

# Role of absolute reticulocyte count (ARC) in assessment of pancytopenia in patients undergoing bone marrow biopsy

## Abstract

**Introduction:** Pancytopenia is a common clinical condition presenting to physicians. It is decrease in all three cell lines (red blood cells, white blood cells and platelets). Bone marrow biopsy is indicated in patients of pancytopenia in which cause is not obvious. Non-invasive methods e.g. absolute reticulocyte count (ARC) may help in preliminary diagnosis to evaluate the cause of pancytopenia.

**Objective:** To see the role of absolute reticulocyte count (ARC) in the evaluation of pancytopenia in patients undergoing bone marrow biopsy.

**Patients and methods:** Prospective study, conducted at Department of Pathology, Pakistan Institute of Medical Sciences Islamabad, during the period of 2 years. Total of 185 patients with pancytopenia were included in the study. Bone marrow biopsy and absolute reticulocyte count was correlated to see the diagnostic significance of absolute reticulocyte count. Data was analyzed using SPSS 20.0.

**Results:** Most common cause of pancytopenia was megaloblastic anemia (28.64%), followed by infection (27.56%), aplastic anemia (20.54%), leukemia (11.35%), mixed deficiency anemia (4.32%), visceral leishmaniasis (3.78%), metastasis (2.7%) and myelodysplastic syndrome (1.08%). Absolute reticulocyte count (ARC) was measured: Aplastic anemia (<25x10<sup>9</sup>/L), myelodysplastic syndrome (25–50x10<sup>9</sup>/L), megaloblastic anemia (50–75x10<sup>9</sup>/L), leukemia (76–100x10<sup>9</sup>/L), infection (101–125x10<sup>9</sup>/L), visceral leishmaniasis and metastasis (126–150x10<sup>9</sup>/L).

**Conclusion:** Absolute reticulocyte count (ARC) is helpful in making preliminary diagnosis of patients presenting with pancytopenia. It can also give useful information about pancytopenia and more invasive and expensive investigations can be avoided.

**Keywords:** pancytopenia, reticulocyte, absolute reticulocyte count, bone marrow biopsy, megaloblastic anemia

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## Introduction

Pancytopenia is very important clinical condition presenting to physicians. It presents as the outcome of various clinical conditions. Pancytopenia is the condition in which all three components of blood (e.g. red blood cells, white blood cells and platelets), are decreased.<sup>1</sup> Initially, mild problems in bone marrow function may not be detected and usually presents during stress period or when demand is increased (e.g. bleeding or sepsis). Various conditions present as pancytopenia with underlying mechanisms being reduced production of hemopoietic cells, bone marrow growth reduction, suppression of cell differentiation, infiltration by abnormal cells, defect in the synthesis of cells which are eliminated from circulation.<sup>2</sup>

Bone marrow aspiration and trephine biopsy is considered important in evaluation of pancytopenia. Bone marrow is indicated in patients of pancytopenia having no obvious cause.<sup>3</sup> It is an invasive procedure and is not recommended when the cause is known with non-invasive procedures (e.g. complete blood count, vitamin B12, serum folate or iron profile), give exact diagnosis. Absolute reticulocyte count is the marker of production of red blood cells. It helps in hyperproliferative and hypoproliferative anemia. It is the calculated index which is derived from the product of reticulocyte count (percentage) and red blood cell count. Its normal value is 50–100X10<sup>9</sup>/L. Absolute

reticulocyte count is very helpful in preliminary evaluation of pancytopenia before undergoing bone marrow biopsy.<sup>4</sup>

Our study helps to see the diagnostic significance of absolute reticulocyte count in patients having pancytopenia who underwent bone marrow biopsy.

## Patients and methodology

It was prospective study performed at Department of Pathology, Pakistan Institute of Medical Sciences Islamabad. It was conducted between the periods of two years. Total of 185 patients were selected for this study. Inclusion criteria was patients filling the criteria of pancytopenia (e.g. hemoglobin <9g/dL, white blood cells count <4000/μL and platelet count <1,00,000/μL). Complete blood count and reticulocyte count was calculated in all patients. These patients were underwent bone marrow biopsy. Absolute reticulocyte count was calculated using the formula,  $ARC \text{ (thousand}/\mu\text{L)} = \text{Reticulocyte \%} \times \text{RBC count (million}/\mu\text{L)} \times 10$ . All cases were compared for diagnosis based on bone marrow biopsy and absolute reticulocyte count. All data were analyzed using SPSS version 20.0.

## Results

(Table 1–3) (Figure 1)

**Table 1** Causes of pancytopenia

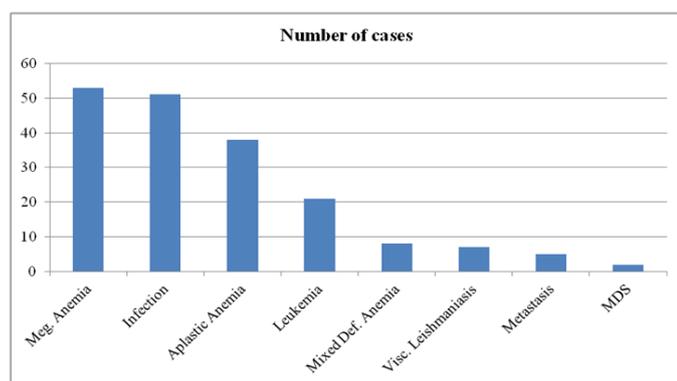
Causes	No. of cases	Mean Hemoglobin (g/dL)	Mean RBC Count (millions/ $\mu$ L)	Mean WBC Count ( $\times 10^9$ /L)	Mean Platelets ( $\times 10^9$ /L)
Megaloblastic anemia	53	7.41 $\pm$ 1.41	3.25 $\pm$ 0.48	2.3 $\pm$ 0.31	52 $\pm$ 21.41
Infection	51	8.27 $\pm$ 1.07	3.19 $\pm$ 0.88	3.58 $\pm$ 0.53	83 $\pm$ 42.02
Aplastic anemia	38	4.91 $\pm$ 1.82	2.04 $\pm$ 0.34	1.41 $\pm$ 0.09	41 $\pm$ 14.23
Leukemia	21	7.48 $\pm$ 2.04	3.43 $\pm$ 1.09	3.18 $\pm$ 0.72	78 $\pm$ 38.74
Mixed deficiency anemia	8	6.79 $\pm$ 1.78	3.83 $\pm$ 0.79	3.21 $\pm$ 0.46	71 $\pm$ 39.81
Visceral leishmaniasis	7	8.22 $\pm$ 1.87	3.98 $\pm$ 1.03	3.10 $\pm$ 0.68	89 $\pm$ 34.61
Metastasis	5	8.31 $\pm$ 2.95	3.21 $\pm$ 0.41	3.61 $\pm$ 0.46	61 $\pm$ 31.63
Myelodysplastic syndrome	2	7.42 $\pm$ 1.52	3.24 $\pm$ 0.83	3.46 $\pm$ 0.61	72 $\pm$ 28.48

**Table 2** Reticulocyte count and absolute reticulocyte count (ARC)

Cause	Reticulocyte Count (%)	Absolute Reticulocyte Count ( $\times 10^9$ /L)
Aplastic anemia	0.1	19.29 $\pm$ 1.41
Mixed deficiency anemia	0.1	27.75 $\pm$ 1.87
Myelodysplastic syndrome	0.1	31.98 $\pm$ 1.41
Megaloblastic anemia	0.2	54.21 $\pm$ 1.32
Leukemia	2.6	85.38 $\pm$ 1.58
Infection	3.5	114.53 $\pm$ 1.58
Visceral leishmaniasis	0.4	126.32 $\pm$ 1.63
Metastasis	4.1	141.81 $\pm$ 2.55

**Table 3** Gender and Age Distribution

Gender	Number/Percentage	Mean Age
Male	89 (48.10%)	35.3 $\pm$ 2.54 years
Female	96 (51.90%)	32.46 $\pm$ 3.10 years



**Figure 1** Number of cases.

## Discussion

Among various causes of pancytopenia, megaloblastic anemia is found to be commonest among them.<sup>5</sup> Our study shows various causes of pancytopenia such as megaloblastic anemia (28.64%),

infection (27.56%), aplastic anemia (20.54%), leukemia (11.35%), mixed deficiency anemia (4.32%), visceral leishmaniasis (3.78%), metastasis (2.7%) and myelodysplastic syndrome (1.08%). Other studies showed similar results (Table 1) (Figure 1). Gayathri et al.<sup>1</sup> showed in his study that most common cause of pancytopenia was megaloblastic anemia (74.04%), followed by aplastic anemia (18.26%).<sup>1</sup> Another study by Sindhu et al.<sup>6</sup> showed that most common cause of pancytopenia was aplastic anemia (33.7%), followed by megaloblastic anemia (32.55%).<sup>6</sup> Absolute reticulocyte count was significant in our study. All causes of pancytopenia showed significant difference in their absolute reticulocyte count e.g. Aplastic anemia (<25  $\times 10^9$ /L), myelodysplastic syndrome (25–50  $\times 10^9$ /L), megaloblastic anemia (50–75 $\times 10^9$ /L), leukemia (76–100  $\times 10^9$ /L), infection (101–125 $\times 10^9$ /L), visceral leishmaniasis and metastasis (126–150 $\times 10^9$ /L) (Table 2). These findings are in favor of study performed by Priya et al.,<sup>4</sup> showed absolute reticulocyte count was <25 $\times 10^9$ /L in aplastic anemia, 25–50 $\times 10^9$ /L for nutritional anemias and >100 $\times 10^9$ /L in bone marrow infiltration and sepsis.<sup>4</sup> Pancytopenia is the decrease in all major three parameters of blood (red blood cells, white blood cells and platelets), so it presents simultaneously as anemia, leucopenia and/or thrombocytopenia. It is basically not a disease, but a triad of specific findings that are caused by different disease processes, which primarily and/or secondary involves bone marrow. Pancytopenia needs complete hematological workup with accurate correlation with clinical background; hence requires investigation of underlying processes.<sup>1,7</sup>

In our study, every independent cause of pancytopenia showed difference in absolute reticulocyte count, so it might help in preliminary diagnosis of pancytopenia based on absolute reticulocyte count before going for invasive procedure e.g. bone marrow biopsy.

## Conclusion

Pancytopenia can present in various clinical condition. Approach in correct direction is very necessary to evaluate the exact cause of its etiology. Non-invasive methods may help in making preliminary diagnosis and to rule out less associated causes.

## Acknowledgments

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## Conflicts of interest

Authors declare that there are no conflicts of interest.

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