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Original Research Article

Bone Marrow Morphology in Geriatric Patients with Anemia

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ABSTRACT

Background Anemia is a common hematological problem in the geriatric age group and its incidence increases with increasing age. Anemia in old age has unique causes, adverse effects and functional outcome. The etiology is often multi-factorial, the most common causes being Anemia of Chronic disease, Nutritional deficiencies, followed by unexplained anemia. Myelodysplastic Syndrome (MDS) is more common in older adults and accounts for a significant number of unexplained anemias in elderly. Bone Marrow Morphology remains the cornerstone in its diagnosis and is an important tool that complements cytogenetic finings for diagnostic and prognostic discrimination in MDS. The present study evaluated the Bone Marrow morphology in Geriatric patients with Anemia and emphasises Myelodysplastic syndrome as one of the important causes of geriatric anemia.
Study Design: prospective descriptive study.
Aim: 1. To evaluate the clinical presenting features and the basic, hematological parameters in Geriatric patients with Anemia. **2.** To evaluate the morphological alterations of Bone marrow aspirates in these Geriatric patients with Anemia. **3.** To correlate these morphological alterations of Bone marrow aspirates with the clinical and basic hematological parameters in these patients.
Materials and Methods: This prospective study was conducted over a period of two years from September 2010-2012 in a tertiary health care hospital. Geriatric patients of age more than 60 years who are presenting with anemia, fulfilling the WHO criteria of anemia were enrolled in the study. Bone marrow was aspirated from the sternum or the posterior superior iliac crest, using a Salah needle.
Results: The anemia was of severe degree in most patients as per WHO criteria. It was often multifactorial. Bone marrow examination showed a Reactive Erythroid Hyperplasia of marrow with micronormoblastic maturation suggestive of a probable Iron deficiency in 41.54% of patients. The present study identified Myelodysplastic syndrome as a possible cause of Geriatric Anemia in 9.23% of patients.
Conclusion Anemia in elderly patients should never be regarded as a normal physiological response to aging. All Elderly patients with Anemia should always be evaluated for an underlying cause and treated accordingly. Hence a Bone marrow examination is often necessary in all cases of geriatric anemia for establishing a diagnosis, particularly in MDS.

***Key words*:** anemia, geriatric, MDS, bone marrow morphology.

INTRODUCTION

Aging is not a cause of anemia; but is seen as a predisposing factor to anemia. Anemia is a common hematological problem in the geriatric age group and its incidence increases with increasing age. [1] Studies have demonstrated that anemia in old age have unique causes, adverse effects and functional outcome. [2] The prevalence of anemia in the general population has

been shown to range from 8 to 44%. The third National Health and Nutrition Examination Survey (NHANES-III) of WHO study revealed prevalence of anemia as 11% of men and 10.2% of women aged 65 years and older. [3] The etiology is multi-factorial, the most common causes being Anemia of Chronic disease, Nutritional deficiencies followed by unexplained anemia. [3] Myelodysplastic Syndrome (MDS) is more common in older adults and accounts for a significant number of unexplained anemias in elderly. [3] The median age at which MDS is diagnosed is between 60-75 years. To understand the cause and effect of anemia on the old person, it is essential to look into the bone marrow for specific changes, for example the diagnosis, classification and prognostication of MDS is, based on the peripheral blood film and Bone Marrow morphology of the patient. [4] Hence Bone Marrow Morphology remains the cornerstone in disease diagnosis and is an important tool that complements cytogenetic finings for prognostic discrimination. [5] Our present study was designed as a prospective descriptive study of the Bone Marrow morphology in Geriatric patients with Anemia.

MATERIALS AND METHODS

This prospective study was conducted over a period of two years in a tertiary health care hospital under due approvals of the Institutional Research Ethics Committee. Patients were sourced from the Departments of General Medicine, General Surgery, Oncology and Geriatric Medicine. Geriatric patients of age more than 60 years who are presenting with anemia, fulfilling the WHO criteria of anemia (Hemoglobin <13gms/dl in males, <12gms/dl in females) were enrolled in the study. Sixty five patients were selected none consecutively. Consent was taken from all patients. The patients were excluded as per the following Exclusion Criteria: (1) Patients with a history of recent transfusion (2) Patients who have undergone major surgical procedure in the past 3months. (3) Acute and Terminally ill patients.

Sixty five patients who satisfied our selection criteria were selected for the study. A detailed clinical interview was undertaken and all details regarding age, gender, occupation, racial characters, socio economic milieu, presenting complaints, previous history as pertaining to the presenting complaints, history of exposure to chemicals or drugs, dietary habits, co-morbid conditions, were recorded. A detailed clinical examination was done and presences of organomegaly, lymphadenopathy, clubbing, cyanosis, pedal edema etc as per protocol were recorded.

A standardized set of lab investigations were ordered for all these patients - Complete Blood Count, Basic Clinical Chemistry, Liver Function Tests, Thyroid Profile, Reticulocyte Count and Peripheral Blood Film. Radiological investigations such as roentgenogram, sonographic studies, CT scans and MRI were performed based on clinical needs. Some patients were given an endoscopic analysis of the upper and lower GIT as clinically required.

All the patients who were selected for the study were advice a bone marrow aspiration study as per standard clinical protocols of our hospital. It was advice in patients with blood smear showing microcytic, normocytic, macrocytic or dimorphic blood picture, cytopenia, and abnormal cellular morphology. Bone marrow was aspirated from the sternum or the posterior superior iliac crest, using a Salah needle. Aspirated were used to make 8-15 smears. The smears were air-dryed, fixed in methanol and stained with Leishman's stain as per standard protocol. One smear was saved for perl's stain (Fig.1&2). The Bone marrow samples were examined and the findings were recorded in a standard format. The smears were assessed for (1)Degree of Cellularity - graded as hypocellular, normocellular or hyper cellular (2) Relative distribution of erythroid, myeloid, and lymphoid cells (3)

Morphological abnormalities of the erythroid, granulocytic, and megakaryocytic series (4) Presence of other cells. The findings were recorded. The results were tabulated and analysed.

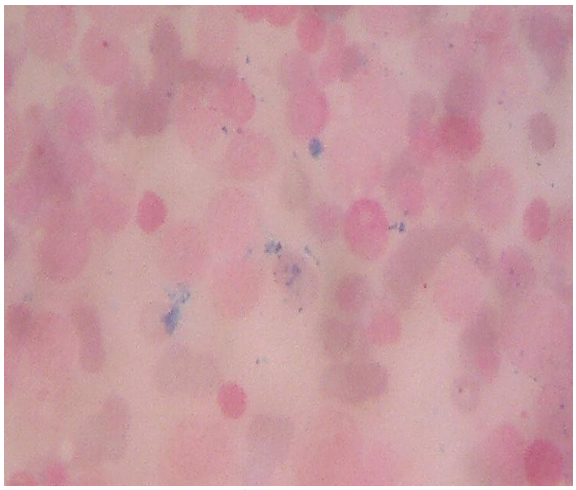

Fig.1: Photomicrograph of a bone marrow smear showing low grade iron stores (perl's stain.x400)

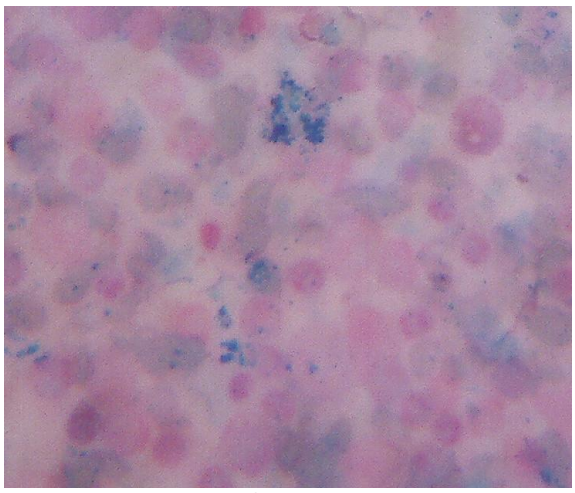

Fig.2: Photomicrograph of a bone marrow smear showing increased iron stores (perl's stain.x400)

OBSERVATION AND RESULTS

Table 1: Age and Gender Distribution of Patients

Age in years	No Of Patients			Percentage
	Men	Women	Total	
60 – 69	23	25	48	73.84
70 – 79	8	7	15	23.08
>80	1	1	2	3.08
Total	**31**	**34**	**65**	**100**

A total of 65 geriatric patients with anemia were evaluated in our study. The patients were in the age group between 60 to 85 years with a mean age of 66.65 years. The majority of the patients were between 60-69 years (Table 1).

The most common presenting complaint was Fatigue found in 24(36.92%) patients followed by exertional dyspnoea in 19(29.23%) patients, pedal edema and abdominal pain in 13(20%) and 9(13.85%) patients respectively (Table 2). 3(4.62%) patients presented with neurological symptoms and another 3(4.62%) patients.

Table 2: Distribution of Presenting Complaints

Symptoms	No of Patients	Percentage
Fatigue	24	36.92
Dyspnoea	19	29.23
Pedal edema	13	20.00
Abdominal pain	9	13.85
Neurological	3	4.62
GI Bleed	3	4.62
Others	8	12.31

The degree of anemia was severe as per WHO criteria in most (52.31%) patients. Moderate degree of anemia was seen in 36.92% of patients and mild anemia was observed in 10.77% of patients (Table3). Patients had comorbidities like hypertension (32.31%), diabetes (18.46%), renal (10.77%) & liver (6.15%) disease, coronary artery disease (7.69%), hypothyroidism (1.54%), and acid peptic disease (3.08%). One was a case of carcinoma breast on chemotherapy. Overlapping features were seen in many patients. Out of the 65 patients, 29 patients underwent upper gastro intestinal endoscopy. Endoscopy revealed mucosal erosions in 34.48% of the patients, mucosal prolapse (3.44%), congestion (31.03%), ulcers (10.34%), esophageal varices (3.44%) and ulcer proliferative gastric growth in one patient.

Table 3: Severity of Anemia

Severity	Gender	No of Patients	Total	Percentage
Mild	Men	2 (3.08%)	7	10.77
	Women	5 (7.69%)		
Moderate	Men	13 (20%)	24	36.92
	Women	11 (16.92%)		
Severe	Men	16 (24.62)	34	52.31
	Women	18 (27.69)		
Total			**65**	**100**

Peripheral smear examination showed microcytic anemia in 49.23% 0f patients, dimorphic blood picture in 18.46%, normocytic anemia in 15.38% and pancytopenia in 7.69% of the patients (Table 4).

Table 4: Peripheral Smear Findings

Type of anemia	No of patients	Percentage
Microcytic	32	49.23
Dimorphic	12	18.46
Normocytic	10	15.38
Macrocytic	6	9.23
Pancytopenia	5	7.69
Total	**65**	**100**

Bone marrow examination done in these patients showed a Reactive Erythroid Hyperplasia of marrow with micronormoblastic maturation suggestive of a probable Iron deficiency in 41.54% of patients, megaloblastic marrow maturation suggestive of a probable Megaloblastic anemia found in 20% patients and Reactive Erythroid Hyperplasia of marrow with micro and macronormoblastic maturation suggestive of a probable combined B12/iron deficiency in 15.38% of patients. We also encountered 3(6.16%) incidental cases of leukemia in these patients. The present study identified Myelodysplastic syndrome as a possible cause of Geriatric Anemia in 9.23% of patients (Table 5). Bone marrow morphology could not be assessed in five patients as the aspirate was hypocellular in three patients even after repeated aspirations and yielded a dry tap in two patients.

Table 5: Spectrum of Bone Marrow Aspiration Findings

S.No	Marrow Findings	Total	%
1.	Reactive Erythroid with Hyperplasia of Marrow Micronormoblastic Erythroid Maturation	27	41.54
2.	Megaloblastic Marrow	13	20.0
3.	Reactive Erythroid with Hyperplasia of Marrow Micro and Macronormoblastic Erythroid Maturation	10	15.38
4.	Myelodysplasia	6	9.23
5.	Leukemia	4	6.15
6.	Others	5	7.69

DISCUSSION

Anemia is common in the older age group. The etiology of anemia in elderly is often multifactorial and is due to nutritional deficiency in one third of cases anemia of chronic disease in one third and unexplained anemia in the remaining one third. [3] Its scientific management requires an exact classification which can be done only after a complete study of blood. In the present study, we analyzed the bone marrow findings and the clinical and laboratory parameters of geriatric patients with anemia.

Unlike in young and middle aged persons, both elderly men and women have an equal chance of developing anemia because of a decrease in androgen levels in elderly males. [6] Anemia is not a diagnosis in itself, but is an objective sign of a deeper disease. The normal limit of haemoglobin concentration varies among different organisations, countries and laboratories. In addition many other factors can influence a healthy person's haemoglobin level including smoking status, altitude of residence, ethnic background and physiologic fluctuations of plasma volume [7] because clinical laboratories do not adjust for these factors, interpretation of haemoglobin test results is the responsibility of clinicians. The WHO criteria of anemia are based on a haemoglobin concentration lower than 120g/L (12.0g/dl) in women and 130g/L (13.0g/dl) in men. [8] Also the interpretation of hematologic data in the context of old age is particularly a matter of concern nowadays. This could be attributed due to the remarkable heterogeneity of the processes related to senescence and partly due to the intricacies in sorting out the effects of age per se from the effects of the occult disease processes that go together with aging. Many variables are postulated that contribute to anemia in the elderly such as (1) decline in physical activity (2) altered cardiovascular function (3) decreased bone marrow function and (4) chronic inflammatory disorders. [9] A. In our study the anemia was severe in majority of the patients. Mild anemia was observed in only 10.77%of patients. A mild normocytic anemia is common in elderly. [10] However, Microcytic hypo chromic anemia (49.23%) was the most common type of anemia in our study. A higher occurrence of microcytic hypo chromic anemia in our study could be attributed to the increased number of patients from rural areas and of low socio economic status.

Bone marrow studies though invasive is a safe and simple procedure and

is the most frequently carried out investigation in the evaluation of haematological disorders. In geriatric patients bone marrow examination is important particularly in the diagnosis of Myelodysplastic syndromes. In our study, Marrow morphology in majority of the cases was of reactive erythroid hyperplasia with micronormoblastic erythroid maturation (41.54%) (Table 6) (Fig.3), suggestive of a probable iron deficiency anemia. Iron stores detected by perl stain, were absent in these patients. These patients presented with microcytic hypo chromic anemia (77.78%) and normocytic anemia in 5 (18.52%) patients. Apart from iron deficiency, anemia of chronic disease most often presents as normocytic anemia. The co-morbid illnesses associated in this group of patients were liver disease, renal disease, CAHD, GI bleed. Upper GI endoscopy detected malignancy in one patient. Hence in elderly patients with microcytic /normocytic anemia, apart from nutritional iron deficiency, other causes of anemia need to be determined through endoscopic evaluation of GIT for evidence of blood loss and evaluation for an underlying renal or liver disease is necessary. [11] Megaloblastic erythroid maturation suggestive of a probable megaloblastic anemia was observed in 20% of patients. An iron store was normal in these patients. These patients presented with a macrocytic anemia (38.46%), dimorphic anemia (38.46%) and pancytopenia (15.38%). vitaminB12/folate deficiency produce a macrocytic anemia. The Mean Corpuscular Volume increases slightly with age but it generally does not lead to significant macrocytosis. Though serum levels of vitamin B12 are subnormal (10-15%), anemia due to B12 deficiency is not so common in elderly (1-2%). [12] Common causes of cobalamin deficiency are inadequate diet, malabsorption, increased requirements as in disseminated cancer and intrinsic factor deficiency. (Table 7)

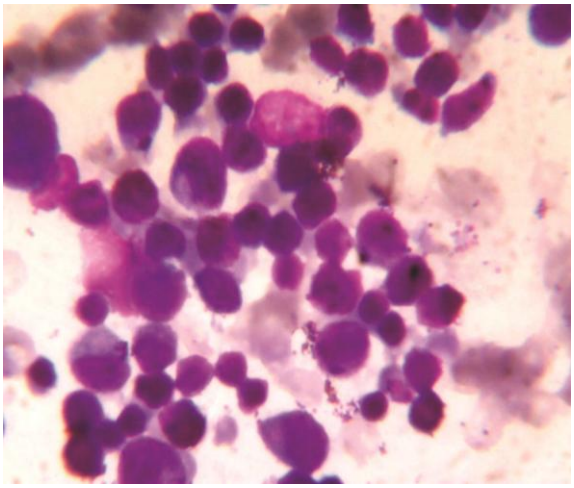

Fig.3: Photomicrograph of a bone marrow smear showing micronormoblastic erythroid maturation. (Leishman's stain.x400)

Table 6: Evaluation of Anemia with Bone marrow showing micronormoblastic erythroid maturation

Parameter	Findings	No of Cases
Peripheral smear	Microcytic	21
	Normocytic	5
	Dimorphic	1
Severity of anemia	Grade I	1
	Grade II	7
	Grade III	13
Iron stores	Absent	27
UGI endoscopy	Malignancy	1

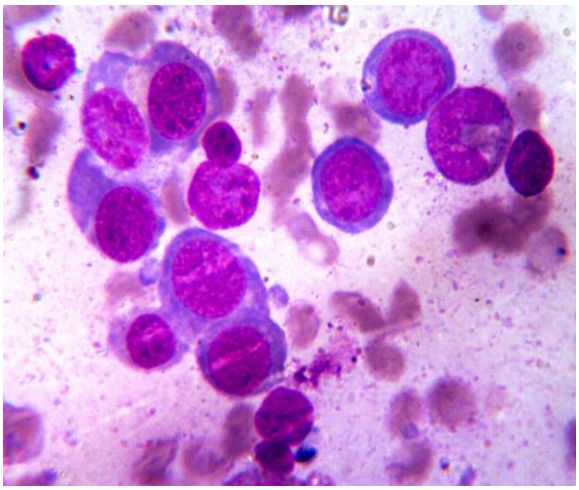

Fig.3: Photomicrograph of a bone marrow smear showing Megaloblastic marrow maturation.(Leishman's stain.x1000)

Table 7: Evaluation of Anemia with Megaloblastic Marrow Maturation

Parameter	Findings	No Of Cases
Peripheral smear	Macrocytic	5
	Dimorphic	5
	Pancytopenia	2
	Normocytic	1
Severity of Anemia	Grade I	-
	Grade II	8
	Grade III	5
Iron Stores	Normal	13

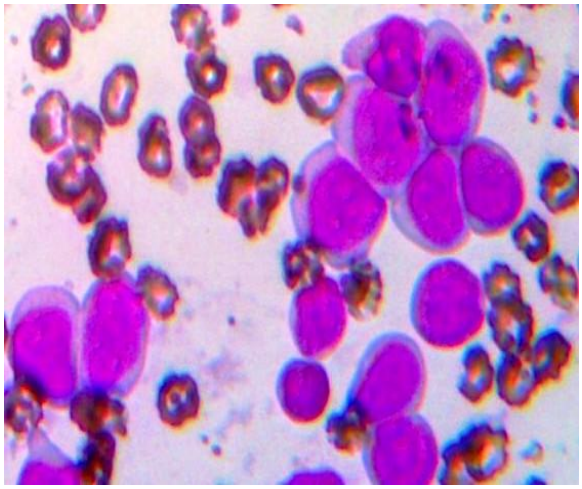

Fig.4. Photomicrograph of a bone marrow smear showing myeloblasts in a case of AML. (Leishman's stain.x1000)

Acute and chronic Leukemias accounted for 7.70% of cases, AML in one patient (Fig.4), CML in 3 patients. Most leukemia has a predilection for the adult age group with the exception of acute lymphoblastic leukemia (ALL). Other less common forms are hairy cell leukemia, large granular lymphocytic leukemia and adult T cell leukemia. [13]

Myelodysplastic syndrome or preleukemia, as it was formerly called, is fairly an infrequent cause of anemia, but is a more common cause in the aged individuals than in younger patients. Milman N et al (1994) has shown that about 5.8% of the total anemia population had Myelodysplastic syndrome (MDS) and 17.2 % of the patients had unexplained anemia. [14] MDS have an estimated annual incidence of approximately 3.5 to 10 per 100 000 in the elderly population. [15] The rising frequency and incidence of MDS in the US population may be attributed to the growing aging population and increasing disease recognition and diagnosis. The etiology and pathogenesis of MDS remain poorly characterized. MDS encompass a spectrum of clonal hematopoietic stem cell disorders characterised by cytopenia, ineffective hematopoiesis, cytopenia, clonal chromosomal abnormalities and a risk for acute leukemic transformation in about 30 - 35 % of patients. [16]

A total of six patients were given a diagnosis of a probable MDS (9.23%) (Table 8) Marrow iron stores were normal or increased in these patients. Anemia and correlated signs and symptoms are the most relevant disease specific manifestation and are the most frequent presenting symptoms of MDS patients. Frequently they can be asymptomatic. In the present study all patients who were suggested a diagnosis of probable MDS were symptomatic. Hepatosplenomegaly and skin manifestations were present in 16.67% of patients. Co morbid illnesses were present in 66.67% of the patients.

Table 8: Evaluation of Anemia in patients with Bone marrow showing Dysplastic Changes

Parameter	Findings	No of cases
Peripheral smear	Pancytopenia	3
	Dimorphic	2
	Microcytic	1
Severity of Anemia	Grade I	-
	Grade II	-
	Grade III	6
Iron Stores	Increased	6
	Normal	

At presentation the most common laboratory finding present in nearly all patients with MDS is anemia and reticulocytopenia. [17] The anemia is typically macrocytic but may also be normocytic. Microcytic hypo chromic anemia is rarely associated with MDS. Anemia may be accompanied by neutropenia and/or thrombocytopenia with pancytopenia found in approximately 50% of all cases. Isolated neutropenia or thrombocytopenia is reported in 5% of cases. The higher the degree and number of cell lines decreased, the worse the prognosis. The thresholds for cytopenias are hemoglobin less than 10g/dl, Absolute Neutrophil count less than 1.8x 10^9/L and platelets less than 100 x 10^9/L. The anemia can be Normocytic, Macrocytic or Microcytic accompanied by a low reticulocyte count. Other RBC abnormalities that can be observed are anisopoikilocytosis, basophilic stippling, Howell-Jolly bodies, fragmented cells and nucleated red cells. There may be

monocytosis, basophilia eosinophilia, or lymphocytosis. Cytoplasmic hypogranularity and hyposegmented neutrophils (pseudo- pelger-Huet anomaly) are other characteristic features. Few circulating Myeloblasts may be seen. Platelets can be large and both hypogranular and hypergranular forms can be seen. In the present study most of the patients presented with pancytopenia. [18] (Table 8)

MDS arising de novo is termed Primary MDS. Predisposing factors could be genetic or acquired. Genetic factors have a role in Pediatric MDS. Secondary MDS is diagnosed when a known acquired predisposition is documented. This could be due to exposure to benzene, tobacco, radiation or MDS evolving from Aplastic anemia and Paroxysmal Nocturnal Hemoglobinuria (PNH). [19] Therapy related MDS is seen in patients who have received chemotherapy earlier, usually for lymphomas.

In the bone marrow the minimum diagnostic criterion for diagnosis of MDS is dysplasia in 10% of any of the myeloid lineages and less than 20% blast cells of all nucleated cells in the marrow unless there are cytogenetic abnormalities suggestive of the diagnosis of MDS as per the world health organisation (WHO). The hallmark finding is dysplasia in all three lineages- Dyserythropoiesis, Dysgranulopoiesis and Dysmegakaryopoiesis (Fig.8) The subgroup determination of MDS can be made after taking in to consideration the four features such as the percent bone marrow Blasts, presence of Auer rods, percent of Ringed Sideroblasts, and absolute number of Monocytes in the peripheral blood. Erythroid Lineage: There is megaloblastic erythropoiesis. Features of dyserythropoiesis are distorted nuclear cytoplasmic maturation, nuclear budding, irregular nuclei, karyorrhexis, intranuclear bridging, multinuclearity (Fig.5). Cytoplasmic abnormalities include vacuolization, basophilia and poor hemoglobinization. The other characteristic morphologic feature is Ringed Sideroblasts. They have five or more granules/cell and encircling more than one third of nucleus and should be more than 15% in the Refractory Anemia with Ringed Sideroblast subtype of MDS. Erythropoiesis is shifted to left and the number of erythroid precursors varies between five to fifty percent. [20] Myeloid hyperplasia is usually seen in MDS. There is hypogranularity and hyposegmentation of myeloid cells. Other nuclear dysplastic features that can be observed are ring shaped nuclei, nuclear sticks and clumping of chromatin [21] (Fig.6). In the marrow, there is megakaryocytic hyperplasia or the number is normal. The characteristic abnormalities are micromegakaryocytes, multinucleated megakaryocytes and hypolobated megakaryocytes. (Fig.7) (Fig.8) Hypolobated megakaryocytes are more common in 5q- syndrome. Micromegakaryocytes dwarf forms), are two times less than the diameter of a neutrophil, and hypolobated megakaryocytes are moderate sized with monolobate eccentric nuclei and hypogranular cytoplasm. [21] Identification of Blast cells is most important in classification and prognostication of MDS. The overall survival and overt leukemic progression is determined by the percentage of blast cells in marrow. [19] Three types of blasts can be recognized that may have prognostic significance. *Type I blasts:* These cells bear a resemblance to promyelocytes, have a reticular nuclear chromatin pattern and one to three nucleoli, with a moderately basophilic cytoplasm. Cytoplasmic granules and Auer rods are absent. *Type II blasts:* These cells contain few azurophilic granules and a lower nuclear/ cytoplasmic ratio. *Type III blasts:* these are blast cells with more than or equal to 20 azurophilic granules without a Golgi zone. The common dysplastic features observed in the present study were megaloblastic maturation, nuclear budding and multinuclearity in erythropoiesis. In myeloid series, nuclear dysplastic features were seen. Both hypo and hypolobated megakaryocytes were seen.

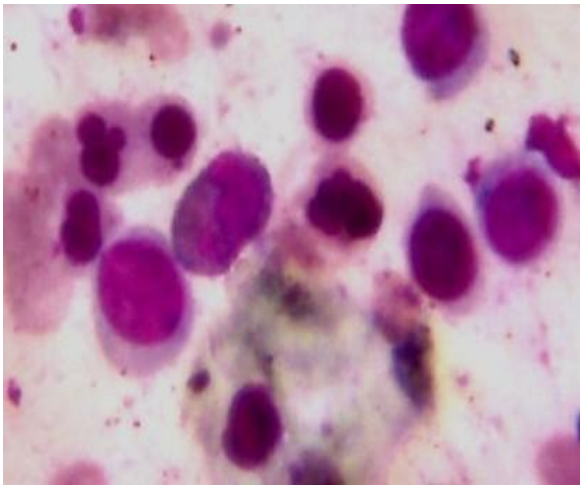

Fig.5: Photomicrograph of a bone marrow smear showing Dyserythropoiesis. (Leishman's stain. x400)

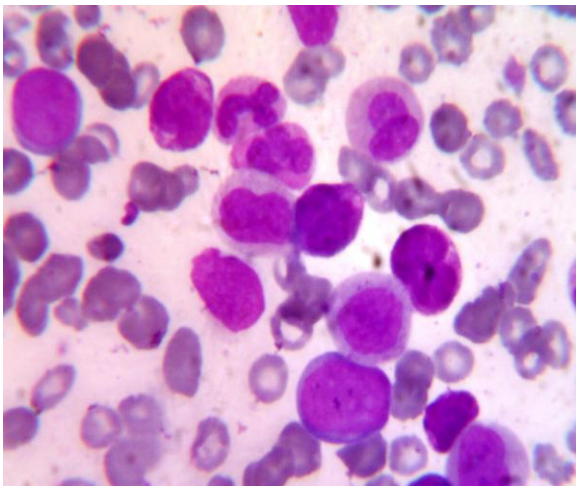

Fig.6: Photomicrograph of a bone marrow smear showing Dysmyelopoiesis. (Leishman's stain.x1000)

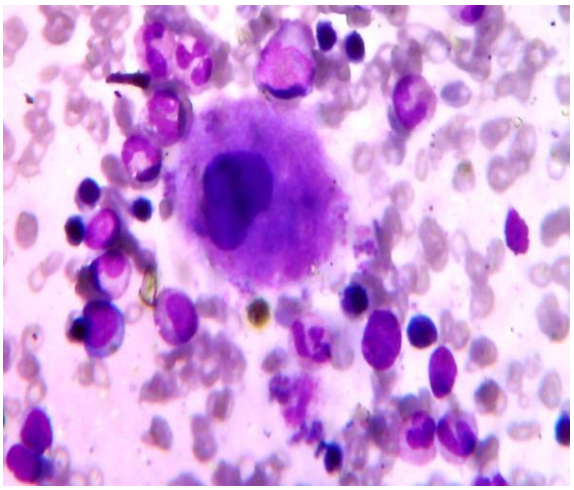

Fig.7: Photomicrograph of a bone marrow smear showing a hypolobated megakaryocyte (Leishman's stain.x400)

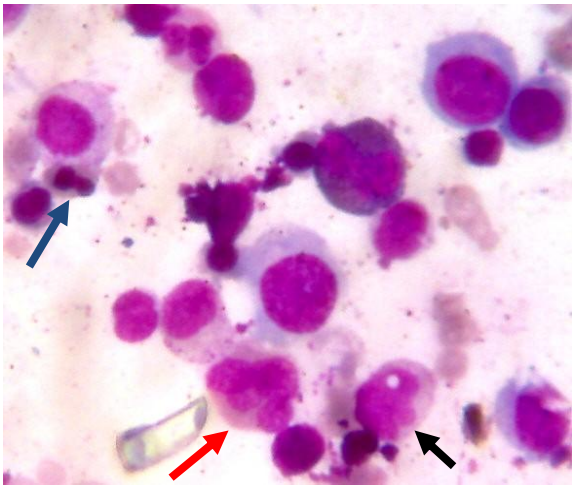

Fig.8: Photomicrograph of a bone marrow smear showing trilineage dysplasia (Leishman's stain. x400) Arrows: Blue – dyserythropoiesis; black – dysmyelopoiesis; red – dysmegakaryopoiesis.

Dysplastic changes in one or two cell lines are seen in some conditions which may be difficult to differentiate from MDS. The non malignant hematological conditions that are associated with Myelodysplasia are vitamin B12/folic acid deficiency, exposure to arsenic and other heavy metals, Congenital Dyserythropoietic anemia, Paroxysmal Nocturnal Hemoglobinuria HIV infection parvovirus B19 infection, G-CSF therapy. Hematological malignancies associated with myelodysplasia are Hypoplastic AML, Myeloproliferative disorders, AML-therapy related and AML in the elderly, Idiopathic myelofibrosis, accelerated phase of CML.

Vitamin B12 and folic acid deficiencies display morphologic alterations in all the hemopoietic cell lines and these revert with appropriate therapy. [23] G-CSF therapy induces marked dysplasia of neutrophil series with hypergranularity; Dohle bodies and nuclear hypolobation and blasts may increase up to 10%. HIV infection results in dysplastic hemopoiesis. Lead poisoning leads to microcytic hypo chromic anemia with basophilic stippling and Sideroblastic erythropoiesis. HIV associated dysplasia includes dyserythropoiesis, dysmegakaryopoiesis and giant metamyelocytes without hypersegmented neutrophils. Following

zidovudine therapy erythropoiesis is megaloblastic and dysplastic changes are greater. However in HIV infection, blasts are not increased.

MDS patients have a reduced life expectancy compared with normal controls. [24] This difference is marked in patients who are less than 60 years. Though the WHO classification of MDS is of prognostic significance, scoring systems provide objective parameters for improved reproducibility. International prognostic scoring system (IPSS) is computed from three parameters-marrow blast percentage, number of lineage affected and bone marrow cytogenetics. Of the different types of MDS, pure sideroblastic anemia and the 5q- syndrome are associated with an excellent prognosis with a low rate of transformation in to acute leukemia.

The only treatment is Allogenic stem cell transplantation. Management is indiviualised and guided by patient's age, prognosis and toxicity of treatment. Low risk MDS is associated with longer survival.hence amelioration of hematological deficits is the therapeutic goal. Treatment consists of erythropoietin and combined administration of G-CSF and GM-CSF, immunosuppressive therapy, antiangiogenic agents and management of neutropenia. High risk MDS have risk of leukemic transformation and shorter survival. Hence, prolongation of survival and waring of leukemic evolution is the target. 5- azacytidine, a DNA hypomethylating/ methyl transferase inhibitor is the most promising therapy for improved quality of life in MDS. [25]

Finally, approximately 5-15% of elder patients with unexplained anemia are liable to have Myelodysplastic syndromes using French American British criteria and a further minor subgroup of patients may have abnormalities that are suspicious for, but not confirmatory of MDS. [26] Aditional studies are needed to better categorise these patients, called pre-MDS category and for better understanding their long term prognosis. Emerging molecular techniques to detect clonal hematopoiesis are expected to provide a vital part in this category.

CONCLUSION

Anemia in elderly patients should never be regarded as a normal physiological response to aging. The main categories of anemia in older patients are the nutritional anemia attributed to iron deficiency, including blood loss, folate and vitamin B12 deficiency, and Anemia of chronic disease in patients with cancer, infections and other chronic inflammation. MDS is more common in elderly individuals and is also a cause for unexplained anemia in elderly. It is almost certainly an under diagnosed condition sice the evaluation of anemia is less likely to include a bone marrow examination in all cases.

Thus to conclude, all Elderly patients with Anemia should always be evaluated for an underlying cause. Indiscriminate administration of iron to a geriatric patient with an unevaluated anemia is not appropriate and may contribute to iron overload especially in AOCD and MDS. Hence a Bone marrow examination is necessary in all cases of geriatric anemia for establishing a diagnosis, particularly in MDS.

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