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RESEARCH

THE EFFECTS OF ANEMIA AND RED CELL TRANSFUSION ON THE RISK OF MORTALITY AMONG GERIATRIC AND NON-GERIATRIC PATIENTS WITH HOSPITAL-ACQUIRED INFECTIONS IN AN INTENSIVE CARE UNIT

ABSTRACT

Introduction: This study aimed to investigate the effects of anemia and red blood cell transfusion on the risk of mortality in geriatric and non-geriatric Intensive Care Unit patients with Hospital-Acquired Infection.

Materials and Method: This study included 546 patients aged ≥18 years; from these, 112 patients had Hospital-Acquired Infection.

Results: Among the patients aged ≥65 years with Hospital-Acquired Infection who were treated in the medical Intensive Care Unit, the risk of mortality was significantly increased in patients with anemia or history of diabetes; in patients who were intubated or in patients with neurological disorders or respiratory failure. Although the abovementioned factors increased the risk of mortality in the elderly, the same relationship was not observed in patients aged<65 years. In addition, blood transfusion did not increase the risk of mortality in patients belonging to both the age groups.

Conclusion: We conclude that in geriatric Intensive Care Unit patients with Hospital-Acquired Infection, anemia increases the risk of mortality but red cell transfusion does not affect the risk of mortality.

Key Words: Intensive Care Unit; Cross Infection; Geriatrics; Anemia; Erythrocyte Transfusion.

ARAŞTIRMA

YOĞUN BAKIM ÜNİTESİNDEKİ HASTANE ENFEKSİYONLU GERİATRİK VE NON-GERİATRİK HASTALARDA, ANEMİ VE ERİTROSİT TRANSFÜZYONUNUN MORTALİTEYE ETKİSİ

ÖZ

Giriş: Bu çalışmada, hastane enfeksiyonlu, geriatrik ve geriatrik olmayan yoğun bakım hastalarında; anemi ve eritrosit transfüzyonunun mortaliteye etkisinin değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntem: On sekiz yaş ve üstü toplam 546 hastada gelişen 112 hastane enfeksiyonlu hasta çalışmaya alınmıştır.

Bulgular: Dahili yoğun bakım ünitemizde takip edilen hastane enfeksiyonu tanılı, 65 yaş ve üzeri yaşlı hastalarda; anemi varlığı, yatış tanısının nörolojik hastalık ve solunum yetmezliği olması, diyabet öyküsü olması, hastanın entübe edilmesi mortaliteyi anlamlı oranda artırmıştır. İleri yaş grubunda mortaliteyi artıran tüm bu faktörlerin, 65 yaş altı hastalarda mortalite artışı ile ilişkisi saptanamamıştır. Her iki grup için de, eritrosit transfüzyonu yapılmasının mortaliteye etkisinin olmadığı görülmüştür.

Sonuç: Yoğun bakımdaki hastane enfeksiyonlu geriatrik hastalarda anemi mortalite riskini artırmaktadır ancak eritrosit transfüzyonu mortalite riskini etkilememektedir.

Anahtar Sözcükler: Yoğun Bakım Ünitesi; Hastane Enfeksiyonu; Geriatrik; Anemi; Eritrosit Transfüzyonu.

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Introduction

Patients with serious problems are monitored and treated in intensive care units (ICUs). Most deaths in ICUs are commonly caused by cardiac, neurological, and respiratory disorders; sepsis; and pneumonia (1,2).

Hospital-acquired infections (HAIs) do not develop during the incubation period at the time of admission to a hospital but are acquired once a patient has been admitted to the hospital. HAIs are a concern that arise with medical improvements and have become a quality indicator for hospitals. HAIs frequently develop in ICU patients and are associated with a notable increase in mortality and morbidity, longer hospital stay, and increased hospital cost (3). In elderly patients admitted to medical ICUs, several factors increase the predisposition to HAIs. Of these comorbidity, age, multiple invasive procedures, and physical conditions are the important causes of multiple complications (4,5).

Anemia is a serious concern in ICU sand is associated with multiple risk factors such as sepsis, occult blood loss, decrease in erythropoietin production, malnutrition, hemolysis, and defective coagulation. Anemia increases the risk of mortality and morbidity because of its cardiovascular and cerebrovascular effects that result in tissue hypoxia (6-8). Treatment of anemia usually involves red blood cell transfusion. However, the ideal hemoglobin (Hb) level for transfusion is unknown. In literature some studies have shown that red blood cell transfusion may increases the risk of mortality, morbidity, and transfusion-related infections and extends hospital stay in ICU patients (3,9,10).

This study aimed to investigate the effects of anemia and red blood cell transfusion on the risk of mortality in geriatric and non-geriatric ICU patients with HAIs.

Materials and Method

This retrospective study was performed in a tertiary nine-bed ICU at our Department of Internal Medicine. This study included 546 patients aged ≥18 years that were monitored for two years; out of these, 112 had HAIs. Patients who were monitored for less than two days were excluded from the study.

The Centers for Diseases Control and Prevention defined HAIs as infections that are not acquired during incubation state at the time of admission to the hospital but that are present after a patient has been admitted to the hospital. HAIs rate and incidence density were calculated as follows: (1) HAIs rate (%) = number of infections developed in the ICU/number of patients in the ICU x 100; (2) incidence density =number of infections developed in the ICU/total number of days a patient has stayed in the ICU x 1000 (11). Blood, urine, and sputum (or deep tracheal aspiration) samples were taken from patients who developed HAIs; samples from wounds, upper respiratory tract, and catheter were taken if necessary. Based on the World Health Organization (WHO) criteria, patients aged ≥65 years were classified as geriatric patients and those aged<65 years were classified as non-geriatric patients

Based on the WHO definition, men with serum Hb level below 13 g/dL and women with serum Hb level below 12 g/Dl were classified as anemic. The decision to initiate transfusion was taken by patient's doctor after evaluating the patient's comorbidities, oxygen saturation, and other vital signs.

Statistical Analysis

Descriptive variables in the collected data were expressed as average ± standard deviation, number and percentage frequencies. Chi-square test was applied to evaluate factors related to mortality, and independent sample t test was applied to evaluate factors related to hospital stay. The probability of type 1 error (·) was taken as 5%. All the statistical analyses were performed using SPSS software (ver.18).

Results

During the two years, 546 patients included in the study were followed up for 5647 patient-days, and the average follow-up time was 47.07±51.29 (range, 4–372) days. HAIs were present in 112 patients, of which 57 (50.9%) were women and 55 (49.1%) were men. HAIs rate was 20.5%, and HAIs incidence rate was 19.8/1000 (1.98%) patient days. The average of age of 112 patients with HAIs was 71.12±13.41 (range, 19–97) years. Out of the 112 patients with HAIs, 27 (24.1%) were aged <65 years (37% female, 63% male) whereas 85 (75.9%) were aged ≥65 years (55.3% female, 44.7% male). The average age of patients aged <65 years was 53.15±12.44 years and that of patients aged ≥65 years was 76.84±7.27 years.

In all, 71 (63.4%) patients with HAIs died in the ICU; out of these, 13 patients were aged<65 years and 58 patients were aged ≥65 years. Patients in the two groups did not show significant differences in the risk of mortality (p=0.25).

Neurological disorders, respiratory failure, cardiovascular disorders, and infections (pneumonia, urinary tract infection, sepsis, etc.) were common reasons for admission to the ICU.

Table 1— Relationship Between Admission Diagnosis and Mortality in the Groups Aged <65 Years and Aged ≥65 Years.

		Aged <65			Aged ≥65 years		
		Discharge Number (Percent)	Exitus Number (Percent)	p	Discharge Number (Percent)	Exitus Number (Percent)	p
Admission diagnoses	Neurological disorder	1 (25.0)	3 (75.0)	0.41	4 (31.0)	9 (69.0)	0.41
	Respiratory failure	4 (44.0)	5 (56)		8 (22.2)	28 (77.8)	
	Infection (pneumonia, urinary system infection, septic shock)	1 (50.0)	1 (50.0)		4 (50.0)	4 (50.0)	
	Cardiovascular disease	3 (60.0)	2 (40.0)		1 (33.3)	2 (66.7)	

Respiratory failure and neurological disorders were more frequent than other conditions in patients aged ≥65 years; moreover, the patients in this group showed an increased risk of mortality (p = 0.03; Table 1).

The most commonly diagnosed HAIs were pneumonia, urinary tract infections, and bacteremia (in the given order). However, these factors did not significantly increase the risk of mortality in the two groups

Presence of comorbidities such as neurological disorders, respiratory failure, cardiovascular diseases, and nephrological disorders did not significantly increase the risk of mortality among patients aged <65 years (p = 0.68) and those aged ≥65 years (p = 0.75). However, presence of diabetes significantly increased the risk of mortality, with 2 out of 5 patients with diabetes aged <65 years (p = 0.99) and 20 out of 22 patients with diabetes aged ≥65 years (p = 0.004) dying during the study period (Table 2).

Acinetobacter, *Pseudomonas*, *Staphylococcus*, and *Escherichia coli* (in the given order) were found to be the most common causes of HAIs. However, infection with these pathogens did not

Table 2— Comparison of Effect of Diabetes Mellitus and other Comorbidities as well as Latest Isolated Infectious Pathogen on Mortality in Both Groups

		Aged <65			Aged ≥65 years		
		Discharge Number (Percent)	Exitus Number (Percent)	p	Discharge Number (Percent)	Exitus Number (Percent)	p
Diabetes mellitus	Diabetic	3 (60.0)	2 (40.0)	0.99	2 (9.1)	20 (90.9)	0.004
	Non-Diabetic	11 (50.0)	11 (50.0)		25 (39.7)	38 (60.3)	
Comorbidities	Neurological disorder	1 (50.0)	1 (50.0)	0.68	7 (70.0)	3 (30.0)	0.75
	Respiratory failure	1 (50.0)	1 (50.0)		- (-)	2 (100.0)	
	Cardiovascular disorder	4 (66.7)	2 (33.3)		7 (58.3)	5 (41.7)	
Latest isolated infectious pathogen	Acinetobacter	2 (25.0)	6 (75)	0.088	3 (15.0)	17 (85.0)	0.024
	Pseudomonas	3 (100.0)	- (-)		3 (30.0)	7 (70.0)	
	Staphylococcus	2 (50.0)	2 (50.0)		1 (16.7)	5 (83.3)	
	E. coli	- (-)	1 (100.0)		7 (63.6)	4 (36.4)	

Table 3— Comparison of Anemia Rates and Transfusion Need in Both Groups.

		Anemia			Transfusion		
		(-) Number (Percent)	(+) Number (Percent)	p	(-) Number (Percent)	(+) Number (Percent)	p
Age	**<65 years**	14 (51.9)	13 (48.1)	0.39	21 (77.8)	6 (22.2)	0.70
	≥65 years	36 (42.4)	49 (57.6)		63 (74.1)	22 (25.9)	

increase the risk of mortality in patients aged <65 years (p = 0.08). However, infection with *Acinetobacter*, *Pseudomonas*, and *Staphylococcus* significantly increased the risk of mortality in patients aged ≥65 years (p=0.02; Table 2).

Out of the 112 patients with HAIs, 62 (13 patients aged<65 years and 49 patients aged ≥65 years) had anemia and 28 (6 patients aged<65 years and 22 patients aged ≥65 years) needed red blood cell transfusion. Rates of anemia and blood transfusion were not significantly different between patients in the two groups (p=0.39 for the rate of anemia and p=0.70 for the rate of blood transfusion; Table 3). In patients aged <65 years, effects of anemia and blood transfusion on the risk of mortality were not significantly different between anemic and non-anemic patients (p=0.57) and between patients receiving and not receiving blood transfusion (p=0.65). However, in patients aged ≥65 years, presence of anemia significantly increased the risk of mortality (p=0.03), but blood transfusion had no effect on the risk of mortality (p=0.60; Table 4).

When the association of intubation, another important mortality-related factor in the ICU, with mortality was analyzed, it was observed that 80 out of 112 patients with HAIs required intubation. Of these, 21 patients were aged<65 years and 59 patients were aged ≥65 years. Therefore, it was concluded that intubation was an important cause of mortality in patients aged ≥65 years (p=0.02) but not in patients aged<65 years (p=0.99).

Discussion

In this study, we observed that low Hb levels during admission, latest isolated HAIs pathogen, presence of neurological disorders or respiratory failure during admission, intubation, and history of diabetes strongly increased the risk of mortality in patients with HAIs aged ≥65 years who were admitted to our medical ICU. None of these factors were associated with mortality in patients aged<65 years.

HAIs rate and HAIs incidence density reported in this study were similar to those reported in other studies performed in our country (12,13). Pneumonia, urinary tract infection, and bacteremia are the most common causes of HAIs worldwide (12,14,15).

Acinetobacter, *Pseudomonas*, *Staphylococcus*, and *E. coli* were the most frequently isolated microorganisms in our study, which was consistent with the findings of previous studies performed in our country (12,16). A study by Avci Met. al. evaluating HAIs frequency, infection type and microbiological characteristics in all hospital patients aged <65 years and those aged ≥65 years showed that HAIs were more fatal in elderly patients than in younger patients (17). Although our study included only ICU patients, our findings showed significantly higher mortality in elderly patients than in younger patients with HAIs caused by the most common pathogens.

Not many studies have determined evaluating the underlying disorders affecting mortality in ICU patients. A study

Table 4— Comparison of Effect of Anemia and Blood Transfusion on Mortality Between Two Groups.

		Aged <65 years			Aged ≥65 years		
		Discharge Number (Percent)	Exitus Number (Percent)	p	Discharge Number (Percent)	Exitus Number (Percent)	P
Anemia	**(-)**	8 (57.1)	6 (42.9)	0.57	16 (44.4)	20 (55.6)	0.03
	(+)	6 (46.2)	7 (53.8)		11 (22.4)	38 (77.6)	
Transfusion	**(-)**	10 (47.6)	11 (52.4)	0.65	21 (33.3)	42 (66.7)	0.60
	(+)	4 (66.7)	2 (33.3)		6 (27.3)	16 (72.7)	

evaluating the incidence of HAIs, risk factors, and mortality-related conditions in the ICU showed no relationship between underlying disorders and infections; however, presence of more than two underlying disorders increased the risk of mortality (18). In our study, although no significant relationship was observed between mortality and presence of comorbidities, except diabetes, in patients belonging to the two age groups, history of diabetes increased the risk of mortality in patients aged ≥65 years.

Different results were obtained from studies investigating the effects of anemia and red blood cell transfusion on the risk of mortality. A broad study evaluating the effects of anemia and blood transfusion in ICU patients showed that anemia did not increase the risk of ICU mortality (6); however, patients receiving blood transfusion showed an increased risk of mortality. A study by Sakr et.al. on patients admitted to surgical ICU showed that mortality and morbidity were significantly higher in anemic patients and were significantly lower in patients with high Hb levels after blood transfusion (19). A study evaluating the effect of red blood cell transfusion on 213 patients with septic shock showed that 90-day mortality was high among patients with low Hb levels, which decreased after blood transfusion (20). A study by Nieves et. al. evaluating risk factors in ICU patients with hospital-acquired pneumonia showed that anemia increased the risk of pneumonia along with factors such as malnutrition, chronic kidney failure, and extended hospital stay (21). A study involving 428 patients with non-bleeding anemia of which half of the patients received blood transfusion whereas the remaining half did not showed that blood transfusion did not have favorable effects on both mortality and morbidity (22). Another study evaluating factors affecting mortality in 456 elderly ICU patients (age, >74 years) with community-acquired pneumonia showed that anemia increased the risk if mortality (23). Two separate studies showed that anemia increased the risk of mortality and morbidity in medical and surgical ICU patients (24,25). In our study, the risk of mortality increased in anemic geriatric patients with HAIs but not in patients receiving blood transfusion.

We conclude that in geriatric ICU patients with HAIs, anemia increases the risk of mortality but red cell transfusion does not increase the risk of mortality. Red cell transfusion may prevent the unfavorable effects of anemia on the risk of mortality.

Further studies evaluating the effects of anemia and blood transfusion on the risk of morbidity and mortality should be performed on a larger sample of patients and by better grouping of patients with different Hb levels; in addition, these studies should consider scoring systems and organ failures in detail.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

1. Ceylan E, İtil O, Arı G, Ellidokuz H, Uçan ES, Akkoçlu A. Factors affecting mortality and morbidity in patients followed in medical intensive care unit. Turkish Thoracic Journal 2001;2:6-12. (in Turkish).
2. Uysal N, Gündoğdu N, Börekçi Ş, et al. Prognosis of patients in a medical intensive care unit of a tertiary care centre. Journal of Medical and Surgical Intensive Care Medicine 2010;1:1-5. (in Turkish).
3. Taylor RW, O'Brien J, Trottier SJ, et al. Red blood cell transfusions and nosocomial infections in critically ill patients. Crit Care Med 2006;34(9):2302-8. (PMID:16849995).
4. Orucu M, Geyik MF. The frequent nosocomial infections in intensive care units. Düzce Medical Journal 2008;1:40-3. (in Turkish).
5. Karahocagil MK, Yaman G, Göktaş U, et al. Determining factors of nosocomial infection and resistance profile. Van Medical Journal 2011;18:27-32. (in Turkish).
6. Vincent JL, Baron JF, Reinhart K, Gattinoni L, Thijs L, et al. Anemia and blood transfusion in critically ill patients. JAMA 2002;288(12):1499-507. (PMID:12243637).
7. Viljoen M, Coetzee IH, Roux JJ, Pretorius JP. Anemia in surgical intensive care patients. Haematologica 1994;79(1):19-24. (PMID:15378944).
8. McEvoy MT, Shander A. Anemia, bleeding, and blood transfusion in the intensive care unit: causes, risks, costs, and news trategies. Am J Crit Care 2013;22(6):eS1-13. (PMID:24186829).
9. Toy P, Gajic O, Bacchetti P, et al; TRALI Study Group. Transfusion-related acute lung injury: incidence and risk factors. Blood 2012;119(7):1757-67. (PMID:22117051).
10. Narick C, Triulzi DJ, Yazer MH. Transfusion-associated circulatory overload after plasma transfusion. Transfusion 2012;52(1):160-5. (PMID:21762464).
11. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. Am J Infect Control 1988;16(3):128-40. (PMID:2841893).
12. Ak O, Batirel A, Ozer S, Colakoğlu S. Nosocomial infections and risk factors in the intensive care unit of a teaching and research hospital: a prospective cohort study. Med Sci Monit 2011;17(5):29-34. (PMID:21525819).
13. Erbay H, Yalcin AN, Serin S, et al. Nosocomial infections in intensive care unit in a Turkish university hospital: a 2-year survey. Intensive Care Med 2003;29(9);1482-8. (PMID:12898002).

14. Zaragoza R, Ramírez P, López-PueyoMJ. Nosocomial infections in intensive care units. Enferm Infecc Microbiol Clin 2014;32(5):320-7. (PMID:24661994).
15. Huoi C, Vanhems P, Nicolle MC, Michallet M, Bénet T. Incidence of hospital- acquired pneumonia, bacteraemia and urinary tract infections in patients with haematological malignancies, 2004-2010: a surveillance-based study. PLoS One 2013;8(3):e58121. (PMID:23472145).
16. Meric M, Willke A, Caglayan C, Toker K. Intensive care unit-acquired infections: incidence, risk factors and associated mortality in a Turkish university hospital. Jpn J Infect Dis 2005;58(5):297-302. (PMID:16249625).
17. Avci M, Ozgenc O, Coskuner SA, Olut AI. Hospital acquired infections (HAI) in the elderly: comparison with the younger patients. Arch Gerontol Geriatr 2012;54(1):247-50. (PMID:21529974).
18. Ott E, Saathoff S, Graf K, Schwab F, Chaberny IF. The prevalence of nosocomial and community acquired infections in a university hospital: an observational study. Dtsch Arztebl Int 2013;110(31-32):533-40. (PMID:24069074).
19. Sakr Y, Lobo S, Knuepfer S, Esser E, Bauer M, Settmacher U, Barz D, Reinhart K. Anemia and blood transfusion in surgical intensive care unit. Crit Care 2010;14(3):92. (PMID:20497535).
20. Rosland RG, Hagen MU, Haase N, et al. Red blood cell transfusion in septic shock-clinical characteristics and outcome of unselected patients in a prospective, multicentre cohort. Scand J Trauma Resusc Emerg Med 2014;22:14. (PMID:24571858).
21. Sopena N, Heras E, Casas I, et al. Risk factors for hospital-acquired pneumonia outside the intensive care unit: a case-control study. Am J Infect Control 2014;42(1):38-42. (PMID:24199911).
22. Leal-Noval SR, Muñoz-Gómez M, Jiménez-Sánchez M, **et al.** Red blood cell transfusion in non-bleeding critically ill patients with moderate anemia: is there a benefit? Intensive Care Med 2013;39(3):445-53. (PMID:23184038).
23. Calle A, Márquez MA, Arellano M, Pérez LM, Pi-Figueras M, Miralles R. Geriatric assessment and prognostic factors of mortality in very elderly patients with community-acquired pneumonia. Arch Bronconeumol 2014;50(10):429-34. (PMID:24629763).
24. Halpern MT, Zilberberg MD, Schmier JK, Lau EC, Shorr AF. Anemia, costs and mortality in chronic obstructive pulmonary disease. Cost Eff Resour Alloc 2006;16(4):17. (PMID:17042950).
25. Weiss G, Goodnough LT. Anemia of chronic disease. N Engl J Med 2005;352(10):1011-23. (PMID:15758012).