Original Article

Etiological Evaluation of Pancytopenia in A Tertiary Care Hospital

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ABSTRACT

Background: Pancytopenia is not a disease by itself, however it is a common hematological problem characterized by simultaneous presence of anemia, leucopenia and thrombocytopenia. The disease pattern associated with pancytopenia varies with geographic location, age group, nutritional status, drug intake and prevalence of infective disorder.

This prospective study was to investigate and identify different causes of pancytopenia with frequency, to ascertain percentage of occurrence of pancytopenia, to determine its incidence in relation to sex and age, and to compare findings with those of other similar studies.

Methods: 80 patients diagnosed with pancytopenia were clinically evaluated, with complete blood count, peripheral smears, and bone marrow aspiration-biopsy whenever possible in Justice K. S. Hegde Hospital attached to Nitte University, Deralakatte, Mangalore, from June 2012 to June 2014.

Results: Among the 80 cases analyzed, most of the cases were seen in the age group of 41-50 years, with male predominance. Hypersplenism (28.75%), malaria (16.25%) and megaloblastic anemia (13.75%) were the three commonest causes in our hospital. In 13 cases of malaria, Plasmodium vivax (8 cases) was most commonly noted.

Conclusion: The present study concludes that varied causes of pancytopenia can be attributed to the geographic area, nutritional and drug intakes, personal habits, infective causes, stringency of diagnostic criteria, and differences in methodology used. Hence, a detailed clinical history and meticulous examination along with hematological investigations provide invaluable information in the complete workup of patients with pancytopenia for understanding the disease processes, planning further investigations and management, and ascertain the cause.

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Introduction

Pancytopenia is defined as reduction of the cellular elements of blood with hemoglobin <10gm/dl, white blood cell count <4000/mm^3 and platelet count <100,000/mm^3. Hence, is not a disease entity but rather a triad of findings that may result from a number of disease processes.[1,2]

The etiology of pancytopenia varies in different populations depending on the age, nutritional status, geographic location and the prevalence of infections. Some causes of pancytopenia with prompt diagnosis are curable. However, in certain circumstances where complete cure is not possible, early diagnosis and supportive treatment can improve the quality of life by decreasing morbidity and mortality.[3,4]

The present study was carried out in patients diagnosed with pancytopenia attending to our hospital in order to find the incidence of various etiological factors with clinical details, hematological findings and bone marrow (BM) aspiration-biopsy whenever possible.

Materials and Methods

This prospective study was carried out over a period of two years, June 2012 to June 2014 in the Clinical Diagnostic Laboratory, Justice K. S. Hegde Charitable Hospital, NITTE University, Deralakatte, Mangalore. Approval from institutional ethical committee of K. S. Hegde Medical Academy (KSHMA) was obtained to conduct this study. The institutional ethical committee felt an informed consent was not required to conduct this study and thus deemed it to be not applicable.

Criteria for inclusion:

i. All age groups and both sexes

ii. Hemoglobin: <10g/dL

iii. Total leukocyte count: <4000/µL, and

iv. Platelet Count: <100,000/µL.

Relevant history was taken in every patient including their habits and intake of drugs, along with meticulous clinical examination. In all patients, complete blood count and peripheral smear study, and BM study wherever possible. Other investigations which whenever indicated included: chest and bone radiographs, ultrasound / C.T. Scan, urine and stool examination, liver function test, urinary Bence Jones proteins and serum electrophoresis, serological investigations and ELISA tests, and tests for serum ferritin, cobalamin, folic acid, lactate dehydrogenase and anti-nuclear antibody.

A clinico-pathological correlation was done in all cases before reaching a definitive diagnosis and the findings of this study was compared with similar other studies.

Result

A total of 80 patients were studied with a male to female ratio of 1.2:1. The age ranged from 2-90 years, with the maximum number of cases observed in the 41-50 years age group followed by 31-40 years (Fig 1). The causes of pancytopenia with age distribution of the patients are shown in Table 1.

Hypersplenism was observed in 23 (28.75%) cases constituting 14 males and 9 females. Hypersplenism was due to alcohol liver disease (ALD) (12 of 23 cases), and chronic liver disease (CLD) of idiopathic type (8 cases) and other causes (3 cases). ALD was most encountered in males between 31-70 years although one case was noted in a 42 year old woman. CLD was mostly noted in women of age group 41-50 years. The other three cases included: portal vein thrombosis with cavernous transformation, compensated portal hypertension caused by multiple liver metastasis from carcinoma rectum and Hodgkins lymphoma.

Of the thirteen (16.25%) cases of malarial infestation with an age range of 5-50 years, Plasmodium vivax was the predominant parasite seen in 8 cases, mixed malarial infestation (Plasmodium vivax and Plasmodium falciparum) in 4 cases and 1 case of Plasmodium falciparum infestation (Fig 2).

Megaloblastic anemia (MA) was seen in 11 (13.75%) cases with the commonest age groups being between 31-50 years (54.55%) and 61-80 years (45.45%). Females were affected more than males. BM examination was performed in 6 cases and showed hypercellular marrow with megaloblastic features and giant metamyelocytes (Fig 3). There were 2 cases with history of alcohol consumption.

We encountered seven (8.75%) cases of acute leukemia (AL) which included 4 children and 3 adults. Among the children, 3 developed Acute Lymphoblastic Leukemia (ALL) with monotonous population of lymphoblasts and 1 had Acute Myeloid Leukemia (AML) (M2). In the adults, all were diagnosed with AML (M2, M3, M4). The case with AML (M4) had increased number of monoblasts (Fig 4).

In our study we observed six (7.5%) cases of pancytopenia following intake of drugs over a long duration of time or as a transient presentation and if when discontinued the blood counts would either come to normal range or remained in low counts. There were two cases of anti-platelet drug intake, clopidogrel which was administered to patients with Ischemic Heart Disease and Non ST elevation Myocardial Infarction. Other cases constituted two cases of chemotherapy-induced, one case of anti-rheumatic drug leflunamide which lead to myelofibrosis grade 2 and a case of Break Bone Fever by Chickungunya virus with four years of self- administered analgesic Indomethicin.

We noted two (2.5%) alcoholic male patients of ages 48 years and 70 years. Both were on heavy alcohol consumption for over 20 years. Ultrasound of both showed features of liver cirrhosis without splenomegaly.

The other causes of pancytopenia included in our study were three (3.75%) cases each of multiple myeloma, aplasitc anemia (AA) and myelodysplastic syndrome (MDS) of Refractory Anemia with Excessive Blasts (RAEB) type; two (2.5%) cases of dengue fever and one (1.25%) case each of myelofibrosis, iron deficiency anemia (IDA), lymphoma (lymphoplasmacytic), HIV infection, systemic lupus erythematous (SLE), multi-focal bone metastasis from adenocarcinoma of prostate, and secondary to autoimmune cause.

Discussion

The present study with a total of 80 patients of pancytopenia was conducted to analyze the incidence of various causes of pancytopenia, age pattern, gender-wise along with their clinical findings, hematological and BM spectrum. The statistical data hence obtained were compared with previous published literature.

The age of the patients ranged 2 - 90 years with the commonest age group being 41 - 50 years (Table 2). Majority of the cases presented in 4th and 5th decade (Fig 1). Few other studies too have reported 4th and 5th decade as the commonest age group for presentation of pancytopenia.[5,6,7,8] A male predominance was noted in our study which was similar to other studies. With social taboos in our society, this could make health care facilities more readily available to males in comparison to females therefore showing an increased in male presentation at hospitals.

The commonest cause of pancytopenia, reported in various studies throughout mostly in the subcontinent area had been MA.[9] This is in sharp contrast with the results of our study, where the commonest cause of pancytopenia was found to be hypersplenism (n = 23, 28.75%). In other similar studies the incidence varies from 3 to 68%.[5] This contrast could suggest that there is an increasing trend of alcoholism in today's society; hence most patients attending to our hospital present with ALD, and hypersplenism being one of the consequences.

Table :. Age distribution of the patients and causes of pancytopenia.

Causes	Age group (in years)									Total
	2-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	
Hypersplenism	-	-	1	7	6	2	6	1	-	23
Malaria	1	4	4	2	2	-	-	-	-	13
Megaloblastic anemia	-	-	-	3	3	-	2	3	-	11
Acute leukemia	3	2	-	-	-	1	-	-	1	7
Drug induced	-	-	-	-	2	3	-	1	-	6
Multiple myeloma	-	-	-	-	2	1	-	-	-	3
Aplastic anemia	1	-	-	-	-	-	2	-	-	3
MDS	-	-	-	-	-	-	1	1	1	3
Dengue	-	-	1	1	-	-	-	-	-	2
ALD without splenomegaly	-	-	-	-	1	-	1	-	-	2
Myelofibrosis	-	-	-	-	1	-	-	-	-	1
IDA	-	-	-	-	-	-	-	1	-	1
Lymphoma	-	-	-	-	-	-	-	1	-	1
HIV	-	-	-	-	1	-	-	-	-	1
SLE	-	-	-	1	-	-	-	-	-	1
Bone mets*	-	-	-	-	-	-	-	1	-	1
Autoimmune cause	-	-	-	-	-	-	1	-	-	1

MDA: myelodysplastic syndrome; IDA: iron deficiency anemia; ALD: alcohol liver disease; HIV: human immunodeficiency virus; SLE: systemic lupus erythematous; Bone mets: Bone involvement by metastatic adenocarcinoma prostate*

Table 2: Comparison of number of cases, age and sex distribution and three most common causes of pancytopenia in different studies conducted in different countries.

Study	Country (Year)	No. of cases	Age group (years)	M : F ratio	Commonest cause	2nd common cause	3rd common cause
Tilak V et al[6]	India (1999)	77	5 to 70	1.1 : 1	MA (68%)	AA (7.7%)	Other causes (24.3%)
Savage DG et al[20]	Zimbabwe (1999)	134	All	-	MA (35.8%)	AA (26.1%)	AIDS (17.2%)
Khodke K et al[27]	India (2001)	50	3 – 69	1.3 : 1	MA (44%)	AA (14%) NEH (14%) KA (14%)	Multiple myeloma (04%)
Khunger et al [7]	India, 2002	200	2 - 70	1.2 : 1	MA (72%)	AA (28%)	SL (5%)
Niazi M et al[2]	Pakistan (2004)	89	1 to 75	1.7 : 1	BM Aplasia (38.3%)	MA (24.7%)	HS (18.4%)
Hamid GA et al[10]	Yemen (2008)	75	3 – 85	1.03 : 1	HS (45.3%)	MA (14.7%)	AA (13.3%)
Devi PM et al[21]	India (2008)	50	3 – 80	1.5 : 1	HA (22%)	MA (18%)	MDS (18%)
Jalbani A et al[4]	Pakistan (2010)	40	12 – 70	2.6 : 1	AA (32.5%)	HS (22.5%)	MA (15%)
Santra G et al[14]	India (2010)	111	13 – 65	1.5 : 1	AA (22.72%)	HS (15%)	DI (13%)
Ashraf S et al[11]	Pakistan (2010)	150	15 – 60	1.1 : 1	HS (68%)	MA (25.4%)	HM (6.6%)
Aziz T et al[32]	Pakistan (2010)	88	15 – 60	2.6 : 1	MA (40.9%)	AA (31.9%)	HS and CM (11.4%)
Gayathri BN et al[9]	India (2011)	104	2 – 80	1.2 : 1	MA (74.04%)	AA (18.3%)	SL (3.8%)
Tariq M et al[40]	Pakistan (2012)	50	15 – 70	1.7 : 1	AA (36%)	MA (16%)	MDS (14%)
Weinzierl EP et al[22]	California (2012)	250	All	-	AL (34.4%)	MDS (22.4%)	AA (7.6%)
Tareen SM et al[16]	Pakistan (2012)	180	All	1.8 : 1	Malaria (29.44)	Leukemia (17.78)	Tuberculosis (16.11)
Kumar DB et al[27]	India (2012)	48	10 – 70	1.0 : 1.8	HM (33.33%)	NEH (27.08%)	Megaloblastic marrow (18.75%)
Metikurke SH et al[1]	India (2013)	58	All	3 : 2	MA (50%)	Nutritional anemia (23.9%)	AA (13.04%)
Jain A et al[5]	India (2013)	250	All	2.6 : 1	HS (29.2%)	Infections (25.6%)	Myelosuppressants (16.8%)
Present study	India	80	2 – 90	1.2 : 1	HS (28.75%)	Malaria (16.25%)	MA (13.75%)

MA: Megaloblastic anemia; AA: Aplastic anemia; AIDS: Acquired immune deficiency syndrome; NEH: Normoblastic erythroid hyperplasia; KA: Kala azar; BM: Bone marrow; HS: Hypersplenism; HA: Hypoplastic anemia; MDS: Myelodysplastic syndrome; DI: Drug induced; HM: Hypoplastic marrow; CM: Chronic malaria; SL: Subleukemic leukemia; AL: Acute leukemia

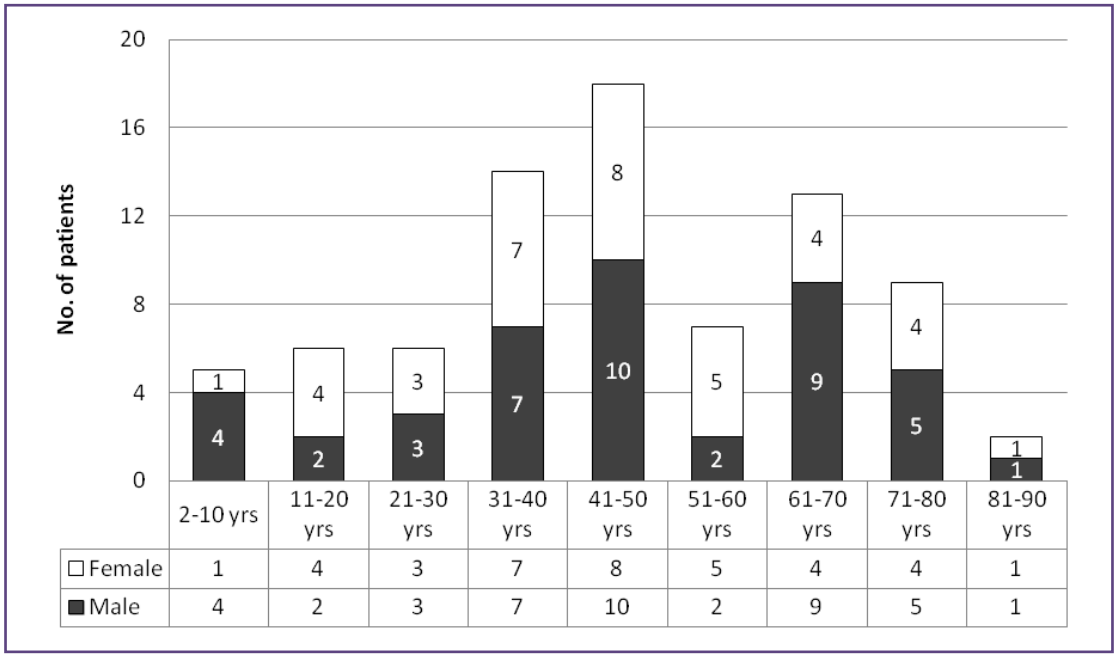

Fig. 1: Age and gender distribution of patients with pancytopenia.

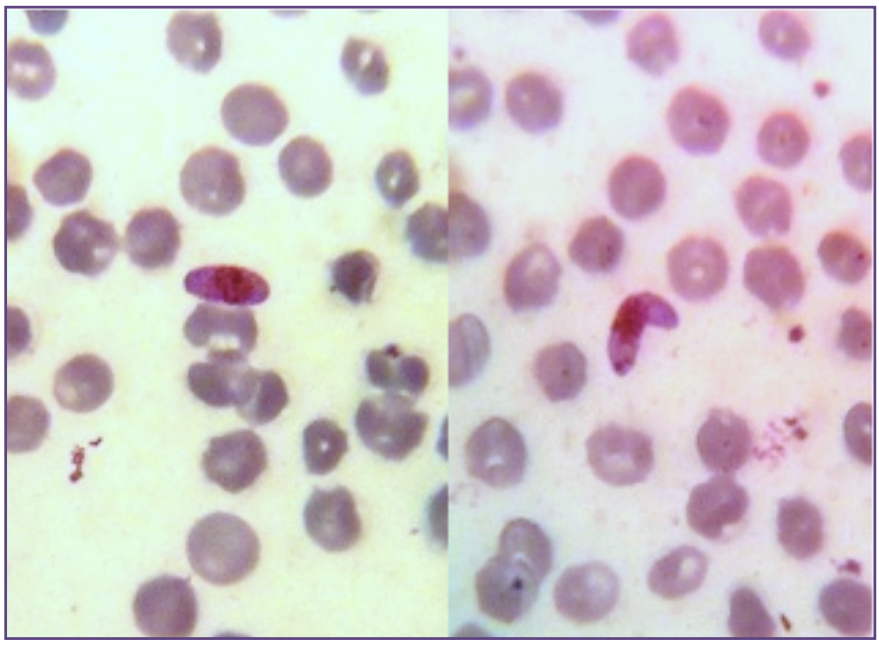

Fig. 2: Peripheral smear of malarial infestation showing Plasmodium falciparum cresentric gametocyte with centrally placed chromatin (Leishman stain 1000X).

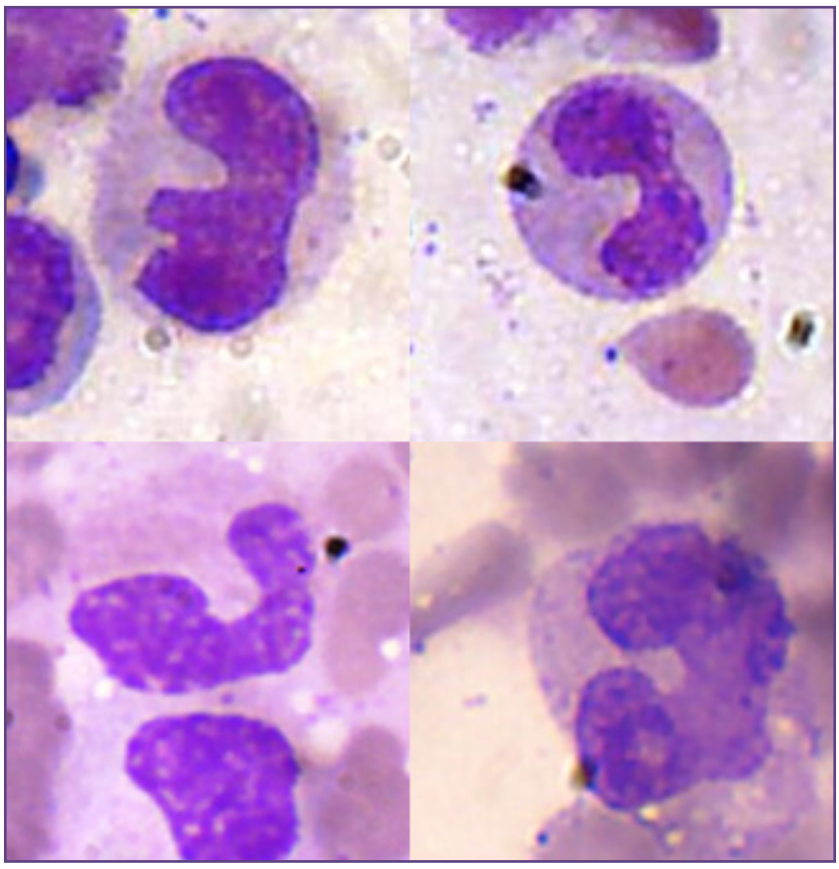

Fig. 3: BM aspiration of MA showing giant metamyelocytes displaying nuclear-cytoplasmic asynchrony with bud-like protrusion and sieve-like chromatin of the nuclei (Leishman stain 1000X).

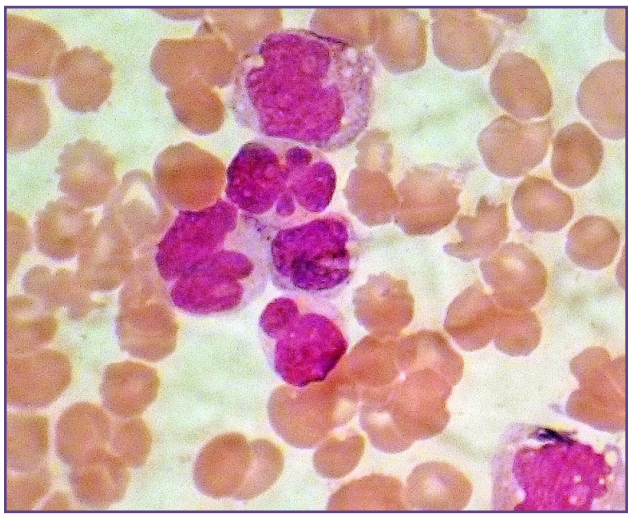

Fig. 4: Buffy coat of AML (M4; Acute Myelomonocytic Leukaemia) shows monoblasts with bluish-gray cytoplasm, pseudopods and cytoplasmic vacuoles. (Leishman stain 1000X).

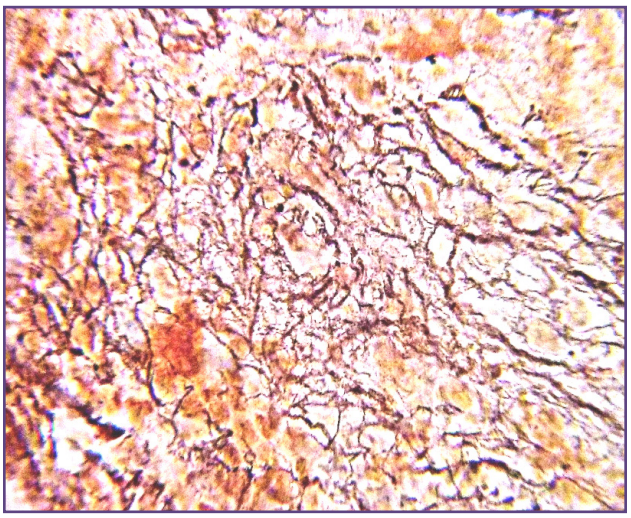

Fig. 5: BM biopsy of myelofibrosis (grade 2) showing increase in reticulin with intersections (Reticulin stain 400X).

In hypersplenism there is peripheral pooling or trapping and destruction of cells in an enlarged spleen which results in cytopenias. Increasing in severity of the condition leads to pancytopenia, commonly seen in patients with liver disease.[5]

Hypersplenism was most encountered among males between 31-70 years with the most affected age group being 31-40 years and a case noted in a 42 year old woman. We believed that this could be reflected by the changes in lifestyle as well as the increased consumption of alcohol from a younger age. Hypersplnism was also the commonest cause of pancytopenia in studies conducted by Hamid GA et al[10] with 45.3%, Ashraf S. et al[11] 68% and Jain A et al[5] 29.2%.

Malaria related cytopenia was noted in literatures done by Cannard and Aouba et al.[12,13] Malaria may cause pancytopenia by direct bone marrow invasion of the parasite, immune hemolysis, disseminated intravascular coagulation, hypersplenism, bone marrow necrosis or hemophagocytosis.[14] Malaria (n = 13, 16.25%) causing pancytopenia was the second commonest cause in our study, which was in contrast to previous literature. The data observed in our study may be explained by the geographic location since Malaria is endemic in Mangalore, Karnataka.[15] Therefore when malaria is diagnosed the clinicians treat the acute illness without advising BM examination. The incidence was similar to the study done by Hamid GA et al in Yemen[10] (14.7%) wherein Malaria was the second common cause of pancytopenia. However Tareen SM et al, Pakistan[16] found malaria (29.44%) to be the commonest cause which probably attributed to the poor sanitation among the low income group. Thakkar BB et al in India[3] reported 19% malaria cases of 100 patients and was the second common cause of pancytopenia.

In our study we noted a higher incidence of Plasmodium vivax malaria parasite causing pancytopenia. However, studies done by Tareen SM et al, Arya TV et al and Hemmer R et al reported that malaria due to Plasmodium falciparum has been implicated as a cause of pancytopenia.[16,17,18] This could be explained by the difference in the geographic distribution of malaria parasites.[19] No deaths have been reported among these patients and have recovered completely.

In our study MA (n=11, 13.75%) stood next to Hypersplenism and Malaria as a cause for pancytopenia which was similar to the study done by Hamid GA et al[10] with 14.7%. However, the data obtained here was in sharp contrast to other previous studies done in India wherein, MA was the most commonest cause of was due to nutritional deficiency.[6,7,9,20,21]

Of the seven (8.75%) cases in leukemia, 4 cases were in the pediatric age group and 3 cases in the adult group. This was comparatively similar to Savage DG et al[20] with eleven cases (8.2%) of AL from the 134 patients with pancytopenia. Jain A et al[5] received 7 leukemia cases out of 250 pancytopenic cases (2.8%) and Metikurke SH et al[1] with five cases (8.8%) of 57 pancytopenic patients. In contrast Weinzierl EP et al[22] from California obtained

a total of 86 cases of AL out of 250 cases of pancytopenia (34.4%). ALL in childhood is the most common association, however pancytopenia preceding AML has been described in the literature and adults are occasionally known to be affected.[5]

We found six cases (7.5%) of drug induced pancytopenia in our study. Two cases of anti-platelet drug Clopidogrel induced, 2 cases of Chemotherapy induced, and one case each of antirheumatic drug Leflunamide and analgesic Indomethacin. Weinzierl EP et al[22] obtained 8 cases of drug induced pancytopenia including chemotherapeutic regimens out of 250 cases of pancytopenia. Santra G et al[14] found 15 cases of pancytopenia secondary to drug induced including chemotherapy cases out of total 111 cases of pancytopenia.

Clopidogrel, an anti-platelet drug, has major adverse effects causing marrow suppression.[23] Previous reports have suggested clopidogrel may be a potential cause of pancytopenia irrespective of the duration of treatment, though rarely seen. Hence, careful clinical and hematological monitoring should be carried out in the course of treatment with clopidogrel.[24] In the present study the two cases were of transient bone marrow suppression due to intake of Clopidogrel. Once the treatment was stopped the blood counts were normalized.

Leflunomide, a disease-modifying antirheumatic drug, inhibits pyrimidine synthesis in lymphocytes (T-cells) and other rapidly dividing cells. It may rarely be associated with life-threatening pancytopenia. Time of onset pancytopenia after the drug intake is variable.[25] On discontinuation of the treatment the patient in our study had improved with time.

Pancytopenia following intake of analgesic drugs have a delay of 2-3 months between BM injury and the onset of pancytopenia.[26] In the present study a case of self-administered non-steroid anti-inflammatory drug (NSAID) Indomethacin for about four years following the diagnosis of Break Bone Fever caused by Chickungunya virus. Unfortunately after withdrawal of the drug there was no improvement in the hematological parameters. Santra G et al[14] found 2 patients out of 111 cases (1.8%) developing pancytopenia following intake of NSAIDs (ibuprofen and diclofenac).

We received three (3.75%) multiple myeloma presenting with pancytopenia, which was in comparison to the incidences found in Tilak V et al[6] (1.3%), Gayathri BN et al[9] (0.96%) and Khodke K et al[27] (4%). Hemoglobin concentration correlated directly with the percentage of myeloma cells in S phase may suggest that the bone marrow cytokine milieu, permissive for myeloma cell proliferation, is not conducive to efficient erythropoiesis. In patients with more advanced disease, there may be thrombocytopenia and neutropenia along with anemia.[28,29]

We had 3 cases (3.75%) of AA. Internationally, AA occurs more commonly in the East than in the West with a higher prevalence in the Indian subcontinent which may be attributed to environmental factors such as exposure to toxic chemicals, viral infections and drugs rather than genetic factors.[22] The incidence of AA usually varies from 7.7% to 43% among pancytopenic patients.[8] However, the incidence in our study was lower to those studies reported by Khunger JM et al[7] (14%), Gayathri BN et al[9] (19%) and Hamid GA et al[10] (13.3%). Fortunately, this was similar to an incidence of 4.8% reported by Jain A et al.[5]

MDS is characterized by ineffective hematopoiesis by its increased apoptosis in early and matured forms of hematopoietic cells. MDS may thus be suspected in cases of pancytopenia.[7] Three cases of pancytopenia with MDS of RAEB (3.75%) were noted in the present study. The incidence of MDS as reported in other similar studies varies from 0 to 18%.[5] Khunger et al[7] reported 2% of MDS causing pancytopenia and Santra G et al[14] with 2.7% cases in 111 adult pancytopenia patients. Jain A et al[5] reported 0.4% case of pancytopenia due to MDS of RAEB type. MDS are most common in the elderly and should be included in the differential diagnosis of elderly patients with pancytopenia, even if mild. Pancytopenic presentation is more common with MDS-RAEB type.[5]

Dengue was found in 2 cases (2.5%) in our study. Santra G et al[14] had a single case of dengue (0.09% of 111 cases) with hypoplasia of BM due to hemophagocytosis. One patient in our study expired due to Dengue Hemorrhagic Fever with shock.

We noted 2 cases (2.5%) of ALD without splenomegaly. Alcohol is known to cause suppression of hematopoeisis especially seen in severe alcoholism, and also may lead to nutritional deficiencies of folic acid and other vitamins that play a role in the hematopoietic cell development.[30] A study done by CF Weston et al[31] from UK observed 3 patients of alcohol liver disease without splenomegaly who presented with pancytopenia.

We found a single case of myelofibrosis (1.25%) in our study. Literature also reveals pancytopenia in myelofibrosis in studies done by Tilak V et al[6] (1 of 77 cases, 1.29%) and Khunger JM et al[7] (2 of 200 cases, 1%).

IDA is usually associated with thrombocytosis due to platelet production by erythropoietin.[32] However, some patients with severe or long standing IDA may develop mild thrombocytopenia possibly due to complicating factors such as folate deficiency or splenic sequestration and the role of iron being required in the late stage of thrombopoiesis.[21] Some studies believed that the increasing severity of iron deficiency leads to normalization and occasionally even decreases the platelet count. The exact mechanism of this is unclear but could be related to the alteration in the activity of iron dependent enzymes in thrombopoiesis and leucopoiesis.[33]

IDA was seen in a single case (1.25%) of our cases of pancytopenia. An incidence of 1.3% by Hamid GA et al[10] and 8% by Devi PM et al[21] were reported.

Non-Hodgkin lymphomas can lead to pancytopenia by BM replacement, autoimmune cytopenias / splenomegaly.[31] The incidence of NHL in other similar studies varies from 0.9 to 10%.[5] We observed a case of Non-Hodgkin lymphoma- Lymphoplasmacytic Lymphoma (1.25%). Weinzierl EP et al[22] observed 5 cases of large B-cell lymphoma out of 125 cases of adults with pancytopenia. Khunger JM et al[7] found 2 cases of Non-Hodgkins Lymphoma from 200 cases of pancytopenia.

One case of HIV infection (1.25%) was noted in the present study. Pancytopenia occurs late during the course of HIV infection.[27] Previous literature reveals an incidence of 1.8% (2 of 111 cases) in Santra G et al[14], 6% (3 of 50 cases) in Devi PM et al[21] and 2% (1 of 50 cases) in Khodke K et al[27].

SLE presenting with pancytopenia was seen in one case (1.25%) in our study. This was similar to the study by Devi PM et al[21] with one case (2%) of SLE with pancytopenia. Santra G et al[14] diagnosed 8 cases of SLE with pancytopenia from 111 total cases. Previous literature has suggested that SLE can present with pancytopenia and bone marrow fibrosis. The non-characterized autoimmune diseases with positive autoimmune serology can also lead to modest reticulin fibrosis.[34]

We received a case (1.25%) of pancytopenia associated with metastatic adenocarcinoma of prostate without prior history of chemotherapy. Weinzierl EP et al[22] observed 2 cases (1.6%) of neoplastic diagnoses among 125 adults with pancytopenia were attributed to metastatic carcinoma involving bone marrow. Devi PM et al[21] also reported a case of pancytopenia following squamous cell carcinoma of nasal septum.

There was one case (1.25%) of pancytopenia secondary to autoimmune cause. Studies done by Bailey FA et al, Roffe C et al and Sumimoto S et al have found the presence of an antibody or suppressor cells directed against hematopoietic stem cells.[35,36,37] Abrams EM et al[38] have suggested the possibility of an underlying relationship of cytotoxic T lymphocytes in the pathogenesis of autoimmune diseases and aplastic anemia. A study by Kritharis A et al[39] had observed a case of idiopathic autoimmune pancytopenia and was screened for rheumatologic, infectious and autoimmune disorders but had a negative work-up, although BM biopsy was consistent with autoimmune destruction of peripheral blood cells with panhyperplasia and mild perivascular plasmacytosis. It was suggested pancytopenia due to autoimmune dysregulation could be secondary to lymphoid hyperactivity or deficiency in lymphocyte apoptotic pathway eg Fas, but the exact cause was unknown.[35]

Conclusion

Pancytopenia is a laboratory diagnosis and is not an uncommon hematological problem. A large proportion of causes for pancytopenia are treatable and reversible, therefore accurate diagnoses and timely intervention maybe lifesaving and will have impact on the morbidity and mortality.

Physical findings and peripheral blood picture provide valuable information in the work up of pancytopenic patients and further helps in planning the investigations as well as management of the patients. In the present study BM examination was deferred in many of the cases especially diagnosed with hyperrsplenism and positive for malarial parasites.

Hypersplenism, especially due to ALD, was the commonest cause of pancytopenia in this study, indicating a change in the trend of lifestyle in the patients who are attending our hospital. The next common cause was malaria. Plasmodium vivax species was a more common parasite, which indicates that pancytopenia depends on geographic location.

Present study concludes that stringent diagnostic criterion and a general conceptual framework for ascertaining the cause of pancytopenia is very valuable and a demand of time.

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Competing Interests

None

Reference

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