

Surface Electromyography of Perianal Muscles in Children with and without Enuresis: A Cross-sectional Study

VIDHI SHAH¹, TUSHAR PALEKAR², PADMAJA GURUPRASAD³

ABSTRACT

Introduction: Enuresis or bedwetting is the most common urological problem seen in children from the age of 5-15 years. Various diagnostic procedures like urodynamics study, urinary system ultrasonography and Electromyography (EMG) are widely used. In most cases, endoanal probe is used for the procedure of EMG which is an invasive technique but surface EMG is pain free and easier.

Aim: To assess the activity of perianal muscle in children with enuresis using surface EMG.

Materials and Methods: Present study was a cross-sectional study in which 20 healthy children and 20 enuretic children in the age group of 5-15 years participated. Both boys and girls without central nervous system disorder were included. Surface EMG of the perianal muscles were performed. The homogeneity

of demographic data like age, weight and height were checked using Student's t-test. Normality of the data was established using Shapiro-Wilk's test.

Results: On analysis, the mean age (years) of normal children was 8.75 ± 2.09 and for enuretic children was 9.3 ± 2.63 . The mean value of amplitudes of surface EMG (Quotient of Motor Unit action Potential-QMUP) in normal children was $428.6 \pm 118.6 \mu V$ and for enuretic children was $248.01 \pm 45.85 \mu V$ ($p < 0.05$). Mean score for enuretic girls was 260 ± 42.95 and normal girls was 414.7 ± 118.1 ($p < 0.05$). Similarly, mean score for enuretic boys was 236 ± 47.71 and normal boys were 442.8 ± 123.7 ($p < 0.05$).

Conclusion: The perianal muscle activity is lowered in children with enuresis than in their age matched normal children. In the enuretic children, there is a need to manage pelvic floor muscle strength along with neuronal control.

Keywords: Bedwetting, Electrodiagnosis, Paediatric population, Pelvic floor muscles, Urodynamics

INTRODUCTION

The International Children's Continence Society (ICCS) defines enuresis as an involuntary voiding of urine during the day and/or night [1]. The children usually are able to let the parents know when they have the urge to pee by the age of 5-6 years, but in some children it is difficult to attain the control that is known as bedwetting. This is mostly common in the age group of 5-15 years [1,2]. Bedwetting can be caused due to wide range of factors such as maturation delay, genetic factors, sleep disorders, behaviour and psychological factors, and endocrinal system causes [1].

Primary nocturnal enuresis is defined as the involuntary voiding of urine during the night. In this type of enuresis, the child never achieves control of his/her bladder [3]. Secondary nocturnal enuresis is defined as the re-occurrence of bedwetting after achieving of bladder control. The child begins to have episodes of bedwetting after having achieved control, i.e., after having six months of dry period [3].

There many evaluations that are performed to assess and diagnose enuresis. The most commonly assessed parameters are like urinalysis and urine culture, urinary system ultrasonography, urodynamic studies, EMG of the pelvic floor and many more. EMG is a diagnostic procedure that is used for assessment of muscle function. It is commonly used in conditions involving the central nervous system and peripheral nervous system. This method is very useful in giving a visual feedback in the form of graphs. EMG can be used in assessment of pelvic floor muscle in the children with enuresis by using various electrodes like endoanal probes, vaginal probes, and button electrodes [4]. Endoanal probes and vaginal probes are invasive and expensive. So, there is a need to assess these muscles in an easier and non invasive method. Surface EMG using the button electrode is a non invasive electrodiagnostic method. Perianal muscles are easier to assess with surface button electrodes. It is

especially useful in children. It can be used as a diagnostic tool as well as an intervention [5].

Perianal muscles are part of assessment of pelvic floor muscle surface EMG. It can be assessed in various positions such as supine, sitting and standing. Each maneuver helps in recruitment of muscles. Children are able to activate their pelvic floor muscles separately from the adjacent hip and abdominal muscle groups [4]. So, surface EMG of perianal muscle was performed by button electrode in this study. This study aimed to assess bladder function using surface EMG of perianal muscles in the children with enuresis.

MATERIALS AND METHODS

This cross-sectional study used purposive sampling method and was conducted in Dr DY Patil College of Physiotherapy from October 2020 to March 2021. Ethical clearance was taken from the Ethical Committee of the Institute {Ethical approval no: DYCPT/IEC/28/2020.} and the trial was also registered in Clinical Trials Registry India (CTRI Reg no.: CTRI/2020/12/029496.) Total of 60 children were screened and the ones that fit the criteria were included in this study. Twenty healthy children and equal enuretic children who fit the inclusion criteria were selected.

Inclusion criteria: Children having age between 5- 15 years, children with history of daytime/night time bedwetting, history of bedwetting for atleast two times a week and duration of bedwetting for atleast three consecutive months [1].

Exclusion criteria: Children with any CNS involvement, any sort of developmental delay, presence of bladder infections, and those taking medications for the management of enuresis, were excluded from the study.

Procedure

Diagnosis of all the enuretic children was confirmed in the presence of paediatricians at the institute where the study took place.

Testing position: A patient was asked to lie in supine with both the knees flexion (crook lying) [6]. The guardian or the parent was asked to be present in the room while the surface EMG was being performed. The surface EMG was performed using button electrodes.

Placement of electrodes: The cathode and anode were placed at the perianal region and the ground electrodes were placed on the thigh to complete the circuit.

Recording of surface EMG readings : The child was instructed to squeeze their knee.

The therapist took 3 readings.

- No contraction (Spontaneous activity- SPA): The child was instructed to stay relaxed for SPA reading. The reading of SPA was recorded as 0.
- Maximum Voluntary Contraction (MVA): The child was asked to contract his/her perineum as if they are controlling their urge to micturate for 10 seconds. Here, the peak-to-peak amplitude was measured as the outcome measure.
- Maximal voluntary contraction (QMUP): The child was asked to contract their perineum maximum capacity for 10 seconds. The average amplitude was recorded as outcome measure.

STATISTICAL ANALYSIS

Sample size estimation was done using Open Epi software version 3.01. The calculated sample size of the study was 39 at 95% confidence level and allowable error was 6%. Data was analysed using primer of biostatistics version 7. The homogeneity of the samples was checked using the Student's t-test. Normality of the data was checked by using Shapiro-wilk's test. Further analysis of the amplitudes of surface EMG was performed using Mann-Whitney test where the p-value was set at 95% confidence interval ($p < 0.05$).

RESULTS

The mean age in the group of normal children was 8.75 ± 2.09 years and for enuretic children was 9.3 ± 2.63 years (p -value 0.47). The mean of SPA readings were 0 μ V. For quantitative analysis, authors used the values of QMUP [Table/Fig-1]. There was a significant difference in the QMUP values of surface EMG between normal and enuretic children. There was also a significant difference between in QMUP values of surface EMG among each gender of normal and enuretic group. However, there was no significant difference found between genders within the normal and enuretic group [Table/Fig-2-4].

| Variables | Children | Mean \pm SD | p-value* |
|-----------|----------|--------------------|----------|
| SPA | Normal | 0 | - |
| | Enuresis | 0 | |
| MVA | Normal | 389.3 \pm 111.6 | 0.001 |
| | Enuresis | 217 \pm 53.54 | |
| QMUP | Normal | 428.6 \pm 118.6 | <0.05 |
| | Enuresis | 248.01 \pm 45.86 | |

[Table/Fig-1]: The comparison of mean scores of SPA, MVA and QMUP in children with and without enuresis.

SPA: Spontaneous activity; MVA: Maximum voluntary contraction; QMUP: Quotient of motor unit action potentia; Student's t-test; *p-value <0.05 is considered to be significant

| Gender | Variables | QMUP Mean \pm SD | p-value* |
|--------|---------------|--------------------|----------|
| Girls | Normal (10) | 414.7 \pm 118.1 | 0.001 |
| | Enuresis (10) | 260 \pm 42.95 | |
| Boys | Normal (10) | 442.8 \pm 123.7 | <0.001 |
| | Enuresis (10) | 236 \pm 47.71 | |

[Table/Fig-2]: Comparison of mean values of QMUP of surface EMG in normal and enuretic girls and boys.

*p-value <0.05 is considered to be significant; Student's t-test

| Children | Variables | QMUP Mean \pm SD | p-value |
|----------|-----------|--------------------|---------|
| Normal | Girls | 414.7 \pm 118.1 | 0.253 |
| | Boys | 442.8 \pm 123.7 | |
| Enuresis | Girls | 260 \pm 42.95 | 0.521 |
| | Boys | 236 \pm 47.71 | |

[Table/Fig-3]: Comparison of mean values of QMUP of surface EMG between girls and boys in normal and enuretic children.

| Gender | Variables | QMUP (μ V) Mean \pm SD | p-value* |
|--------|-----------|-------------------------------|----------|
| Girls | Normal | 414.7 \pm 118.1 | 0.001 |
| | Enuresis | 260 \pm 42.95 | |
| Boys | Normal | 442.8 \pm 123.7 | <0.05 |
| | Enuresis | 236 \pm 47.71 | |

[Table/Fig-4]: Comparison of mean values of QMUP of surface EMG in normal and enuretic girls and boys.

*p-value <0.05 is considered to be significant

DISCUSSION

One of the causative factor of enuresis is pelvic floor muscle weakness. Surface EMG is a non invasive electrodiagnostic method which helps in analysing the activity of the muscle with a visual representation in the form of graphs [7]. Wennergren H and Oberg B concluded that EMG can be used as a tool of assessment in children [5]. So, that the pelvic floor muscle can be recruited [8]. Another study performed by Glazer HI et al., was to understand the reliability of using surface EMG for pelvic floor muscle assessment this study concluded that surface EMG is highly reliable [9]. The present study found significant difference ($p < 0.05$) in the mean score of peak-to-peak amplitude for pelvic floor muscles between normal and enuretic children. A study conducted by Abd El-Moghny SM et al., [6] on children with Primary Monosymptomatic Nocturnal Enuresis (PMNE) found a significant decline in pelvic floor muscle activity peak when comparing each PMNE group with its age matched normal group. They concluded that the peak ($X \pm SD$) significantly changed ($p = 0.001$) from 199.3 ± 1.0 , 200.9 ± 0.9 , and 201.9 ± 1.2 of normal groups to 90.0 ± 0.8 , 92.1 ± 1.1 , and 93.9 ± 0.9 of PMNE groups, for age-matched categories 8, 9, and 10 years, respectively. The percentages of peak decline in PMNE groups from normal groups were 54.8%, 54.2%, and 53.5% for age-matched categories for 8, 9, and 10 years, respectively [6].

In the present study, there was a significant difference between the amplitude of the surface EMG of the pelvic floor muscles in children suffering from enuresis. It only goes to prove that, the weakness in the pelvic floor muscles could be one of the reasons of bedwetting in children with enuresis [10]. This was in agreement with the study performed by Kulaksizoğlu H et al., they aimed to find out the efficacy of pelvic floor muscle training in Overacting Bladder (OAB). They found that pelvic floor muscle training helps in improving bladder function. They also stated that in normal physiological process, the pelvic floor muscles and bladder functions are controlled from the level of pontine micurition centre [11]. Abd El-Moghny SM et al., reasoned that the pelvic floor muscles activity suppression in children with PMNE could be attributed to the neural control of continence which involves a competent sphincter mechanism, including not only the sphincter striated and smooth muscle but also the pelvic floor muscle via a physiological spontaneous activity called "tonic" which depends on prolonged activation of certain tonic motor units leading to increased pelvic floor muscle activity with bladder filling [6].

Another research studied the prevalence and determinants of nocturnal enuresis in school going children in southern Maharashtra found that the prevalence of nocturnal enuresis in boys (14.34%)

was significantly more than the prevalence in girls (8.31%). So, in the present study the comparison between the gender was analysed, but it showed that there was no difference in the pelvic floor muscle strength in enuretic girls and boys. It proves that the pelvic floor strength may not be the direct cause for the higher prevalence in boys [2].

So, there is a need to conduct a study with a larger population along with comparison between genders for pelvic floor muscle electrodiagnosis.

Limitation(s)

The sample size selected was small and were collected from a restricted area. Also, the socio-economic status and the stress levels of the children were not taken into consideration.

CONCLUSION(S)

This study concluded that there was decrease in the perianal muscle activity in children with enuresis as compared to normal. There was no gender-wise significance found in QMUP of pelvic floor muscles. This further helps in understanding the role of pelvic floor muscle training in children with enuresis. Furthermore, the values of the EMG readings of the enuretic children can also be used as a reference values for the pelvic floor activity in children.

REFERENCES

- [1] Haid B, Tekgöl S. Primary and secondary enuresis: Pathophysiology, diagnosis, and treatment. *Eur Urol Focus*. 2017;3(2-3):198-206.
- [2] Nakate DP, Vaidya SS, Gaikwad SY, Patil RS, Ghogare MS. Prevalence and determinants of nocturnal enuresis in school going children in Southern Maharashtra, India. *Int J Contemp Pediatr*. 2019; 6(2):564-68.
- [3] Enkc P, Vodusek DB (2006) Electromyography of pelvic floor muscles. *J Electromyogr Kinesiol*. 2001;16:568577.
- [4] Wennergren H, Larsson LE, Sandstedt P. Surface electromyography of pelvic floor muscles in healthy children: A methodological study. *Scandinavian Journal of Caring Sciences*. 1989;3:63-69.
- [5] Wennergren H, Oberg B. Pelvic floor exercises for children: A method of treating dysfunctional voiding. *Br J Urol*. 1995;76(1):09-15.
- [6] Abd El-Moghny SM, El-Din MS, El Shemy SA. Effectiveness of intra-anal biofeedback and electrical stimulation in the treatment of children with refractory monosymptomatic nocturnal enuresis: A comparative randomized controlled trial. *Int Neurourol J*. 2018;22(4):295-304.
- [7] Deindl FM, Vodusek DB, Bischoff C, Hofmann R, Hartung R. Dysfunctional voiding in women: Which muscles are responsible? *British Journal of Urology*. 1998;82(6):814-19.
- [8] Haid B, Tekgöl S. Primary and secondary enuresis: Pathophysiology, diagnosis, and treatment. *Eur Urol Focus*. 2017;3(2-3):198-206.
- [9] Glazer HI, Romanzi L, Polaneczky M. Pelvic floor muscle surface electromyography: Reliability and clinical predictive validity. *J Reprod Med*. 1999;44(9):779-82.
- [10] Ashraf A, Seham S. Pelvic floor muscles activity deviation from the normal among children with primary monosymptomatic nocturnal enuresis. *Sylwan*. 2019;163:104-15.
- [11] Kulaksizoglu H, Akand M, Çakmakçi E, Gül M, Seçkin B. Effectiveness of pelvic floor muscle training on symptoms and uroflowmetry parameters in female patients with overactive bladder. *Turk J Med Sci*. 2015;45(2):449-53.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Neuropaediatric Physiotherapy, Dr. D.Y. Patil College of Physiotherapy, Pune, Maharashtra, India.
2. Principal, Dr. D.Y. Patil College of Physiotherapy, Pune, Maharashtra, India.
3. PG Scholar, Department of Neuropaediatric Physiotherapy, Dr. D.Y. Patil College of Physiotherapy, Pune, Maharashtra, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Padmaja Guruprasad,
Pimpale Gurav, Pune, Maharashtra, India.
E-mail: padmajag1997@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Jun 15, 2021
- Manual Googling: Oct 30, 2021
- iThenticate Software: Dec 06, 2021 (11%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Jun 10, 2021**

Date of Peer Review: **Jul 24, 2021**

Date of Acceptance: **Nov 08, 2021**

Date of Publishing: **Jan 01, 2022**