Original Article

Role of uroflowmetry with electromyography in the evaluation of children with lower urinary tract dysfunction

Ramesh Babu, Vinu Gopinath

Department of Pediatric Urology, Sri Ramachandra Medical College, Porur, Chennai, India

ABSTRACT

Introduction: A conventional urodynamic study (UDS) is considered invasive while uroflowmetry is considered inadequate in the evaluation of children with lower urinary tract dysfunction. The aims of this study were to identify the role of uroflowmetry with electromyography (UFEMG) in this group.

Methods: A cohort of 121 children (age 5–12 years; M:F = 2:3) with symptoms of lower urinary tract dysfunction underwent a detailed voiding history and clinical assessment. Those with evidence of neurological abnormality, obstructive uropathy or active urinary tract infection were not included. They were prospectively studied using UFEMG first, followed by UDS on the same day.

Results: A total of 76 (63%) children had abnormality on UFEMG while only 12 (10%) had abnormality on UDS. UFEMG was significantly superior in picking up abnormality ($P = 0.03$). Three types of UFEMG abnormalities were identified: (1) dysfunctional voiding (prolonged staccato trace with active pelvic floor and normal voided volume: $n = 42$), (2) idiopathic detrusor overactivity (shortened trace with quiet pelvic floor and reduced voided volume: $n = 16$) and (3) detrusor underutilization disorder (prolonged flat trace with quiet pelvic floor and large voided volume: $n = 18$).

Conclusions: UFEMG is ideal non-invasive test in children with lower urinary tract dysfunction. It helps in identifying the different patterns and the appropriate treatment modality.

Key words: Children, electromyography, voiding dysfunction, lower urinary tract dysfunction, urodynamic study, uroflowmetry

INTRODUCTION

Lower urinary tract dysfunction is one of the leading causes of urinary tract infections in children. The etiology of lower urinary tract dysfunction is still unknown, and its incidence varies from 2% to 25% among toddlers. Frequency, urgency and enuresis are the main symptoms of lower urinary tract dysfunction. Most children who present to the outpatient department with lower urinary tract dysfunction have no identifiable neurologic or anatomic abnormality. Although several authors[1-3] supported conventional urodynamic study (UDS) in the evaluation of these patients, others[4,5] did not recommend routine UDS in children with non-neurogenic lower urinary tract dysfunction as it did not generally change the management and treatment.

Uroflowmetry (UF) alone has been used for the evaluation of lower urinary tract dysfunction in children, and the flow pattern is used to interpret the pathology. But UF as a stand-alone investigation is inadequate as it gives no information on the pelvic floor activity during voiding. Several authorshave felt that diagnoses based on UF pattern appearance without simultaneous electromyography (EMG) to support them can be misleading and that reliance on UF pattern alone can lead to over diagnoses of dysfunctional voiding (DV) and detrusor underactivity.[6-8] When assessing patients with lower urinary tract dysfunction, UF with EMG (UFEMG) can be superior to UF alone or a conventional UDS for improving diagnostic accuracy and selecting the most appropriate therapy. In the present study, we evaluated the role of UFEMG in evaluation of children with non-neurogenic lower urinary tract dysfunction

For correspondence: Dr. Ramesh Babu,
3/5 Jai Nagar 7th Street, Arumbakkam, Chennai - 600 106, India.
E-mail: drrameshbabu1@gmail.com

Access this article online	
Quick Response Code:	Website: www.indianjurol.com
	DOI: 10.4103/0970-1591.166469

as compared with a conventional urodynamic study. In addition, we have also tried to categorize the UFEMG patterns into distinct defined patterns described earlier[9-11] such that treatment options can be formulated.

MATERIALS AND METHODS

Children who presented to the outpatient department with lower urinary tract dysfunction as suggested by wetting, urgency, urge incontinence, frequency, etc., were identified. After taking a detailed history, a thorough physical examination was performed to rule out underlying abnormalities. All children were subjected to X-ray of the spine and ultrasonogram of the kidney, ureter and bladder to exclude a neurologic cause or underlying anatomic abnormalities of the urinary tract. A urine culture was performed and those with active urinary infections were enrolled only after prompt treatment and a negative repeat culture.

After ensuring adequate bladder filling on ultrasonogram, UFEMG was first performed: Patch electrodes were applied to the perineum on either side of the anal opening; after connecting to the EMG unit, the child was asked to pass urine on an UF meter. This was followed by a conventional UDS with 6 F double-lumen urethral catheters and rectal lines using a standard urodynamic machine (Laborie Medical®, Williston, VT, USA) on the same day with antibiotic cover. The presence of abnormality on UFEMG versus UDS was expressed as percentage and the results were compared using the Fishers exact test.

UFEMG patterns were categorized into one of the urodynamically defined patterns described earlier[8-11]: Type 1 – DV characterized by an active pelvic floor during voiding, Type 2 – idiopathic detrusor overactivity (IDOA) characterized by a quiet pelvic floor and reduced voided volume, Type 3 – detrusor underutilization disorder (DUU) characterized by prolonged flat trace with quiet pelvic floor and large voided volume, Type 4 – primary bladder neck dysfunction (PBND) characterized by prolonged lag time (the time between the start of pelvic floor relaxation on volitional voiding effort and the start of urine flow) and a quiet pelvic floor.

RESULTS

Between 2012 and 2014, a total of 121 children (age 5–12 years; M:F = 2:3) were prospectively analyzed. All children underwent UFEMG followed by UDS successfully on the same day. Forty-four children had no abnormality detected in either of the studies. Of a total of 77 abnormalities detected, 11 children had abnormality on both UFEMG and UDS, 65 had abnormality only on UFEMG while one had abnormality only on UDS [Table 1]. A total of 76 (63%) children had abnormality on UFEMG while only 12 (10%) had abnormality on UDS. UFEMG was significantly superior in picking up abnormalities ($P = 0.03$; Fisher's exact test).

Table 1: Contingency table comparing urodynamics and uroflow EMG in identifying an abnormality in children with lower urinary tract dysfunction

	UDS normal	UDS abnormal	Total
UFEMG normal	44	1	45
UFEMG abnormal	65	11	76
Total	109	12	121

UDS=Urodynamics; UFEMG=Uroflow and electromyography. Note: A total of 76 (63%) children had abnormality on UFEMG while only 12 (10%) children had abnormality on UDS. UFEMG was significantly superior in picking up abnormalities (P=0.03; Fisher's exact test)

Figure 1 describes the different types of UFEMG patterns encountered. In addition to the normal pattern (n = 44), the three types of UFEMG abnormalities identified were: DV (n = 42), IDOA (n = 16) and DUU (n = 18). We did not encounter any patient with PBND described earlier. Table 2 describes the symptoms and UF parameters in the groups. Frequency and urgency/urge incontinence were the most common in those with IDOA, constipation and holding maneuvers in those with DV and decreased frequency in those with DUU. Daytime wetting was prevalent in all the groups while nighttime wetting was more common in those with normal UFEMG. UF parameters revealed high post-void residue (PVR) in those with DSD, high Q_{max} in those with IDOA and large voided volume in those with DUU.

One of the 42 children with DV detected on UFEMG had detrusor overactivity (2.5%) on UDS. Ten of the 16 children with IDOA on UFEMG had detrusor overactivity (62%) on UDS. None of the patients with DUU had any filling phase abnormality. A total of 11/12 (91.6%) children with UDS abnormalities fall into type 1 (8.3%) or type 2 (83.3%) UFEMG abnormality in our study. By following a UFEMG first protocol [Figure 2], we would have identified most of the patients with UDS abnormality with a non-invasive test itself instead of an invasive UDS.

DISCUSSION

Several authors[1-3] still consider UDS as a gold standard in the evaluation of children with non-neurogenic lower urinary tract dysfunction, while others[4-5] have questioned its usefulness in picking up a voiding phase abnormality. Conventional UDS is considered invasive, while uroflowmetry inadequate in the evaluation of children with lower urinary tract dysfunction. Studies have favored UFEMG as the first choice in this setting to identify different patterns of abnormalities.[6-11]

In the present study, we have attempted to compare the usefulness of UFEMG and UDS by performing them on the

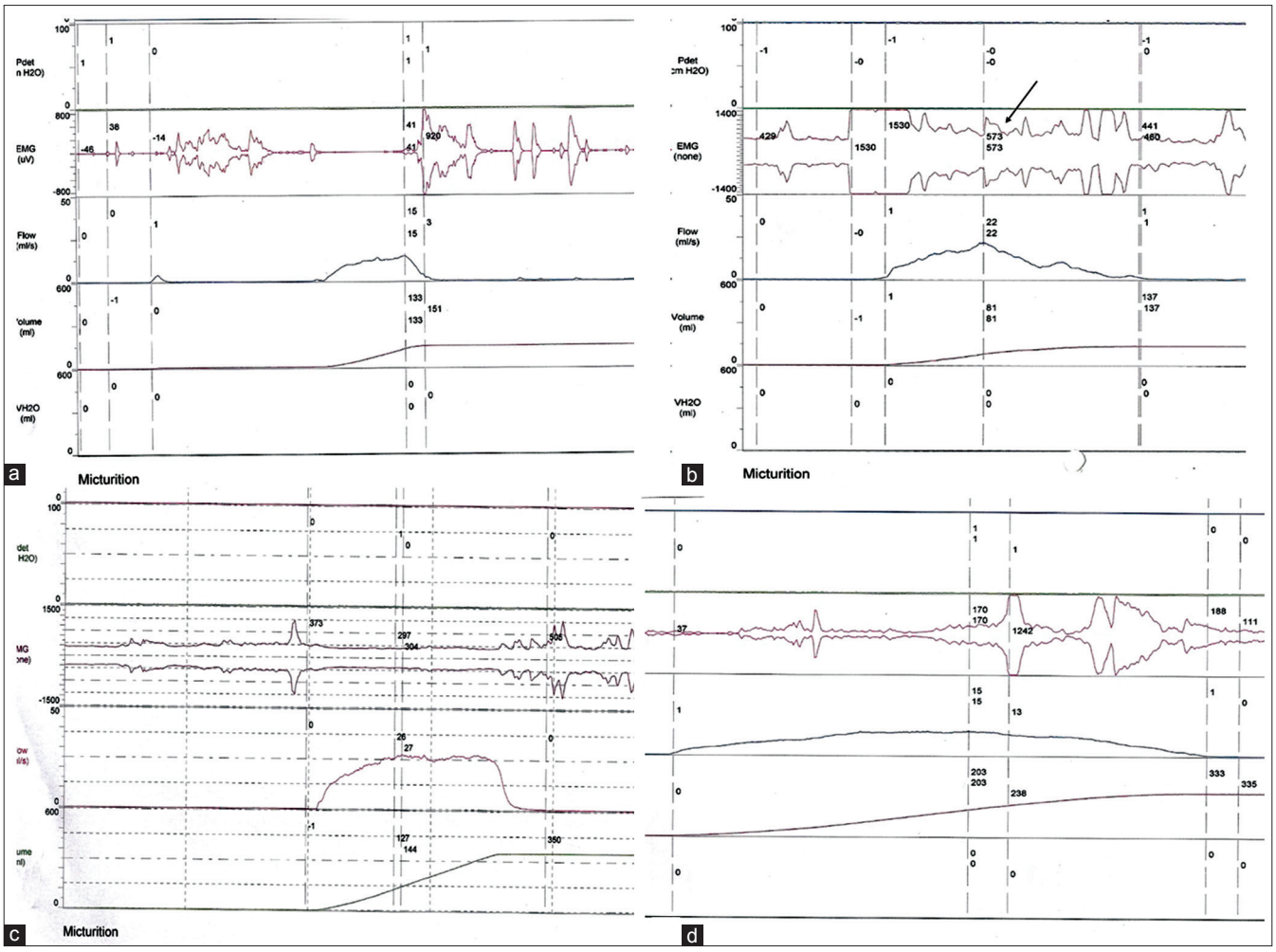

Figure 1: Different types of uroflow (UF) with electromyography (EMG) patterns with top trace showing the EMG activity, middle trace showing the UF and bottom trace showing the voided volume. (a) Normal, (b) dysfunctional voiding – active pelvic floor (arrow) during voiding and staccato UF, (c) idiopathic detrusor overactivity –IDOA shortened tower-shaped UF with quiet pelvic floor and (d) detrusor underutilization disorder – prolonged flat UF with quiet pelvic floor

Table 2: Symptoms and uroflow parameters in the different patient groups

	Normal UFEMG (*n*=45)		Abnormal UFEMG (*n*=76)		
	Normal UDS (*n*=44)	Abnormal UDS (*n*=1)	DV (*n*=42)	IDOA (*n*=16)	DUU (*n*=18)
Frequency	12	1	12	14	4
Urgency/urge incontinence	10	-	24	15	2
Decreased frequency	4	-	0	0	12
Daytime wetting	14	1	12	12	6
Nighttime wetting	12	-	2	4	4
Day+night time wetting	18	-	2	2	2
Holding maneuvers	2	-	32	9	2
Constipation	4	-	34	10	4
Detrusor overactivity on UDS	0	1	1	10	0
PVR >10% of bladder capacity	0	-	18	4	12
Mean Q_{max} (mLl/s)	11.2	12.1	19.9	23.3	9.8
Mean Q_{ave} (mLl/s)	10.2	11.8	14.8	16.2	9.1
Mean voided volume (mLl)	192	184	142	116	286

same day on each patient. Our findings reveal that UFEMG is superior in picking up an abnormality compared with UDS. In addition, it also allows us to classify them into different types as proposed by Glassberg[10] and choose an

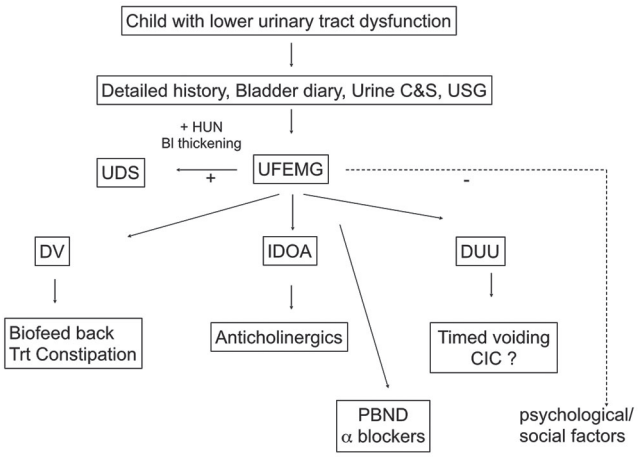

Figure 2: Algorithm for evaluation of children with lower urinary tract dysfunction. Note: After excluding neurological or obstructive etiology, uroflow with electromyography (UFEMG) is performed in all cases. A urodynamic study is reserved for cases where UFEMG is positive or bladder wall thickening/ hydroureteronephrosis is present on ultrasonogram

appropriate treatment modality; Type 1: DV, managed by treating constipation, bio feedback, relaxation techniques; Type 2: IDOA managed with anti-cholinergics; Type 3: DUU disorder managed with timed voiding and clean intermittent catheterization in refractory cases; and Type 4: PBND treated with alfa blockers. In our study, we did not encounter any patient with PBND. This is probably due to the small numbers enrolled in our study. We also did not attempt to further sub-classify IDOA based on lag time analysis as proposed by others,[9-11] and these are some of the limitations of our study.

In the present study, 35% had DV, 13% had idiopathic overactivity and 15% had DUU disorder on UFEMG, and the findings are comparable to that reported by other authors.[7-11] Among those with UDS abnormality, 92% had UFEMG abnormality as well. Thus, if we had employed UFEMG as the first modality of evaluation, we could have avoided many unnecessary invasive urodynamics. UFEMG is superior to UF alone or UDS as it helps to identify the different dysfunctional patterns and choose the appropriate treatment modality. Being a non-invasive test, we propose the UFEMG-first approach [Figure 2] for evaluation of children with lower urinary tract dysfunction. UDS can be reserved for those with upper tract dilatation, bladder wall thickening or pervious abnormal UFEMG. Further larger studies with detailed lag time analysis are required to support or negate our findings.

REFERENCES

1. Nitti VW, Lefkowitz G, Ficazzola M, Dixon CM. Lower urinary tract symptoms in young men: Videourodynamic findings and correlation with noninvasive measures. J Urol 2002;168:135-8.
2. Glazier DB, Murphy DP, Fleisher MH, Cummings KB, Barone JG. Evaluation of the utility of video-urodynamics in children with urinary tract infection and voiding dysfunction. Br J Urol 1997;80:806-8.
3. Hoebeke P, Van Laecke E, Van Camp C, Raes A, Van De Walle J. One thousand video-urodynamic studies in children with non-neurogenic bladder sphincter dysfunction. BJU Int 2001;87:575-80.
4. Soygür T, Arikan N, Tokatli Z, Karaboga R. The role of video-urodynamic studies in managing non-neurogenic voiding dysfunction in children. BJU Int 2004;93:841-3.
5. Parekh DJ, Pope JC 4th, Adams MC, Brock JW 3rd.The use of radiography, urodynamic studies and cystoscopy in the evaluation of voiding dysfunction. J Urol 2001;165:215-8.
6. Wenske S, Combs AJ, Van Batavia JP, Glassberg KI. Can Staccato and interrupted/Fractionated Uroflow Patterns Alone Correctly Identify the Underlying Lower Urinary Tract Condition? J Urol 2012;187:2188-93.
7. Elmissiry M, Abdelkarim A, Badawy H, Elsalmy S, Ali GA. Refractory enuresis in children and adolescents: How can urodynamics affect management and what is the optimum test? J Pediatr Urol 2013;9:348-52.
8. Chrzan R, Czernik J, Apoznański W, Patkowski D, Siekanowicz P. Uroflowmetry in children – is it necessary to repeat the study in a single patient? Eur J Pediatric Surg 2005;15:26-9.
9. Van Batavia JP, Combs AJ, Hyun G, Bayer A, Medina-Kreppein D, Schlussel RN, *et al*. Simplifying the diagnosis of 4 common voiding conditions using uroflow/electromyography, electromyography lag time and voiding history. J Urol 2011;186:1721-6.
10. Glassberg KI, Combs AJ, Horowitz M. Nonneurogenic voiding disorders in children and adolescents: Clinical and videourodynamic findings in 4 specific conditions. J Urol 2010;184:2123-7.
11. Combs AJ, Graftein M, Horowitz M, Glassberg KI. Primary bladder neck dysfunction in children and adolescents: Pelvic floor electromyography lag time- a new non invasive method to screen for and monitor therapeutic response: J Urol 2005;173:207.

How to cite this article: Babu R, Gopinath V. Role of uroflowmetry with electromyography in the evaluation of children with lower urinary tract dysfunction. Indian J Urol 2015;31:354-7.

Source of Support: Nil, **Conflict of Interest:** None declared.