



CLINICAL MANIFESTATIONS AND OUTCOMES OF VITAMIN B12 DEFICIENCY: A RETROSPECTIVE STUDY

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ABSTRACT:

Objective: To examine the clinical manifestations of vitamin B12 deficiency and assess their impact on patient health, focusing on the variety of symptoms and outcomes associated with this condition.

Methods: A retrospective cohort study was conducted using medical records from three healthcare institutions covering the period from January 2019 to December 2023. Inclusion criteria were: (1) diagnosis of vitamin B12 deficiency with serum levels below 200 pg/mL; (2) availability of comprehensive clinical data; and (3) age 18 years or older. Exclusion criteria included incomplete records, secondary causes of vitamin B12 deficiency, age <18 years, and pre-existing vitamin B12 supplementation. Data on patient demographics, clinical symptoms, treatment regimens, and outcomes were analyzed.

Results: The study included 200 patients with a mean age of 64.3 years. Clinical manifestations were categorized into hematological (60%), neurological (42.5%), gastrointestinal (35%), and psychiatric (27.5%). Neurological symptoms included peripheral neuropathy (58.8%) and cognitive impairment (23.5%). Treatment led to improvement in 70-80% of patients across most symptom categories, though some patients experienced persistent symptoms.

Conclusion: Vitamin B12 deficiency presents with a range of clinical manifestations that impact multiple organ systems. Early diagnosis and treatment are crucial for mitigating severe symptoms and improving patient outcomes. Despite treatment, some patients may require ongoing management due to persistent symptoms. This study highlights the importance of recognizing and addressing the diverse effects of vitamin B12 deficiency to enhance patient care.

Keywords: Vitamin B12 deficiency, clinical manifestations, hematological symptoms, neurological symptoms, treatment outcomes.

INTRODUCTION

Vitamin B12, also known as cobalamin, is an essential water-soluble vitamin crucial for various physiological processes, including DNA synthesis, red blood cell production, and neurological function (1,2). Deficiency of this vitamin can lead to significant clinical manifestations affecting multiple organ systems, highlighting its critical role in maintaining overall health.

Vitamin B12 is primarily absorbed in the ileum and its deficiency can result from various causes, including inadequate dietary intake, malabsorption syndromes, and certain medications (3,4). Inadequate dietary intake is particularly common in individuals following vegetarian or vegan diets, as B12 is predominantly found in animal products (5). Malabsorption issues, such as those seen in

pernicious anemia or gastrointestinal disorders, can also significantly impact B12 levels (6,7).

Clinically, vitamin B12 deficiency often presents with a range of hematological, neurological, gastrointestinal, and psychiatric symptoms. One of the hallmark manifestations is megaloblastic anemia, characterized by the presence of large, dysfunctional red blood cells and a decrease in hemoglobin levels (8). This condition is often accompanied by fatigue, weakness, and pallor (9). Neurologically, deficiency can lead to peripheral neuropathy, which manifests as numbness, tingling, and a loss of proprioception (10). More severe neurological involvement can result in subacute combined degeneration of the spinal cord, affecting the dorsal columns and corticospinal tracts, and leading to gait disturbances and balance issues (11).

Gastrointestinal symptoms such as glossitis, angular cheilitis, and loss of appetite are also common (12). Additionally, psychiatric manifestations including depression and cognitive impairment have been reported, particularly in older adults (13). Elevated homocysteine levels, a result of disrupted vitamin B12 metabolism, further contribute to cardiovascular risk (14).

Despite these well-documented effects, vitamin B12 deficiency often remains underdiagnosed due to the variability in symptoms and their overlap with other conditions. Early recognition and management are critical to prevent irreversible damage and improve patient outcomes (15).

This introduction aims to provide a comprehensive overview of the clinical manifestations associated with vitamin B12 deficiency, emphasizing the importance of timely diagnosis and treatment.

Aim

To investigate the clinical manifestations of vitamin B12 deficiency and their impact on patient health, focusing on the range of symptoms and potential outcomes associated with this condition.

Objectives

1. To identify and categorize the primary clinical manifestations of vitamin B12 deficiency across different organ systems.
2. To assess the impact of vitamin B12 deficiency on patient outcomes, including the severity of symptoms and potential long-term effects.

Materials and Methods

This study utilized a retrospective design to examine the clinical manifestations of vitamin B12 deficiency and their impact on patient health. Data were collected from medical records of patients diagnosed with vitamin B12 deficiency at three healthcare institutions from January 2017 to December 2018. Patients were included if they met the following criteria: (1) diagnosis of vitamin B12 deficiency based on clinical and biochemical criteria, including serum vitamin B12 levels below 200 pg/mL and elevated methylmalonic acid (MMA) or homocysteine levels; (2) availability of comprehensive clinical data, including symptom documentation and follow-up information; and (3) age 18 years or older.

Exclusion criteria were: (1) patients with incomplete or missing clinical data on symptoms, treatment, or follow-up; (2) individuals with secondary causes of vitamin B12 deficiency such as known malignancies or specific gastrointestinal disorders that were not the primary focus of the study; (3) patients younger than 18 years; and (4) those who had started vitamin B12 supplementation before their initial diagnosis.

Data collected included patient demographics, clinical symptoms categorized by organ system (hematological, neurological, gastrointestinal, and psychiatric), treatment regimens, and follow-up outcomes. Statistical analyses were performed to evaluate the prevalence and severity of symptoms, as well as the association between vitamin B12 deficiency and various clinical manifestations. The study was approved by the institutional review board, ensuring ethical considerations and patient confidentiality.

Results:**Table 1: Baseline Characteristics of Patients with Vitamin B12 Deficiency**

Characteristic	Value
Total Patients (n)	200
Mean Age (years)	64.3 ± 11.5
Gender (Male/Female)	90/110
Mean Serum Vitamin B12 (pg/mL)	150 ± 50
Mean Follow-Up Duration (months)	12.5 ± 6.2

The study included 200 patients with a mean age of 64.3 years. There was a slightly higher proportion of females compared to males. The mean serum vitamin B12 level was 150 pg/mL, and patients were followed for an average of 12.5 months.

Table 2: Distribution of Clinical Manifestations by Organ System

Symptom Category	Number of Patients (n)	Percentage (%)
Hematological	120	60%
Neurological	85	42.5%
Gastrointestinal	70	35%
Psychiatric	55	27.5%

The most common clinical manifestations were hematological, affecting 60% of the patients. Neurological symptoms were observed in 42.5%, gastrointestinal issues in 35%, and psychiatric symptoms in 27.5%.

Table 3: Severity of Neurological Symptoms in Patients with Vitamin B12 Deficiency

Neurological Symptom	Number of Patients (n)	Severity (%)
Peripheral Neuropathy	50	58.8%
Subacute Combined Degeneration	25	29.4%
Cognitive Impairment	20	23.5%

Among patients with neurological symptoms, peripheral neuropathy was the most common, affecting 58.8% of those with neurological involvement. Subacute combined degeneration and cognitive impairment were observed in 29.4% and 23.5% of patients, respectively.

Table 4: Impact of Vitamin B12 Deficiency on Treatment Outcomes

Outcome	Number of Patients (n)	Improvement (%)
Hematological Symptoms	120	80%
Neurological Symptoms	85	70%
Gastrointestinal Symptoms	70	65%
Psychiatric Symptoms	55	60%

Treatment led to improvement in 80% of patients with hematological symptoms and 70% of those with neurological symptoms. Gastrointestinal and psychiatric symptoms showed improvements in 65% and 60% of

patients, respectively, with a lower proportion experiencing worsening symptoms.

Discussion

This study sheds light on the diverse clinical manifestations of vitamin B12 deficiency and

their impact on patient health. Our findings confirm that vitamin B12 deficiency presents with a wide array of symptoms affecting multiple organ systems, with significant implications for diagnosis and management.

Hematological manifestations, including megaloblastic anemia, were observed in 60% of our patients, consistent with existing literature (1,2). Vitamin B12 is crucial for proper red blood cell formation, and its deficiency often results in the production of abnormally large, ineffective red blood cells, leading to anemia (3). This condition typically presents with symptoms such as fatigue, weakness, and pallor, which were prevalent in our cohort.

Neurological symptoms, affecting 42.5% of patients, include peripheral neuropathy, subacute combined degeneration of the spinal cord, and cognitive impairment. Peripheral neuropathy was the most common neurological manifestation, affecting 58.8% of those with neurological symptoms. This aligns with prior studies that highlight the role of vitamin B12 in maintaining myelin integrity, and its deficiency can lead to nerve damage and neurological dysfunction (7, 16). Subacute combined degeneration, affecting 29.4% of patients, is particularly concerning as it can lead to irreversible neurological deficits if not promptly addressed (17). Cognitive impairment, affecting 23.5% of patients, underscores the impact of vitamin B12 deficiency on mental health, with previous research linking low B12 levels to cognitive decline and dementia (13).

Gastrointestinal and psychiatric manifestations were less common but still significant. Gastrointestinal symptoms such as glossitis and loss of appetite affected 35% of patients, which is consistent with reports highlighting the role of vitamin B12 in maintaining gastrointestinal mucosa (9). Psychiatric symptoms, including depression and irritability, were noted in 27.5% of patients. These findings corroborate studies linking vitamin B12 deficiency to mood disorders and cognitive disturbances (10, 14).

The impact of treatment was notable, with significant improvement in hematological and neurological symptoms in 70-80% of patients.

This suggests that early diagnosis and appropriate vitamin B12 supplementation can effectively mitigate many of the adverse effects associated with deficiency (11). However, a portion of patients did not experience complete resolution of symptoms, highlighting the need for ongoing management and monitoring (15).

In conclusion, this study reinforces the importance of recognizing the broad spectrum of clinical manifestations associated with vitamin B12 deficiency. It emphasizes the need for comprehensive evaluation and treatment strategies to address both the direct and indirect impacts of this deficiency on patient health.

Conclusion

This study underscores the multifaceted clinical manifestations of vitamin B12 deficiency and their significant impact on patient health. The findings illustrate that vitamin B12 deficiency can present with a broad spectrum of symptoms, affecting hematological, neurological, gastrointestinal, and psychiatric systems. Specifically, megaloblastic anemia, peripheral neuropathy, subacute combined degeneration of the spinal cord, and cognitive impairment were prevalent among patients, reflecting the vitamin's essential role in red blood cell formation and neurological function.

The association between elevated symptom severity and vitamin B12 deficiency highlights the critical importance of early diagnosis and intervention. Our results indicate that vitamin B12 supplementation leads to substantial improvement in many symptoms, particularly hematological and neurological manifestations. However, persistent symptoms in a subset of patients suggest that ongoing management may be necessary, emphasizing the need for continuous monitoring and personalized treatment approaches.

Overall, this study reinforces the need for heightened awareness among healthcare providers regarding the diverse presentations of vitamin B12 deficiency. Timely identification and treatment are crucial to prevent severe and potentially irreversible complications, improving patient outcomes and quality of life.

Future research should continue to explore the underlying mechanisms of vitamin B12 deficiency and evaluate long-term management strategies to optimize patient care.

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