Clinical Cancer Investigation Journal-ISSN: 2278-0513

Assessment of anemia and low hemoglobin level as a risk factor for asymptomatic bacteriuria in women of reproductive and postmenopausal age

Abstract

The Impact of anemia on the function of the immune system and eventually on infectious diseases is a challenging issue being debated for many years. Regarding the role of hemoglobin level in the function of the immune system, anemia may be an independent risk factor for developing different types of infection including asymptomatic bacteriuria and urinary tract infection. In this study, we address any association between anemia and low hemoglobin level and asymptomatic bacteriuria in women of reproductive and Postmenopausal age. In present study, 188 women of reproductive and Postmenopausal age (age above 15) with and without asymptomatic bacteriuria were enrolled in our study. The hemoglobin level of all participants was evaluated. The patients with a hemoglobin level below 12 mg/dl were considered anemic. The association between anemia and low hemoglobin level and asymptomatic bacteriuria was evaluated and the correlation between any specific uropathogenic with Hb level was analyzed accordingly. We evaluated hemoglobin levels in positive and negative urine samples and also analyzed the association of specific uropathogenic with hemoglobin levels in patients with asymptomatic bacteriuria. The mean level of hemoglobin in all culture-positive samples was 11.65 mg/dl while it was 13.48 mg/dl in culture-negative samples. The mean hemoglobin level was 11.63 mg/dl and 11.72 mg/dl in *E. coli* and Non- *E. coli* positive urine cultures respectively. Our findings were consistent with previous studies that consider the anemic state as a risk factor for infection. Asymptomatic bacteriuria was significantly more common in anemic patients compared with non-anemic individuals.

Keywords: *Anemia, Hemoglobin, Bacteriuria, Escherichia coli.*

Mehrdad Haghighi [1,2], Mehdi Goudarzi [3,2], Seyedpouzhia Shojaei[4], Nader Tavakoli[5], Maryam Mehrazi[6], Mohammad Seyed Hosseini[7]*

[1]*Infectious Diseases and Tropical Medicine Research Center, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran*

[2]*Shahid Beheshti University of Medical Sciences, School of Medicine, Tehran, IR Iran*

[3]*Department of Microbiology, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran*

[4]*Department of Anesthesiology and Critical Care Medicine, Imam Hossein (A.S.) Medical and Educational Center, Shahid Beheshti University of Medical Sciences, Tehran, Iran*

[5]*Emergency Medicine, Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran.*

[6]*Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran.*

[7]*Saghi Research and Treatment Clinic, Tehran Iran*

***Correspondence author:*

E-mail: saghiclinic@hotmail.com

Tel: +982144044441

Introduction

The association between anemia and the function of the immune system and infection is an interesting topic being debated for many years. Anemia is the most common blood disorder and a significant global public health disease that particularly affects young children and pregnant women. WHO estimates that 42% of children less than 5 years of age and 40% of pregnant women worldwide are anemic. Iron deficiency anemia is the most common type of anemia with a considerable burden of disease worldwide. According to some previous studies, humoral, cell-mediated, and nonspecific immunity and the activity of cytokines are influenced by iron deficiency anemia (1). In another observational research in the pediatric hematology unit in 2016, Hassan et al concluded that humoral, nonspecific immunity (phagocytic activity and oxidative burst), and IL-6 are influenced in patients with iron deficiency anemia (2).

Considering the fundamental role of the immune system in the prevention of infection, anemic patients may be more prone to acute bacterial and viral infections. The relationship between anemia and lower respiratory tract infection (LRTI) in children was addressed in a case-control study in 2015. This study revealed that anemic children were found to be 4.99 times more susceptible to ALRTI compared to the non-ALRTI control group (3). In another study that evaluated bacteremic and nonbacteremic pneumococcal pneumonia, nearly one-third of patients had substantial anemia (hemoglobin < or = 10 g/dL) on admission, which may have predisposed them to infection (4).

The innate immune system in the urinary tract has an essential role in the prevention of infection. When uropathogens invade the urinary tract, innate immune cells start signaling cascades that lead to the local immune response by releasing anti-inflammatory mediators. Moreover, anemia can probably influence the functioning of the innate and adaptive arms of the immune system in the urinary tract, leading to more vulnerability to asymptomatic bacteriuria and perhaps frank urinary tract infection (UTI).

Objectives

This study aimed to address any association between anemia and low hemoglobin level and asymptomatic bacteriuria in women of reproductive and Postmenopausal age.

Methods

In a period of 5 years (between 2016-2022), 188 women of reproductive and Postmenopausal age (age above 15) with and without asymptomatic bacteriuria were enrolled in our study. Bacteriuria was diagnosed when a significant colony-forming unit (CFU) of a bacterium was cultured from appropriately collected urine samples. All participants had no signs or symptoms of urinary tract infection. Negaresh pathobiology laboratory was the reference laboratory. The exclusion criteria were as follows: 1) use of any antibacterial agent within the last 3 months 2) nephrolithiasis 3) history of surgical procedure in urinary tract within the last 3 months 4) presence of indwelling urinary catheters 5) pregnancy 6) gynecological disorders 7) urinary tract stent or nephrostomy tube and 8) symptomatic patients.

Clean voided midstream urine samples were processed within 2 hours of collection. Samples were considered positive if they contained $\geq 10^5$ CFU of the urinary pathogen/ml of pure culture. Blood agar, MacConkey agar, and Eosin methylene blue plates were used for pathogen identification and differentiation. The complete blood count (CBC) and hemoglobin level of all participants were evaluated and analyzed accordingly. The patients with a hemoglobin level below 12 mg/dl were considered anemic. The association between anemia and low hemoglobin level and asymptomatic bacteriuria was evaluated using SPSS version 22 (IBM, New York, USA). Kolmogorov–Smirnov test was performed to evaluate the normal distribution of data.

Results

A total of 500 medical records were evaluated in our assay. After excluding documents with missing data and other exclusion criteria, 188 women with and without asymptomatic bacteriuria were enrolled in the study. We evaluated hemoglobin levels in positive and negative urine samples and also analyzed the association of specific uropathogenic with hemoglobin levels in patients with asymptomatic bacteriuria. All study participants were female. The mean age of women who participated in our study was 49 years old with maximum and minimum ages of 91 and 16 respectively. The mean age of women with positive urine culture was 59 and it was 40 for negative urine samples. E- coli was found to be the major pathogen among the positive urine culture and accounted for 75 percent of infections. *Klebsiella pneumoniae* was the second pathogen isolated from urine samples and accounted for 16 percent of infections. The remainder of uropathogens included *Staphylococcus saprophyticus*, Enterococcus, and Enterobacter and accounted for 8 percent of infections. The mean hemoglobin level of all participants was 12.66 mg/dl with maximum and minimum levels of 15.6 mg/dl and 7.7 mg/dl respectively. The mean level of hemoglobin in all culture-positive samples (including *E. coli* and non-E. *coli* positive samples) was 11.65 mg/dl while it was 13.48mg/dl in culture-negative samples (P value <.05). Our findings were consistent with previous studies that consider the anemic state as a risk factor for infection. Asymptomatic bacteriuria was significantly more common in anemic patients compared with non-anemic individuals. The maximum level of hemoglobin in culture-positive and culture-negative samples was 13.7 mg/dl and 15.6 mg/dl respectively. The mean hemoglobin level was 11.63 mg/dl and 11.72 mg/dl in *E. Coli* and Non-*E. Coli*-positive urine culture respectively (P value 0.279) (Figure 1).

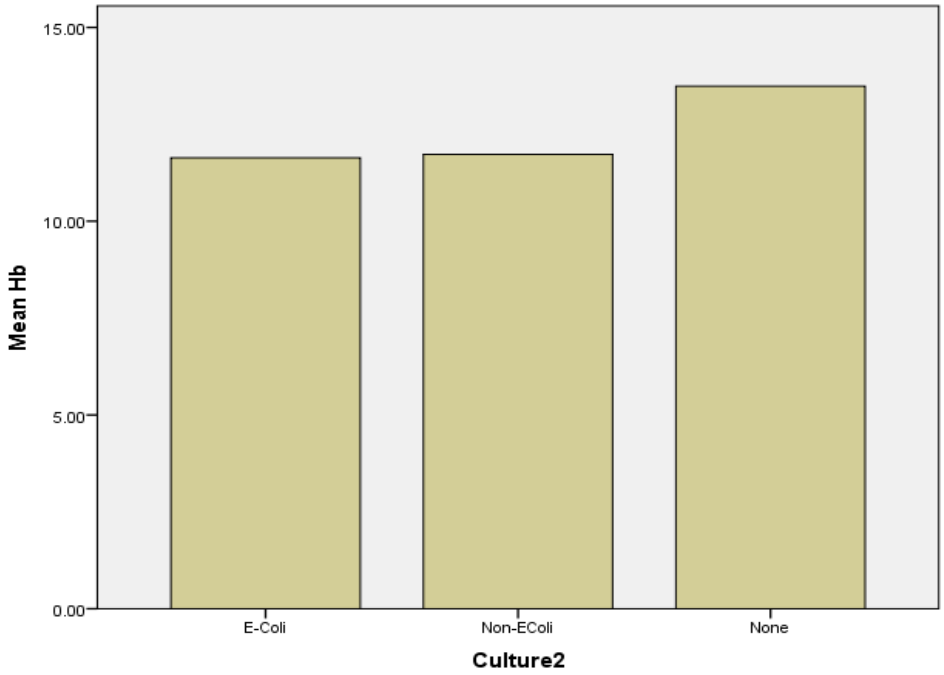

Figure 1. HB level in culture negative and *E. Coli* and Non-*E. Coli*-positive urine culture.

Discussion

We evaluated any association between hemoglobin level and asymptomatic bacteriuria in women of reproductive and Postmenopausal age. We also evaluated the association of any specific uropathogenic with Hb level in the study population with a positive culture. Considering the potential progression of asymptomatic bacteriuria to frank urinary tract infection (UTI), eliminating any risk factor for asymptomatic bacteriuria may lower the chance of developing a UTI.

The relationship between Infection and anemia is a topic of research for many years. According to some previous studies, both the cell-mediated immune response and the bactericidal activity of leucocytes are impaired when levels of hæmoglobin fall to 10 g/dl or less (5). In another research that evaluated the association between different clinical and laboratory parameters and asymptomatic bacteriuria, the authors concluded that iron deficiency anemia is an independent risk factor for asymptomatic bacteriuria (6). Impairment of cell-mediated immunity in iron-deficient humans has been well described in a study by Vishal Kumar and V.P. Choudhry and Several mechanisms including reduced neutrophil function with decreased myeloperoxidase (MPO) activity have been proposed for the pathogenesis of this impairment (7). Compatible with the above studies, Ahluwalia et al concluded in their study that Iron deficiency is associated with impairments in cell-mediated and innate immunity and may render older adults more vulnerable to infections (8).

In our study, the mean level of hemoglobin was 11.65 mg/dl and 13.48 mg/dl in culture-positive and culture-negative urine samples respectively. These data were of statistical significance and we concluded that there is a significant correlation between anemia and asymptomatic bacteriuria in the studied population. As mentioned previously we defined anemia as a hemoglobin level below 12 mg/dl. The mean hemoglobin level in *E. coli* and non-E. *coli*-positive urine culture had no significant difference. Considering some investigations that specifically link anemia and urinary tract infection, our finding would be of importance. Areej-A.Jabbar evaluated the association between anemia and urinary tract infection among pregnant women and concluded that there is an association between urinary tract infection and anemia of different causes during pregnancy (9). Our findings were consistent with previous studies that consider the anemic state as a risk factor for infection.

Conclusion

Our findings were consistent with previous studies that consider the anemic state as a risk factor for infection. Asymptomatic bacteriuria was significantly more common in anemic patients compared with non-anemic individuals.

Footnote

Authors' Contribution:

MH, MG, and SS designed the study. MH, SS, NT, MM, and MSH reviewed the literature. MH and MG performed the laboratory investigations. MH, SS, NT, MM, and MSH participated in data interpretation. MH, MG, and MSH drafted the manuscript. MH, MG, MM, and NT critically reviewed the manuscript and approved the final version of the manuscript. All authors read and approved the final manuscript.

Acknowledgment: We appreciate the assistance of the staff of the Negaresh laboratory, who recruited the volunteers.

Conflict of Interest: The authors declare no competing interests.

Funding: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Ethical statements. The entire procedures were approved by the Ethics Committee of the Shahid Beheshti University of Medical Sciences in Tehran, Iran. A written informed consent was obtained from participants.

References

1. Ekiz C, Agaoglu L, Karakas Z, Gurel N, Yalcin I. The effect of iron deficiency anemia on the function of the immune system. The Hematology Journal. 2005;5(7):579-83.
2. Hassan TH, Badr MA, Karam NA, Zkaria M, El Saadany HF, Rahman DMA, et al. Impact of iron deficiency anemia on the function of the immune system in children. Medicine. 2016;95(47).
3. Km R, Gupta V, Ahmad S, Ranhotra S, Issrani R, Prabhu N. Assessment of anemia as a risk factor for acute lower respiratory tract infections in children: a case-control study. International Journal of Clinical Pediatrics. 2015;4(2-3):149-53.
4. Musher DM, Alexandraki I, Graviss EA, Yanbeiy N, Eid A, Inderias LA, et al. Bacteremic and nonbacteremic pneumococcal pneumonia. A prospective study. Medicine. 2000;79(4):210-21.
5. Srikantia S, Bhaskaram C, Prasad JS, Krishnamachari K. Anaemia and immune response. The Lancet. 1976;307(7973):1307-9.
6. Cuttitta F, Torres D, Vogiatzis D, Buttà C, Bellanca M, Gueli D, et al. Obesity and iron deficiency anemia as risk factors for asymptomatic bacteriuria. European journal of internal medicine. 2014;25(3):292-5.
7. Kumar V, Choudhry V. Iron deficiency and infection. The Indian Journal of Pediatrics. 2010;77(7):789-93.
8. Ahluwalia N, Sun J, Krause D, Mastro A, Handte G. Immune function is impaired in iron-deficient, homebound, older women. The American journal of clinical nutrition. 2004;79(3):516-21.
9. Jabba A-A. The association between anemia and urinary tract infection among pregnant women in Baghdad. Journal of the Faculty of Medicine Baghdad. 2006;48(3):267-71.