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DYNAMICS OF HEMOREGULATION INDICES AFTER TREATMENT ABSOLUTE ANEMIA WITH CHRONIC KIDNEY DISEASE IN CHILDREN

Abstract: This manuscript is dedicated to a comprehensive approach to the treatment of children with chronic kidney disease and absolute anemia, as well as determining their hemodynamic and cytokine profile indicators. Studies have been conducted in which the results of iron metabolism parameters (serum iron, serum ferritin, and transferrin) and anemia hormones (erythropoietin and hepcidin) were determined. Results were also obtained for blood cytokine markers (IL-6 and TNF- α). In addition to traditional therapy, a preparation containing sucrosomial iron (Sideral) was included. Thus, the need for an individualized approach to the treatment of absolute anemia in patients with varying degrees of chronic kidney disease is important.

Key words: anemia, chronic kidney disease, serum iron, serum ferritin, transferrin, erythropoietin, hepcidin, sucrosomial iron.

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Introduction

Children with chronic kidney disease face a serious problem—anemia, which requires a comprehensive approach to treatment. In recent years, various therapeutic and diagnostic measures have been carried out to eliminate anemia in children with diseases associated with CKD [1-7, 9]. Correction of anemia is a key factor in reducing mortality rates in children with CKD [8, 10, 11]. Erythropoiesis-stimulating agents (ESA) in the treatment of anemia in children with CKD help improve quality of life, appetite, and physical activity tolerance [7]. Currently, modern medicine has two main components that help treat anemia in children with CKD—iron preparations and erythropoietin [6, 9]. In the treatment of anemia that occurs with chronic renal failure in children, various modern drugs such as epoetin alfa, epoetin beta, and darbepoetin alfa are used. They are widely used to increase hemoglobin levels in the blood of children with chronic kidney disease [11, 12, 23, 24]. Iron preparations can correct

iron levels in the body. Drugs such as iron sulfate or gluconate can be used as oral preparations, as well as injections such as iron succinate [10, 13-16]. In children with chronic kidney disease, anemia can negatively affect their growth and development. This is due to its adverse effects on their psychological and physical development. Therefore, its treatment requires constant attention from medical professionals and parents [17-22].

Thus, the problem of treating anemia in chronic CKD in children remains relevant and requires a comprehensive approach to each patient, comprehensive examination, timely treatment, and constant health monitoring [25].

Objective of the study: To assess the data of iron metabolism indicators (serum iron and ferritin, transferrin), anemia hormones (erythropoietin and hepcidin), and blood cytokine profile after comprehensive therapy in children with absolute anemia and chronic kidney disease.

Materials and Methods

Out of 95 examined patients with chronic kidney disease (CKD), 29 children had absolute anemia. These children were divided into 2 groups. Group I

consisted of 15 children (including 6 children with stage II CKD, 5 children with stage III, and 4 with stage IV CKD) who received traditional therapy. Group II included 14 children (4 children with stage II, 5 with stage III, and 5 with stage IV), who were treated with a comprehensive therapy method (traditional therapy + Sideral) (Fig.1).

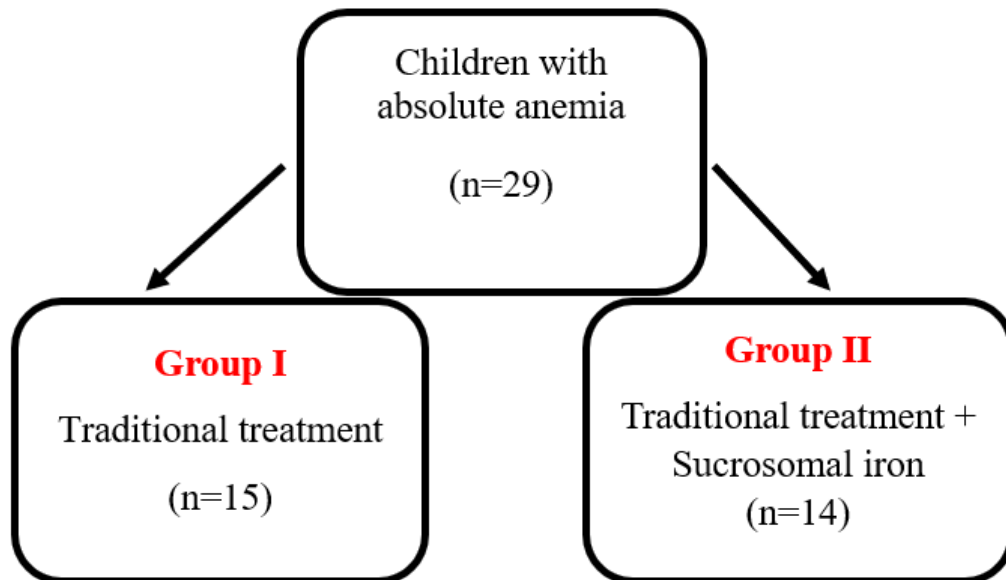


Fig.1. Distribution of Children with Absolute Anemia in CKD by Therapy Method

Duration of Sideral Intake in Patients with Absolute Anemia: The duration of Sideral intake in patients with absolute anemia was 3 months from the start of basic kidney therapy. Children weighing less than 30 kg were prescribed 1 mg/kg, corresponding to 1-2 capsules per day, regardless of the time of day or food intake. Children weighing more than 30 kg were prescribed the standard dosage of "Sideral Forte" 30 mg once a day. Hemoglobin levels were monitored every 2 weeks to observe hemodynamics after the administration of the drug.

This drug is designed to minimize side effects, and no negative consequences were observed in any patient using Sideral. However, like any medical drug, it may cause unwanted reactions such as gastrointestinal disorders, metallic taste in the mouth, allergic reactions, darkening of stool, dizziness, and headache.

After a 3-month course of medical interventions, the condition of patients receiving comprehensive treatment showed very positive results: the remission period of CKD was extended in children, appetite improved, body weight increased, and the pallor of the skin and mucous membranes disappeared. Children were much more diligent in their studies, engaged in

physical exercises, and were less frequently troubled by symptoms such as dizziness, headaches, visual darkening, and rapid fatigue.

Results and Discussion

A special place in our study was occupied by the results of iron metabolism parameters in the blood. Serum iron in the examined Group I after traditional therapy was 9.15±0.25 (p <0.001) µmol/L, while in Group II children, after the comprehensive method, its level doubled to 15.4±0.73 (p <0.001) µmol/L, proving the effectiveness of sucrosomial iron in this treatment. Serum ferritin increased after standard treatment to 64.84±3.26 (p <0.001) µg/L; however, after the comprehensive method, this indicator approached the normal mark by 60%, reaching 83.27±3.18 (p <0.001) µg/L, indicating a reliable reserve of the trace element after comprehensive procedures. Transferrin in the blood after traditional therapy was 2.97±0.09 (p <0.001) g/L, while in children after comprehensive treatment, it decreased to healthy levels, amounting to 2.76±0.07 g/L (p <0.001), indicating normalization of its production after treatment (Table 1).

Table 1. Indicators of Iron Metabolism in Blood After Treatment in Children with Absolute Anemia

Indicators	Healthy, M±m (n=20)	Before Treatment, M±m (n=29)	After Treatment	
			Group I, M±m (n=15)	Group II, M±m (n=14)
Serum iron, μmol/L	14,35±2,26	6,01±0,28	9,15±0,25 P<0,001	15,4±0,73 P<0,001
Ferritin, μg/L	90,0±18,97	52,32±2,9	64,84±3,26 P<0,001	83,27±3,18 P<0,001
Transferrin, g/L	2,8±0,25	3,37±0,15	2,97±0,09 P<0,001	2,76±0,07 P<0,001
Erythropoietin, mIU/mL	17,8±3,85	48,25±3,4	29,84±2,31 P<0,001	25,45±1,05 P<0,001
Hepcidin, ng/mL	40,5±12,49	68,16±3,11	54,12±3,24 P<0,001	52,74±2,05 P<0,001

Note: p - significance of differences between blood iron parameters and those before treatment

The erythropoietin level after traditional treatment was 29.84±2.31 (p <0.001) mIU/mL, while after the comprehensive therapy method, this indicator decreased almost by half, reaching

25.45±1.05 (p <0.001) mIU/mL, as the hemoglobin and red blood cell levels return to normal following the successful action of sucrosomial iron (Fig. 2).

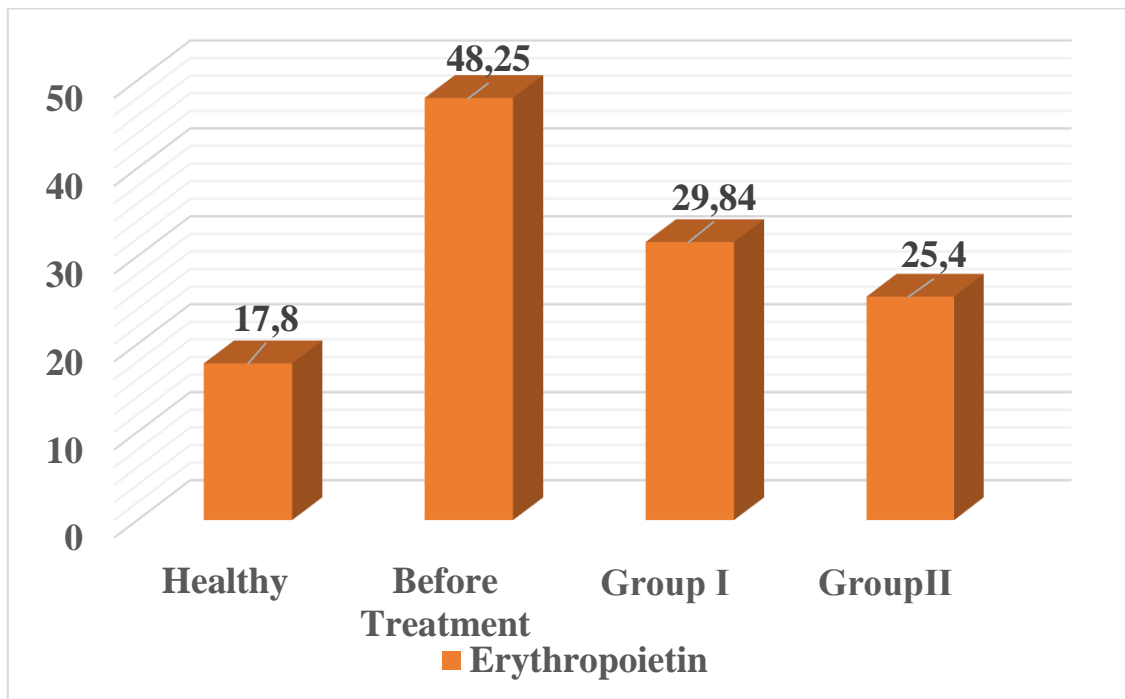


Fig.2. Results of erythropoietin indicators after treatment in children with absolute anemia

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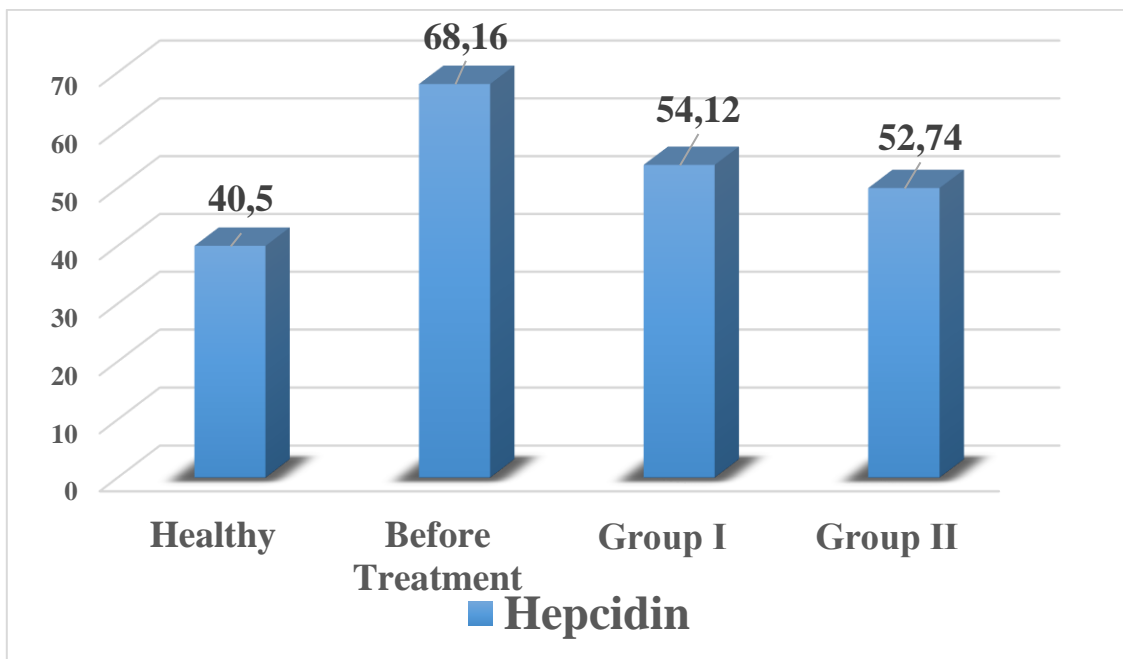


Fig. 3. Results of hepcidin indicators after treatment in children with absolute anemia

The hepcidin concentration decreased by 50% and amounted to 54.12 ± 3.24 ($p < 0.001$) and 52.74 ± 2.05 ($p < 0.001$) ng/ml in group I and group II, respectively, indicating the absolute nature of anemia in CKD patients, as no significant inflammation was observed in these children (Fig. 3).

Table 2 shows that the levels of IL-6 and TNF- α in the blood of patients after traditional procedures did

not show significant changes (8.35 ± 0.45 ($p > 0,05$) and 3.33 ± 0.29 ($p < 0.001$) pg/ml), while in children after comprehensive therapy, their values were 6.71 ± 0.23 ($p < 0.001$) and 3.8 ± 0.19 ($p < 0.001$) pg/ml, confirming the absence of an inflammatory process in children with absolute anemia and CKD.

Table 2. Cytokine marker parameters after treatment in children with absolute anemia

Indicators	Healthy, M \pm m (n=20)	Before Treatment, M \pm m (n=29)	After Treatment	
			Group I, M \pm m (n=15)	Group II, M \pm m (n=14)
IL-6, pg/ml	5,5 \pm 1,42	8,61 \pm 0,48	8,35 \pm 0,45 P>0,05	6,71 \pm 0,23 P<0,001
TNF- α , pg/ml	2,5 \pm 0,47	5,09 \pm 0,5	3,33 \pm 0,29 P<0,001	3,8 \pm 0,19 P<0,001

Note: p - significance of differences between cytokine markers and those before treatment

Conclusion

The comprehensive method, namely sucrosomal iron, positively affects absolute anemia and is much more effective than the iron forms used in traditional treatment. Sideral, by increasing iron, indirectly impacts kidney function, easing the stage of chronic kidney disease in patients. The significant changes in anemia parameters in Group II after comprehensive procedures indicate the more effective action of

Sideral on the blood system, resulting in an increase in hemoglobin, red blood cells, and serum iron. The decrease in transferrin concentration and increase in serum ferritin indicate that iron and its reserves are optimally regulated in the body. The absence of significant changes in hepcidin hormone and blood cytokine profile markers indicates minimal inflammation, which is characteristic of absolute anemia.

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