

Accuracy of pediatric residents in determination of dehydration in children with gastroenteritisEzzat Khodashenas¹, Anoush Azarfar², Elham Bakhtiari³, Amir Reza Daneshmand Eslami⁴, Masoud Shaghasi Roodi⁵, Yalda Ravanshad^{6,7}

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Abstract

Objective: The aim of the present study was to determine the accuracy of pediatric residents in diagnosis of dehydration in children with gastroenteritis.

Methods: This was a cross-sectional study in Dr. Sheikh Hospital, affiliated with Mashhad University of Medical Sciences (Mashhad, Iran), in 2016. One hundred fifteen children aged 1 month to 14 years with gastroenteritis were included according to easy sampling. All patients were weighed. Dehydration was scored as mild, moderate and severe by pediatric residents according to Nelson standard table including pulse rate, blood pressure, blood skin supplement, skin turgor, fontanel, mucus membrane, tear respiration and urine output criteria. Patients were rehydrated and reweighed consequently. Percent loss of body weight (PLBW) was calculated and compared with dehydration score. Statistical analysis was performed using SPSS windows program version 19 (SPSS Institute, Inc., Chicago, IL, USA)

Results: Of the 115 children, 65 patients were male (56.5%) with the median age of 14.5 months. The Kendall's tau-b and Spearman correlation coefficient for residents' estimation and PLBW were 0.18 and 0.23 respectively ($p=0.01$ and 0.12 respectively). The ICC between estimated dehydration and PLBW was 0.47. According to residents' estimation and gold standard, PLBW was 6.76% and 1.33%, respectively. The serum level of sodium, potassium, urea and creatinine were 141.8 mEq/L, 4.6 mEq/L, 34.45 mg/dL and 0.6 mg/dL, respectively.

Conclusion: There is positive but weak correlation between residents' estimation and PLBW in patients with dehydration. It is necessary to enhance the educational level of pediatric residents to increase the accuracy of physical examination and decrease medical errors.

Keywords: Dehydration, Child, Gastroenteritis, Resident

1. Introduction

Medical errors are one of the common problems in medicine (1). These may include an incomplete or inaccurate diagnosis or treatment of a disease (1, 2). It has been estimated that 142,000 people died in 2013 because of misdiagnosis or adverse effects of treatment (3). Medical errors are correlated with several factors including

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inexperienced physicians (4). Improvement of training and capability, leads to the development of necessary skills to deliver high-quality patient care. Educational hospitals have more patients referrals. On the other hand, in educational hospitals residents are more involved in the diagnosis and treatment processes. Therefore, the rate of medical error is usually higher in the educational hospitals (5). Since children are a vulnerable population, correct diagnosis and on time treatment are very important for them. Dr. Sheikh Hospital is a main children's referral center in the northeast of Iran. No study has been done evaluating the medical error as well as accuracy of the diagnosis and physical examination of the pediatric residents in Dr. Sheikh Hospital. Because of the high rate of children referred to this hospital, determining the accuracy of pediatric residents in physical examination and diagnosis seems completely necessary. Dehydration is a condition which occurs in several diseases including gastroenteritis, and if ignored, can lead to several complications, even death (6). Accurate diagnosis of dehydration is very important. Inaccurate diagnosis in children with low dehydration leads to over hydration treatment and edema, and in children with high degree of dehydration, leads to deprivation of appropriate treatment and inadequate hydration. The reliability of various clinical findings in the diagnosis of dehydration has always been discussed (7). Experienced clinicians, particularly residents, will play a critical role in early diagnosis of dehydration. Since pediatric residents have an important role in the management of children's diseases, improvement of their knowledge in early symptoms of dehydration would be helpful. The aim of the present study was to evaluate the accuracy of pediatric residents in diagnosis of dehydration in children with gastroenteritis.

2. Material and Methods

2.1. Patients and methods

This cross-sectional study was performed in the emergency department of Dr. Sheikh Hospital, Mashhad University of Medical Science, Mashhad, Iran in 2016. The study participants included were 115 children aged between 1 month and 14 years with gastroenteritis. Patients' and parental informed consent were obtained prior to the study. The diagnosis of dehydration was documented based on percent loss of body weight (PLBW) documented in the Nelson Textbook of Pediatrics as a pediatrics reference. According to Nelson protocol, dehydration was classified as mild (less than 5%), moderate (6-10%) and severe (more than 10%) (8). The patients were weighed before admission and before discharge using calibrated scales. After dehydration diagnosis by residents, treatment was initiated. Blood sample was taken for biochemistry analyses. A sample size study population of 168 patients was determined for the study.

2.2. Statistical analysis

Statistical analysis was performed using SPSS windows program version 19 (SPSS Institute, Inc., Chicago, IL, USA). All experimental values are presented as Mean \pm standard deviation (SD). The association between the estimated diagnosis residents and PLBW was evaluated using Kendall's tau-b and Spearman correlation coefficient and interclass correlation coefficient (ICC). P values less than 0.05 was considered significant. The sample size determined to be 168 patients (9).

2.3. Ethics

All procedures performed in studies including human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki Declaration of Ethical Standards. This study was approved by Mashhad University of Medical Sciences ethics committee, Mashhad University of Medical Sciences, Mashhad, Iran (Ethic number: IR.MUMS.REC.1392.207). Study was started after the ethics committee acceptance. All patients' information was private. Written informed consent was obtained from parents of all included patients.

3. Results

Of the 115 children, 56.5% were male (n=65) and 43.5% were female (n=50). The average age of patients was 14.45 ± 15.36 months. Demographic characteristics are presented in Table 1. The dehydration estimation was according to criteria including pulse rate, blood pressure, blood skin supplement, skin turgor, fontanel, mucus membrane, tear, respiration and urine output. Results are presented in Table 2. The serum level of sodium, potassium, urea and creatinine were 141.83 ± 8.88 mEq/L, 4.61 ± 1.44 mEq/L, 34.45 ± 23.17 mg/dL and 0.6 ± 0.28 mg/dL, respectively (Table 3). The mean of resident estimation for dehydration was $6.76 \pm 3.39\%$. According to PLBW the mean of dehydration was 1.33%. The Kendall's tau-b and Spearman correlation coefficient between residents' estimation and PLBW were 0.18 and 0.23 respectively (p=0.01 and 0.12 respectively). The ICC between estimated dehydration and PLBW was 0.47.

Table 1. Demographic characteristics of 115 patients with gastroenteritis

Variable	Mean±SD	Minimum	Maximum
Age (month)	14.45±15.36	1	96
Admission weight (kg)	8.76±3.067	2.8	22
Discharge weight (kg)	8.96±3.32	2.8	24
Estimated dehydration (%)	6.76±3.39	1	15

Table 2. Criteria for assessment dehydration severity in 115 children with gastroenteritis

Variable	Normal	Mild-moderate	Severe
Pulse rate	Normal	Rapid, weak	Rapid, feeble
	54.8% (n=63)	39.1% (n=45)	6.1% (n=7)
Blood pressure	Normal	Orthostatic hypotension	Hypotension
	73% (n=84)	14.8% (n=17)	12.2% (n=14)
Skin blood supplement	Normal	Decreased	Weak
	53.9 % (n=63)	32.2% (n=37)	13.9% (n=16)
Skin turgor	Normal	Decreased	Markedly decreased
	58% (n=50.4)	28.3% (n=44)	11.3% (n=13)
Fontanelle	Normal	Sunken	Very sunken
	26.1% (n=30)	40.9% (n=47)	9.6% (n=11)
Mucus membrane	Moist	Dry	Very dry
	57% (n=96)	32.2% (n=37)	7.8% (n=9)
Tear	Yes	Yes or No	No
	41.7% (n=48)	26.1 % (n=30)	32.2% (n=37)
Respiration	Normal	Deep, rapid	Deep, rapid
	67.8 % (n=78)	23.5 % (n=27)	8.6% (n=10)
Urine output	Normal	Oliguria	Anuria
	51.3% (n=59)	51.3% (n=59)	6.1% (n=7)

Table 3. Biochemical analysis of 115 children with gastroenteritis

Variable	Mean±SD	Minimum	Maximum
Sodium (mEq/L)	141.83±8.88	122	179
Potassium (mEq/L)	4.61±1.44	2.9	9.8
Urea (mg/L)	34.45±23.17	3	162
Creatinine (mg/L)	0.6±0.28	0.2	2.4

4. Discussion

One hundred fifteen children with dehydration were studied, evaluating the correlation between residents' estimation and PLBW protocol as a gold standard. Results showed that there was significant positive but weak correlation between residents' estimation and PLBW. The estimated dehydration was 6.76% versus 1.33 % according to PLBW. The ICC between residents' estimation and PLBW was not significant ($p=0.474$). Medical errors, especially human errors are unavoidable. Despite not being able to eliminate medical errors, we can decrease them via education, and through training the residents and junior physicians. Courtlandt et al. in a longitudinal study on 36 pediatrics residents showed that a quality improvement training curriculum increased knowledge and skills of residents significantly (10). Estimation methods of dehydration were discussed in several studies (7, 11-18). Gorelick et al. reported a significant correlation between the dehydration estimation and PLBW (7). The serum level of sodium, potassium, urea and creatinine were more consistent with PLBW compared with residents' estimation. On the other hand, the diagnostic power of the considered items for dehydration diagnosis is different and may have affected results. Researchers have shown a great enthusiasm for investigating new approaches, particularly, jugular vein diameter using ultrasound to assess pediatric dehydration (19). According to Shirvani et al., decreased skin turgor and abnormal capillary refill time were detected in 13% and 11% of patients with dehydration, respectively (20). Recent findings have shown that the most useful clinical signs for assessment of 5% dehydration were prolonged capillary refill time, decreased turgor and deep respiratory with or without tachypnea, and dehydration estimation improved when these signs were jointly considered (17). Recent reports have emphasized that dehydration related gastroenteritis is a major cause of morbidity even in developed countries (7), while in

developing countries, dehydration is one of the causes of both morbidity and mortality (6). The successful management of dehydration in the developed states has been a result of selecting the most conspicuous clinical signs (7, 21). However, there may be objections against the current study on the accuracy of the estimation of dehydration degree. In a prospective study, dehydration estimation was performed by junior physicians, and the clinical signs of dehydration became apparent at 3-4% rather than 5% dehydration (15). They concluded that the degree of dehydration had been overestimated in their study, which is compatible with our study. In the present study, the involved residents were junior, and each patient was examined by one resident. Furthermore, all residents used items for dehydration estimation according to patient's age. The mean of dehydration estimation was 6.76% which showed an overestimation in comparison with PLBW. It may lead to unnecessary hospitalization, management errors, overtreatment with intravenous solution, parents' inconvenience and unnecessary financial burden, which are all examples of medical errors and should be considered in a children's referral center. Regarding the study limitation, the actual sample size was decreased because some patients withdrew during the study. The weight of some patients before gastroenteritis was not available.

5. Conclusions

There is positive but weak correlation between residents' estimation and PLBW in patients with dehydration. According to present study, it is necessary to enhance the educational level of pediatric residents to increase the accuracy of physical examination and decrease medical errors. Multicenter studies with larger sample size in referral centers evaluating residents and young physicians' skills in physical examination as well as diagnosis may be a good approach for future researches.

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Conflict of Interest:

There is no conflict of interest to be declared.

Authors' contributions:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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