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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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No 11 (344) 2023

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HEPCIDIN AND IRON BIOMARKERS MODULATED IN HEMODIALYSIS PATIENTS

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Abstract.

Background: Chronic kidney disease (CKD) describes abnormal kidney function and/or structure. It is common, frequently unrecognized, and often exists together with other conditions.

Aim: to investigate the role of serum hepcidin in inflammation among hemodialysis patients with chronic kidney disease (CKD).

Materials and methods: This prospective hospital-based study conducted in Kirkuk city included 30 CKD patients undergoing regular hemodialysis at Kirkuk General Hospital, along with 30 healthy individuals as controls. Blood samples were collected before and after hemodialysis, as well as from the control group, and analyzed for various parameters. The blood samples were collected for determination of hepcidin levels were determined using Enzyme-Linked Immunosorbent Assay, while S. iron, total iron-binding capacity (TIBC).

Results: The study found that HD patients had significantly higher levels of serum hepcidin compared to the control group. The mean serum hepcidin level in HD patients was 246.1±72.4 ng/ml, while in the control group, it was 105.7±20.2 ng/ml. Serum ferritin levels were also found to be significantly higher in HD patients compared to the control group (430.5±148.3 ng/ml vs. 153.8±60.6 ng/ml). HD patients had lower serum iron and total iron-binding capacity (TIBC) levels compared to the control group (63.10±15.62 µg/dl vs. 92.98±26.68 µg/dl and 265.4±61.1 µg/dl vs. 273.3±65.9 µg/dl, respectively). After dialysis, both serum hepcidin levels decreased, with the mean serum hepcidin decreasing from 246.1±72.4 ng/ml to 206.3±61.8 ng/ml The study also demonstrated a positive correlation between hepcidin levels serum ferritin, urea, and creatinine, and a negative correlation with serum iron and hemoglobin levels in patients before hemodialysis.

Conclusions: HD patients have higher levels of serum hepcidin, ferritin, iron and TIBC, suggesting potential involvement in inflammation and iron metabolism dysregulation.

Key words. Hemodialysis, Hepcidin, CKD, Iron, Ferritin.

Introduction.

Chronic kidney disease (CKD) describes abnormal kidney function and/or structure. It is common, frequently unrecognized, and often exists together with other conditions (such as cardiovascular disease and diabetes) [1]. The risk of developing CKD increases with age. As kidney dysfunction progresses, some coexisting conditions become more common and increase in severity [2]. People with CKD are five to ten times more likely to die prematurely than they are to progress to end stage kidney disease. Many people are asymptomatic or have nonspecific symptoms such as lethargy, itch, or loss of appetite. Diagnosis is commonly made after chance findings from screening tests (urinary dipstick or blood tests), or when symptoms become severe [3]. One of the most important complications associated with CKD are dyslipidemia and cardiovascular risk [4]. Chronic kidney disease is a global health burden estimated to affect up to 15% of adult populations and is independently associated with increased cardiovascular disease (CVD) risk similar to the risk of diabetes mellitus or coronary heart disease [5]. This risk increases as CKD advances and is evidenced by worsening excretory function, usually manifest as declining glomerular filtration rate, and increasing proteinuria [6]. The increased cardiovascular risk associated with end-stage renal disease has been well established, and estimated cardiovascular mortality rates are 10- to 100-fold higher among dialysis patients than age- and sex-matched individuals in the general population [7]. Anemia in CKD patients is a multifactorial complex problem influenced by the combination of insufficient erythropoietin production, absolute and function iron deficiency, as well as chronic inflammatory states [8]. As of now, a nephrologist treating anemia has a choice diagnostic tool at their disposal to discern the anemia etiology. Hepcidin is a peptide produced by the liver to regulate iron absorption and mobilization [9]. Hepcidin level is affected by iron stores, inflammation states, and erythropoiesis. These factors, as well as decreased renal clearance are believed to be the main determinants of hepcidin levels in CKD patients [10]. Hemodialysis (HD), which is the most common form of treatment for end stage renal disease (ESRD). In this technique, filter waste products (like Cr, urea, and free water) from the blood and to restore normal constituents to it [3]. The aim of this study is to evaluate the role of serum hepcidin in inflammation among hemodialysis patients in relation with serum iron and total iron binding capacity [11-14].

Patients and Methods.

This prospective hospital-based study was done in Kirkuk city from the period from the beginning of December 2022 to the end of March 2023. The study included 30 patients with CKD who underwent regular hemodialysis were included in this study at Kirkuk General Hospital and their age were between 18 to 80 years. They were clinically diagnosed by nephrologist as ESRD patients (on hemodialysis), based on their history, clinical examination, renal function tests and other laboratory tests, undergoing hemodialysis. The study also included 30 adult persons looks healthy with no prior medical or family history of CKD as a control participated in this study.

Inclusion criteria: The main inclusion criteria were individuals ≥18 years of age with end stage CKD (GFR <15 (mL/min/1.73 m^2). All subjects underwent a comprehensive medical health examination and filled out questionnaires on health and lifestyle at the time of enrollment.

Exclusion criteria: Exclusion criteria for enrollment in the study were patients with acute chest infection, heart failure,

history of lung TB, lung cancer and neuromuscular disease.

Ethical approval: Approval of the council of College of Medicine/ Tikrit University was obtain for the proposal of the study. Approval permission was presented to the director of Kirkuk Health Directorate / Kirkuk General Hospital. An interview was carried out with these patients using questionnaire form designed by the investigator including age, sex, duration of CKD, duration of hemodialysis sessions, frequency of hemodialysis sessions per week and time of diagnosis of CKD.

Biochemical analysis: Five ml of blood was collected by vein puncture 5 ml syringes from each patient (before hemodialysis (pre —HD) and 2-4 hours after hemodialysis (post — HD) and control enrolled in this study. Blood samples were placed into two sterile test tubes, in one of them 1.5 ml of blood was put in test tube containing anticoagulant EDTA and used for assessment of complete blood count (CBC) test using Swelab autoanalyzer. The tube then was centrifuged (3000 rpm) for 15 min. The clear serum was pipetted into clear dry Eppendorf's tubes and stored at (-20°C) for determination of hepcidin by ELISA and S. iron, total iron-binding capacity (TIBC), blood urea and serum creatinine by biochemical colorimetric methods and Hemoglobin level by autoanalyzer hematology instruments.

Results.

Table 1 presents the distribution of patients under haemodialysis based on age and sex. The study showed that the largest age group was 73-82 years, comprising 33.33% of the total HD patients, followed by 63-72 years with 26.67%. The smallest age group was 33-42 years, representing only 3.33%. The mean of age was 57.9±12.9 years In terms of sex, 56.67% were male, while 43.33% were female, with 17 and 13 HD patients, respectively.

Table 1. *Distribution of studied patients according to age and sex.*

Age groups (years)	No.	%
33-42	1	3.33
43-52	5	16.67
53-62	6	20
63-72	8	26.67
73-82	10	33.33
Total	30	100
Mean ±SD	57.9±12.9	
Sex	Count	%
Female	13	43.33
Male	17	56.67

According to the Table, 2 below, the highest percentage of HD patients falls within the 4-6 years duration group, accounting for 33.33% of the patients. The 7-9 years and 10-13 years duration groups both have the same percentage, with 23.33% each. The 1-3 years duration group represents 20% of the HD patients and the mean of duration was 4.5 years.

The study demonstrated that haemodialysis patients have higher serum hepcidin levels compared to individuals in the control group (246.1±72.4 ng/ml and 105.7±20.2 ng/ml) respectively. The difference was significant at P-value:0.001 (Table 3).

Table 2. *Distribution of HD patients according to duration of dialysis.*

Duration of dialysis (years)	No.	%
1-3	6	20
4-6	10	33.33
7-9	7	23.33
10-13	7	23.33
Total	30	
Mean ±SD	4.5±1.6	

Table 3. *Mean of serum hepcidin in hemodialysis patients and the control group.*

Studied groups	Serum Hepcidin (ng/ml)				P-value
	Mean ±SD	Min	Median	Max	
Hemodialysis patients	246.1±72.4	108.4	261.8	376.5	0.001
Control group	105.7±20.2	79.2	102.9	149.6	

The study findings revealed that haemodialysis patients exhibit significantly elevated levels of serum ferritin when compared to individuals in the control group (430.5±148.3 ng/ml and 153.8±60.6 ng/ml, respectively). Additionally, the study observed lower serum iron and TIBC levels in haemodialysis patients (63.10±15.62 µg/dl and 265.4±61.1 µg/dl, respectively) as compared with the control group (92.98±26.68 and 273.3±65.9µg/dl, respectively). These differences were found to be statistically significant, with a reported p-value <0.05 (Table 4).

Table 4. *Mean of iron markers in hemodialysis patients and the control group.*

Parameters (Mean±SD)	Hemodialysis patients	Control group	p value
Ferritin (ng/mL)	430.5±148.3	153.8±60.6	0.001
Serum iron (µg/dl)	63.10±15.62	92.98±26.68	0.001
Serum TIBC (µg/dl)	265.4±61.1	273.3±65.9	0.033

The study showed that the mean of serum hepcidin before dialysis was 246.1±72.4 ng/ml, whereas after dialysis, it decreased to 206.3±61.8ng/ml, the difference in hepcidin levels before and after dialysis is statistically significant (P-value:0.022), Table 5 and Figure 1.

Table 5. *Level of serum hepcidin in patients before and after hemodialysis.*

Hemodialysis patients	Hepcidin (ng/ml)				P-value
	Mean±SD	Min	Median	Max	
Before dialysis	246.1±72.4	108.4	261.8	376.5	0.022
After dialysis	206.3±61.8	89.0	199.6	388.3	

The study showed that hepcidin level had positive correlation with NGAL, serum ferritin, urea and creatinine and negative correlation with serum iron and haemoglobin level in patients before haemodialysis. The study also showed that serum NGAL had positive correlation with serum ferritin, urea and creatinine and negative correlation with serum iron and haemoglobin level in patients before haemodialysis (r value> 0.2 and P-value<0.01), Table 6.

Table 6. *Correlation of hepcidin and NGAL with other parameters before HD.*

Hepcidin and NGAL before dialysis	Factors before dialysis	r value*	Type of correlation	P-Value
Hepcidin	Ferritin	0.91	Positive	0.001
	Iron	-0.84	Negative	0.001
	B. Urea	0.74	Positive	0.001
	Creatinine	0.79	Positive	0.001
	TIBC	-0.14	No correlation	0.450
	Hb	-0.59	Negative	0.001
	NGAL HD	0.88	Positive	0.001

* r- value: Correlation coefficient
r- value: (+): positive correlation, (-): negative correlation
≤0.2: No correlation (P-value >0.05)
>0.2 : correlation present (P-value ≤0.05)

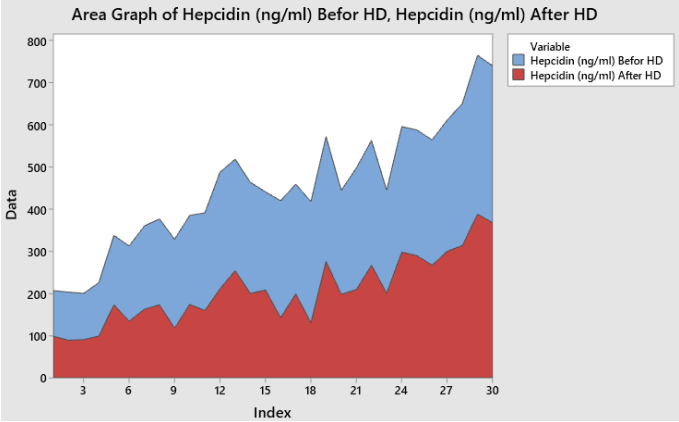

Figure 1. *Change in hepcidin levels in patients and before and after hemodialysis.*

Discussion.

The current study reveals that the largest age group among HD patients was elderly and the mean of age of HD patients was 57.9 years. In agreement with these finding, Al-Rubaie et al [15] in Baghdad found that most of HD patients was old age males and the average age of the patients was found to be 50 years. The current findings are consistent with Theofilou's study in Greece [16], which also demonstrated a significant association between older age and end-stage renal disease (ESRD), with a mean age of 50.9 years. While our finding was higher compared to the mean ages reported in other studies. For instance, the study by Rasheed et al [17] in Iraq and Low et al [18] in the UK reported mean ages of 31.3 years and 41 years, respectively. However, our findings These variations in mean ages across different studies might be attributed to differences in sample populations, geographical locations, and other factors affecting the prevalence of ESRD in different age groups.

In agreement with these finding, Al-Rubaie et al [15] in found that haemodialysis patients generally exhibit higher serum hepcidin levels compared to individuals in the control group. The current results were also consistent with the findings of the study conducted by Eleftheriadis et al [19] in Greece, reported elevated hepcidin levels in ESRD patients when compared to control subjects. The consistency across these studies suggests that elevated hepcidin levels are a characteristic feature of ESRD patients.

Moreover, Babitt and Lin [20] found suggested CKD patients have impaired absorption of dietary iron and impaired release of iron from body stores may be caused by an excess of the key iron regulatory hormone hepcidin. Several other studies also provide support for the hypothesis that individuals with end-stage renal disease (ESRD) tend to have significantly higher levels of hepcidin compared to individuals in the control group [21]. In hemodialysis patients, the disruption of normal kidney function and the inflammatory state associated with end-stage renal disease (ESRD) can lead to elevated serum hepcidin levels. This dysregulation of hepcidin can contribute to abnormalities in iron homeostasis, leading to iron deficiency or iron overload in these patients. However, it's important to note that individual variations and other factors may influence serum hepcidin levels [22].

In line with this finding, Rasheed et al [17] found that hemodialysis patients have elevated serum ferritin levels and decreased serum iron and TIBC levels. Also, Al-Rubaie et al [15] and Low et al [18] in similar studies support the findings that hemodialysis patients exhibit elevated serum ferritin levels and decreased serum iron and TIBC levels. This aligns with the results of the current study, which also demonstrated similar alterations in iron markers in hemodialysis patients compared to the control group. According to the study conducted by Bross et al [23] in the USA, it was noted that in patients with chronic kidney disease (CKD), iron deficiency may be paradoxically associated with lower Total Iron-Binding Capacity (TIBC) values. This is because TIBC serves as the denominator for calculating the iron saturation ratio. When iron levels are low, the TIBC decreases, resulting in an increased iron saturation ratio. This finding suggests the potential paradoxical relationship between iron deficiency and lower TIBC levels in CKD patients [24-28].

The observed decrease in mean hepcidin levels after dialysis was in agreement with the study which done by Zaritsky et al [29] who found that hepcidin levels was decrease significantly after dialysis. The results of this study provide strong evidence that hemodialysis (HD) contributes to the removal of hepcidin itself from the bloodstream. These findings are consistent with two prior studies that also reported a reduction in mean hepcidin levels following dialysis [30,31]. The clear demonstration of decreased hepcidin levels after HD supports the understanding that the dialysis procedure directly affects the clearance or elimination of hepcidin. This reinforces the knowledge that HD is capable of effectively removing various substances, including both small molecules and proteins, from the blood [32]. The observed decrease in mean hepcidin levels after dialysis suggests that the dialysis procedure itself may have an impact on hepcidin production or clearance in hemodialysis patients. Hepcidin is a key regulator of iron metabolism and plays a crucial role in controlling iron absorption and distribution in the body. It is primarily synthesized and released by the liver [33]. There are several potential mechanisms by which dialysis could influence hepcidin levels. Firstly, dialysis is known to remove various substances from the bloodstream, including small molecules and proteins [34]. It is possible that hepcidin, being a relatively small peptide (25 amino acids), could be cleared to some extent during the dialysis process. This clearance could contribute to the reduction in hepcidin levels observed after dialysis [35].

Secondly, it is important to consider the impact of uremia, a condition characterized by the accumulation of uremic toxins in the blood due to kidney dysfunction. Uremia is common in patients with end-stage renal disease who require hemodialysis [36]. Studies have shown that uremia can disrupt normal hepcidin regulation, leading to elevated hepcidin levels. Hemodialysis, by removing uremic toxins, may help restore hepcidin regulation to a more physiological state, resulting in decreased hepcidin levels [37,38]. In contrast to the observed decrease in hepcidin levels after hemodialysis (HD), Yamamoto et al [39] study found no significant difference in the reduction rate of hepcidin between pre and post HD. These results suggest that the HD procedure did not have a substantial impact on hepcidin clearance. A previous pilot study reported no significant difference in hepcidin clearance following dialysis [40]. It is important to note that hepcidin clearance during dialysis can be influenced by various factors, including the dialysis membrane properties, dialysate composition, and individual patient characteristics. In addition to hepcidin, other markers including adiponectin, obestatin, and cytokine should be considered in patients with CKD [41-43].

Conclusion.

In conclusion, this study provided valuable insights into the levels of serum hepcidin, ferritin, iron, total iron-binding capacity (TIBC), and hemoglobin in hemodialysis (HD) patients compared to a control group. The findings revealed that HD patients had significantly higher levels of serum hepcidin, and ferritin, indicating potential involvement in inflammation and iron metabolism dysregulation. Conduct additional studies with larger sample sizes to validate the observed associations between serum hepcidin, ferritin and iron, levels in hemodialysis patients. Longitudinal studies can provide insights into the temporal changes and clinical implications of these biomarkers.

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