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Urine Density and pH: Do They Have a Relationship with Voiding Dysfunction?

İdrar Dansitesi ve pH; İşeme Disfonksiyonu ile İlişkili Midir?

Özgün Araştırma
Research Article

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ABSTRACT

Objective: *The etiology of voiding dysfunction has garnered constant attention in the literature. Various factors such as UTI, bowel problems and constipation, negative attitudes of the social environment and the family, and genetics have been inspected and are still topics of investigation. UTI was found to have a strong association with pelvic wall dysfunction, constipation and lazy bowel syndrome, and voiding dysfunction. In this study we aimed to investigate the effects of urine pH and urine density studied in complete urinalysis on pediatric voiding dysfunction in order to contribute to the etiology of voiding dysfunction.*
Method: *A total of 43308 children were included in the study. Based on results of screening, 42196 children without voiding dysfunction were included in Group 1 and 1112 children with voiding dysfunction were assigned to Group 2. Results of complete urinalysis of all identified children were scanned to obtain urine pH and density values. Differences between the two groups in terms of independent parameters (urine pH and density) were analyzed using Student's t-test. A p value<0.05 was considered statistically significant.*
Results: *The group with voiding dysfunction was determined to have a statistically significantly higher mean age. There was no difference between the groups in terms of urine pH values. However, urine density values were statistically significantly lower in the group with voiding dysfunction.*
Conclusion: *In general, children with voiding dysfunction are expected to have lower urine pH values, while urine density is not expected to show any differences. However, our study determined no differences in urine pH but detected lower urine density compared to the control group. Clearly, more advanced molecular or experimental prospective studies are required to explain this situation.*

Keywords: *Urine Dysfunction, Urine pH, Urine Density*

ÖZ

Amaç: *İşeme disfonksiyonunun etiyolojisi literatürde sürekli ilgi konusu olmuştur. İYE, bağırsak sorunları ve kabızlık, sosyal çevrenin ve ailenin olumsuz tutumları, genetik vb. gibi bir çok neden üzerinde durulmuş ve hala araştırmalara konu olmaktadır. İYE ile pelvik duvar disfonksiyonu, kabızlık ve barsak tembellikleri ve işeme disfonksiyonu arasında yoğun ilişki saptanmıştır. Biz de bu çalışmamızda, işeme disfonksiyonunun etiyolojisine katkı sağlayabilmek için tam idrar tahlilinde çalışılan idrar pH ve idrar dansitesinin pediatrik işeme disfonksiyonunda ki etkisini incelemeyi amaçladık.*
Yöntem: *Toplam 43308 çocuk çalışmaya dahil edildi. Tarama sonucunda işeme disfonksiyonu olmayan 42196 çocuk grup 1, işeme disfonksiyonu olan 1112 çocuk grup 2 olarak belirlendi. Tespit edilen tüm çocukların tam idrar tahlilleri tarandı ve idrar pH ve dansite verileri elde edildi. 2 grup arasında bağımsız parametreler (idrar pH ve dansite) açısından farklılık Student t test kullanılarak istatistiksel açıdan analiz edildi. p<0,05 değeri istatistiksel olarak anlamlı kabul edildi.*
Bulgular: *İşeme disfonksiyonu olan grup istatistiksel olarak anlamlı düzeyde yaş olarak daha büyük saptandı. İdrar pH değerinde gruplar arasında farklılık bulunmadı. İdrar dansite değeri ise işeme disfonksiyonu olan grupta istatistiksel olarak anlamlı ölçüde düşük saptandı.*
Sonuç: *İşeme disfonksiyonu olan çocuklarda idrar pH değerinin daha düşük çıkması beklenirken, idrar dansitesinde genelde farklılık beklenmez. Fakat bizim çalışmamızda idrar pH değerinde farklılık saptanmazken, idrar dansitesi kontrol grubuna göre düşük saptanmıştır. Bu durumun açıklanması için daha ileri düzeyde, moleküler ya da deneysel, prospektif çalışmalara ihtiyaç olduğu açıktır.*

Anahtar kelimeler: *İşeme Disfonksiyonu, İdrar pH, İdrar Dansitesi*

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INTRODUCTION

Since cortical maturation is not complete in infancy, the pontine urination center undertakes the primary role and the inhibitory action of the cortex is not yet present. This period is characterized by hourly small-volume voiding coordinated with feeding. Between ages of 1-3 years, inhibitory pathways develop between the cortex and the pons and the cortex becomes fully functional around the age of 4 as a center of control over functions of pons Therefore, it is thought that urinary control is established at age 4 [1-3]. Voiding dysfunction can be defined as failure to establish toilet training habits at the age of 4, which is when toilet training habits are completely established, due to adopting wrong habits because of behavioral problems at ages 2-4 during which these habits are learned. Subsequently, cortical maturation cannot gain full command and normal urinary control of urination centre in the pons cannot be instituted [2]. The ensuing disorders can be listed as; Urge syndrome, Dysfunctional Voiding involving Detrusor-Sphincter Dyssynergia (DSD), and Enuresis [4].

The primary etiology of urge syndrome is urinary tract infection (UTI). It is thought that the urinary tract infection stimulates afferent fibers of bladder causing detrusor fibers to become overactive [4]. These children have lower than normal bladder capacity, and therefore, urinate more frequently.

Dysfunctional voiding is an acquired condition due to the child delaying urination to continue playing and constantly contracting pelvic wall muscles. These children can receive an accurate diagnosis based on a thorough clinical history and voiding cystometry together with electromyography (EMG). Test results determine that the pelvic wall muscles contract and thus stop the sphincter from relaxing. Therefore, the main problem is believed to be acquired DSD [5]. Moreover, questionnaire scales have been developed to be used in anamnesis and in identifying this problem. The most common questionnaire scales include Dysfunctional Voiding Symptoms Score (DVSS), Dysfunctional Voiding and Incontinence Symptoms Score (DVISS), and Incontinence Symptoms Index- Pediatric (ISI-P). Studies have attributed the greatest diagnostic value to DVISS [6].

Enuresis is a condition of nighttime incontinence after the age of 5 at least two times per week for a minimum period of three months [7]. Enuresis is encountered in 15% of children of this age and 80% of these cases do not demonstrate additional symptoms (monosymptomatic enuresis) [2]. Although many factors have been implicated in the etiology of enuresis, monosymptomatic enuresis is a condition of which the etiology is still being investigated in the literature.

The etiology of voiding dysfunction has garnered constant attention in the literature. Various factors such as UTI, bowel problems and constipation, negative attitudes of the social environment and the family, and genetics have been inspected and are still topics of investigation. UTI was found to have a strong association with pelvic wall dysfunction, constipation, lazy bowel syndrome, and voiding dysfunction [8]. Behavioral therapies (focus on hygiene, timed voiding etc.) coupled with appropriate antibiotic therapy and medical treatment for constipation are known to precede anticholinergics as the first-line treatment for children with voiding dysfunction [9,10].

This study aims to investigate the effect of urine pH and density values obtained through complete urinalysis on pediatric voiding dysfunction in order to contribute to the etiology of voiding dysfunction.

MATERIAL and METHODS

Files of children aged between 4-18 years who presented to the urology and pediatric urology polyclinics at our hospital were scanned retrospectively

over the system. Patients with neurological disorders, history of chronic medication use, and history of traumatic surgeries or accidents that could have caused urethral obstruction were excluded from the study. A total of 43308 children were included in the study. Based on screening, 42196 children without voiding dysfunction were included in Group 1 and 1112 children with voiding dysfunction were assigned to Group 2. Complete urinalyses of all identified children were scanned to obtain urine pH and density values. The normality of the data was evaluated through frequency analysis using skewness and kurtosis. Then, the differences between the two groups in terms of independent parameters (urine pH and density) were analyzed using Student's t-test. A p value<0.05 was considered statistically significant.

RESULTS

Mean ages of Groups 1, 2, and all children in the study were 9.9±3, 11.46±4.3, and 9.94±3.05 years; urine pH values were 6.30±0.60, 6.28±0.61, and 6.30±0.60; and urine densities were 1021.75±8.73, 1019.44±8.58, and 1021.69±8.7, respectively. The group with voiding dysfunction was determined to have a statistically significantly higher mean age w (p<0.001). There was no difference between the groups in terms of urine pH values (p=0.172). However, urine density values were statistically significantly lower in the group with voiding dysfunction at levels (p<0.001) (Table 1).

Table 1. Sex, age, urine pH, urine density values and statistical outcomes for patients in all groups.

	Group 1 (n=42196)	Group 2 (n=1112)	Total (n=43308)	P value*
Sex Girl (n)	23559	704	24263	
Boy (n)	18637	408	19045	
Age (years) (mean.±SD)	9.9±3	11.46±4.3	9.94±3.05	<0.001
Urine pH (mean.±SD)	6.30±0.60	6.28±0.61	6.30±0.60	0.172
Urine Density (mean.±SD)	1021.75±8.73	1019.44±8.58	1021.69±8.7	<0.001

*SD: standard deviation, *: Student's t Test, n=number of children*

DISCUSSION

The diagnosis of pediatric voiding dysfunction is made primarily using noninvasive diagnostic methods. A thorough history, detailed physical examination, filling a voiding diary, and symptom scoring (DVSS, DVISS etc.) are the diagnostic methods that need to be referred at first. Beyond this stage, the most fundamental tests that are utilized are complete urinalysis, uroflowmetry, and the measurement of residual urine volume and bladder wall thickness using urinary ultrasonography (USG) [11]. The International Children's Continence Society (ICCS) recommends that the expected bladder volume in children is to be estimated using the formula [(age + 1) x 30]. Bladder volume can be evaluated by comparing the bladder volume determined by this formula with the bladder volume determined by diagnostic methods (volume of voided urine in uroflowmetry + residual volume in USG). Moreover, frequency-volume charts (FVC) filled in a minimum period of 48 hours are also recommended by ICCS [12]. The relationship between voiding dysfunction with bowel problems and constipation was established, and the Bristol scale was developed for this purpose. This scale can classify feces based on its properties and detect bowel problems in children, if there are any. In this way, one can have an idea about the causes of voiding dysfunction [13]. The DVSS score is a modified version of the International Prostate Symptoms Score (IPSS), which is used in adults for Benign Prostate Hyperplasia (BPH) and Lower Urinary Tract Symptoms (LUTS), to be administered to children [14]. Another fundamental diagnostic method is urinalysis. It is an essential test, particularly for determining underlying UTI. Parameters used to establish diagnosis nclude leukocyte, nitrite, and leukocyte esterase positivity. Two other important parameters tested in urinalysis are pH and density. While pH can provide information about the metabolic and infectious states, density gives an idea about inadequate or excess water intake. Diabetes Insipidus (DI), and presence of concentration defects. Children with voiding dysfunction may have concomitant pelvic floor dysfunction.

Accordingly, children with pelvic floor dysfunction were also found to demonstrate constipation problems, incomplete voiding of the bladder, and consequently, a higher prevalence of UTI. The antibiotic therapy suggested for these children typically comprises trimethoprim-sulfamethoxazole or nitrofurantoin [15]. In the light of this information, urine pH is expected to be lower in children with voiding dysfunction as recurrent UTIs induced by E.coli are more common. However, a review of the literature revealed no studies that have directly investigated pediatric voiding dysfunction with regard to urine pH and density. Studies in the literature have predominantly focused on the relationship of urinary calcium excretion with enuresis, hematuria, and urolithiasis. In a study that included 204 children, Kozerska et al. [16] investigated the relationship between monosymptomatic enuresis (MNE) and urinary calcium excretion, and determined that children with MNE had higher urinary Ca+2 levels compared to controls in both spot and 24-hour urine samples. The same study determined no difference in urine pH values. Similarly, our study did not determine any differences in the pH levels of the group with voiding dysfunction when compared to the control group. The mean urine pH values of the groups in the Kozerska et al. [16] study were around 6.3; thus, they were acidic as was determined in our study. This situation suggests that urine pH is more acidic in the pediatric age group compared to adults. There was not any studies in the literature that compared voiding dysfunction and a control group in terms of urine density values. Kozerska et al. [16] determined in their study that urine osmolality was higher in the enuretic group than in the control group. On the other hand, our study determined significantly lower urine density levels in the group with voiding dysfunction. The higher osmolality determined in children with enuresis in the study by Kozerska et al. may be connected to increased urinary calcium excretion due to use of desmopressin in these children. We think that urine density values were higher in the control group in our study because most of the children represented voiding dysfunction subgroups that did not require desmopressin as our study did not only include children with enuresis. Based on our general medical information, causes of low urine density include parameters such as excess liquid intake, DI, and diuretic use. Since children who possess the last two parameters were excluded from the study, it is clear that more advanced molecular or experimental prospective studies are required to explain these low urine density values detected in the group with voiding dysfunction.

CONCLUSION

Considering that the higher number of patients (n=43308), and enuretic cases (n=1112) included in our study, it would not be wrong to say that our study was the first study to reveal the relationship between urine density, PH, and voiding dysfunction in a real sense. In general, children with voiding dysfunction are expected to have lower urine pH values, while urine density is not expected to show any differences. However, our study determined no differences in urine pH but detected lower urine density in enuretic cases compared to the control group. Clearly, more advanced molecular or experimental prospective studies are required to explain this relationship.

Ethics Committee Approval: The study was approved by the institutional review board and the ethics committee of the Bezmialem Vakif University, and all procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflict of Interest: All authors declare no conflict of interest.

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Informed Consent: As this is retrospective study there is no informed constent.

REFERENCES

1. Bauer SB. Special considerations of the overactive bladder in children. Urology. 2002;60(5):43-8. [CrossRef]
2. Bauer SB, Koff SA, Jayanthi VR. Voiding dysfunction in children: neurogenic and non-neurogenic. In: Walsh PC, Retik AB, Vaughn ED, Wein AJ, editors. Campbell's Urology. 8th Ed. Philadelphia: WB Saunders Co. 2002. pp. 2231-83.
3. Kaefer, M, Zurakowski, D, Bauer SB, Retik AB, Peters CA, Atala A, Treves TS. Estimating normal bladder capacity in children. The Journal of urology. 1997;158(6):2261-4. [CrossRef]
4. Feldman AS, Bauer SB. Diagnosis and management of dysfunctional voiding. Current opinion in pediatrics. 2006;18(2):139-47. [CrossRef]
5. Van Batavia JP, Combs AJ. The Role of Non-invasive Testing in Evaluation and Diagnosis of Pediatric Lower Urinary Tract Dysfunction. Current Urology Reports. 2018;19(5):34. [CrossRef]
6. Altan M, Çitamak B, Bozaci AC, Mammadov E, Doğan HS, Tekgül S. Is there any difference between questionnaires on pediatric lower urinary tract dysfunction?. Urology. 2017;103:204-8. [CrossRef]
7. Chaurasia K, Singh B. A Comparative Study of Anxiety Level of Enuretic and Non-Enuretic Children. International Journal of Indian Psychology. 2017, Vol. 5, (1), DIP: 18.01.002/20170501. [CrossRef]
8. Belman AB. Urinary tract infection, wetting, and constipation. Pediatrics. 1998;102(1):158. [CrossRef]
9. McKenna PH, Herndon CA. Voiding dysfunction associated with incontinence, vesicoureteral reflux and recurrent urinary tract infections. Current Opinion in Urology. 2000;10(6):599-606. [CrossRef]
10. McKenna, PH, Herndon CA, Connery S, Ferrer FA. Pelvic floor muscle retraining for pediatric voiding dysfunction using interactive computer games. The Journal of Urology. 1999;162(3):1056-62. [CrossRef]
11. Chang SJ, Yang SSD. Non-invasive assessments of pediatric voiding dysfunction. LUTS: Lower Urinary Tract Symptoms. 2009;1(2):63-9. [CrossRef]
12. Neveus T, von Gontard A, Hoebeke P, Hjälmås K, Bauer S, Bower W, Jorgensen TM, Rittig S, Walle JV, Jeung CK, Djurhuus JC. The standardization of terminology of lower urinary tract function in children and adolescents: report from the Standardisation Committee of the International Children's Continence Society. J Urol. 2006;176:314-24. [CrossRef]
13. Longstreth GF, Thompson WG, Chey, WD, Houghton LA, Mearin F, Spiller RC. Functional bowel disorders. Gastroenterology. 2006;130(5):1480-91. [CrossRef]
14. Farhat W, Bägli DJ, Capolicchio G, O'reilly S, Merguerian PA, Khoury A, McLorie GA. The dysfunctional voiding scoring system: quantitative standardization of dysfunctional voiding symptoms in children. The Journal of urology. 2000;164(3):1011-5. [CrossRef]
15. Shortliffe LM. Urinary Tract Infections in Infants and Children. In: Cambell's Urology. 7th edn. Walsh, Retik, Vaughan and Wein (editors). Philadelphia: W.B. Saunders; pp. 1681±1702, 1998.
16. Korzeniecka-Kozerska A, Porowski T, Wasilewska A, Stefanowicz M. Urinary calcium excretion in children with monosymptomatic enuresis. Irish Journal of Medical Science. 2015;184(4):899-905. [CrossRef]