

## **Application of Rehydration Therapy for Viral Gastroenteritis in Young Children**

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**Abstract:** Diabetes mellitus (DM) is a metabolic disorder resulting from a defect in insulin secretion, and it has been described as a public health challenge of the 21st century. A survey was carried out in Gashua metropolis Yobe State Northeast Nigeria between August, 2021 and February, 2022, to ascertain the prevalence of Diabetes mellitus (DM) among the residents. Out of One hundred (100) blood samples that were collected from age group 15-60 years and analysed in the Haematology unit, Yobe State Specialist Hospital Gashua, prevalence rate of 14(14. 0)% was observed . The gender of study population was also considered where more positive samples were observed among females than their male counterparts. The higher prevalence of Diabetes mellitus recorded could be attributed to increase in individual-level risk factors. There is a need for strategic planning towards change in lifestyle amongst in order to reduce the devastating effects of the disease.

**Keywords:** Prevalence, Diabetes, Residents, Gashua, Yobe, Nigeria.

### **Introduction**

A child, especially in the first 5 years of life, suffers several episodes of acute febrile illnesses during the year [1–3]. Acute respiratory viral infections and acute intestinal infections (AEI) occupy a major place in the structure of morbidity in children [1–5]. It should be noted that infectious diarrhea causes enormous economic damage, while official statistics mostly include data on patients from outbreaks and outbreaks of diarrheal diseases and information on hospitalized patients with intestinal infections. The incidence of acute gastroenteritis in children is significantly higher than in adults, and the majority of reported cases occur in children under 7 years of age. 49% of cases of ACI of deciphered etiology in 2022 are due to rotavirus infection, while the incidence (61.7 per 100 thousand population) remains below the long-term average level (75.60) for the period 2010–2019, and the proportion of cases norovirus infection among infectious diarrhea of established etiology amounted to 23.9% and continues to grow from year to year.

In pediatric practice for various infectious diseases, especially intestinal infections, the severity of the patient's condition is determined by the severity of the following symptoms and syndromes: general infectious syndrome (fever, intoxication, lethargy, adynamia);

- dehydration syndrome (exicosis), including metabolic acidosis and electrolyte disorders;
- syndrome of local changes (nature and frequency of diarrhea, vomiting, flatulence, abdominal pain syndrome, intestinal paresis) [6, 7].

In acute gastroenteritis, life-threatening conditions are primarily associated with dehydration due to rapidly increasing losses of water and electrolytes with vomiting and loose stools. Due to

dehydration, central and peripheral hemodynamics and all types of metabolism are disrupted; toxic metabolites accumulate in cells and intercellular space, which affect the organs and tissues of patients.

It is believed that the frequent occurrence of exicosis (dehydration syndrome) in children is due to the anatomical and physiological characteristics of the child's macroorganism: relatively high water content in the body, immaturity of regulatory mechanisms, frequent refusal to eat and drink when they feel unwell, especially in young children [6, 7]. In conditions of infectious diseases accompanied by fever, as well as loss of fluid with vomiting and diarrhea, the listed factors lead to a rapid breakdown of adaptation mechanisms and decompensation of the functions of organs and systems. The outcome of the disease will be determined by the timeliness of therapeutic measures aimed at eliminating the metabolic disorders that have arisen [8, 9].

If pathological losses are incorrectly compensated for in acute intestinal infections (incorrect choice of solution for rehydration, excessively high rate of compensation for losses), in addition to hyponatremia, pulmonary edema, cerebral edema, disseminated intravascular coagulation syndrome, and acute renal failure may develop. According to international consensus on the treatment of acute gastroenteritis, in countries with upper-middle economic levels, infectious diarrhea resolves within 1–3 days in most patients. Diarrhea poses a danger exclusively for young children and persons with a burdened premorbid background. In international consensuses, the only effective treatment is the restoration of water and electrolyte balance through oral rehydration, while parenteral fluid administration is recommended only in cases of severe dehydration [4, 6, 7]. Domestic guidelines, including current clinical recommendations for the provision of medical care to children, declare as a fundamental principle a pathogenetic approach to the treatment of acute intestinal infections, including: rehydration (oral, if necessary in combination with infusion therapy), dietary correction and nutritional support, cytomucoprotective agents or enterosorbents and prescription of probiotics (drugs with proven clinical effectiveness) from the first day of therapy [8, 9]. However, despite all the efforts made to treat and prevent ACI, 50 years of success in the use of oral rehydration solutions, infectious diarrhea, unfortunately, remains the second leading cause of death among children under 5 years of age in the world [1, 10, 11].

In addition, it is known that treatment of children with infectious diarrhea, especially in countries with below-average economic development, includes not only oral rehydration solutions (ORS), but also high doses of zinc as an important addition to OSR, zinc serves to further reduce duration and severity of diarrhea, prevents its recurrence in the near future [12, 13].

Although the widespread adoption of oral rehydration therapy has been an invaluable advance in reducing child mortality, its implementation worldwide has lagged compared with other evidence-based treatments. Thus, while global vaccination coverage has reached 85%, ORR coverage lags significantly behind at 42% [12, 14, 15].

Oral rehydration and zinc supplementation are cost-effective, affordable, and easy to implement. However, the number of children under 5 years of age with diarrhea who receive recommended ORR treatment is too low in all regions. Despite the fact that the prescription of ORR in our country is included in the criteria for the quality of medical care and in current clinical recommendations, in practical healthcare there are still errors in the prescription of ORR (refusal of low-osmolar ORR and rehydration with salt-free solutions, use of normoosmolar solutions, incorrect dilution of glucose-saline solutions), unreasonable infusion therapy. All of the above disadvantages justify the need to conduct research on the effectiveness of low-osmolar ORRs in children of different ages. There are enough studies in the available sources on the comparative effectiveness of low-osmolar and normoosmolar ORRs, and we conducted another version of the comparative study [9, 17, 18].

**Purpose of the study:** to compare the effectiveness of oral rehydration with a low-osmolar solution with zinc and infusion therapy with saline and glucose-saline solutions in children suffering from viral gastroenteritis (VGE) complicated by dehydration syndrome of the 1st-2nd degree and 2nd degree.

### **Material and methods**

The examinations were carried out at the city children's hospital No. 1.

The inclusion criteria for the study were:

- children's age from 6 months to 6 years;
- diagnosis of acute intestinal infection of viral etiology established on the basis of clinical data (fever, intoxication, vomiting, watery diarrhea, occurrence of the disease in a characteristic season (cold season), absence of damage to the large intestine clinically and laboratory) and verified by laboratory methods;

early periods of hospitalization in a hospital (no more than 2 days from the onset of the disease);

- no history of allergic reactions to drugs;
- absence of severe somatic pathology;
- signing by the patient's parents of a voluntary informed consent to participate in the study.

Randomization was carried out randomly by alternating the distribution of patients who met the inclusion criteria into groups in the order of admission of patients to the hospital. Basic therapy in the compared groups was comparable and included enterosorbents (Smecta), probiotics and symptomatic therapy (antiemetics, antispasmodics and antipyretics). The clinical study involved 79 patients aged from 6 months to 6 years, patients with acute intestinal infections and hospitalized in the department of intestinal infections on the 1st–2nd day of the disease in a state of moderate severity.

All children were divided into 2 groups: the main group (n=45) - using low-osmolar solutions in therapy (Orsa with zinc: scheme and dosage were carried out according to the instructions) and the comparison group (n=34) - using infusion therapy with glucose-saline solutions. The severity of acute gastroenteritis was assessed using a modified Vesicari scale, where mild severity of the disease is 0–8 points, moderate severity is 9–11 points, and more than 11 points is severe severity. The use of this scale helps to objectify the severity of the patient's condition with HEV [5, 6].

Laboratory diagnostics included a clinical blood test, a general urine test, a scatological examination, a biochemical blood test (determination of the level of urea, creatinine, transaminases, amylase, glucose, and basic electrolytes in the blood serum). The norms of hematological parameters were determined in accordance with the recommended standards of the Guide to Outpatient Pediatrics, ed. A.A. Baranova [19].

For all patients, in order to replenish the existing deficiency of fluid and electrolytes, as well as to stop ongoing pathological losses, after examination and filling out primary documentation, the volume and rate of infusion therapy with saline and glucose-saline solutions were calculated. The prescription of infusion therapy to a child in both groups was carried out in accordance with the calculation of the daily fluid requirement based on data on body weight, age, existing fluid deficiency and pathological losses (fever, vomiting, loose stools). The criteria for selecting children into the main group were the technical impossibility of peripheral vein catheterization that emerged during treatment (n=19, 42.2±7.3%), refusal of the child's legal representative to carry out infusion therapy (n=11, 24.4%± 6.4) and complications of infusion therapy, such as extravasal entry of a peripheral catheter (n=6, 3.33%±2.6), allergic reaction to intravenous solutions (n=3, 6.66%±3.7) and spontaneous removal of a peripheral catheter by a child (n=6, 13.33%±5.0). After a detailed conversation with the legal representative and an assessment of

the compliance of possible oral rehydration, oral administration of ORR was carried out for 6 hours according to a scheme in accordance with the patient's body weight, with monitoring of the condition and assessment of the effectiveness of the therapy.

Statistical processing of the material was carried out using the Statistica for Windows, v. program. 10 (StatSoft, USA) using parametric and nonparametric tests. For each group, the following were calculated: frequency of occurrence of the characteristic (for discrete characteristics), the average value of the indicator (M), standard deviation ( $\sigma$ ), error of the mean (m). To determine the significance of differences in the two compared samples, the Student's t-test and the Wilcoxon-Mann-Whitney rank U-test were used. Comparison of the frequency of occurrence of characteristics in groups was performed using Pearson's  $\chi^2$  test and Fisher's exact method.

## Results and discussion

All patients were admitted to the hospital with symptoms of dehydration of the 1st–2nd degree and 2nd degree on the 1st–2nd day of illness. The average severity of the patients' condition on the Vesikari integral scale was  $13.26 \pm 0.7$  points for VGE, which corresponds to an average degree of severity. Pathological losses in both groups were represented by vomiting, loose stools, and fever, which were the reason for hospitalization.

General infectious symptoms were statistically significantly more common in the comparison group: lethargy  $91.1 \pm 4.8\%$  and fever  $85.2 \pm 6.0\%$ . Vomiting was statistically significantly more common in the main group, while losses with loose stools were more typical for the comparison group. There were no significant differences in the incidence of dry mucous membranes and decreased diuresis in patients. The time of straightening of the skin fold on the abdomen was also comparable in the compared groups:  $2.1 \pm 0.07$  s versus  $1.9 \pm 0.08$  s. That is, there were no significant differences between the groups in the severity of dehydration syndrome.

In the biochemical blood test initially, hypokalemia was detected statistically significantly less often in children from the main group -  $13.3 \pm 5.0\%$  versus  $26.4 \pm 7.5\%$  in the comparison group. In both groups, hyponatremia, increased levels of urea and creatinine, characteristic of grade 1-2 dehydration, were recorded with the same frequency. In 42 ( $93.3 \pm 4.5\%$ ) patients of the main group, during the first 6 hours it was possible to achieve stabilization of the condition and a decrease in the volume of pathological losses, and therefore the child continued oral rehydration. Active use of oral rehydration solution in this case was carried out for 24–48 hours with assessment of the dynamics of general and local symptoms, as well as laboratory parameters of water-electrolyte balance and nitrogen excretion function of the kidneys. Due to the lack of proper effect from oral rehydration, associated with the resumption of vomiting and the impossibility of further therapeutic manipulations, 3 people ( $6.66 \pm 3.7\%$ ) who required further parenteral fluid administration were excluded from the study.

Against the background of oral rehydration in the main group, the duration of persistence of the feverish reaction was comparable in duration to the comparison group. Normalization of general well-being in the form of disappearance of lethargy was noted in the compared groups at the same time. The cessation of vomiting in a statistically significantly shorter time was recorded in the main group. Exicosis and diarrhea were managed in the main group and the comparison group in almost comparable times.

To objectify the assessment of the effectiveness of the therapy, all patients were monitored for biochemical blood parameters one day after the start of rehydration therapy. In the main group, in  $90.9 \pm 6.4\%$  of cases there was normalization of sodium levels, in  $83.3 \pm 5.0\%$  - normalization of urea levels, in 100% - normalization of creatinine levels. In the main group, the duration of hospital stay was reduced to  $3.1 \pm 0.5$  days, in the comparison group it was  $4.5 \pm 0.8$  days.

It is known that for more than 20 years, the World Health Organization and other professional associations have been insisting on the use of rehydration solutions with reduced osmolality

(225–245 mOsmol/L) as oral rehydration agents for children with infectious diarrhea. However, in everyday life, both parents and health care providers often use normosmolar ORRs in young children. It is osmolarity in the range of 225–245 mOsmol/l that improves fluid absorption, prevents osmotic diarrhea, reduces the load on the kidneys, and promotes faster relief of diarrhea and dehydration. In addition, hypotonic ORRs have a more pleasant taste, which makes them easier to use in pediatric practice. One of the low-osmolar rehydration solutions is Orsa with zinc, which includes the trace element zinc at a dose of 3 mg in one sachet. Zinc provides additional anti-inflammatory, immunomodulatory, antiseptic and regenerative effects, which helps relieve diarrhea and prevent re-infection with intestinal pathogens in the near future [12, 15]. In addition, the drug contains additional components - maltodextrin, which reduces the osmotic load on the intestines and has a prebiotic effect, as well as silicon dioxide, which has a sorbing and regenerating effect [12, 13, 15].

Thus, the use of low-osmolar solutions with zinc for oral rehydration in children with HEV was characterized by high clinical and laboratory effectiveness and good tolerability, reduced the need for parenteral rehydration by 55.8%, showed a high safety profile and can be recommended in the initial treatment of viral acute intestinal infections in children hospitalized in a hospital.

## Conclusion

General infectious (fever, lethargy) and local (vomiting and diarrhea) symptoms of VGE, as well as dehydration syndrome of the 1st-2nd degree and 2nd degree in children aged 6 months to 6 years are relieved by oral rehydration with a low osmolar solution with the addition of zinc is as fast and effective as with the parenteral administration of saline and glucose-saline solutions. The use of ORR helps to avoid possible complications of parenteral fluid administration and a traumatic situation for a small patient. Widespread introduction into practical healthcare of modern ORRs with reduced osmolarity will help reduce the frequency of hospitalization of children with HEV and other watery diarrhea and rational use of healthcare resources.

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