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Aamir Jalal Al-Mosawi *

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Short Communication

The Uses of Intravenous Vitamin B12: An Educational Article and expert Opinion

Aamir Jalal Al-Mosawi

Advisor doctor The National Training and Development Center and Baghdad Medical City.

*Corresponding Author: Aamir Jalal Al-Mosawi, Advisor doctor The National Training and Development Center and Baghdad Medical City.

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Abstract

Intravenous vitamin B12 has been employed in medical practice since the 1950s for various therapeutic purposes, demonstrating broad potential across multiple conditions. This article synthesizes the applications and efficacy of intravenous vitamin B12. Initially used for treating pernicious anemia and neurological disorders, its therapeutic scope has expanded to include management of infective hepatitis, cyanide poisoning, and neuropathies. Notably, intravenous hydroxocobalamin is recognized as an effective antidote for cyanide toxicity, while intravenous methylcobalamin shows promise in alleviating peripheral neuropathy and promoting nerve regeneration. The treatment has also been beneficial in cognitive and emotional function improvements in dementia, reduction of chemotherapy-induced peripheral neuropathy, and normalization of hyperhomocysteinemia in chronic renal failure. Additional uses include addressing vasoplegic syndrome and mitigating nitrous oxide-induced myelopathy. Recent findings further highlight its role in treating megaloblastic anemia and preventing complications in vegetarians. Overall, intravenous vitamin B12 demonstrates substantial therapeutic potential across a range of medical conditions, reinforcing its value in both acute and chronic clinical settings.

Keywords: intravenous vitamin b12; therapeutic applications; expert opinion

Summary

Intravenous vitamin B12 has been explored for various medical uses since the 1950s, with research spanning multiple conditions and applications.

Intravenous vitamin B12 has been used as early as the 1950s in the treatment of pernicious anemia, diabetic complications, and neurological conditions. It has long been used in treating pernicious anemia and related neurological issues, demonstrating efficacy in improving symptoms and outcomes [1, 2, 3].

In 1960, Jain and Mukerji reported their observations suggesting that intravenous B12 has the potential to have a therapeutic value in infective hepatitis [4]. In 1965, Grasso reported the use of intravenous vitamin B12 with other vitamins in the treatment of infective viral hepatitis [5]. In 1968, Fieschi and colleagues reported the use of intravenous vitamin B12 (Hydroxycobalamin) in the treatment of pain radicular syndromes [6].

Observations from the 1960s suggested that intravenous B12 might be beneficial in managing infective hepatitis, although this use is less commonly highlighted in more recent literature [4, 5].

Intravenous hydroxocobalamin is well-established as an effective antidote for cyanide poisoning. It works by preventing cyanide transfer to tissues, thereby reducing the risk of cyanide toxicity.

As early as 1978, Cottrell et al. reported a study which included patients received nitroprusside alone, and patients received nitroprusside plus intravenous vitamin B12 (Hydroxycobalamin). The study showed show that intravenous vitamin B12 can prevent cyanide transfer from red cells and plasma to tissue following nitroprusside metabolism, and thus it can prevent cyanide intoxication associated with intravenous sodium nitroprusside [7].

In 1992, Kurabayashi et al. from Japan described a 59-year-old female patient who developed post-gastrectomy megaloblastic anaemia, fecal incontinence, and paraesthesia in her 4 extremities. Anemia responded to treatment with a total dose of 17 mg of intramuscular mecobalamin. However, the neurological abnormalities didn't improve. After 5 months, a total dose of 7.5 mg of intravenous mecobalamin was given over a period of 5 weeks. Treatment was associated with gradual improvement in incontinence and peripheral neuropathy which led completely cure within 8 weeks [8].

There is evidence suggesting that intravenous vitamin B12 can benefit cognitive and emotional functions in Alzheimer-type dementia, with improvements in memory, communication, and overall cognitive function.

In 1992, Ikeda et al. from Japan reported the beneficial effect of intravenous vitamin B12 (Mecobalamin) when used in the treatment of Alzheimer-type dementia. Treatment was associated with improvement in cognitive

functions, memory, emotional functions, and communication. Treatment was not associated with side effects and was considered safe [9].

In 1993, Forsyth et al. from the United States reported a study which included healthy heavy smokers' male volunteers. The study showed that a 5-gram intravenous dose of vitamin B 12 (Hydroxocobalamin) can reduce blood cyanide levels by 59% and increased urinary cyanide excretion in heavy smokers. Treatment was associated with a temporary reddish discoloration of urine skin, mucous and membranes. Treatment was also associated with 13.6% increase in systolic, 25.9% increase in diastolic blood pressure, and 16.3% decrease in heart rate. Therefore, the treatment was considered safe [10].

In 1999, Kuwabara et al reported a study which included 9 patients who had polyneuropathy (Uremic or uremic-diabetic) and were treated with maintenance hemodialysis. The patients treated with intravenous methylcobalamin (500 microg) three times weekly for 6 months. Treatment was associated with ultra-high levels of vitamin B12 because of the lack of urinary excretion. Treatment was associated with improvement in pain or paraesthesia, and in the ulnar motor and median sensory nerve conduction velocities. Treatment was not associated with side effects, and was considered safe [11].

In 2001, Buccianti et al. from Italy reported a study which included 55 patients with chronic renal failure treated with maintenance hemodialysis. 27 patients were treated with an intravenous preparation containing folinic acid and vitamin B12 for megaloblastic anemia at the end of each hemodialysis session for six months. Treatment was associated with considerable lowering of plasma homocysteine level [12].

Intravenous vitamin B12, often combined with folic acid, can help normalize elevated homocysteine levels in patients with chronic renal failure, improving their overall metabolic profile.

In 2002, Koyama et al. from Japan emphasized that hyperhomocysteinemia associated with chronic renal failure results from defective remethylation pathway cannot be cured by folic acid treatment alone. They reported a controlled study which included twenty-one patients treated with maintenance hemodialysis who was receiving oral folic acid (15 mg daily). Seven of the 21 patients received intravenous methylcobalamin 500 mg after hemodialysis sessions, and seven patients received intravenous methylcobalamin 500 mg plus oral vitamin B6 (60 mg daily) for three weeks. Twelve patients treated with maintenance hemodialysis who was receiving methylcobalamin alone were used as the control group. Seven healthy volunteers were included in the study as the normal control group. The 14 patients treated with folic acid plus intravenous methylcobalamin 500 mg experienced normalization of fasting homocysteine levels (Below 12 ng/ml). Therefore, the study showed that intravenous methylcobalamin can significantly reduce homocysteine levels [13].

In 2003, Nagaishi et al. reported a 40-year-old female who had pancytopenia, megaloblastic anemia, a clinical diagnosis of subacute combined degeneration, and hair grayness. Magnetic resonance imaging revealed hyperintensity in the posterior column below the thoracic spinal cord. Serum homocysteine was significantly increased, but serum vitamin B12 was within normal. However, she responded to treatment with intravenous vitamin B12 (Mecobalamin) 0.5 mg daily and experienced improvements in muscle strength, sensory impairment, pancytopenia, megaloblastic anemia, and hair grayness [14].

In 2006, Uhl et al. from Germany confirmed the safety profile of large doses of intravenous vitamin B 12 (Hydroxocobalamin). They reported a placebo-controlled which included 136healthy volunteers who received intravenous hydroxocobalamin doses of 2.5, 5, 7.5, 10 grams or placebo over 7.5 to 30 minutes. Common side effects included asymptomatic, transient chromaturia and skin reddening. Other side effects included pustular/papular rash, headache, and reduction of lymphocyte percentage, nausea, pruritus, chest discomfort, and dysphagia. Elevation of blood pressure was observed in some volunteers. Two allergic reactions were observed with 5 grams and 10 grams doses responded to treatment with dexamethasone and/or dimethindene maleate [15].

In 2012, Thompson and Marrs from the United Kingdom reviewed the literature and emphasized that intravenous vitamin B 12 (Hydroxocobalamin) is an effective antidote for cyanide poisoning. They also emphasized that experimental studies on animal and clinical studies showed that that large dose intravenous vitamin B 12 (Hydroxocobalamin) is generally not associated with important adverse effects. However, one study on volunteers, reported the occurrence of delayed but prolonged rashes in one-sixth of volunteers who received 5 grams or more. Rare reported adverse effects include dyspnea, facial edema, and urticaria [16].

Studies have shown that intravenous vitamin B12, particularly methylcobalamin, can improve symptoms of neuropathy and aid in nerve regeneration, including in conditions like diabetic polyneuropathy and peripheral nerve injuries.

In 2014.Shibuya et al. from Japan underscored the evidence from experimental studies suggesting that a high dose of vitamin B12 (Methylcobalamin) can enhances axonal growth in peripheral nerve injury. They reported a study which included 14 patients who had immune-mediated or hereditary neuropathy who were treated with intravenous methylcobalamin (25 mg daily for 10 days followed by 25 mg every month for 5 months). Treatment was stopped in one patient because of respiratory tract infection at two months, and was stopped in a second patient because of seborrheic dermatitis at three months. The other twelve patients experienced no side effects. Treatment was considered safe and effective in patients who peripheral neuropathy and chronic axonal degeneration [17].

High-dose intravenous vitamin B12 has been used to prevent or reduce the severity of peripheral neuropathy induced by chemotherapy, offering a protective effect against this side effect.

In 2017, Zhang et al. from China reported a study which included 65 newly patients who had multiple myeloma treated with bortezomib. 27 patients received high-dose intravenous vitamin B 12 (Mecobalamin) and 38 patients served as control. The study showed that intravenous mecobalamin can offer a safe prophylaxis for the treatment of bortezomib-induced peripheral neuropathy in the patients with multiple myeloma [18].

Intravenous vitamin B12 has shown potential in treating vasoplegic syndrome, especially when it is refractory to traditional treatments, such as during cardiopulmonary bypass surgery.

In 2017, Cai et al from the United States the successful use of intravenous vitamin B 12 (Hydroxocobalamin) in the treatment of vasoplegic syndrome complicating cardiopulmonary bypass surgery that was refractory to traditional vasoconstrictor treatment with methylene blue [19]. In 2021, Peyko and Finamore from the United States also, reported the use of intravenous vitamin B 12 (Hydroxocobalamin) without methylene blue in the treatment of refractory vasoplegic syndrome following cardiopulmonary bypass surgery [20].

In 2021, Huang et al. from China reported the prevention and treatment of peripheral neuropathy in patients with multiple myeloma with intravenous glutathione 2.4 grams once daily 2-3 days before chemotherapy plus intravenous vitamin B 12 (Mecobalamin) 500 µg once on alternate days until the end of the chemotherapy treatment cycle. Patients who did not receive intravenous glutathione mecobalamin served as controls. Treatment was associated with marked decrease in the severity and incidence and of chemotherapy induced peripheral neuropathy [21].

In 2023, Patel et al from the United States emphasized despite the increased hydrogen sulfide is an important contributor to the development of vasodilatation and hypotension in septic shock, conventional treatments do not address this pathophysiological mechanism. They reported the treatment of 20 critical patients having septic shock with either a single 5 grams dose of intravenous vitamin B 12 (Hydroxocobalamin) or placebo (0.9% saline solution). The study showed a beneficial effect of intravenous vitamin B 12 that was attributed to preventing hydrogen sulfide formation, and thus contributing to the restoration of vascular tone and accelerating recovery [22].

For individuals suffering from nitrous oxide-induced myelopathy, intravenous vitamin B12 can counteract the functional B12 deficiency caused by nitrous oxide, preventing further neurological damage

In 2003, Jones et al. from the United States reported the successful treatment of nitrous oxide abuse-induced subacute combined degeneration with evidence of myelopathy in a female patient with intravenous vitamin B12 due to the clinical and radiographic evidence of nitrous oxide-induced. They attributed the benefits of intravenous vitamin B12 to its ability to improve nitrous oxide abuse-induced functional B12 deficiency which can result in irreversible nerve damage if not treated [23].

In 2024, Singh et al. described the successful treatment of a vegetarian male patient who had megaloblastic anemia presenting with knuckle hyperpigmentation with intravenous vitamin b12 followed by oral vitamin B12 and folate therapy [24].

Conclusion and expert opinion:

Intravenous vitamin B12 has proven to be a versatile and valuable therapeutic tool across a range of clinical conditions. Its applications include effective management of pernicious anemia, cyanide poisoning, neuropathies, and cognitive decline in dementia. Notably, its role as an antidote for cyanide toxicity and its potential in treating chemotherapy-induced peripheral neuropathy and hyperhomocysteinemia in chronic renal failure underscore its broad utility. Emerging evidence supports its efficacy in addressing vasoplegic syndrome, nitrous oxide-induced myelopathy, and megaloblastic anemia in vegetarians. Despite its extensive use and generally favorable safety profile, continued research and clinical trials are essential to fully elucidate its mechanisms, optimize dosing strategies, and explore additional therapeutic benefits. Overall, intravenous vitamin B12 remains a critical component in the management of diverse medical conditions, offering significant benefits in both acute and chronic therapeutic contexts.

Conflict of interest: None.

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