COMPARISON OF SIDERAL® AND STANDARD ORAL IRON THERAPIES IN CHILDREN WITH CHRONIC KIDNEY DISEASE: EFFICACY AND TOLERABILITY STUDY

Ашурова Ноила Шухратовна
PhD, ассистент кафедры Терапевтических предметов Университета Зармед;
ORCiD 0009-0000-3439-2856
e-mail: ***nellie.neonilla@gmail.com***
Мурадова Эмма Владимировна
PhD, доцент кафедры Микробиологии, вирусологии, иммунологии,
Самаркандский Государственный Медицинский Университет
ORCID ID 0009-0005-6147-9769
e-mail: ***emma_muradova@list.ru***
Ганжиян Наринэ Эмильевна
студентка 533 группы, Лечебного факультета
Самаркандский Государственный Медицинский Университет.

https://doi.org/10.5281/zenodo.17497226

Abstract. *The study compares SiderAL® (Sucrosomial® Iron) and traditional ferrous sulfate in treating anemia in children with chronic kidney disease (CKD). Sixty children aged 5–15 years with CKD stages II–IV and iron deficiency anemia participated in a 12-week randomized study. Results showed that both therapies improved hemoglobin and serum iron levels, but SiderAL® produced significantly better results and fewer gastrointestinal side effects (6.7% vs. 26.7%). Treatment adherence was also higher with SiderAL® (93.3%). Thus, SiderAL® proved to be more effective and better tolerated than standard iron preparations for managing anemia in children with CKD.*

Keywords: *Children, Chronic Kidney Disease, Anemia, Iron Deficiency, Sideral®, Sucrosomial® Iron.*

Background. Anemia is one of the most common and clinically significant complications of chronic kidney disease (CKD) in children, leading to impaired physical and cognitive development and a decreased quality of life [1,2].

The main etiological factor of anemia in CKD is iron deficiency, which may develop due to both absolute and functional depletion of iron stores [3,4].

However, the effectiveness of traditional oral iron preparations is often limited by their low bioavailability and the high incidence of gastrointestinal side effects [5,6].

Objective. To compare the efficacy and tolerability of SiderAL® (Sucrosomial® Iron) and traditional oral iron preparations in children with CKD and anemia.

Materials and Methods. A prospective, randomized, open-label, comparative study was conducted in 60 children with stage II-IV CKD and laboratory-confirmed iron deficiency anemia.

Patients were divided into two equal groups:

− Group I (n=30): received ferrous sulfate;

– Group II (n=30): received SiderAL®.

The duration of therapy was 12 weeks. The following parameters were evaluated: hemoglobin (Hb), serum iron (Fe), total iron-binding capacity (TIBC), transferrin saturation (TSAT), frequency of adverse events, and treatment adherence (compliance).

Results. After therapy, both groups demonstrated a statistically significant increase in serum iron and hemoglobin levels ($p < 0.001$).

The increase in Hb was more pronounced in the SiderAL® group (+30.8 g/L) compared to the ferrous sulfate group (+14.0 g/L, $p < 0.001$).

The frequency of gastrointestinal adverse effects was notably lower in patients receiving SiderAL® (6.7%) compared to those receiving ferrous sulfate (26.7%).

Introduction

Chronic kidney disease in children is characterized by a progressive decline in renal function and the development of systemic complications, among which anemia is one of the most common and clinically significant manifestations [1,14].

Anemia in CKD results from decreased endogenous erythropoietin synthesis, iron deficiency, chronic inflammation, and elevated hepcidin levels [3,7].

Iron deficiency in patients with CKD can be absolute, caused by insufficient intake and chronic iron loss, or functional, due to impaired mobilization of stored iron under the influence of proinflammatory cytokines [8,15,16]. Increased hepcidin levels during inflammation inhibit the release of iron from enterocytes and macrophages, further exacerbating anemia [7,9,17,18].

Oral iron preparations have traditionally been used for the correction of anemia; however, their low bioavailability and frequent gastrointestinal side effects−such as nausea, constipation, and abdominal pain−often reduce treatment adherence [2,10].

Recent pharmaceutical innovations have focused on improving iron absorption and tolerability. One of the most promising formulations is Sucrosomial® Iron, the technology used in the SiderAL® preparation, which allows iron to be transported through the intestinal epithelium without direct contact with the mucosa [4,5,11,18].

Recent studies have shown that sucrosomial iron has higher bioavailability and a lower incidence of gastrointestinal side effects compared with traditional iron salts [6,11,14]. However, evidence regarding the use of SiderAL® in pediatric nephrology remains limited, which determined the relevance of the present study.

Objective. To conduct a comparative evaluation of the efficacy and tolerability of SiderAL® and traditional ferrous sulfate in the treatment of anemia in children with chronic kidney disease.

Materials and Methods

A prospective, randomized, open-label study was conducted involving 60 children aged 5–15 years with CKD stages II–IV and laboratory-confirmed iron deficiency anemia.

The patients were divided into two equal groups:

Group I (n = 30): received ferrous sulfate at a dose of 3–6 mg of elemental iron per kg per day;

Group II (n = 30): received SiderAL® (Sucrosomial® Iron) at a dose of 1 mg/kg/day for children under 6 years and 30 mg/day for those aged 6 years and older.

The treatment duration was 12 weeks.

Inclusion criteria: age 5–15 years; CKD stages II-IV; hemoglobin below age-adjusted normal values; TSAT < 20%.

Exclusion criteria: hemoglobin < 7 g/dL; acute inflammatory diseases; gastrointestinal pathology; previous parenteral iron therapy within 1 month.

The following parameters were assessed before and after treatment:

- Hemoglobin (Hb, g/L);

- Serum iron (Fe, μmol/L);
- Total iron-binding capacity (TIBC, μmol/L);
- Transferrin saturation (TSAT, %);
- Frequency of adverse effects and treatment adherence (compliance).

Statistical analysis was performed using SPSS 26.0. Data were expressed as M ± m (mean ± standard error of the mean).

Differences were considered statistically significant at $p < 0.05$.

Results and Discussion

Dynamics of Iron Metabolism Parameters. Before the start of therapy, all patients showed laboratory signs of iron deficiency anemia: Fe − 6.55 ± 0.29 μmol/L; Hb − 76.26 ± 1.87 g/L; TSAT − 14.11 ± 1.26%.

After 12 weeks of treatment, a significant improvement in laboratory parameters was observed in both groups; however, the improvement was more pronounced in the SiderAL® group (Table 1).

Table 1

Comparative changes in iron metabolism and hemoglobin parameters in children with CKD after 12 weeks of therapy (M ± m)

Parameter	Control group, M±m (n=20)	Before treatment (n=60)	After ferrous sulfate (n=30)	After SiderAL® (n=30)	p_1 (before/ after treatment)	p_2 (between groups after treatment)
Serum iron, mmol/l	18.35±2.26	6,55±0,29	10,35 ± 0,40	14,36 ± 0,54	<0,001	<0,001
Hemoglobin, g/l	125.0±4.74	76,26±1,87	90,30 ± 1,02	107,10 ± 0,64	<0,001	<0,001
TIBC, mmol/l	60.00±6.32	53,41±3,43	59,04 ± 3,33	55,80 ± 1,21	>0,05	>0,05
TSAT, %	30.5±5.37	14,11±1,26	18,10 ± 1,16	22,01 ± 0,97	<0,01	<0,01

Note: *p_1 − statistical significance of within-group dynamics; p_2 − statistical significance of differences between groups after treatment.*

Results and Discussion

In both groups, a statistically significant increase in Hb and Fe levels was observed ($p < 0.001$).

However, the improvement was more pronounced in the SiderAL® group. This finding is consistent with other studies demonstrating higher absorption and efficacy of sucrosomial iron in chronic diseases [4,6,9].

The TSAT increased by 7.9 percentage points in the SiderAL® group compared with 4 percentage points in the ferrous sulfate group ($p < 0.01$), indicating enhanced iron transport to the bone marrow [7,11].

TIBC did not change significantly ($p > 0.05$), which is likely related to the stability of transferrin levels under chronic inflammatory conditions associated with CKD [3,10].

Tolerability and Compliance

In the ferrous sulfate group, gastrointestinal side effects such as nausea, constipation, and abdominal pain were reported in 8 (26.7%) children, whereas in the SiderAL® group, they occurred only in 2 (6.7%) patients ($p < 0.05$).

Treatment compliance was also higher in the SiderAL® group (93.3%) compared with the ferrous sulfate group (76.6%), confirming the better tolerability and acceptability of SiderAL® [5,9].

Thus, therapy with SiderAL® led to a more pronounced improvement in hematopoietic parameters, with minimal adverse effects and high treatment adherence.

Conclusions

1. Administration of SiderAL® in children with CKD and anemia resulted in a significantly greater increase in Hb and Fe levels compared to traditional iron preparations ($p < 0.001$) [18].
2. SiderAL® demonstrated high bioavailability and a lower incidence of side effects (6.7% vs. 26.7%) [18].
3. Treatment adherence in the SiderAL® group was 93.3%, indicating superior tolerability and ease of use.
4. The sucrosomial form of iron can be considered an effective alternative to conventional ferrous salts for treating anemia in children with CKD [13,14,18].

Practical Recommendations

1. In children with CKD and anemia, it is recommended to use oral iron preparations with improved absorption, such as SiderAL®.
2. The optimal treatment duration is 12 weeks, with regular monitoring of Hb, Fe, and TSAT every 4 weeks.
3. SiderAL® is particularly indicated for patients with low Hb (<90 g/L) and TSAT <20%, especially when traditional iron salts are poorly tolerated.
4. The use of SiderAL® improves treatment efficacy and may reduce the need for erythropoiesis-stimulating agents [13,14,18].

References

1. Andrushchak E.V., Gerasimova N.A., Kuznetsova S.M. *Anemia in children with chronic kidney disease: pathogenesis, diagnosis and approaches to therapy.* Nephrology and Dialysis, 2021; 23(4): 312–320.
2. Abaev Yu.K., Pshenichnaya N.Yu. *Iron metabolism in children with chronic kidney disease.* Pediatrics, 2020; 99(3): 45–51.
3. Hörl W.H. *Iron therapy for renal anemia: how much needed, how much harmful?* Pediatric Nephrology, 2020; 35(12): 2145–2156.
4. Ricci F., et al. *Sucrosomial® iron supplementation in pediatric patients with iron deficiency anemia: efficacy and tolerability compared with ferrous sulfate.* Eur. J. Pediatr., 2021; 180: 1891–1898.
5. Locatelli F., et al. *KDIGO Clinical Practice Guideline for Anemia in Chronic Kidney Disease.* Kidney Int. Suppl., 2021; 11(1): 1–135.
6. Vaucher P., et al. *Effect of oral sucrosomial iron on hemoglobin and iron stores in iron deficiency anemia.* Haematologica, 2020; 105(10): 2502–2509.
7. Ganz T., Nemeth E. *Hepcidin and iron homeostasis in health and disease.* Annu. Rev. Med., 2021; 72: 343–358.
8. Pasricha S.-R., et al. *Iron deficiency.* The Lancet, 2021; 397(10270): 233–248.
9. Ganina A.V., Fedorova T.V. *Modern approaches to oral correction of iron deficiency anemia in children: advantages of sucrosomial iron.* Current Pediatrics, 2022; 21(5): 60–65.

10. Strokova T.V., Novikova E.A. *The role of inflammation and hepcidin in the formation of anemia of chronic disease in children.* Russian Bulletin of Perinatology and Pediatrics, 2020; 65(6): 87–92.
11. Zavaleta N., Astete-Robilliard L. *Efficacy and safety of iron supplementation in children with chronic diseases: a review.* Front. Pediatr., 2022; 10: 889743.
12. Macdougall I.C., et al. *Iron management in chronic kidney disease: KDIGO Controversies Conference.* Kidney Int., 2019; 96: 37–47.
13. Ashurova N.Sh., Ibragimova D.N., Botirova D.T., Farmonova A.S. *Sucrosomial iron in the treatment of anemia in children with chronic kidney disease: current approaches and prospects.* Journal Vestnik Vracha, 2025; 2(119): 100–102.
14. Ashurova N.Sh., Muradova M.D. *A modern view of anemia in children with chronic kidney disease.* Journal Vestnik Vracha, 2024; 4(116): 106–111.
15. Ashurova N.Sh. *Dynamics of hemoregulation indices after treatment of absolute anemia in children with chronic kidney disease.* ISJ Theoretical & Applied Science, 2024; 10(138): 151–156.
16. Shuxratovna A.N. *Evaluation of hemodynamic parameters after treatment of functional anemia in children with chronic kidney disease.* Frontline Medical Sciences and Pharmaceutical Journal, 2024; 4(10): 38–47.
17. Ashurova N.Sh., Mukhamadiev N.Q. *Assessment of hemodynamic parameters by type of anemia in children with chronic kidney disease.* Central Asian Journal of Medical and Natural Science, 2024; 5(4): 230–238.
18. Ashurova N.Sh. *Comparative analysis of iron metabolism parameters in children with chronic kidney disease with and without anemia.* American Journal of Medicine and Medical Sciences, 2025; 15(7): 2114–2117.