

Association of Anemia with Rehabilitation Outcome for Subacute Geriatric Rehabilitation Patients in a Secondary Hospital in Malaysia

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Abstract

Objective: To evaluate the effect of Anemia on Rehabilitation Outcome for Geriatric Subjects in Taiping Hospital Subacute Geriatric Rehabilitation Ward.

Methodology: This was a retrospective study, with 126 subjects to compare the change in modified Barthel Index score of anemic and non anemic subjects.

Results: 44% of subjects were anemic and the Mean corpuscular hemoglobin and Mean corpuscular volume for anemic subjects were 85.4pg and 29.8fL. Among anemic subjects 45.5% were Malay, 38.2% were Chinese, 14.5% were Indian and 1% were others. The Median(IQR) Modified Barthel Index (MBI) on admission for anemic subjects and non anemic subjects were insignificantly difference which were 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 anemic subjects which were 14 (5, 26) and 8 (1, 18) ($p=0.021$). Subject with hemoglobin (hb) ≥ 9 g/dL were significantly associated with MBI improvement of more than 20, $p=0.014$. Multiple linear regression revealed a significant linear relationship between age and MBI score improvement ($p=0.010$). Subjects 10 years younger showed a 3.55 score improvement in MBI.

Conclusion: The study suggested that non-anemic subjects showed significant MBI improvement. Our study also suggested judicious transfusion practices to maintain a hemoglobin threshold of 9 g/dL might be able to improve subject's functional outcome. These results should encourage further research with a larger elderly subject population to provide insights and awareness for the need to correct anemia in rehabilitation subjects.

Introduction

Anemia is a common disease in the elderly population worldwide. According to WHO, definition of anemia is hemoglobin (hb) lower than 13 g/dL in men, Hb less than 12 g/dL in non-pregnant women, and less than 11g/dL in pregnant women [1]. In Malaysia, the prevalence of anemia among community dwelling older people age more than 60 was 35.3% [2]. Geriatric inpatient has higher anemia prevalence than community 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 are usually presented with nonspecific symptoms such as tiredness and weakness, which are frequently assumed to be part of the ageing process. Awareness of the effects of anemia is rising as anemia in elderly have been shown to have poorer outcome in geriatric patients including increased risk of physical, cognitive impairment, functional, hospitalisation and mortality [3, 5]. Hemoglobin level is associated with improvement of activity of daily living (ADL) for hospitalized patients [6–8]. Studies have shown that treating anemia in specific patient groups decreases their length of stay or improves their function [9–12]. A cohort study of postoperative

hip fracture geriatric patients with higher hemoglobin level were independently associated with greater walking distance and functional recovery [13].

The hemoglobin threshold to trigger treatment for anemia has been debatable for elderly. Attempts were made to determine the optimal hemoglobin levels to guide management of anemia includes blood transfusion therapy. This strategy has been confounded by baseline function, hemoglobin level and additional co-morbidities including cardiovascular disease and risk of treatment. To the best of the authors' knowledge, there is scanty evidence available to suggest hemoglobin 'trigger' for rehabilitation and recovery purpose. The published guidelines [14–32] acknowledged patients' co-variables (including age) or others patient – specific criteria to be taken into consideration when making decision for blood transfusion therapy. Consensus was reached that transfusion may be of benefit when the hemoglobin is below 6 to 7g/dL. However, for those with hemoglobin above 10g/dL, transfusion is not beneficial mainly for mortality benefit. One of the strategies proposed for prudent transfusion strategy for elderly is to keep hemoglobin thresholds of 9–10 g/dL [33]. The aim of this study is to examine the effect of anaemia and hemoglobin threshold of 9g/dL on rehabilitation outcome of patients in subacute geriatric rehabilitation ward.

Methods

Study Population

Medical records of all subjects admitted to the subacute geriatric ward, Hospital Taiping from January 2018 until April 2019 were reviewed. Sample size was estimated using Open EPI software. Assumption was made that non anemic subjects might have a 20% improvement in MBI relative to subjects with anemic subjects. 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 percent. 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/missing their initial/final MBI (n = 26), those who were younger than 60 years (n = 10), or those who did not have hemoglobin on admission, or 1 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 ward provides multidisciplinary treatment modalities to subjects including doctors, nurses, physiotherapists, occupational therapists, speech and language therapists, and dieticians. Selection of subjects from general ward to subacute ward were made by dedicated geriatric doctors who deemed subjects have good potential for recovery based on the local setting criteria. Upon admission, subjects were assessed by all team members for individualized plan. Daily physiotherapy or occupational therapy of at least 3 hours were provided for all suitable subjects. Subject's progress was reviewed and plan was discussed during the multidisciplinary team meeting which was held once per week until discharge.

Hematological Test Results

Hemoglobin levels and blood investigations results were collected on the admission day. 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. Anemia was defined according to the WHO criteria as hemoglobin concentration below than 12g/dL for women or below than 13g/dL for men [1].

Functional Assessment

Subjects' functional status was assessed using a validated MBI by qualified occupational therapists on weekly basis until discharge. The items can be divided into two groups, one related to self-care (feeding, grooming, bathing, dressing, bowel and bladder care, and toilet use) and the other related to mobility (ambulation, transfers, and stair climbing). With a maximal score of 100, dependency levels are upgraded by every 20 score which include total dependency (0–19), very dependent (20–39), partial dependency (40–59), minimal dependency (60–79), and independency (80–100) [34]. We used cut-off point of 60 as it depicts the transition of subjects from dependency to assisted independency, with marked livelihood of living in the community [35].

Statistical Analysis

Statistical analysis was carried out by means of the IBM SPSS Statistics Version 21. Normally distributed data were compared with T Test and not normally distributed were compared with Fischer's Exact and Mann-Whitney U Tests. Predictors for the outcome of the modified Barthel Index were analyzed by multiple linear regression. A cut-off points of $p < 0.05$ was taken for statistical significance.

Results

The demographic characteristics of the 126 subjects were summarised in Table 1 below. 44% ($n = 55$) of subjects were anemic and they have higher creatinine level with a mean of 188 $\mu\text{mol/L}$ and lower albumin level of 30.2g/dL as compared with non anemic subjects who had mean creatinine of 92.7 $\mu\text{mol/L}$ and albumin of 36.2g/dL ($p < 0.001$).

Table 1
Demographics of the study
subjects (n = 126)

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

The MBI for anemic subjects on admission was higher than non anemic subjects, but the difference was not significant ($p = 0.059$). Both groups were mainly in the partially dependency category (MBI was within 40–59) [34]. The MBI improvement for non-anemic subjects was significantly higher in non-anemic subjects ($p = 0.021$). (Table 2)

Table 2

Variables comparison for anemic and non anemic subjects (*Fisher's Exact Test, **Mann-Whitney U Test, ***Pearson's chi square)

	Anemic, n (%)	Non-anemic, n (%)	p-value
Gender	17(30.9)	35(49.3)	0.036*
Male	38(69.1)	36(50.7)	
Female			
Race	25(45.5)	36(50.7)	0.770*
Malay	21(38.2)	25(35.2)	
Chinese	8(14.5)	10(14.1)	
Indian	1(1.8)	0	
Other			
Biochemistry results	9.7(3.7)	10.9(4.5)	0.113
Mean(SD)	10.0(1.6)	14.0(1.2)	-
WCC	85.5(12.0)	86.4(8.8)	0.662
Hb	29.8(9.5)	29.9(6.4)	0.946
MCV	277.6(161.6)	243.1(72.5)	0.112
MCH	188.9(171.5)	92.7(49.6)	< 0.001
Platelet	30.2(7.9)	36.2(6.1)	< 0.001
Creatinine			
Albumin			
Charlson Comorbidity Index	5 (4, 7)	5 (4, 6)	0.031**
Clinical Frailty Scale	3 (3, 6)	3 (3, 3)	< 0.001**
Length of Stay (days)	Median (IQR)	Median (IQR)	0.166**
	9 (6, 14)	11 (7, 15)	
MBI Score	Median (IQR)	Median (IQR)	0.059**
On admission	47 (29, 63)	36 (21, 59)	0.599**
On discharge	64 (39, 79)	60 (37, 78)	0.021**
Score Improvement	8 (1, 18)	14 (5, 26)	
Subjects with MBI score improvement \geq 20 (n(%))	9 (16.4)	27 (38.0)	0.008***

	Anemic, n (%)	Non-anemic, n (%)	p-value
Subjects with MBI score \geq 60 at discharge (n(%))	26 (47.3)	36(50.7)	0.702***

Comparisons of MBI on admission, length of stay, clinical frailty scale and Charlson comorbidity index for subjects hemoglobin cut off value 9 g/dL as shown in Table 3. Hemoglobin above 9g/dL was significantly associated with MBI improvement of more than 20 (Table 4). The length of stay for both groups was not significantly different. Using simple logistic regression analysis, it was determined that age ($p = 0.205$), MBI at presentation ($p = 0.006$), and Hb level ($p = 0.004$) significantly affect MBI improvement of more than 20 units whereas Charlson comorbidity Index and clinical frailty scale do not. Multiple logistic regression revealed a significant relationship between age and MBI score improvement ($p = 0.010$), where subjects 10 years younger showed a 3.55 score improvement in MBI.

Table 3

MBI on admission, length of stay, clinical frailty scale and Charlson comorbidity index for subjects hemoglobin cut off value 9 g/dL. (* Mann-Whitney U Test, ** Pearson's chi square)

	Hemoglobin < 9g/dl, (n = 15) Median (IQR)	Hemoglobin \geq 9g/dl, (n = 111) Median (IQR)	p-value
MBI admission	55 (39, 77)	39 (25, 59)	0.020*
Charlson Comorbidity Index	5 (4, 6)	5 (4, 7)	0.969*
Clinical Frailty Scale	3 (3, 7)	3 (3, 4)	0.107*
Length of stay (days)	8 (5, 14)	10 (8, 15)	0.097*
MBI discharge \geq 60 (n(%))	7 (46.6)	55 (49.5)	0.834**

Table 4

MBI improvement \geq 20 and MBI improvement < 20 for subjects hemoglobin cut off value 9 g/dL. (*Pearson's chi square, $p = 0.014$)

	Hemoglobin < 9g/dl, n (%)	Hemoglobin \geq 9g/dl, n (%)	p-value
MBI improve \geq 20	0	33 (29.7)	0.014*
MBI improve < 20	15 (100%)	78 (70.3)	

Discussion

The prevalence of anemia in our study subjects was high (44%) and comparable to a large observational study [36] reported that the prevalence of anemia was 46.8% in hospitalised older subjects. Hospitalised

elderly population had a higher prevalence of anemia than community living elderly population of 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 lower albumin, higher creatinine level, higher Charlson comorbidity index and higher clinical frailty scale significantly (Table 2). The majority of anemic subjects had normocytic normochromic anemia. Previous study suggested that anemia in elderly adults were more likely due to chronic illness than nutritional deficiencies [37]. As this was a cross-sectional survey, causative relationships and aetiology of anemia could not be established.

The MBI on admission was found to be higher in anemic subjects than the non anemic subjects but it was insignificant. This finding was in contrast with anemia were associated with a higher number of impaired ADLs upon hospital admission in general ward [36]. However, Charlson comorbidity index and clinical frailty scale were higher for the anemic subjects (Table 2). The possible explanation was clinician selection bias of subjects with presumed better recovery potential were more likely to be admitted to subacute geriatric ward for active rehabilitation. Nonetheless, both groups were mainly in partially dependency category (MBI was within 40–59) [34].

There was a significant MBI improvement for all subjects of median 10 (IQR 3, 23) ($p < 0.001$) after treated with active rehabilitation. Number of subjects who were dependent (MBI < 60) at admission was also reduced from 75.4–49.83% 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 multidisciplinary team approach being the key element for a successful rehabilitation. The time and effort invested was important to promote recovery and independence in elderly subjects with multiple comorbidity in order 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 ($p = 0.021$). The finding was comparable with a large observational study that anemic subjects have a lower rate of recovery than non anemic subjects, and anemia was associated with a substantially lower likelihood of regaining independence at hospital discharge [36]. Subgroup analysis showed a small number of subjects of Hemoglobin $> 9\text{g/dL}$ had significantly higher MBI improvement ≥ 20 ($P = 0.014$) as shown in Table 4 and the finding was not confounded by Charlson comorbidity index and clinical frailty scale.

This finding suggested that the Hemoglobin threshold of 9–10 might be adequate for elderly subjects as suggested by other report [33]. Moderate anemic (Hb 7.0-9.9 g/dl) subjects have few symptoms or no symptom at all, it is because of body homeostasis mechanisms that preserve tissue perfusion to vital organ. These homeostasis mechanisms include increased blood circulation due to reduced blood viscosity, increased oxygen supply to tissues due to raised red cell bisphosphoglycerate (2,3 BPG), increased plasma volume, and redistribution of blood flow [37]. In general, anemic subjects begin to experience symptoms of tiredness, shortness of breath and palpitation, only when the hemoglobin level is less than 7g/dL (about two-thirds of normal) as the basal cardiac output increases [38–40]. However, the

elderly population especially those with cardiovascular disease may have impaired compensatory mechanisms. Elderly subjects with moderate anemia have lost the compensatory mechanism of tachycardia and increased cardiac output and resulted to be more passive and demotivated for active rehabilitation. However, higher hemoglobin target by liberal transfusion strategy to Hb at 11.3g/dl did not improve recovery of post operation of hip fracture frail elderly as demonstrated in a RCT [38].

In this study, the non anemic or Hb > 9g/dL did not have significant difference to achieve MBI \geq 60, with marked livelihood of living in the community [35]. This might imply that the improvement of MBI > 20 might ease the caregiver burden and patient quality of life than subject's livelihood of living in the community.

Limitation of the Study

This was a retrospective study involving a small sample of subjects admitted in a subacute rehabilitation ward for geriatric patients, and was only a snapshot of the patients in a secondary referral hospital. There was also a risk of selection bias of subjects by clinician to admit subjects from acute treatment wards. There was no assessment of caregiver stress and patient quality of life.

Conclusion

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

Declarations

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

Ethics approval and consent to participate

Ethics approval was obtained from Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (Ref: NMRR-19-1965-47705(IIR)). All the experiment protocols were in accordance to the Malaysian Good Clinical Practice Guidelines. "Consent waiver" was obtained from MREC. MREC did not require consent from individual subjects for retrospective study involving collecting data from medical records, provided data analysis was conducted as a group, and no single subject can be identified from the data.

Consent for publication

Not applicable.

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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Authors' contributions

Conceptualization: Chin ML, Cheah WK. Methodology: Chin ML, Chan CWS, Chong HE. Formal analysis: Chin ML, Chan CWS. Project administration: Chin ML. Writing original draft: Chin ML. Writing review and editing: Chin ML, Chan CWS, Chong HE. Approval of final manuscript: all authors.

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