Correlations of Serum Level of 25(OH)D and Bone Mineral Density (BMD) among chronic patients of Spinal Cord Injury (SCI)

Dr. Minhaj Akhter[1], Dr. Rajeshwari Jindal[2§], Dr. Mrinal Joshi[3], Dr. Sunil Goenka[4], Dr Nikhil Agarwal[5]

[1]Junior Resident, Department of PMR, SMS Medical College, Jaipur (Rajasthan) India.
[2,4]Professor, Department of PMR, SMS Medical College, Jaipur (Rajasthan) India
[3]Sr Professor & Head, Department of PMR, SMS Medical College, Jaipur (Rajasthan) India
[5]Senior Resident, Department of PMR, SMS Medical College, Jaipur (Rajasthan) India
[§]Corresponding author's Email: minhajrnt@gmail.com

Abstract*—Chronic patients of spinal cord injury has been detected with severe reduction of bone mineral density. Patients with SCI show mostly osteopenia or osteoporosis of the hip and spine. Vitamin D deficiency may contribute to development of osteoporosis in SCI. So a study was conducted on 100 chronic SCI patients to find out status of correlation of Vitamine D and bone mineral density (BMD). Blood samples were collected and investigated routine biochemistry with serum 25(OH)D. DXA scan of hip and spine was also done. This study observed that 55% patients had suboptimal vitamin D. Positive correlation was found between vitamin D & bone mineral density. It is concluded from this study that monitoring of Serum 25(OH)D levels and annual surveillance of bone mineral density is crucial among persons with chronic SCI to reduce progression of osteoporosis and minimize the risk for further fractures.*

Keywords: 25(OH)D: 25 Hydroxy Vitamin D, DXA: Dual Energy X-Ray Absorptiometry, BMD: Bone Mineral Density.

I. INTRODUCTION

Spinal cord injury is an assault to the spinal cord, resulting in change either temporary or permanent in its motor, sensory and autonomic functions.

Osteoporosis is a disease characterized by low bone mass, compromised bone structure and an increased fracture risk.[1] The WHO (World Health Organization) operationally defines osteoporosis as a bone density that falls 2.5 Standard Deviation (SD) below the mean for young healthy adults of the same sex (T-score of <-2.5). Those with a T-score <-1.0 (Osteopenia) have low bone density and are at increased risk for osteoporosis.[21] Immobilization secondary to SCI is considered the most important factor in osteoporosis.[2]

Severe reduction of bone density has been detected in patients with spinal cord injury (SCI). Decreased bone mineral density (BMD) is a known consequence of spinal cord injury. Many factors are proposed as predictors in BMD loss in patients with SCI including demographic features such as age, sex, body weight, and body mass index (BMI). Studies show that all patients with SCI show mostly osteopenia or osteoporosis of the hip, but BMD values in the rest of the body are more stable and the reduction of BMD which occurs in the spinal vertebrae in these patients is not large. The high bone turnover rate after the SCI can last for 1–2 years which leads to rapid bone loss.[3]

Dual-energy X-ray absorptiometry (DXA) is routinely used to assess bone mineral density (BMD), diagnose osteoporosis.[4]

Moreover, it is believed that individuals with SCI are particularly susceptible to inadequate nutritional status of vitamin D because of a lifestyle that limits sun exposure.[5]

Vitamin D deficiency may contribute to development of osteoporosis in SCI.[6] The prevalence of Vitamin D deficiency in SCI population has been estimated as high as 93%.[7] Additionally, one third of individuals with chronic SCI demonstrated serum 25-hydroxy vitamin D (serum 25(OH)D) level less than the normal range.[8]

The storage form of vitamin D, specifically 25-hydroxy vitamin D [vitamin D25(OH)], or calcifediol, is the functional indicator of vitamin D status in terms of nutrition. The term vitamin D deficiency refers to serum 25(OH)D levels <20 ng/mL, insufficiency 20-30 ng/mL and sufficiency 30-100 ng/mL.[9]

The primary purpose of this study was to identify the proportion of individuals with chronic SCI that have suboptimal vitamin D status (serum 25(OH) D < 20 ng/ml) and the correlations of serum 25(OH)D and BMD among chronic patients of SCI patients.

II. METHODOLOGY

This hospital based cross-sectional descriptive type of observational study survey was conducted in Department of Physical Medicine and Rehabilitation, SMS Medical College and Attached Hospital, Jaipur in year 2017.

Sample size was calculated 95% confidence level assuming suboptimal vitamin D level 39% of chronic SCI patients as per results of a study.[10] At the absolute allowable error (precision) of 10%, 92 patients were required as sample size. It was further enhanced and rounded off to 100 patients as final sample size for present study expecting 10% dropout/attrition.

So for this study, 100 subjects were selected randomly from 20years to 60 years aged SCI patients follow up of > 12 month (from date of trauma) visited in OPD or admitted in department of PMR SMS Medical College, Jaipur who had SCI with ASIA scale A-D and had given written informed consent was included. Patients who had any co-morbid medical and surgical condition which affects bone metabolism were excluded from the study.

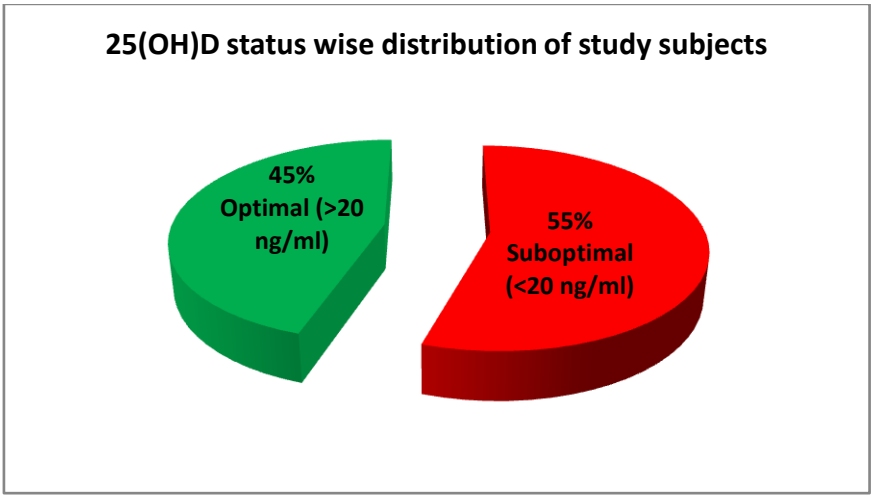
After taking preliminary information of the subject and his/her trauma. Neurologic assessment and determination of the SCI level was ascertained according to the ASIA impairment scale. Blood collection after fasting for at least 12 hours, was performed by trained phlebotomist. Routine biochemistry with Serum 25(OH) D level (Chemiluminescence method by ADVIA centaur XP immunoassay system) and DXA scan of Hip & Spine (HOLOGIC 800.321.4659 model EXPLORE) was done of every subject included in study.

Statistical analysis: Continuous variables summarized as mean and standard deviations while nominal categorical variables summarized as proportions (%). Unpaired 't' test was used for comparison of continuous variables whereas Chi square/ Fischer exact test was used for nominal/ categorical variables. Spearmann and Pearson correlation coefficient was used depending upon the data type & yield. 'P' value < 0.05 was considered as significant. Medcalc 12.2.1.0 version software was used for all statistical calculation.

III. RESULTS

In this study, among hundred SCI patients with chronic spinal cord injury, suboptimal level of 25(OH)D(<20 ng/ml) was found in 55 percent study subjects while optimal level of 25(OH)D(>20 ng/ml) was found in 45 percent. Mean serum 25(OH)D level was observed 20.28 with standard deviation11.40. (Figure 1)

Figure 1



It was further revealed that 25(OH)D had positive correlation with hip T score and spine T score. Correlations of 25(OH)D with hip T score was statistically significant. (Table 1 & Figure 2&3)

Table 1
Correlation of 25(OH)D with DXA score

		DXA	
		Hip T score	Spine T score
25(OH)D	R	0.28	0.18
	P value	<0.01	0.07

Figure 2
Correlation of 25(OH)D with Hip T score

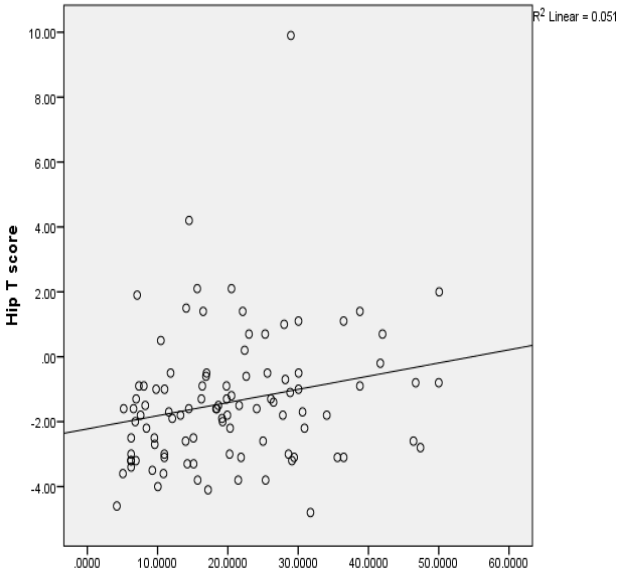
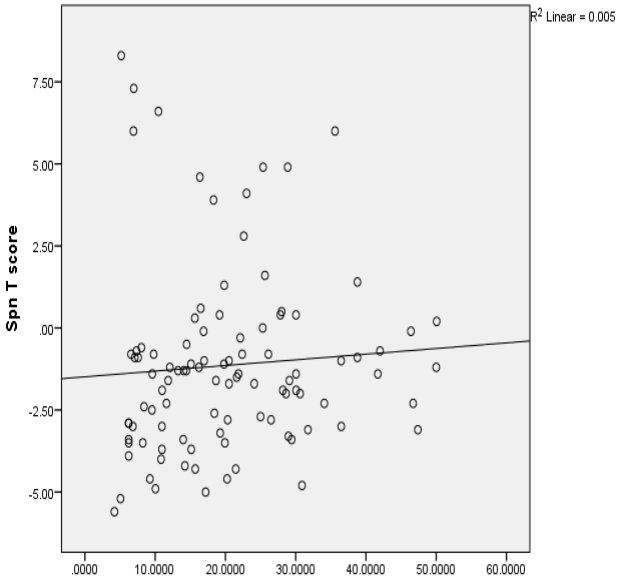


Figure 3
Correlation of 25(OH)D with Spine T score



IV. DISCUSSION

In this current study among 100 SCI patients' serum 25(OH)D levels were suboptimal (<20ng/dl) in 55% patients, this was in accordance with several previous studies. Oleson et al., and Nemunaitis GA et al., identified in their studies that more than ninety percent studied population were vitamin D deficient.[8,11] Irena Doubelt et al., observed in 60% while Arcangelo Barbonetti et al., in 73% vitamin D deficiency in chronic SCI patients in their studies.[12,13] On the other hand Bauman WA et al., and Kayla Hummel et al., found in their studies that only one third population of chronic SCI were vitamin D deficient.[1,14]

The reasons for the vitamin D deficiency state were postulated to be numerous and multifactorial and included prolonged bedridden stage which leads to insufficient exposure to sunlight, restricted calcium intake, medications that accelerated metabolism, and associated renal disease.

In present study serum vitamin D3 level significantly positively correlated with hip and spine T score. K Hummel et al., Bauman WA et al., C. V. Oleson et al., Amina chain et al., had found similar results.[1,5,14] Gaspar AP et al., Bauman WA et al., observed that serum 25(OH)D level was positively correlated with the lumbar spine T score.[14,16]

V. CONCLUSION

It can be concluded from this present study that quite a large (55%) proportion of such SCI cases were with subnormal vitamin D level and positive correlation was found between vitamin D & bone mineral density.

Monitoring of Serum 25(OH)D levels & serum calcium and annual surveillance of bone mineral density is crucial among persons with chronic SCI to reduce progression of osteoporosis and minimize the risk for further fractures.

CONFLICT OF INTEREST

None declared till now.

REFERENCES

1. K hummel BC, Giangregorio. serum 25(OH)D, PTH and correlates of suboptimal 25(OH)D levels in persons with chronic spinal cord injury spinal cord (2012) 50, 812-816.
2. Inanc Karapolat, H.U. Karapolat, Yesim Kirazli, Kazim Capaci, Yesim Akkoc, and Kamil Kumanlioglu. Longitudinal study of bone loss in chronic spinal cord injury patients. J Phys Ther Sci. 2015 May; 27(5): 1429–1433.Published online 2015 May 26. doi: 10.1589/jpts.27.1429.
3. Abbas Norouzi Javidan, Hadis Sabour, Sahar Latifi, Farzad Shidfar, Mohammad Reza Vafa, Ramin Heshmat, Hasan Emami Razavi, Bagher Larijani,and Hamidreza Aghaei Meybodi. Evaluation of bone mineral loss in patients with chronic traumatic spinal cord injury in Iran J Spinal Cord Med. November, 2014; 37(6): 744–750.
4. Harrison's principle of internal medicine; 19th edition p;2463-2464,2488, 2493,96e-8.
5. Amina Chain, Josely C. Koury, Flávia Fioruci, Bezerra. Physical activity benefits bone density and bone-related hormones in adult men with cervical spinal cord injury ;September 2012, Volume 112, Issue 9, pp 3179–3186.
6. Morse LR, Battaglino RA, Stolzmann KL, Hallett LD, Waddimba A, Gagnon D, et al. Osteoporotic fractures and hospitalization risk in chronic spinal cord injury. Osteoporos Int. 2009 Mar;20(3):385–92.
7. Jiang SD, Jiang LS, Dai LY. Mechanisms of osteoporosis in spinal cord injury. ClinEndocrinol (Oxf) 2006 Nov;65(5):555–65.
8. Nemunaitis GA, Mejia M, Nagy JA, Johnson T, Chae J, Roach MJ. A descriptive study on vitamin D levels in individuals with spinal cord injury in an acute inpatient rehabilitation setting. PM R. Mar;2(3):202–8. quiz 28.

9. Determining Vitamin D Total (VitD) in Serum or Plasma using the ADVIA Centaur VitD assay on ADVIA Centaur and ADVIA Centaur XP Systems.
10. L. Maimoun, I. C. Ouret, J. Micallef, E. Peruchon, D. Mariano-Goulart, M. Rossi, J. Leroux and F. Ohanna, " Use of bone biochemical markers with dual-energy X-Ray absorptiometry for early determination of bone loss in persons with SCI," Metabolism, pp. 958-963, 2002.
11. Oleson C.V., Patel P.H., Wuermser L.A. Influence of season, ethnicity, and chronicity on vitamin D deficiency in traumatic spinal cord injury. J. Spinal Cord Med. 2010;33(3):202–213.
12. Arcangelo Barbonetti, Maria Rosaria, C. Vassallo, Giorgio Felzani, Sandro Francavilla and Felice Francavilla. Association between 25(OH)-vitamin D and testosterone levels: Evidence from men with chronic spinal cord injury. J Spinal Cord Med. 2016 May; 39(3): 246–252.
13. Irena Doubelt, Julia Totosy, Zepetnek, Maureen J. MacDonald, Stephanie A, Atkinson, Influences of nutrition and adiposity on bone mineral density in individuals with chronic spinal cord injury. A cross-sectional, observational study Bone Rep. 2015 Jun; 2: 26–31.Published online 2015 Feb 18. doi:10.1016/j.bonr.2015.02.002.
14. Bauman WA, Spungen AM. Metabolic changes in persons after spinal cord injury. Phys Med RehabilClin N Am. 2000;11:109–140.
15. Christina V. Oleson, MD, Benjamin J. Seidel, DO, Tingting Zhan, Association of vitamin D deficiency, secondary hyperparathyroidism, and heterotopic ossification in spinal cord injury; Journal of Rehabilitation Research & Development (JRRD)Volume 50 Number 9, 2013 Pages 1177 — 1186.
16. Gaspar AP, Brandão CM, Lazaretti-Castro M. Bone mass and hormone analysis in patients with spinal cord injury: evidence for a gonadal axis disruption. J ClinEndocrinolMetab 2014;99(12):4649–55. doi: 10.1210/jc.2014-2165.