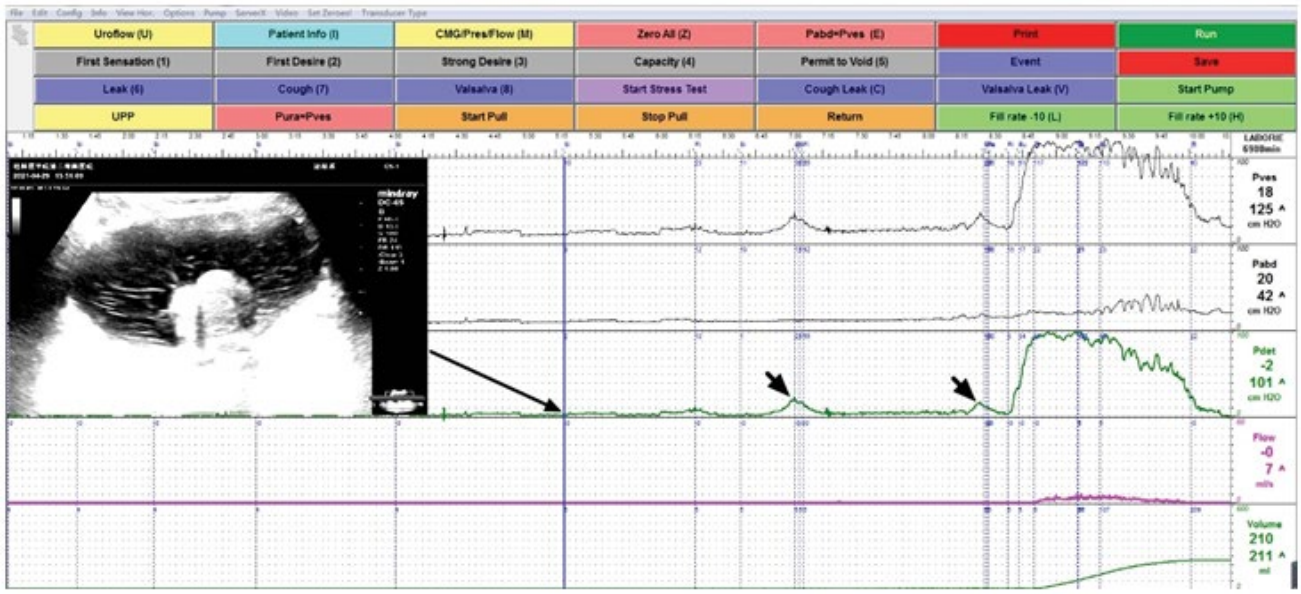

Figure 1 During a Sonography Video Urodynamic Study (SVUDS) of a 65-year-old male patient suffering from frequency, urgency, nocturia and recurrent Lower Urinary Tract Infections (LUTIs), frequent occurrence of detrusor overactivity (black arrowheads), the amplitude of detrusor contraction is more than 15cm H_2O during storage phase, and increased bladder wall (5.5 mm at 150 ml of bladder volume) (black arrow) were detected.

Correlations in Children

Although lack of control groups, Qvist and associates found that the children with more pronounced DO and recurrent LUITs should receive bladder-specific anticholinergics and antibiotics prophylactically, but the children with less pronounced only were given antibiotics prophylactically [3]. The proportion of girls with LUTIs is predominant in the majority of studies on children with LUTIs, and Hansson found that 75% of girls with asymptomatic or covert bacteriuria had urodynamically consistent DI and hypothesized that the girls with LUTIs and DI have an underlying functional disorder of Lower Urinary Tract (LUT) and a secondary liability to LUTIs, if the dysfunction was initiated by various infection in LUT or genital area, a vicious circle of LUTs and LUTD may be activated [4]. Regarding the fact that no great effect was previously found in the children with LUTD and LUTIs treated with only antibiotics, it may be fact that the children would obtain better results in the choice of therapy protocol according to UDS.

However, Whether DO was a normal picture of urodynamics in infants is unknown, since few studies on urodynamic patterns of healthy infants were underwent. Bachelard performed cystometry in infants with LUTIs and found 61% (55/90) male and 68% (46/68) female infants had DO, and higher intravescial pressure was detected in infants compared to older children [5]. Bachelard combined voiding cystourethrography with cystometry to perform Video Urodynamic Studies (VUDS) in infants with LUTIs and found that bladder wall irregularity, elongation of bladder shape and filling of posterior urethra were positively related with DO and more such finding, stronger the indication [6]. However, Bachelard's researches did not answer the question that whether these urodynamic findings of DO are the normal characteristics of infants [5].

In a research, Wen and yeung underwent video cystometry in 37 infants with hydroureteronehrosis or LUTIs but without LUTD, and they found that DO and intermittent voiding pattern occurred respectively in 8.6% and 57% of those subjects, by which the authors suggested that DO is uncommon and intermittent voiding may be a physiological phenomenon regarding the immature voiding function in infants [7]. However, there also was not a true control group performing video urodynamic study combined with simultaneous EMG recording as a baseline.

Mutual Effect of DO and LUTIs

There is another question need to answer that whether patients with DO have a tendency of inoculate bacterial in LUT. Wullt divided 16 patients with recurrent LUTIs into 4 groups, in which patients in one group have normal bladder function and patients with neurogenic bladder disorder and undergone ileocystoplasty were divided into other 3 groups according to their etiology, and found that long-term colonization of *E.coli* 83972 without expression of P-fimbriae or attaching to human uroepithelial was unsuccessful in patients without bladder disorder [8]. Although this study suggested that elimination of urinary *E. coli* may be depended on intact bladder mucosa and emptying to maintain sterility of urinary tract, but discrepancy in susceptibility to LUTIs in patients with various causes may be on account of different antibacterial efficiency of LUT.

Moreover, Moore and Simons compared the incidence of bacterial cystitis between patients with DO or DO/Genuine

Stress Incontinence (GSI) and with only GSI to determine whether patients with DO had a tendency to involve within LUTIs [9]. A significant relationship between DI and bacterial cystitis was found in this study and patients with bacteriuria were not more likely to be DO, they suggested that the acute inflammation of bladder mucous resulting from bacterial cystitis but not bacteriuria evoked detrusor contractility proven by animal studies, in which an increased afferent discharge and rhythmic detrusor contractions were induced and an increased expression of nociceptive neuropeptides, such as substance p and calcitonin gene-related peptide, also were detected [10-12]. However, lower concentration of Adenosine Thriphosphate (ATP) detected in urine samples of female patients with refractory DO and microbiological evidence of bacteriuria compared to with sterile, contrary to that expected increasing of intravesical ATP concentration in female patients with bacteriuria [13]. Therefore, there are various mechanisms involved within induction of DO by LUTIs and it is not immediately apparent what correlations were observed between refractory DO and LUTIs.

Since bacterial cystitis is mostly induced by uropathogenic *E. coli* strain, Schwarz found that the bacterial derived f-MLP induced an increasing of permeability of bladder urothelium and a hyperalgesic state resulting from releasing of PGE2, which increase the sensitivity of primary afferent, through COX-1 and COX-2 dependent mechanisms in detrusor of human and rabbit but not guinea pig [14]. Endothelial Nitric Oxide Synthase (eNOS) related pathway and inducible NOS-regulated *ERK1/2* signaling were found, respectively, involved within short and long-term uropathogenic *Escherichia coli* (UPEC) treatment-induced responses of isolated rat detrusor strips by weng's team [15]. Moreover, the increasing expression of GAP-43, which involved within the mechanism of nerve regeneration after an insult to bladder, with previous history of LUTIs was found in subepithelium and detrusor of patients with Idiopathic Detrusor Overactivity (IDO) in a study by Schofield [16]. Hence, epithelial permeability and sensory afferent nerve hyperalgesia should play important roles in in the mechanisms of DO due to cystitis.

Recently, mounting evidences suggested that urine is not sterile and urinary microbiota may contribute to LUTD. In a review, Balachandran found increasing evidence in exacerbation of DO due to chronic colonization of low-grade bacteria in bladder uroepithelium by advanced tests such as RNA sequencing and suggested that LUTIs might play a role in pathology of DO [17]. Brubaker reviewed a few studies using enhanced urine culture technique to detected DNA derived from microbes since 2012 and observed differences in urine microbiota in female patients with Urgency Incontinence (UI) compared to without and suggested that there is urinary microbiota basis in occurrence of UI [18]. Chen supported Brubaker's view by detection of diverse urinary microbiota in patients with refractory UI and recurrent UITs through Culture-independent profiling using bacterial 16S RNA profiling [19]. Recent studies revealed that the urinary tract is not sterile and there is a complex microbial network of urinary tract in individual body, dysfunctional disorders in LUT might occur if imbalance of the network [20]. Contrary to stuides mentioned above, Rodrigues considered recurrent LUTIs may be an effect of DO and not its cause by his finding of obvious increasing of DO in female patients with recurrent UITs by performing at least three repeating urodynamic tests with an additional ice water [21].

Role of DV in LUTIs

The occurrence of DO frequently found in storing phase of micturition, is there any abnormal dysfunctions of bladder in voiding phase in patients with LUTIs? Recurrent LUTIs may diagnosed in 40% in patients with Dysfunctional Voiding (DV), which was referred to external urethral sphincter spasticity when voiding in patients without neurological disorders, regarding as a learn behavior resulting from adverse pelvic conditions including LUTIs [22]. Minardi found that storage symptoms were detected in 87.6% female patients with recurrent LUTIs and DV and thicker detrusor in LUTIs patients with DV compared to without DV [23]. Girls with DV were also more likely to present with a history of LUTIs than with DO [24]. Higher incidence of DV (25%) and poor relaxation of pelvic floor muscle (20%) were found compared to DO (11%) in female patients with LUTS and recurrent LUTIs by video urodynamic studies [25]. It may be the fact that increased thick of detrusor was derived from Bladder Outlet Obstruction (BOO) due to DV, which contributed to DO, and disruption of laminar urinary flow resulted from DV might cause LUTIs on account of milk back phenomenon transferring bacteria back from meatus to bladder, which might in turn prompt exacerbation of DO.

Conclusion

Although those researchers strove to evaluate the correlations between LUTIs and DO in children and adults, there has was not a conclusion that bladder dysfunction may be the primary cause of LUTIs or the inverse and mounting evidence suggested that urine is not sterile and urinary microbiota may contribute to LUTD and LUTs. With video urodynamic studies and enhanced urine culture technique, more scheduled studies should be performed during presentation of bladder dysfunction to resolve the issue. Similar with gut microbiota, urinary microbiota may be varied considerably according to conditions of human body, such as age, gender, dietary diet, MBI and medical disease, and may play a role in DO and LUTIs. Given the well-known connections between bladder function and Central Nerve System (CNS), studies that link the urinary microbiota with CNS function should be underwent in the future. Therefore, it is suggested that clarification of relationship between DO and LUTIs will provide accurately information to help us manage the patients more appropriately.

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Conflict of Interest

None to disclose.

References

1. Eapen RS, Radomski SB (2016) Review of the epidemiology of overactive bladder. Res Rep urol 8: 71-6
2. Walter S, Andersen JT, Hebjon S, Vejlsgaard R (1977) Detrusor hyperreflexia and bacteriuria. Urol int 32: 117-22.
3. Qvist N, Nielsen KK, Kristensen ES, Ehlers D, Jensen KM, et al. (1986) Detrusor instability in children with recurrent urinary tract infection and/or enuresis. II. Urol int 41:199-201.
4. Hansson S, Hjälmås K, Jodal U, Sixt R (1990) Lower urinary tract dysfunction in girls with untreated asymptomatic or covert bacteriuria. J urol 143: 333-335.
5. Bachelard M, Sillén U, Hansson S, Hermansson G, Jodal U, et al. (1998) Urodynamic pattern in infants with urinary tract infection. J urol 160:522-26.
6. Bachelard M, Verkauskas G, Bertilsson M, Sillén UJ, Jacobsson B (2001) Recognition of bladder instability on voiding cystourethrography in infants with urinary tract infection. J urol 166: 1899-1903.
7. Wen JG, Yeung CK, Chu WC, Shit FK, Metreweli C (2001) Video cystometry in young infants with renal dilation or a history of urinary tract infection. Urological research 29: 249-255.
8. Wullt B, Connell H, Röllano P, Månsson W, Colleen S, et al. (1998) Urodynamic factors influence the duration of Escherichia coli bacteriuria in deliberately colonized cases. J urol 159: 2057-2062.
9. Moore KH, Simons A, Mukerjee C, Lynch W (2000) The relative incidence of detrusor instability and bacterial cystitis detected on the urodynamic-test day. BJU International 85:786-972.
10. Mahon MSB (1988) Neuronal and behavioural consequences of chemical inflammation of rat urinary bladder. Agents and actions 25:231-233.
11. Callsen-Cencic P, Mense S (1997) Expression of neuropeptides and nitric oxide synthase in neurones innervating the inflamed rat urinary bladder. Auton Neurosci 65: 33-44.
12. Smet PJ, Moore KH, Jonavicius J (1997) Distribution and colocalization of calcitonin gene-related peptide, tachykinins, and vasoactive intestinal peptide in normal and idiopathic unstable human urinary bladder. Lab Invest J tech Methods Pathol 77: 37-49.
13. Walsh CA, Cheng Y, Mansfield KJ, Parkin K, Mukerjee C, et al. (2013) Decreased intravesical adenosine triphosphate in patients with refractory detrusor overactivity and bacteriuria. J Urol 189: 1383-1387.
14. Schwarz NT, Jung SY, Kalff JC, Chancellor M, Bauer AJ (2002) Bacterial toxin N-formyl-methionyl leucyl-phenylalanine acutely contracts human and rabbit detrusor through the release of eicosanoids. J Urol 167: 2603-2612.
15. Weng TI, Chen WJ, Wu HY, Liu SH (2006) Uropathogenic Escherichia coli alters muscle contractions in rat urinary bladder via a nitric oxide synthase-related signaling pathway. J Infect Dis 194: 1774-1782.
16. Schofield EC, Clausen JA, Burcher E, Moore KH (2005) GAP-43 immunoreactivity of subepithelial detrusor muscle nerve fibres in patients with refractory idiopathic detrusor overactivity. Neurourology and Urodynamics 24: 325-333.
17. Balachandran AA, Wildman SS, Strutt M, Duckett J (2016) Is chronic urinary infection a cause of overactive bladder? Eur J Obstet Gynecol Reprod Biol 201: 108-112.
18. Brubaker L, Wolfe AJ (2017) Microbiota in 2016: Associating infection and incontinence with the female urinary microbiota. Nat Rev Urol 14: 72-74.
19. Chen Z, Phan MD, Bates LJ, Peters KM, Mukerjee C, et al. (2018) The urinary microbiome in patients with refractory urge incontinence and recurrent urinary tract infection. Int Urogynecol J 29: 1775-1782.
20. Magistro G, Stief CG (2019) The urinary tract microbiome: The answer to all our open questions? Euro Urol Focus 5: 36-38.
21. Rodrigues P, Hering F, Campagnari JC (2014) Involuntary detrusor contraction is a frequent finding in patients with recurrent urinary tract infections. Urol Int 93: 67-73.
22. Carlson KV, Rome S, Nitti VW (2001) Dysfunctional voiding in women. J Urol 165: 143-147.
23. Minardi D, Parri G, d'Anzeo G, Fabiani A., El Asmar Z, et al. (2008) Perineal ultrasound evaluation of dysfunctional voiding in women with recurrent urinary tract infections. J Urol 179: 947-951.
24. Van Batavia JP, Ahn JJ, Fast AM, Combs AJ, Glassberg KI (2013) Prevalence of urinary tract infection and vesicoureteral reflux in children with lower urinary tract dysfunction. J Urol 190: 1495-1499.
25. Lee PJ, Kuo HC (2020) High incidence of lower urinary tract dysfunction in women with recurrent urinary tract infections. J Urol 12: 33-40.