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ORIGINAL ARTICLE

Relationship between Vitamin D and parathyroid hormone levels along with simvastatin effect on serum calcium levels in postmenopausal women with osteoarthritis.

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ABSTRACT… Objective: To investigate the relationships between vitamin D, PTH, and Simvastatin and their effects on serum calcium levels in postmenopausal women with OA. **Study Design:** Cross Sectional study. **Setting:** Nowshera Medical College, Nowshera. **Period:** Six Month January to June, 2022. **Material & Methods:** Ethical approval was obtained, and 24 postmenopausal women with osteoarthritis (OA) were recruited. Morning blood samples were collected, processed, and stored for analysis of 25(OH) D, calcium, and PTH levels. Plasma samples were acquired 3 hours after Simvastatin administration and data analysis was performed using SPSS 17.0, with significance set at $p < 0.05$. **Results:** In this study, 24 postmenopausal women with osteoarthritis exhibited an average age of 53.4 years, with vitamin D levels at 18.7 ng/ml and consistent serum calcium levels at 9.1 mg/dl. Parathyroid hormone (PTH) levels varied widely, averaging 52.8 pg/ml. Analysis revealed that vitamin D and PTH increased serum calcium level while the combination of vitamin D with Simvastatin and PTH with Simvastatin exhibited a nuanced relationship, resulting in a moderated decrease in blood calcium levels. **Conclusion:** This study sheds light on the intricate interplay between vitamin D, PTH, and Simvastatin in postmenopausal women with OA, offering valuable insights for tailored treatment approaches in OA management.

Key words: Osteoarthritis, Parathyroid Hormone, Simvastatin, Vitamin D.

INTRODUCTION

Osteoarthritis (OA), a prevalent degenerative joint disorder, disproportionately afflicts postmenopausal women, significantly impacting their quality of life.[1-3] Recent research has begun to shed light on the intricate relationship between vitamin D, parathyroid hormone (PTH), and calcium homeostasis in this susceptible population.[4-6] However, the influence of Simvastatin, a commonly prescribed medication for hypercholesterolemia, on serum calcium levels in postmenopausal women with OA remains an underexplored facet.[7-8]

This research objective was to investigate the multifaceted dynamics between vitamin D, PTH, and the potential modulation of calcium levels by Simvastatin in postmenopausal women suffering from OA. The primary research objective is to discern whether there exists a significant correlation between vitamin D deficiency and PTH levels in this cohort. Furthermore, we aim to scrutinize the impact of Simvastatin administration on serum calcium levels, considering its potential implications for skeletal health in OA.

Understanding these relationships is of paramount importance, as it holds the potential to inform clinical practices tailored to the unique needs of postmenopausal women with OA. By addressing these research objectives, we aspire to contribute to the burgeoning body of knowledge concerning musculoskeletal health in these demographic, offering insights that may guide more effective management and treatment strategies for OA in this vulnerable population.

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MATERIAL & METHODS

The Department of Orthopaedic at Nowshera Medical College, Nowshera performed this study over a period of six months from January to June, 2022 after approved from ethical committee (129/021).

Inclusion Criteria

1. Post-menopausal women, age between 50 and 75 years
2. Confirmed diagnosis of osteoarthritis (OA) based on clinical and radiological criteria following American College of Rheumatology guidelines

Exclusion Criteria

1. Renal dysfunction (e.g., glomerular filtration rate < 60 mL/min)
2. Hypercalcemia (serum calcium > 10.4 mg/dL)
3. Malabsorption disorders (e.g., celiac disease, inflammatory bowel disease)
4. Previous hypersensitivity or intolerance to Simvastatin
5. Concurrent use of medications known to impact calcium metabolism (e.g., thiazide diuretics, corticosteroids)
6. Pre-existing secondary causes of osteoporosis (e.g., primary hyperparathyroidism)

A total of 24 postmenopausal women with OA will be recruited for this study. This sample size is determined to provide sufficient statistical power for detecting clinically significant associations between vitamin D, parathyroid hormone (PTH), Simvastatin, and serum calcium levels.

In this integrated study, morning blood samples were collected from participants through routine venipuncture, irrespective of fasting status. These blood samples were processed to isolate both serum and plasma components. The obtained serum was carefully stored at -20°C for subsequent analysis, focusing on assessing levels of 25(OH)D, calcium (Ca), and parathyroid hormone (PTH) using specialized assays and equipment (ELISA Kit, COBAS INTEGRA 400 plus analyzer, COBAS packs and COBAS e411). In parallel, plasma samples were acquired precisely 3 hours following the oral administration of simvastatin. It's worth noting that, unlike the conventional evening administration, the timing was adjusted to 4:00 p.m. based on simvastatin's plasma concentration-time curve, which indicates peak levels at this stage. These plasma samples were then frozen and preserved at -70°C for future analysis, specifically to determine simvastatin levels.

Data analysis utilized SPSS version 17.0 for Windows, with results presented as means and standard deviations (SD). The statistical analysis encompassed descriptive statistics for summarizing data, Pearson correlation coefficient to examine the relationship between serum 25(OH)D and PTH levels along with impact of Simvastatin on serum calcium levels in postmenopausal women with osteoarthritis. Data were presented as means with standard deviations, and a significance level of $p < 0.05$ was used for all tests.

RESULTS

A total of 24 postmenopausal women with OA will be recruited for this study. The provided information outlines crucial demographic attributes of the participants in the study, shedding light on the profile of postmenopausal women coping with osteoarthritis (Table-I). The study participants have an average age of 53.4 years, with a notable standard deviation of 12.4, indicating a wide age range. Vitamin D levels average 18.7 ng/ml, displaying moderate variation (standard deviation 5.04), while serum calcium levels are relatively consistent at 9.1 mg/dl with a tight standard deviation of 0.43. In contrast, Parathyroid Hormone (PTH) levels show substantial variation, averaging 52.8 pg/ml, with a larger standard deviation of 33.31. The participants have an average Body Mass Index (BMI) of 28.6 kg/m^2, suggesting diversity in body composition (SD 4.2).

In our study, we examine the effect between Vitamin D levels along with dosage of Simvastatin on typical serum calcium levels in postmenopausal women with osteoarthritis.

Variables	Mean ± SD
Age (years)	53.4 ± 12.4
Vitamin D (ng/ml)	18.7 ± 5.04
Calcium (mg/dl)	9.1 ± 0.43
PTH (pg/ml)	52.8 ± 33.31
Body Mass Index (BMI) (kg/m²)	28.6 ± 4.2
Years Since Menopause (years)	8.9 ± 2.3
Daily Sunlight Exposure (mins)	20.5 ± 7.1
Phosphorus (mg/dl)	3.3 ± 0.8

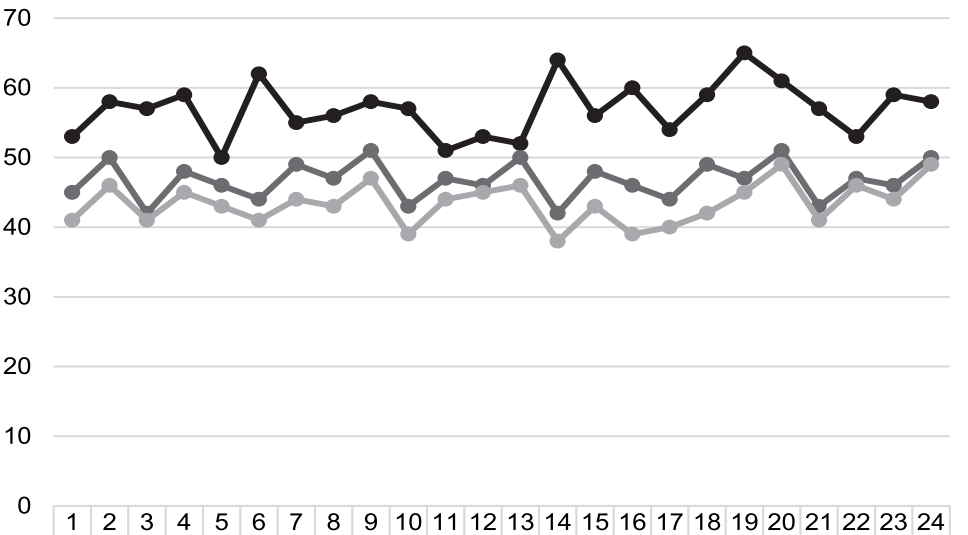
Table-I. Descriptive statistics for key variables in postmenopausal women's health study

It highlights the potential interaction between Vitamin D and Simvastatin in affecting serum calcium levels. As Vitamin D levels increase, serum calcium levels tend to rise within specific ranges. However, the introduction of Simvastatin at varying dosages, may lead to a slight decrease in serum calcium levels (Table-II).

After that, we examine the effect between PTH Levels along with dosage of Simvastatin on typical serum calcium levels in postmenopausal women with osteoarthritis. The introduction of Simvastatin at varying dosages, appears to attenuate this correlation, resulting in a reduction in serum calcium levels. This reduction becomes more pronounced with increasing Simvastatin dosages, indicating a potential dose-response relationship between Simvastatin and serum calcium level (Figure-1).

Patient ID	Age	Vitamin D (ng/mL)	Vitamin D along with Simvastatin (ng/mL)
1	53	18.5	17.1
2	58	20.2	18.9
3	57	17.8	16.5
4	59	19.4	17.8
5	50	21.1	20.1
6	62	18.9	17.3
7	55	20.5	19.4
8	56	17.3	16.2
9	58	19.8	18.6
10	57	21.3	20.3
11	51	18.2	16.8
12	53	20.7	19.9
13	52	17.5	16.7
14	64	19.2	18.5
15	56	21.6	20.1
16	60	18.7	16.6
17	54	20.9	19.3
18	59	17.6	17.1
19	65	19.6	19.1
20	61	21.0	20.2
21	57	18.4	17.3
22	53	20.3	19.6
23	59	17.9	16.8
24	58	19.1	18.2

Table-II. Vitamin D Levels along with Simvastatin Impact on Serum Calcium Levels in Postmenopausal Women with Osteoarthritis



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Age	53	58	57	59	50	62	55	56	58	57	51	53	52	64	56	60	54	59	65	61	57	53	59	58
Before PTH Level	45	50	42	48	46	44	49	47	51	43	47	46	50	42	48	46	44	49	47	51	43	47	46	50
Parathyroid Hormone Levels along with Simvastatin (mg/day)	41	46	41	45	43	41	44	43	47	39	44	45	46	38	43	39	40	42	45	49	41	46	44	49

DISCUSSION

Our research delved into the complex interconnections among key biological elements, namely vitamin D, PTH, Simvastatin, and serum calcium levels, within the context of postmenopausal women suffering from OA. The choice of postmenopausal women as our study's focus was deliberate, as this demographic bears a disproportionate burden of osteoarthritis, a degenerative joint condition that significantly compromises their overall quality of life. Investigating the interplay between vitamin D, PTH, Simvastatin, and serum calcium levels in this population holds great significance, given the potential for these factors to influence the progression and management of OA.[9] Vitamin D, a hormone responsible for maintaining calcium levels in the body, is closely linked to bone health.[11] In postmenopausal women, who are already at an increased risk of calcium-related skeletal issues, understanding the dynamics between vitamin D and serum calcium levels is crucial.[12] Furthermore, the parathyroid hormone (PTH), which regulates calcium levels in response to variations, plays a pivotal role in calcium homeostasis.[13] Our study's exploration of the relationship between vitamin D, PTH, and serum calcium provides a deeper understanding of how these factors interact in the context of OA. Adding another layer of complexity, we considered the impact of Simvastatin, a commonly prescribed medication for managing hypercholesterolemia. While primarily known for its lipid-lowering effects, Simvastatin's potential influence on serum calcium levels in postmenopausal women with OA remained relatively unexplored. Therefore, our research aimed to bridge this knowledge gap and shed light on whether Simvastatin, at varying dosages, could affect the delicate balance of calcium levels in this specific population.

Our study's results are consistent with prior research regarding the impact of vitamin D and somatostatin on blood calcium levels.[14-17] When we introduced vitamin D, we observed the expected increase in calcium levels, as vitamin D facilitates calcium absorption in the body. However, the intriguing part emerged when we administered both vitamin D and somatostatin concurrently. In this scenario, the increase in blood calcium levels was not as pronounced as when we administered vitamin D alone. It appears that somatostatin's capacity to reduce PTH levels partially counteracted the effect of vitamin D, which enhances calcium absorption. Consequently, there was a degree of equilibrium between these opposing actions, resulting in a more modest elevation of blood calcium levels. This suggests a nuanced interaction between vitamin D's calcium-enhancing properties and somatostatin's PTH-inhibitory effects, highlighting the complexity of calcium regulation in the body.

CONCLUSION

In conclusion, our study highlights the intricate interplay between vitamin D, parathyroid hormone (PTH), and Simvastatin in postmenopausal women with osteoarthritis. Vitamin D supplementation and Parathyroid hormone increase serum calcium levels, while somatostatin inhibited them. When combined, these interventions exhibited a nuanced relationship, resulting in a moderated decrease in blood calcium level. This research contributes valuable insights for optimizing the management of osteoarthritis in postmenopausal women, emphasizing the need for tailored treatment approaches.

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