Hematological profile in geriatric patients with special emphasis on morphological and etiological classification of anemia in patients presenting at a tertiary care hospital

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Abstract

Background& Objective: Anemia is prevalent among geriatric populations and can have significant implications for health outcomes. Understanding the hematological profile of geriatric patients, particularly the morphological and etiological classification of anemia, is crucial for effective management and intervention.This study aimed to investigate the demographic characteristics, etiology, and correlation of red blood cell indices with anemia in geriatric patients presenting at a tertiary care hospital. **Methods:** A prospective analysis was conducted on data from geriatric patients with anemia, focusing on age, gender distribution and etiology. Hemoglobin levels and hematological indices were correlated with underlying causes of anemia. **Results:** The majority of participants (83.6%) fell within the 65-75 age range, with a slightly higher representation of females (56.2%). Iron deficiency (35.2%) was the most common cause of anemia, followed by anemia of unknown etiology (34.2%), anemia of chronic diseases (19.6%), megaloblastic anemia (8.5%), and dimorphic anemia (2.5%). Correlation analysis revealed distinct patterns in red blood cell indices across different etiological subtypes, with significant differences in hemoglobin levels, mean corpuscular volume, mean corpuscular hemoglobin, mean corpuscular hemoglobin concentration, and red cell distribution width. **Conclusion:** The study provides valuable insights into the hematological profile of geriatric patients with anemia, highlighting the prevalence, causes, and correlations associated with this condition. These findings underscore the importance of comprehensive assessment and tailored management strategies for older adults with anemia. Prospective, multicenter studies are needed to validate these findings and improve outcomes for geriatric patients with anemia.

Keywords: Geriatric patients, Anemia, Hematological profile, Red blood cell indices.

Introduction

Anemia is defined as a state of decreased oxygen carrying capacity of the blood where in the hemoglobin is less than 13 gm/dL in men and less than 12 gm/dL in non-pregnant women by WHO reference standards[1]. The demographic transition with ageing of population is a global phenomenon and in recent years there has been an increasing international awareness of health issues relating to ageing population[2, 3]. According to a 2004 report of the United States National Health And Nutritional Examination Survey (NHANES) III, 10 % of Americans who are 65 years and older are anemic, rising to a 25 % of men and 20 % of women who are 85 years and older[4].

The prevalence of anemia among elderly Indians, as reported in Indian cross sectional studies is between 6 and 30 % among men and between 10 and 20 % among women[5]. Among those older than 65 years, anemia has been associated with poor exercise performance, diminished cognitive function, risk of developing dementia, decreased mobility, increased risk of recurrent falls, low bone density, low skeletal muscle density and increased rate of major depression[2]. Symptoms may sometime be due to ageing process itself and even mild anemia in elderly patient leads to increased morbidity and mortality.

Anemia is diagnosed based on various hematological parameters, including hemoglobin levels, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC), as well as peripheral blood smear examination. In geriatric patients, the normal values for these parameters may vary slightly from younger adults due to age-related changes in hematopoiesis and other physiological factors.

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The normal values for hemoglobin levels in geriatric patients are typically lower compared to younger adults, ranging from 12.0 to 15.5 grams per deciliter (g/dL) for women and 13.5 to 17.5 g/dL for men[1]. Mean corpuscular volume (MCV), which reflects the average size of red blood cells, is normally between 80 and 100 femtoliters (fL). Mean corpuscular hemoglobin (MCH), which measures the amount of hemoglobin per red blood cell, should fall within the range of 27 to 31 picograms (pg). Mean corpuscular hemoglobin concentration (MCHC), representing the concentration of hemoglobin in red blood cells, typically ranges from 32 to 36 grams per deciliter (g/dL)[6].

Peripheral blood smear examination is another important diagnostic tool used to assess the morphology of red blood cells. In a normal peripheral blood smear, red blood cells appear uniform in size and shape, with a central pallor representing the area of central hemoglobinization. Deviations from these normal morphological characteristics may indicate underlying pathology and aid in the classification of anemia[7].

Microcytic anemia is characterized by small red blood cells (low MCV) and reduced hemoglobin content (low MCHC), typically associated with iron deficiency, thalassemia, or chronic disease. In microcytic anemia, the MCV is often less than 80 fL, and the MCHC is decreased[8]. Normocytic anemia, on the other hand, is characterized by normal-sized red blood cells (normal MCV) but decreased hemoglobin levels[9]. Macrocytic anemia is characterized by enlarged red blood cells (high MCV), typically greater than 100 fL, and may indicate deficiencies in vitamin B12 or folate, alcoholism, or myelodysplastic syndromes[10].

Etiological classification of anemia involves identifying the underlying cause or contributing factors responsible for the development of the condition. Common etiologies of anemia in geriatric patients include iron deficiency, vitamin B12 deficiency, folate deficiency, chronic kidney disease, inflammatory conditions, and malignancies[11]. Most of the time despite a complete evaluation

a significant number of cases have no etiology identified[12,13]. Accurate etiological classification is essential for implementing targeted treatment strategies aimed at addressing the underlying cause of anemia and improving patient outcomes[14].

The present study aims to investigate the hematological profile of geriatric patients presenting at a tertiary care hospital, with a special emphasis on the morphological and etiological classification of anemia. By analyzing a cohort of geriatric patients and performing comprehensive hematological evaluations, including red blood cell indices, peripheral blood smear examination, and additional investigations such as serum ferritin levels, vitamin B12, and folate levels, the study seeks to elucidate the diverse spectrum of anemia in this population.

The findings of this study have the potential to inform clinical practice and guide evidence-based management strategies for anemia in geriatric patients. Early detection, accurate diagnosis, and targeted treatment of anemia are essential for improving quality of life, reducing morbidity and mortality, and optimizing healthcare resource utilization in older adults. By advancing our understanding of the hematological profile of geriatric patients, this research contributes to the ongoing efforts to address the growing burden of anemia in an aging population.

Study methodology

Study Design: The study utilized a hospital-based observational design, specifically a cross-sectional study. This design was chosen to provide a snapshot of the hematological profile of geriatric patients presenting at a tertiary care hospital over a defined period. A cross-sectional approach allowed for the simultaneous assessment of multiple variables, including hematological parameters and etiological factors, to characterize the prevalence and patterns of anemia in this population.

Study Setting: Conducted at the Central Hematology Pathology Laboratory, Department of Pathology, S.S.G. Hospital and Medical College, Baroda, the study benefitted from access to advanced laboratory facilities and experienced healthcare professionals. This setting provided an ideal environment for conducting comprehensive hematological investigations and facilitating collaboration between clinicians and pathologists.

Study Participants with Inclusion and Exclusion Criteria

Inclusion Criteria: The study included patients aged 65 years and above, reflecting the geriatric population vulnerable to age-related hematological changes and anemia. Additionally, men with hemoglobin levels less than 13 mg/dL and women with hemoglobin levels less than 12 mg/dL were eligible for inclusion, aligning with established diagnostic criteria for anemia.

Exclusion Criteria: Patients below the age of 65 years were excluded from the study to focus specifically on the geriatric population. This criterion ensured a homogeneous study population and minimized confounding factors related to age-related hematological differences.

Study Sampling: Sampling involved a retrospective review of data from the past two years to identify cases with hemoglobin levels lower than standard WHO values. This approach ensured the inclusion of a diverse range of patients presenting with anemia-related symptoms and facilitated the comprehensive assessment of hematological profiles in the study population.

Study Sample Size: Based on the review of past data and considering a data collection period of seven months, the estimated sample size ranged between 250 and 300 participants. This sample size was deemed sufficient to achieve the study objectives and provide statistically meaningful results while accounting for potential variations in patient demographics and hematological parameters.

Study Outcome Paragraph: The primary outcome of the study was to characterize the hematological profile of geriatric patients, focusing on the morphological and etiological classification of anemia. This encompassed the assessment of various hematological parameters, including hemoglobin levels, RBC indices, and peripheral blood smear findings, to identify the prevalence and patterns of anemia in the study population. Secondary outcomes included evaluating iron status, total iron-binding capacity, and other relevant hematological parameters to elucidate underlying etiologies contributing to anemia in geriatric patients.

Study Procedure: The study procedure involved a systematic approach to data collection, hematological investigations, and laboratory assays. Samples showing low hemoglobin levels were selected from the Central Hematology Pathology Laboratory, and medical history was obtained for each participant. Comprehensive hematological investigations were conducted, including complete blood counts, peripheral blood smear examination, reticulocyte counting, and assessment of iron status and total iron-binding capacity using validated laboratory assays.

Data Collection: Data collection encompassed recording demographic information, medical history, and hematological parameters for each participant. This involved meticulous documentation of laboratory findings, including hemoglobin levels, RBC indices, WBC count, differential count, platelet count, and hematocrit, as well as relevant iron markers such as ferritin levels and total iron-binding capacity.

Data Analysis: Statistical analysis of the collected data involved descriptive and inferential techniques to characterize the hematological profile of geriatric patients and identify factors associated with anemia. Descriptive statistics were used to summarize demographic characteristics and hematological parameters, while inferential statistics, including correlation analysis and regression modeling, were employed to assess associations between variables and predict outcomes related to anemia prevalence and etiology.

Result and analysis

Demographic Characteristics of Study Participants

The demographic characteristics of the study participants reveal important insights into the composition of the geriatric population under investigation. The majority of patients, constituting 83.6%, fell within the age range of 65 to 75 years, with smaller proportions in the 76-85 years (15.3%) and 86-95 years (1.1%) age groups. Regarding gender distribution, there was a slightly higher representation of females, accounting for 56.2% of the total participants, compared to males at 43.8%. Further analysis within age groups showed a balanced distribution of sexes, with a slightly higher proportion of females across all age brackets. These findings suggest that the study sample predominantly comprises elderly individuals in the lower end of the geriatric spectrum, with a relatively equal representation of males and females across age groups, highlighting the importance of considering both age and gender factors in the assessment of hematological profiles in geriatric patients. Mean age was 70.99 and standard deviation was 5.85.

Table 1: Demographic Characteristics of Study Participants

Demographic Characteristic	Age Group (years)	No. of Patients	Percentage	Sex	No. of Patients	Percentage
	65-75	235	83.6	Male	123	43.8
	76-85	43	15.3	Female	158	56.2
	86-95	3	1.1			
Total		**281**	**100**		**281**	**100**

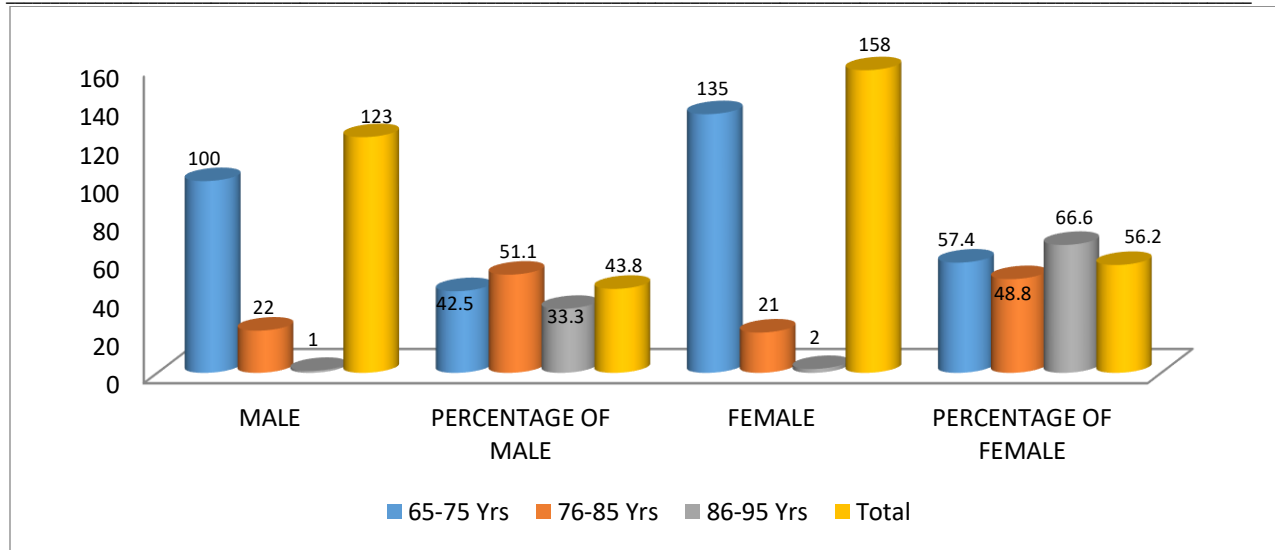**Figure 1: Demographic Characteristics of Study Participants**

Table 2: Etiology of Anemia

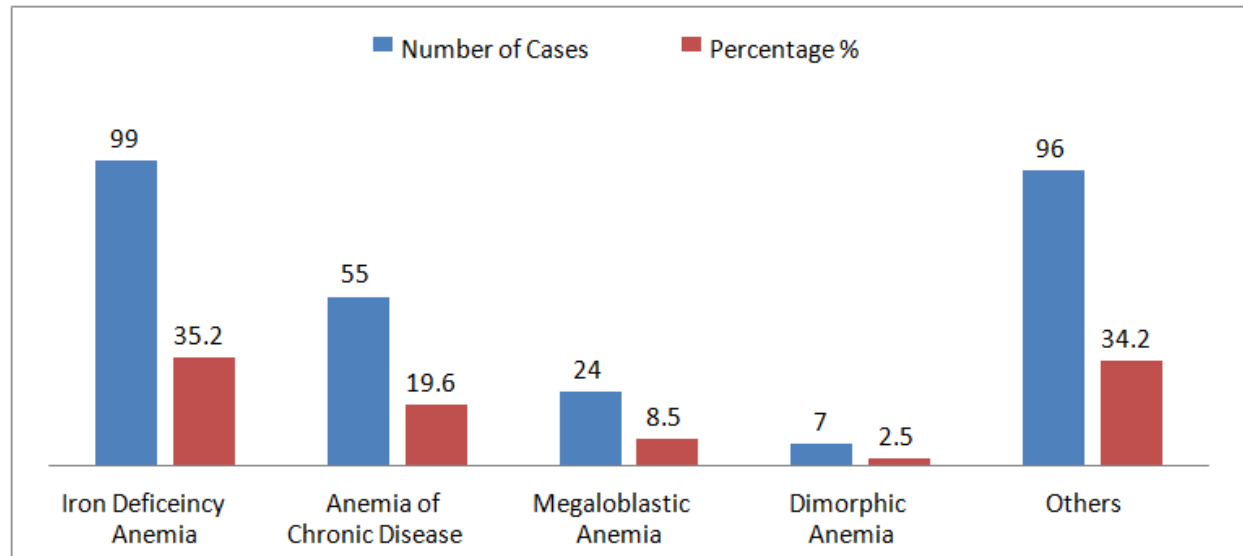| DIAGNOSIS	No. of Cases	Percentage
Iron Deficiency Anemia	99	35.2
Anemia of Chronic Disease	55	19.6
Megaloblastic Anemia	24	8.5
Dimorphic Anemia	7	2.5
Others	96	34.2
Total	**281**	**100**

Figure 2: Etiology of Anemia

Correlation of red blood cell indices withetiology of anemia
The average levels of Hemoglobin among the IDA (Iron Deficiency Anemia), ACD(Anemia of Chronic Disease), Megaloblastic Anemia, Dimorphic Anemia, AUE (Anemia of Unknown Etiology) was 6.7 gm/dl, 9.12 gm/dl, 7.1 gm/dl, 7.52 gm/dl and 9.24 gm/dl respectively. The average of MCV, MCH, MCHC and RDW in IDA was found to be 73.46 fL, 43.94 pg/cell, 31.65 gm/dl and 18.45 %. The average of MCV, MCH, MCHC and RDW in ACD was found to be 81.95 fL, 27.07 pg/cell, 32.41 gm/dl and 17.24 %. The average of MCV, MCH, MCHC and RDW in Megaloblastic Anemia was found to be 92.88.46 fL, 28.94 pg/cell, 32.34 gm/dl and 17.14 %. The average of MCV, MCH, MCHC and RDW in Dimorphic Anemia was found to be 74.37 fL, 25.87 pg/cell, 31.42 gm/dl and 19.64 %. The average of MCV, MCH, MCHC and RDW in AUE was found to be 82.46 fL, 26.76 pg/cell, 32.33 gm/dl and 17.02 %.

Table 3: Correlation of Red Blood Cell Indices with Etiology of Anemia

Type of Anemia	Average Hemoglobin (gm/dl)	Average MCV (fL)	Average MCH (pg/cell)	Average MCHC (gm/dl)	Average RDW (%)

IDA	6.7	73.46	43.94	31.65	18.45
ACD	9.12	81.95	27.07	32.41	17.24
Megaloblastic Anemia	7.1	92.88	28.94	32.34	17.14
DimorphicAnemia	7.52	74.37	25.87	31.42	19.64
AUE	9.24	82.46	26.76	32.33	17.02

Discussion

The findings of this study provide valuable insights into the hematological profile of geriatric patients, particularly in relation to the morphological and etiological classification of anemia. Understanding the demographic characteristics of the study participants is essential for contextualizing the prevalence and distribution of anemia within this population. Furthermore, the correlation analysis sheds light on the relationship between red blood cell indices and the underlying causes of anemia, offering important implications for clinical practice and research.

The demographic characteristics of the study participants reveal important trends in the composition of the geriatric population under investigation. The majority of patients fell within the age range of 65 to 75 years, with smaller proportions in the older age groups. This distribution is consistent with the expected age distribution of geriatric patients, as the risk of anemia tends to increase with age due to factors such as nutritional deficiencies, chronic diseases and medication use. Interestingly, there was a slightly higher representation of females compared to males in the study sample. While the reasons for this disparity are not explored in this study, it is well-established that females have a higher prevalence of anemia, particularly due to factors such as menstrual blood loss and pregnancy.

Table 4: Comparison of Mean age in the Present Study with otherStudies

	PRESENT STUDY	AMIT BHASIN ET AL 2010[15]	MOH. JASEEM HASSAN ET AL 2020[16]	SAURABH RSRIVASTAVAET AL2013[17]	TETTAMANTIM ET AL2010[18]	CHULWONCHOI ETAL 2003[19]
AGE	70.99	70.51	64.2	73.06	75.8	71.5

The etiological classification of anemia provides important insights into the underlying causes of this condition among geriatric patients. Iron deficiency emerged as the most common cause of anemia, accounting for a significant proportion of cases. This finding is consistent with existing literature highlighting iron deficiency as a major contributor to anemia, especially in older adults who may have inadequate dietary intake, malabsorption issues, or chronic blood loss. Anemia of chronic diseases was also prevalent in the study population, reflecting the impact of underlying medical conditions such as chronic kidney disease, inflammatory disorders, and malignancies on erythropoiesis and red blood cell function. Megaloblastic anemia, characterized by impaired DNA synthesis and macrocytic red blood cells, was identified as another significant etiological subtype. This type of anemia is commonly associated with vitamin B12 or folate deficiencies, which can occur due to poor dietary intake, malabsorption syndromes, or certain medications. The presence of megaloblastic anemia in the study population underscores the importance of evaluating micronutrient status and addressing deficiencies in geriatric patients with anemia.

Dimorphic anemia, characterized by the coexistence of microcytic and macrocytic red blood cells, was less common but still noteworthy. This type of anemia can arise from a variety of underlying conditions, including chronic blood loss, nutritional deficiencies, and chronic diseases. The identification of dimorphic anemia highlights the complexity of anemia diagnosis in geriatric patients and emphasizes the need for comprehensive evaluation and management strategies.

Table 5: Comparison of peripheral smears findings in the present study with otherstudies

	PRESENT STUDY	KAURET AL2013[20]	SFURTIMAN NET AL2014[21]	SAURABH RSRIVASTAVAET AL2013[17]	TETTAMANTI M ET AL2010[18]	CHULWONC HOI ETAL 2003[19]
MCHC ANEMIA	46.61%	34%	40.40%	11.6%	72.3%	93.5%
NCNC ANEMIA	42.34%	56%	50%	69.8%	16.9%	3.5%
DIMORPHIC ANEMIA	2.4%	8%	10%	4.44%	-	-

The correlation analysis between red blood cell indices and the etiology of anemia provides further insights into the pathophysiology of these conditions. Hemoglobin levels were significantly lower in patients with iron deficiency and megaloblastic anemia compared to other etiological subtypes. This observation is consistent with the characteristic hypochromic and macrocytic red blood cell morphology seen in these conditions. Additionally, the mean corpuscular volume (MCV) was elevated in megaloblastic anemia, reflecting the larger size of red blood cells due to impaired DNA synthesis. In contrast, patients with anemia of chronic diseases had lower MCV values, indicative of normocytic or microcytic red blood cells commonly seen in this condition.

Moreover, the analysis revealed differences in other hematological indices such as mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) across different types of anemia. These variations reflect the underlying pathophysiological mechanisms and clinical characteristics associated with each etiological subtype. For instance, the elevated RDW observed in dimorphic anemia suggests a greater degree of variability in red blood cell size, indicative of concurrent microcytic and macrocytic populations.The findings of this study offer significant insights into the hematological profile of geriatric patients, particularly in relation to the morphological and etiological classification of anemia. Understanding the demographic characteristics of the study participants provides essential context, revealing a predominance of individuals aged 65 to 75 years with a slightly higher representation of females.

Iron deficiency emerged as the most common cause of anemia, followed by anemia of unknown etiology, anemia of chronic diseases, megaloblastic anemia and dimorphic anemia. While these findings shed light on prevalent etiological subtypes, several limitations must be acknowledged, including the single-center retrospective design and potential biases in data collection and analysis. Moving forward, future research should aim to address these limitations by conducting

prospective, multicenter studies to validate the findings and explore additional factors contributing to anemia in geriatric populations. Furthermore, tailored screening, management, and prevention strategies are recommended based on the identified etiological subtypes, emphasizing the importance of early detection and personalized approaches to patient care in this vulnerable population.

Table 6: Comparison of Etiology of anaemia in the present study withotherstudies

	IRON DEFICIENCY ANEMIA	ANEMIA OF CHRONIC DISEASE	MEGALOBLASTIC ANEMIA	ANEMIA OF UNKNOWN ETIOLOGY
PRESENT STUDY	35.2%	19.6%	8.5%	34.2%
SFURTIMANN ET AL 2014[21]	35%	41.66%	0.3%	0.6%
TETTAMANTIM ET AL 2010[18]	16%	17.4%	10.1%	26.4%
CHUL WONCHOI ET AL 2003[19]	7%	-	-	-

Conclusion

In conclusion, this study provides a comprehensive analysis of the hematological profile of geriatric patients, focusing on the morphological and etiological classification of anemia. The findings highlight several key insights into the prevalence, causes, and correlations associated with anemia in this population. Iron deficiency emerged as the most common cause of anemia, followed by anemia of chronic diseases, megaloblastic anemia, and dimorphic anemia, with a notable proportion of cases classified as of unknown etiology. The correlation analysis revealed distinct patterns in red blood cell indices across different etiological subtypes, underscoring the importance of considering both morphological and etiological factors in the assessment and management of anemia in geriatric patients. Despite the study's limitations, including its single-center retrospective design, these findings have important implications for clinical practice and research. Moving forward, efforts to validate these findings through prospective, multicenter studies and to develop tailored screening and management strategies are warranted to improve outcomes for older adults with anemia.

Data Availability:

The raw data supporting the conclusions of this article are available from the authors upon reasonable request.

Ethical statement:

The study was a retrospective analysis of existing data and did not involve any direct patient contact or intervention. All patient data were anonymized and de-identified to protect patient confidentiality. The study was approved by the Institutional Ethics Committee for Biomedical and Health Research (IECBHR), Medical College & S.S.G. Hospital Baroda.

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