Editorial

ANNALS OF MEDICINE & SURGERY

OPEN

Sunshine and shadows: role of vitamin D supplementation on total body irradiation

Hafsa Arshad Azam Raja, MBBS[a], Mohsin Fayaz, MS[b], Bipin Chaurasia, MS[b,c,*]

Total body irradiation (TBI) is a powerful therapeutic tool, employed in the treatment of hematological malignancies and before bone marrow transplantation. While TBI effectively eradicates harmful cells, it also wreaks havoc on healthy tissues, leading to a cascade of detrimental effects including severe immunosuppression, bone marrow suppression and an increased risk of infections[1]. This leaves patients vulnerable, demanding a multi-pronged approach to minimize harm and optimize recov ery. Within this context, the role of vitamin D supplementation has emerged as a potential player, offering a potential avenue to alleviate some of the debilitating consequences of TBI. Vitamin D, often dubbed as the 'sunshine vitamin,' a fat-soluble vitamin plays a vital role in calcium absorption, bone health, and immune function[2]. While primarily produced by the skin upon exposure to sunlight, inadequate exposure, particularly in patients under going TBI, can lead to deficiency. This deficiency is exacerbated by the immunosuppressive effects of TBI, further compromising the body's ability to fight off infections and recover from treatment.

Effects of TBI on vitamin D metabolism

TBI significantly disrupts vitamin D metabolism, creating a complex interplay between irradiation and vitamin D levels. The following mechanisms contribute to this disruption: The skin, the primary site of vitamin D synthesis, is directly exposed to radiation during TBI. Damage to skin cells can impair their ability to produce vitamin D[3]. TBI can disrupt the liver and kidneys, the organs responsible for converting vitamin D into its active form (calcitriol)[4]. This leads to reduced levels of active vitamin D, further exacerbating its deficiency. TBI can stimulate the pro duction of enzymes that degrade vitamin D, leading to a rapid decline in its circulating levels.

[a]Department of Neurosurgery, Rawalpindi Medical University, Rawalpindi, Pakistan, [b]Department of Neurosurgery, Sher I Kashmir institute of Medical Science, Shrinagar, India and [c]Department of Neurosurgery, Neurosurgery Clinic, Birgunj, Nepal

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

*Corresponding author. Address: Department of Neurosurgery, Neurosurgery Clinic, Birgunj, Nepal. Tel.: +977 984 545 4636. E-mail: trozexa@gmail.com (B. Chaurasia).

Annals of Medicine & Surgery (2024) 86:6374–6375

Received 22 June 2024; Accepted 5 September 2024

Published online 19 September 2024

http://dx.doi.org/10.1097/MS9.0000000000002577

Potential benefits of vitamin D supplementation in TBI patients

Several studies suggest a potential benefit of vitamin D supplementation in mitigating the adverse effects of TBI. Human studies have hinted at a possible link between vitamin D levels and the severity of post-TBI complications, suggesting that supplementation could potentially improve patient outcomes. Vitamin D receptors are present in brain tissue, and adequate levels of vitamin D have been associated with improved mood and cognitive function The proposed mechanisms by which vitamin D supplementation might exert its beneficial effects are multifaceted. Firstly, vitamin D plays a crucial role in immune modulation, promoting the differentiation of T helper cells, B cells, macrophages and the production of antimicrobial peptides to control inflammation and prevent excessive immune response[5]. This enhanced immune function can help combat the increased risk of infection post-TBI. Secondly, vitamin D supplementation may also mitigate the bone loss and osteoporosis that are often associated with TBI, contributing to overall recovery and skeletal integrity. Thus, playing a crucial role in bone density and health[6]. Lastly, Vitamin D possesses anti-inflammatory proper ties, potentially alleviating the inflammatory response triggered by TBI. Studies have suggested that vitamin D supplementation might contribute to a faster and smoother recovery following TBI[7]. This can be attributed to its synergistic effects on immune function, bone health, and inflammation.

The psychological and physiological impacts of TBI extend beyond bone health and immune function. Patients undergoing intensive treatment regimens such as TBI often experience fatigue, mood disturbances, and decreased quality of life. Vitamin D supplementation is being explored as a potential treatment for depression and anxiety in cancer patients. Research suggests that vitamin D, which has receptors in the brain, may play a role in mood regulation[8]. Because adequate vitamin D levels are linked to better mood and cognitive function, scientists are investigating if it could be used alongside standard cancer treatments to improve mental well-being. While more research is needed to establish definitive links, the potential benefits of vitamin D on mood regulation and overall well-being are promising for patients navigating the challenges of TBI.

Challenges and considerations

Despite the potential benefits, the role of vitamin D supplementation in TBI remains complex and requires further investigation. Key challenges and considerations include: the optimal dosing and monitoring of vitamin D levels in patients undergoing TBI. Guidelines for vitamin D supplementation in cancer patients generally recommend higher doses than those for the general population, particularly in cases of deficiency or insufficiency. As

the immune system is already deranged, an excessive dosage may impair the kidney regulation and immune cells modulations. Moreover, 25-hydroxyvitamin D may interfere with the corticosteroids used in patients undergoing radiation therapy. Routine monitoring of serum 25-hydroxyvitamin D levels is essential to ensure therapeutic efficacy and prevent potential toxicity such as hypercalcaemia, hypercalciuria, hypervitaminosis D and kidney dysfunction[9]. Therefore, healthcare teams must balance the benefits of supplementation with the risks and closely monitor patients throughout the treatment course. Individual variability: the response to vitamin D supplementation can vary significantly among individuals based on factors such as age, genetics, and pre-existing conditions and potential interactions of vitamin D supplementation with other medications commonly prescribed to TBI patients, requiring careful monitoring and adjustments.

Future research and directions

To fully understand the role of vitamin D supplementation in TBI, further research is essential. Future studies should focus on well-designed clinical trials to evaluate the efficacy and safety of vitamin D supplementation in TBI patients. These trials should assess the impact on immune function, bone health, infection rates, and overall recovery; Biomarkers: identifying reliable biomarkers to monitor vitamin D status and response to supplementation in TBI patients is crucial. Role of personalized medicine must be tailored with vitamin D supplementation on their specific characteristics, including vitamin D status, genetic predisposition, and medical history, might improve treatment outcomes[10].

Conclusion

Despite the need for further investigation, the potential benefits of vitamin D supplementation in the context of TBI are promising. It offers a low-cost, readily accessible intervention that could potentially enhance patient recovery and minimize the debilitating effects of this critical treatment. As we delve deeper into the interplay between vitamin D and TBI, we may unlock a new dimension of care, offering a ray of sunshine in the wake of such a challenging therapy. However, the current evidence base remains limited, and a more robust cohort, randomized and non-randomized controlled trials (RCTs) are needed to firmly establish the role of vitamin D supplementation in optimizing dosage, timing, and individualization of vitamin D supplementation and managing TBI complications. This will pave the way for personalized interventions aimed at improving therapeutic outcomes and enhancing patient well-being.

Ethical approval

Ethical approval was not required for editorial.

Consent

Informed consent was not required for this editorial.

Source of funding

Not applicable.

Author contribution

Both authors have contributed equally in formation of manuscript.

Conflicts of interest disclosure

The authors declare no conflicts of interest.

Research registration unique identifying number (UIN)

Not applicable.

Guarantor

Bipin Chaurasia.

Data availability statement

Not applicable.

Provenance and peer review

Not commissioned, externally peer-reviewed.

References

[1] Sabloff M, Tisseverasinghe S, Babadagli ME, *et al*. Total body irradiation for hematopoietic stem cell transplantation: what can we agree on? Curr Oncol 2021;28:903–17.
[2] Rebelos E, Nikolaos, Tentolouris, *et al*. The role of vitamin D in health and disease: a narrative review on the mechanisms linking vitamin d with disease and the effects of supplementation. Drugs 2023;83:665–85.
[3] Mostafa WZ, Hegazy RA. Vitamin D and the skin: focus on a complex relationship: a review. J Adv Res 2015;6:793–804.
[4] Shirazi A, Mihandoost E, Ghobadi G, *et al*. Evaluation of radio-protective effect of melatonin on whole body irradiation induced liver tissue damage. Cell J 2013;14:292–7.
[5] Athanassiou L, Mavragani CP, Koutsilieris M. The immunomodulatory properties of vitamin D. Mediterranean J Rheumat 2022;33:7–13.
[6] Voulgaridou G, Papadopoulou SK, Detopoulou P, *et al*. Vitamin D and calcium in osteoporosis, and the role of bone turnover markers: a narrative review of recent data from RCTs. Diseases (Basel, Switzerland) 2023;11:29.
[7] Liu W, Zhang L, Xu HJ, *et al*. The anti-inflammatory effects of vitamin D in tumorigenesis. Int J Mol Sci 2018;19:2736.
[8] Kennel KA, Drake MT. Vitamin D in the cancer patient. Curr Opin Support Palliat Care 2013;7:272–7.
[9] Marcinowska-Suchowierska E, Kupisz-Urbańska M, Łukaszkiewicz J, Płudowski P, Jones G, *et al*. Vitamin D toxicity—a clinical perspective. Front Endocrinol 2018;9:550.
[10] Roizen JD, Levine MA. Vitamin D therapy and the era of precision medicine. J Clin Endocrinol Metab 2019;105:891–3.