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Association of anemia with rehabilitation outcomes for subacute geriatric rehabilitation patients in a secondary hospital in malaysia

Mann Leon Chin[a, *], Christopher WS Chan[b], Huey Ee Chong[c], Wee Kooi Cheah[b, c]

[a] *Department of Internal Medicine, Hospital Pulau Pinang, Ministry of Health, Pulau Pinang, Malaysia.*
[b] *Clinical Research Centre, Hospital Taiping, Ministry of Health, Perak, Malaysia.*
[c] *Department of Medicine, Hospital Taiping, Ministry of Health, Perak, Malaysia.*

Abstract

Background: To evaluate the effects of anemia on rehabilitation outcomes for geriatric subjects in the Taiping Hospital subacute geriatric rehabilitation ward.
Methods: This was a retrospective study with 126 subjects that compared the change in the modified Barthel Index score of anemic and non-anemic subjects.
Results: In the study, 43.7% of subjects were anemic. Among anemic subjects, 45.5% were Malay, 38.2% were Chinese, 14.5% were Indian, and 1% were others. The median (Interquartile (IQR)) modified Barthel Index (MBI) on admission for anemic and non-anemic subjects was insignificantly different, at 47 (29, 63) and 36 (21, 59), respectively ($P = 0.059$). The median (IQR) of MBI improvement for non-anemic subjects was found to be significantly higher than for anemic subjects, which were 14 (5, 26) and 8 (1, 18; $P = 0.021$). Subjects with hemoglobin (hb) ≥ 9 g/dL were significantly associated with MBI improvement of more than 20, $P = 0.009$. Simple linear regression found that the P-values were not significant for albumin, creatinine, the Charlson comorbidity index, or the clinical frailty scale; hence, they were not significantly associated with rehabilitation outcome.
Conclusions: The study suggested that non-anemic subjects showed significant MBI improvement. Our study also suggested that judicious practices to target a hb threshold of 9 g/dL might be able to improve a subject's functional outcome. These results should encourage further research with a larger elderly population to provide insights and awareness for the need to treat anemia in rehabilitation subjects.
Keywords: Geriatric, anemia, rehabilitation, modified barthel index

Introduction

Anemia is a common disease in the elderly population worldwide. According to the World Health Organisation (WHO), the definition of anemia is hemoglobin (hb) less than 13 g/dL in men, less than 12 g/dL in non-pregnant women, and less than 11 g/dL in pregnant women [1]. In Malaysia, the prevalence of anemia among community-dwelling people older than 60 years of age was 35.3% [2]. Geriatric inpatients have a higher anemia prevalence than community-dwelling older people [3]. In Singapore, the anemia prevalence in geriatric inpatients is as high as 57% [4].

Anemia in the elderly is often under-recognized because they usually present with nonspecific symptoms such as tiredness and weakness, which are frequently assumed to be part of the aging process. Awareness of the effects of anemia is rising, as it has been shown to have poorer outcomes in geriatric patients, including increased risk of physical disability, cognitive impairment, hospitalization, and mortality [3, 5].

The etiology of anemia in elderly individuals is often more than one and may substantially aggravate the anemia, especially for acute hospitalized patients. The common causes of anemia include malnutrition; blood loss; endocrinologic and metabolic causes; a chronic inflammatory state, such as chronic kidney disease or cancer; un-

* Corresponding author: Mann Leon Chin
Mailing address: Department of Internal Medicine, Pulau Pinang Hospital, Jalan Residensi, 10990 George Town, Pulau Pinang, Malaysia.
Email: drleoncm@gmail.com
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explained, clonal, or drug-induced anemia; and increased consumption or destruction of erythrocytes [6]. Correction of anemia can not only provide symptom management but can also improve the activities of daily living (ADL) like toileting, mobility and dressing and clinical outcomes for hospitalized patients [7-9]. Studies have shown that treating anemia in specific patient groups decreases their length of stay or improves their function [10-13]. A cohort study of postoperative hip fracture geriatric patients with higher hb levels was independently associated with greater walking distance and functional recovery [14].

The hb threshold to trigger treatment for anemia in the elderly remains debatable. Attempts have been made to determine the optimal hb levels to guide management of anemia, including blood transfusion therapy. This strategy has been confounded by baseline function, hb level, and additional co-morbidities, including cardiovascular disease and risk of treatment. To the best of the authors' knowledge, there is scant evidence available to suggest an hb 'trigger' for treatment of anemia for rehabilitation and recovery purposes. The published guidelines [15-33] acknowledge patients' co-variables (including age) and other patient-specific criteria to be taken into consideration when making decisions for blood transfusion therapy. A consensus was reached on restrictive transfusion such that transfusion may be of benefit when the hb is less than 6-7 g/dL. However, for those with hb greater than 10 g/dL, correction of anemia is not beneficial, mainly for mortality benefit. Patients discharged with lower hb levels may have suboptimal functional recovery and quality of life [34-39]. One of the strategies proposed for prudent anemia correction in the elderly is to keep hb thresholds at 9-10 g/dL [40]. The aim of this study is to examine the effects of anemia and an hb threshold of 9 g/dL on the rehabilitation outcome of patients in a subacute geriatric rehabilitation ward.

Materials and methods

Study population

Medical records were reviewed from January 2018 until April 2019 for all subjects admitted to the subacute geriatric ward in Taiping Hospital. The sample size was estimated using Open EPI software. The assumption was made that non-anemic subjects might have a 20% improvement in MBI relative to subjects with anemia. Preliminary unpublished data indicated that at least 20 subjects were needed in each group to demonstrate the assumption with a level of significance of 0.05 and a power of 80%. According to previous data, the ratio of anemic subjects without transfusion was calculated as 1:5. The total number of subjects to be investigated to obtain the final study population was 167. Subjects whose medical records were incomplete or missing their initial or final MBI (n = 26), those who were younger than 60 years of age (n = 10), or those who did not have hb on admission or one week prior or later (n = 5) were excluded from the study. After accounting for these criteria, a total of 126 subjects were included in this study.

Subacute geriatric wards provide multidisciplinary treatment modalities to subjects including doctors, nurses, physiotherapists, occupational therapists, speech and language therapists, and dieticians. The selection of subjects from the general ward to the subacute ward was made by dedicated geriatric doctors who deemed the patients to have strong potential for recovery based on the local setting criteria. Upon admission, subjects were assessed by all team members for an individualized plan. At least three hours of daily physiotherapy or occupational therapy was provided for all suitable subjects. The subjects' progress was reviewed and their plans were discussed during the multidisciplinary team meeting, which was held once per week until discharge.

Hematological test results

Hb levels and blood investigation results were collected on the day of admission. If there were no blood investigations on admission, laboratory results a week prior to or after admission to the subacute ward were traced from the pathology department.

Functional assessment

Subjects' functional status was assessed using a validated MBI by qualified occupational therapists on a weekly basis until discharge. The items could be divided into two groups, one related to self-care (feeding, grooming, bathing, dressing, toilet use, and bowel and bladder care) and the other related to mobility (ambulation, transfers, and stair climbing). With a maximum score of 100, dependency levels were upgraded by every 20 points: total dependency (0-19), very dependent (20-39), partial dependency (40-59), minimal dependency (60-79), and independence (80-100) [41]. We used a cut-off point of 60, as it depicted the transition of subjects from dependency to assisted independence, with a marked likelihood of living in the community [42].

Statistical analysis

Statistical analysis was carried out by means of the IBM SPSS Statistics Version 21. Normally distributed data were compared with the t-test, and abnormally distributed data were compared with Fisher's exact and Mann-Whitney U tests. Predictors for the outcome of the MBI were analyzed by multiple linear regression. A cut-off point of $P < 0.05$ was taken for statistical significance.

Results

The demographic characteristics of the 126 subjects are summarized in Table 1 below. The results show that 43.7% of subjects (n = 55) were anemic; they had a higher creatinine level, with a mean of 188.9 umol/L, and they had a lower albumin level of 30.2 g/dL, as compared with non-anemic subjects who had a mean creatinine of 92.7 umol/L and an albumin of 36.2 g/dL ($P < 0.001$; Table 2). The MBI for anemic subjects on admission was higher than for non-anemic subjects, but the difference was not significant (P = 0.059). Both groups were mainly in the partial dependency category (MBI was within 40-59) [41]. The MBI improvement for non-anemic subjects was significantly higher in non-anemic subjects (P = 0.021; Table 2).

Subgroup analysis for the subjects' hb cut-off value of 9 g/dL is shown in Table 3. Individuals with hb levels of less than 9g/dL have significantly higher creatinine and lower albumin levels. Charlson comorbidity index > 2 and clinical frailty scale > 5 were not significantly different, but their MBIs on admission were significantly higher. Upon discharge, hb levels greater than 9g/dL were significantly associated with MBI improvement of more than 20.

Simple linear regression found that the P-values were not significant for albumin, creatinine, the Charlson comorbidity index, or the clinical frailty scale. Otherwise, age, hb, and admission MBI were significantly associated with

Table 1. Demographics of the Study Subjects (n = 126).

	***n* (%)**
Age (years)	
60-69	44 (34.9)
70-79	42 (33.3)
80 and older	40 (31.8)
Sex	
Male	52 (41.3)
Female	74 (58.7)
Race	
Malay	61 (48.4)
Chinese	46 (36.5)
Indian	18 (14.3)
Other	1 (0.8)

Table 2. Variables Comparison for Anemic and Non-Anemic Subjects.

	Anemic (*n* = 55)	**Non-Anemic (*n* = 71)**	***P*-value**
Age, Median (IQR)	77 (65, 85)	75 (66, 80)	0.243*
Gender, *n* (%)			
Male	17 (13.5)	35 (27.8)	0.036**
Female	38 (30.2)	36 (28.5)	
Race, *n* (%)			
Malay	25 (19.8)	36 (28.6)	0.770**
Chinese	21 (16.7)	25 (19.8)	
Indian	8 (6.3)	10 (7.9)	
Other	1 (0.9)	0	
Biochemistry results, Mean (SD)			
WBC	9.7 (3.7)	10.9 (4.5)	0.113***
MCV	85.5 (12.0)	86.4 (8.8)	0.662***
MCH	29.8 (9.5)	29.9 (6.4)	0.946***
Platelet	277.6 (161.6)	243.1 (72.5)	0.112***
Creatinine	188.9 (171.5)	92.7 (49.6)	< 0.001***
Albumin	30.2 (7.9)	36.2 (6.1)	< 0.001***
Charlson Comorbidity Index > 2 (moderate-severe)	52 (42.6)	70 (53.4)	0.317*
Clinical Frailty Scale > 5 (moderate-severe)	18 (75.0)	6 (25.0)	< 0.001**
Length of Stay (days), Median (IQR)	9 (6, 14)	11 (7, 15)	0.166***
MBI Score, Median (IQR)			
On admission	47 (29, 63)	36 (21, 59)	0.059***
On discharge	64 (39, 79)	60 (37, 78)	0.599***
Score Improvement	8 (1, 18)	14 (5, 26)	0.021***
Number of subjects with the following MBI Scores, *n* (%)			
Initial Score ≥ 60	17 (50.0)	17 (50.0)	0.422**
Discharge score ≥ 60	26 (41.9)	36 (58.1)	0.702**
Score improvement ≥ 20	9 (25.0)	27 (75.0)	0.008**

* Fisher's Exact Test, ** Mann-Whitney *U* Test, *** Pearson's Chi Square.

rehabilitation outcome. Therefore, it was appropriate to draw a conclusion that albumin, creatinine, the Charlson comorbidity index and the clinical frailty scale were not significantly associated with rehabilitation outcomes.

Discussion

The prevalence of anemia in our study subjects was high (43.7%) and comparable to a large population observational study [9] that reported that the prevalence of anemia was 46.8% in hospitalized older subjects. The hospitalized elderly population had a higher prevalence of anemia than the community-living elderly population (35.5%) in Malaysia [2] because anemia was associated with higher comorbidity and poorer health status [3]. As shown in this study, anemic subjects had significantly lower albumin levels, higher creatinine levels, and a higher clinical frailty scale (> 5; Table 2). The majority of anemic subjects had normocytic normochromic anemia. A previous study suggested that anemia in elderly adults was more likely due to chronic illness than nutritional deficiencies [43]. As this was a cross-sectional survey, causative relationships and etiology of anemia could not be established.

The MBIs on admission were found to be higher in anemic subjects than in non-anemic subjects, but it was insignificant. However, it was significant in individuals with hemoglobin < 9 g/dL. This finding was in contrast with anemia, which was associated with a higher number of impaired ADLs upon hospital admission to the general ward [9]. The possible explanation was geriatrician selection bias; individuals with a presumed better potential for recovery were more likely to be admitted to subacute geriatric wards for active rehabilitation. Individuals with more comorbidities, poorer health status, and a baseline clinical frailty scale would not be subjected to subacute ward rehabilitation. Nonetheless, both groups were mainly in the partial dependency category (MBI was within 40-59) [41]. After treatment with active rehabilitation, there was a significant MBI improvement for all subjects of median 10 (IQR 3, 23; $P < 0.001$). The number of subjects who were dependent (MBI < 60) at admission was also re-

Table 3. Variables Comparison for Hb < 9g/dL and Hb ≥ 9g/dL Subjects.

	Hemoglobin < 9g/dl, (*n* = 15)	**Hemoglobin ≥ 9g/dl, (*n* = 111)**	***P*-value**
Age, Median (IQR)	77 (65, 84)	75 (66, 83)	0.114*
Gender, *n* (%)			
Male	3 (2.4)	49 (38.9)	0.075**
Female	12 (9.5)	62 (49.2)	
Race, *n* (%)			
Malay	8 (6.3)	54 (42.9)	0.879*
Chinese	6 (4.8)	39 (31.0)	
Indian	1 (0.8)	17 (13.5)	
Other	0 (0)	1 (0.8)	
Biochemistry results, Mean (SD)			
WBC	9.93 (3.72)	10.46 (4.27)	0.982***
MCV	86.02 (9.14)	86.01 (10.43)	0.307***
MCH	28.07 (3.69)	30.19 (8.24)	0.163***
Platelet	260.00 (162.20)	257.95 (114.72)	0.590***
Creatinine	274.93 (178.98)	115.95 (107.19)	< 0.001***
Albumin	26.00 (9.10)	34.47 (6.78)	0.002***
Charlson Comorbidity Index > 2 (moderate-severe)	16 (13.1)	106 (86.9)	1.000*
Clinical Frailty Scale > 5 (moderate-severe)	9 (9.4)	87 (90.6)	0.076*
MBI Score, Median (IQR)			
On admission	55 (39, 77)	39 (25, 59)	0.020***
On discharge	71 (50, 84)	62 (37, 78)	0.174***
Number of subjects with the following MBI Scores, *n* (%)			
Initial Score ≥ 60	7 (23.5)	27 (76.5)	0.116**
Discharge score ≥ 60	9 (14.5)	56 (85.5)	0.587**
Score improvement ≥ 20	0 (0)	36 (100)	0.009*

* Fisher's Exact Test, ** Pearson's Chi-Square, *** Mann-Whitney *U* Test.

duced from75.4% to 49.83% upon discharge ($P < 0.001$; not included in table). The mean length of stay was 11 days (± 5.7). These findings supported the role of short rehabilitation in the subacute geriatric ward, with a multidisciplinary team approach being the key element for successful rehabilitation. The time and effort invested was important to promoting recovery and independence in elderly subjects with multiple comorbidities to reduce institutionalization of these subjects and to reduce caregiver burden.

Non-anemic subjects had significantly higher MBI recovery than anemic subjects, as shown in Table 2 ($P = 0.021$). This finding was comparable with a large observational study that showed that anemic subjects had a lower rate of recovery than non-anemic subjects, and anemia was associated with a substantially lower likelihood of regaining independence after hospital discharge [9]. Subgroup analysis showed that a small number of subjects with an hb ≥ 9 g/dL had a significantly higher MBI improvement ≥ 20 ($P = 0.009$), as shown in Table 3, and the finding was not confounded by albumin, creatinine, the Charlson comorbidity index, or the clinical frailty scale.

This finding suggested that the hb threshold of 9-10 might be adequate for elderly subjects, as suggested by another report [40]. Moderately anemic (hb 7.0-9.9 g/dL) subjects have few symptoms or no symptoms at all. This is because of body homeostasis mechanisms that preserve tissue perfusion to vital organs. These homeostasis mechanisms include increased blood circulation due to reduced blood viscosity, increased oxygen supply to tissues due to raised red cell 2,3-bisphosphoglycerate (2,3-BPG), increased plasma volume, and redistribution of blood flow [43]. In general, anemic subjects begin to experience symptoms of tiredness, shortness of breath, and palpitations only when the hb level is less than 7 g/dL (about two-thirds of normal) as the basal cardiac output increases [44-46]. However, the elderly population, especially those with cardiovascular disease, may have impaired compensatory mechanisms. Elderly subjects with moderate anemia (hb 7.0-9.9 g/dL) have lost the compensatory mechanism of tachycardia and increased cardiac output, resulting in being more passive and demotivated for active rehabilitation. However, liberal strategy to target hb higher than 11.3 g/dL did not improve post operation recovery of elderly patients with hip fracture frailty, as demonstrated in a randomize control trial [44].

In this study, the non-anemic group (or hb ≥ 9g/dL) did not have a significant difference in achieving an MBI ≥ 60, which they did not have a marked likelihood of living in the community [42]. This might imply that the improvement of MBI > 20 might ease the caregiver's burden and increase the patients' quality of life more than the subject's likelihood of living in the community.

Conclusions

A geriatric rehabilitation ward plays a significant role in facilitating the recovery of subjects to return to independent living in the community. In this study, non-anemic subjects showed significant MBI improvement. Our study also suggested that judicious practices to target an hb threshold of 9 g/dL might be able to improve a subject's functional outcome. These results should encourage further research with a larger elderly population to provide insights and awareness for the need to diagnose and treat anemia in rehabilitation subjects.

Declarations

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Availability of data and materials: The data that support the findings of this study are available from the corresponding author (Chin ML) upon reasonable request.

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