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Correlations of serum level of 25(OH)D, Parathyroid Hormone (PTH) and Bone Mineral Density (BMD) among chronic patients of Spinal Cord Injury (SCI)

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Abstract

Background: *Patients with SCI show mostly osteopenia or osteoporosis of the hip and spine. Vitamin D deficiency and secondary hyperparathyroidism may contribute to development of osteoporosis in SCI cases.*

Method: *A correlation study was conducted on 100 chronic SCI patients admitted in the Department of Physical Medicine &Rehabilitation, Sawai Man Singh Medical College, Jaipur. After taking information regarding subject and his/her injury, blood samples were collected to investigated for routine biochemistry with serum PTH and serum 25(OH)D. DXA scan of hip and spine was also done. Correlation between 25(OH)D with DXA and with PTH was found by Pearson correlation. Correlation between PTH with DXA was also found by Pearson correlation.*

Result: *The study revealed that 55% patients had subnormal vitamin D (<20 ng/mL). Positive correlation was found between vitamin D & BMD which was found significant for hip T score but not for spine T score. Whereas negative correlation was found between parathyroid hormone (PTH) & BMD which was found significant with both hip and spine T score. Negative correlation was found between vitamin D & PTH, which was also found significant.*

Conclusion: *Vitamin D and PTH play important role in SCI cases. So, monitoring of Serum 25(OH)D levels, serum PTH & 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.*

Keywords: *25 Hydroxy Vitamin D (25(OH)D), Dual Energy X-Ray Absorptiometry (DEA), PTH: Parathyroid Hormone (PTH), Bone Mineral Density (BMD).*

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.[2]

Although immobilization secondary to SCI is considered the most important factor in osteoporosis, hormonal alterations (e.g., affecting parathyroid hormone, vitamin D, sex steroids, thyroid hormone, and leptin) are also implicated in the pathogenesis of osteoporosis.[3]

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).[3,4]

Patients with SCI show mostly osteopenia or osteoporosis of the hip. However, BMD level in the rest of the body quite stable and likewise reduction of BMD in the spinal vertebrae in these patients is very less. The high bone turnover rate after the SCI can last for 1–2 years which leads to rapid bone loss.[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 and secondary hyperparathyroidism 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, and had associated secondary hyperparathyroidism, potentially contributing to accelerated bone resorption.[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]

This study was conducted to identify the proportion chronic SCI cases with subnormal vitamin D status (serum 25(OH) D < 20 ng/ml) and the correlations of serum PTH, serum 25(OH)D and BMD among these SCI cases.

Materials and Methods

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 20 years 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.

Methods

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. Dual-energy X-ray absorptiometry (DXA) is routinely used to assess bone mineral density (BMD), diagnose osteoporosis.[11]

Investigations done

1. Routine biochemistry
2. Serum 25(OH) D level (Chemiluminescence method by ADVIA centaur XP immunoassay system)
3. Serum PTH level (Chemiluminescence method by ADVIA centaur XP immunoassay system)
4. DXA scan :- Hip and Spine (HOLOGIC 800.321.4659 model EXPLORE)

Outcome Measures

1. Serum 25 (OH)D
2. Serum parathyroid hormone (PTH)
3. T score of hip and spine

Statistical analysis: Continuous variables summarized as mean and standard deviations while nominal categorical variables summarized as proportions(%). Unpaired 't' test[12] 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.

Results

In this study, mean 25(OH)D level was found 20.28±11.40 ng/ml. Among hundred patients with chronic spinal cord injury suboptimal level of 25(OH)D (<20 ng/ml) was found in 55 (55%) SCI cases. (Figure 1)

It was further revealed that 25(OH)D had positive correlation with hip T score and spine T score which was found significant for hip t score but not for spine T score, whereas PTH had negative correlation with hip T score and spine T score which was found statistically significant for both. So as 25(OH)D level increases DXA level also increases but as PTH level increases DXA level decreases. (Table 1, Figure 2 & 3)

25(OH)D had negative correlation with PTH and Correlation coefficient was -0.45 and this correlation was statistically significant. So as 25(OH)D level increases PTH level decreases. (Table 2, Figure 4)

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

		DXA	
		Hip T score	**Spine T score**
25(OH)D	**R**	0.28	0.18
	P value	<0.01	0.07
PTH	**R**	-0.24	-0.27
	P value	0.01	<0.01

Table 2 Correlation of 25(OH)D with PTH level and DXA score

	PTH	
25(OH)D	**R**	-0.45
	P value	<0.001

Figure 1

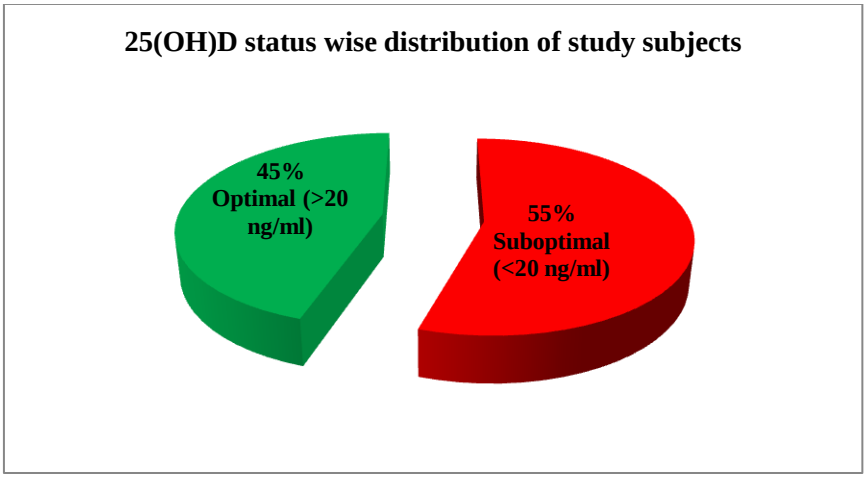


Figure 2 Correlation of 25(OH)D with Hip T score and with Spine T score

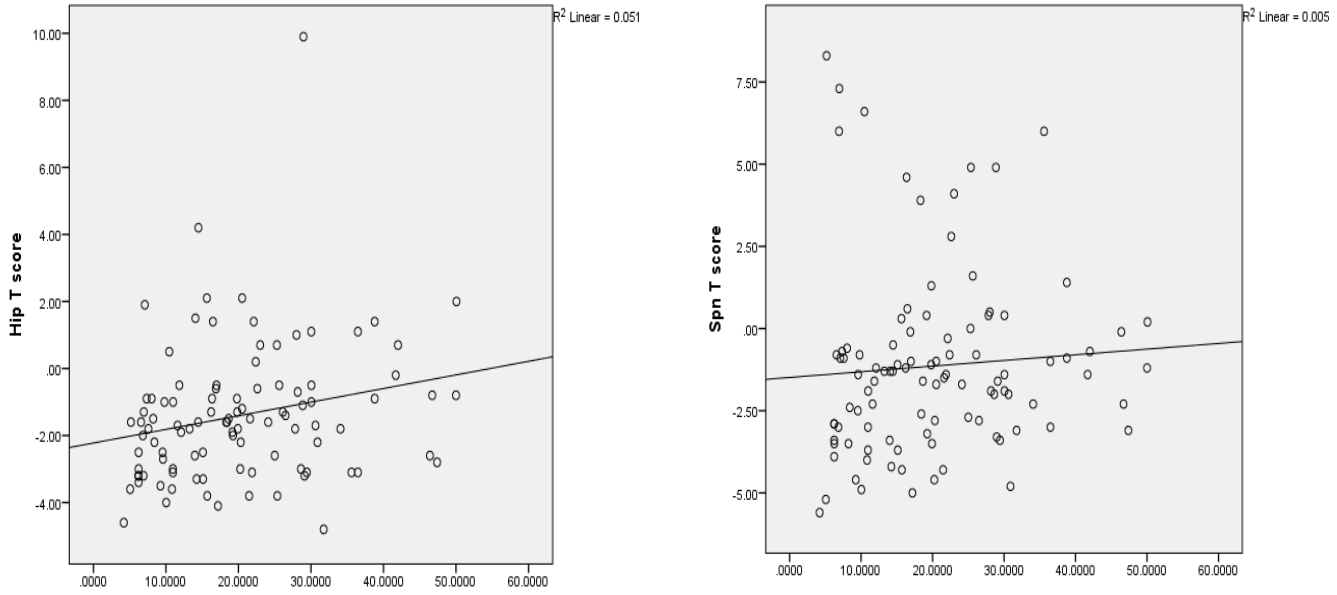


Figure 3 Correlation of PTH with Hip T score and with Spine T score

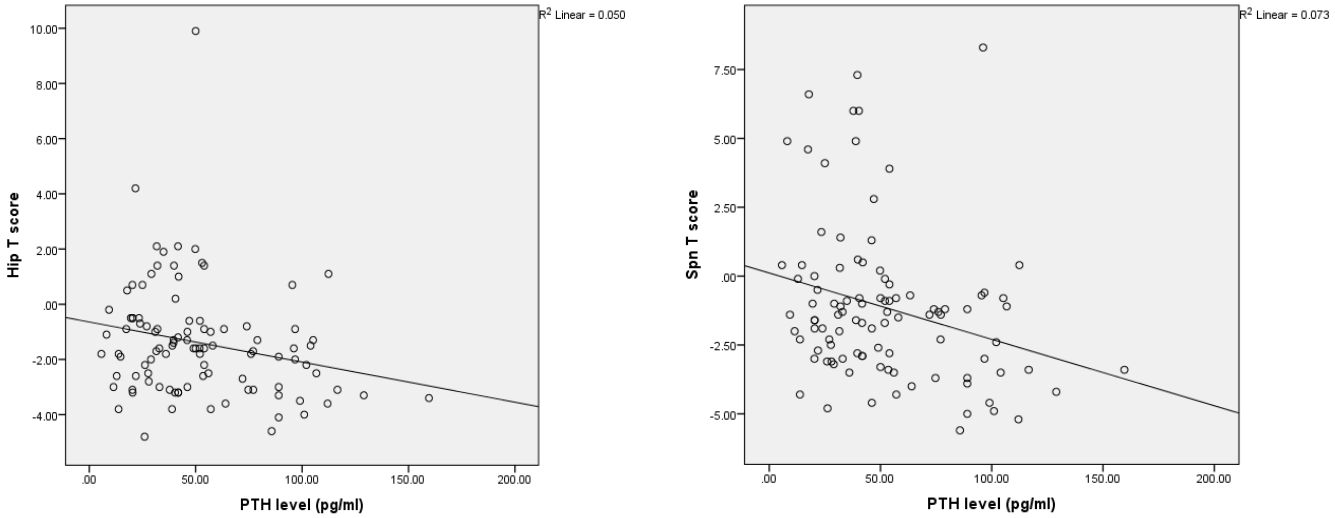
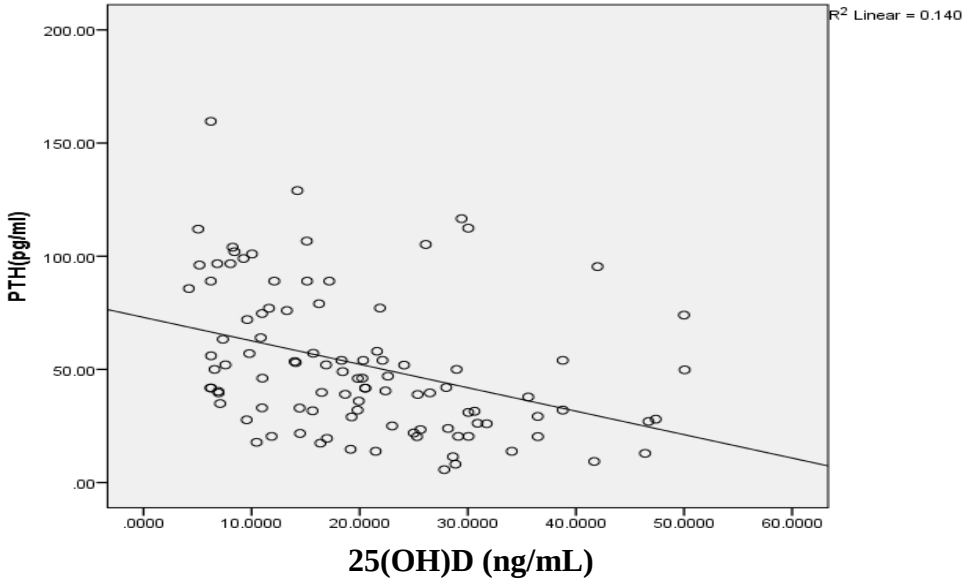


Figure 4 Correlation of 25(OH)D with PTH level



Discussion

In current study, among 100 SCI cases suboptimal (<20ng/dl) serum 25(OH)D levels was found in 55% of cases. Although Oleson et al.[13] and Nemunaitis GA et al.[9] reported more than ninety percent vitamin D deficient cases among studied SCI cases but other authors reported almost similar like Irena Doubelt et al[14] and Arcangelo Barbonetti et al[15] found 60% and 73% cases with vitamin D deficiency in chronic SCI patients in their studies. On the other hand Bauman WA et al.[16] and Kayla Hummel et al.[17] found in their studies that only one third of chronic SCI cases were vitamin D deficiency. The reasons for the vitamin D deficiency may be numerous and multifactorial which includes prolonged bedridden stage which leads to insufficient exposure to sunlight, restricted calcium intake, medications that accelerated metabolism and associated renal disease.

In present study PTH was found to be significantly negative correlated with hip and spine T-score. William A et al., also found secondary hyperparathyroidism in chronic SCI patients having osteoporosis.[18]

In present study serum vitamin D3 level significantly negative correlated with PTH level while vitamin D3 was positively correlated with hip and spine T score. Amina chain et al,[6] Bauman WA et al.,[16] Kayla Hummel et al.[17] and C. V. Oleson et al.,[19] also reported their observations well in resonance to the present study. Gaspar AP et al.[20] and Bauman WA et al.,[16] observed that serum 25(OH)D level was positively correlated with the lumbar spine T score. Finding of present study was that secondary hyperparathyroidism was associated with lower serum 25(OH)D and increased bone resorption, suggesting that negative correlation of the vitamin D – PTH axis might be a contributor to excess resorption and declining bone mass in the chronic SCI population.

Conclusion

It can be concluded from this present study that negative correlation was found between vitamin D & parathyroid hormone (PTH) and between parathyroid hormone (PTH) & bone mineral density (BMD). While positive correlation was found between vitamin D & bone mineral density. So, monitoring of Serum 25(OH)D levels, serum PTH & 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.

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Conflict of interest: None declared

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