

Diagnostic value of mean corpuscular volume in the detection of vitamin B12 deficiency

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ABSTRACT

Background: Vitamin B12 deficiency is thought to be more common than was previously believed. A strict vegetarian diet has been associated with increased risk of vitamin B12 deficiency. Erythrocyte indices have been used in the initial evaluation of anemic patients. Raised mean corpuscular volume (MCV) is commonly used by physicians as an indicator for megaloblastic anemia caused by vitamin B12 deficiency. **Objective:** (1) The objective of the study was to study the correlation between serum vitamin B12 level and MCV. (2) Prevalence of vitamin B12 deficiency in this region. **Materials and Methods:** We had retrospectively observed the records of serum vitamin B12 and complete blood cell count of both outpatients and inpatients from January 2016 to February 2017. Total, 1110 cases were studied. Peripheral smears of all patients were studied. **Results:** The prevalence of vitamin B12 was 33.06%. Most common age was the 4th decade with female predominance. Out of 367 patients who were vitamin B12 deficient, 28% had low MCV, and 52% had normal MCV. Out of 743 patients with normal vitamin B12 level, 12% had high MCV. It suggests that there is no correlation between vitamin B12 levels and MCV in the majority of cases. **Conclusion:** Every third person is vitamin B12 deficient in this region. MCV is unreliable as a screening parameter for the presumed diagnosis of macrocytic anemia, which is associated with vitamin B12 deficiency.

KEY WORDS: Megaloblastic Anemia; Vitamin B12; Mean Corpuscular Volume


INTRODUCTION

The megaloblastic anemia are a group of disorders characterized by the presence of distinctive morphologic appearances of the developing red cells in bone marrow. The marrow is usually hypercellular, and the anemia is based on ineffective erythropoiesis. The cause is usually a deficiency of either vitamin B12 or folate, but megaloblastic anemia may occur because of genetic or acquired abnormalities that affect the metabolism of these vitamins or because of defects in DNA

synthesis not related to cobalamin or folate. Megaloblastic anemia is characterized by decreased level of hemoglobin with macrocytosis and mean corpuscular volume (MCV) >100 fl.^[1] A measurement of serum vitamin B12 is the most commonly used biochemical test for diagnosing vitamin B12 deficiency.^[2] Erythrocyte indices have been used in the initial evaluation of anemic patients; high MCV value is a traditional criterion for folate and vitamin B12 deficiencies.^[3] We did an observational study with aimed to study the correlation between serum vitamin B12 level and MCV and prevalence of vitamin B12 deficiency in this region.

MATERIALS AND METHODS

This observational study was conducted in Department of Pathology at Tertiary Care Hospital during the period from January 2016 to February 2017. In this study, 1110 cases were observed. Participant recruitment procedure is convenient.

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Both outpatients and inpatients were included in the study. Patients in which simultaneous complete blood cell count (CBC) and vitamin B12 was done, were included in the study. The patients in which treatment of vitamin B12 deficiency was given in the form of injection or oral supplements, were excluded. CBC was studied in 5 part automated hematology analyzer; Beckman Coulter LH 750 with the principle of volume, conductivity and scatter. Serum vitamin B12 was measured with standardized biochemistry kit in fully automated hormone immunoassay machine COBAS e 411 with principle of electrochemiluminescent.

Statistical Analysis

Pearson correlation, Chi-square test, and SPSS 24 software were used for statistical analysis of the study.

RESULTS

In this study, total 1110 patients were studied. 33.06% (367/1110) patients were vitamin B12 deficient in this region. Normal range of vitamin B12 is 191-663 pg/ml. In this study, vitamin B12 is more common in females (55.05%). The most common decade for vitamin B12 deficiency is 4th decade with mean age of 41.46 ± 15.80 .

Table 1 suggest that out of total 1110 patients, 9.5% (105/1110) had serum vitamin B12 < 100 pg/ml with mean MCV of 91.8 fl. 23.6% (262/1110) patients had serum vitamin B12 between 100-191 pg/ml with mean MCV of 87.3 fl. 66.9% (743/1110) patients had serum vitamin B12 > 191 pg/ml with mean MCV of 85.3 fl. Table 2 suggest that out of 367 vitamin B12 deficient patients; 28% (108/367) had low MCV, 52% (190/367) had normal MCV, so 80 % patients had normal or low MCV even they were vitamin B12 deficient. 12% (88/743) patients were having high MCV even they were having normal vitamin B12 level. It suggests that there is no correlation between MCV and serum vitamin B12.

Table 1: Distribution of patients according to vitamin B12 level

Vitamin B12 (pg/ml)	Number of cases (%)	Mean MCV (fl)
<100	105 (9.5)	91.8
100-191	262 (23.6)	87.3
>191	743 (66.9)	85.3
Total	1110 (100)	-

MCV: Mean corpuscular volume

Table 2: MCV distribution in patients with low vitamin B12 levels (n=367)

Low MCV (<83 fl)	Normal MCV (83-96 fl)	High MCV (>96 fl)
103 (28%)	190 (52%)	74 (20%)

MCV: Mean corpuscular volume

DISCUSSION

The prevalence of vitamin B12 in our region is 33.06%, which was correlated with previously done studies. Kankonkar et al.^[4] reported 33% prevalence of vitamin B12 deficiency in 2004. Gupta et al.^[5] reported 39% prevalence of vitamin B12 deficiency in 2004. Khanduri et al.^[6] reported 46.9% prevalence of vitamin B12 deficiency in 2005. Bhatia et al.^[7] reported 33.8% prevalence of vitamin B12 deficiency in 2010 and Jain et al.^[8] reported 36.5% prevalence of vitamin B12 deficiency in 2011. In this study, 80% (293/367) patients were having normal or low MCV even they are vitamin B12 deficient. Bhatia et al.^[7] reported 75% patients were having normal or low MCV even they are vitamin B12 deficient. Jain et al.^[8] reported 89% patients were having normal or low MCV even they are vitamin B12 deficient. Oosterhuis et al.^[9] reported 84% patients were having normal or low MCV even they are vitamin B12 deficient. Thompson et al.^[10] reported that 82% of patients with low B12 levels seen at Bellevue Hospital, New York, had MCV values below 95 fl; they suggested that further evaluation of the suspected B12 deficiency should not be deterred by a normal MCV value which is one of the important observations in our study. We found several interesting observations during our study in which traditional criteria of vitamin B12 and MCV association was not followed in most of the cases. Among 1110 patients only 14.59% had macrocytosis, 32.34% had microcytosis and 53.07% were normocytic. These findings suggest that concomitant iron or other nutritional deficiencies or hemoglobinopathies may have been responsible for the normal or even low MCV values in some of our anemic patients; such anemias and hemoglobinopathies have been seen commonly in Southeast Asians.^[3] Thus, physicians should not consider elevated MCV as diagnostic criteria for Vitamin B12 deficiency. Oosterhuis et al.^[9] analyzed the diagnostic value of an elevated MCV for B12 deficiency where the sensitivity was only 17-30%, and up to 84% of the deficiency would be missed.

Our study has some important limitations; first, dietary information was not available. Second, our study was based on serum B12 results, which alone, without other biochemical markers such as homocysteine, methylmalonic acid might not be accurate measures of B12 deficiency.^[2] Even if our findings are valid, we must consider their clinical significance. We believe that B12 deficiency is not just a laboratory finding but a clinically relevant issue as the symptoms are vague and nonspecific but respond to appropriate vitamin B12 deficiency therapy.

CONCLUSION

Every third person is vitamin B12 deficient in this region. There is no correlation between serum vitamin B12 level and MCV in the majority of cases. MCV should not be the only criteria to order vitamin B12 for anemia under evaluation.

The peripheral smear findings such as macrocytes, macroovalocytes, cabot's ring, basophilic stippling, and hypersegmented neutrophils can help to get differential diagnosis of anemia due to deficiency of vitamin B12; that is megaloblastic anemia.

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