VITAMIN D DEFICIENCY AND CHRONIC LOWER BACK PAIN IN LUMBAR DISC HERNIATED SUBJECTS

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Introduction

Lumbar disc herniation and degeneration associated with lower back pain is one of the commonest musculoskeletal disorders that affect the global population. According to the data that there is a prevalence of sciatica pain associated with lumbar disc herniation between 1-40 % in adult population in the United States. This is a multifaceted process which ultimately alters the structure and function of the affected intervertebral disc. However, etiology of lumbar disc disease remains unclear. Factors such as physical loading, driving heavy motor vehicles, vibrations, trauma, and smoking are some factors that are attributed to the above condition. According to recent studies, genetic factors and familial predisposition has been suggested as predisposing factors for lumbar disc disease. Association of many genes have been proven in relation to lumbar disc disease such as genes associated with structural, catabolic, anti-catabolic, and inflammation [1]. However among these genes association between vitamin D receptor gene and collagen 9A2 genes have been studied in great extent in different ethnic populations [1].

Vitamin D is a steroid hormone derived from cholesterol. It involves in the mineralization of the skeleton and regulating calcium and phosphate metabolism in vertebrates including humans. Vitamin D is also termed as neurosteroid hormone for its protective action against neurotoxicity and detoxification pathways which are important in disc cells' nutrition balance. It regulates the intervertebral disc tissue nutritional supply and waste excretion. Vitamin D has the properties to defend against cell injury and also plays an important role in down regulating cytokines that induces pain. In addition to its vital role in bone mineralization and calcium homeostasis, vitamin D also plays an important role in maintaining the muscle strength [2]. Recent studies conducted in Asian populations have proven that there is a widespread of vitamin D deficiency in both males and females irrespective of the age [3]. In addition there are no studies conducted in Sri Lanka to evaluate the serum 25-OH vitamin D (total) levels in patients with lower back pain.

25-OH vitamin D (total) is the universally accepted marker of vitamin D status as it has a longer half-life in circulation (2-3 weeks). In addition, it could be easily measured and correlates well with clinical state of the diseases as well. 25-OH vitamin level also reflects the recent ingestion and production of cutaneous vitamin D indicating the status of vitamin D reservoir, whereas the biologically active form of vitamin D, (1, 25 $(OH)_2$ vitamin D) is less available and tightly regulated as its

concentration depends on the body availability of 1, 25 $(OH)_2$ vitamin D, parathyroid hormone, hypophosphataemia and ionized calcium levels.

Hence this present study was carried out to identify the serum vitamin D levels in patients undergoing lumbar discectomy surgery as the treatment option for lumbar disc herniation in comparison to normal subjects in Sri Lanka.

Methodology

Study design and setting

A descriptive cross-sectional study was carried out at the Central hospital and Faculty of Medical Sciences, University of Sri Jayewardenepura after obtaining written consent from all participants. The study was approved by the Ethics Review Committee of Faculty of Medical Sciences, University of Sri Jayewardenepura.

Study subjects

Test: Forty five (n = 45) patients confirmed for lumbar disc herniation with a Magnetic Resonance Imaging (MRI) and also confirmed for herniation by the consultant neurosurgeon and consultant radiologist.

Control: Individuals (n=45) without known previous history of back pain and who have not received any medication for back pain for the past one month.

Blood sample collection

Sample of venous blood was taken from all the participants adhering to standard protocols for phlebotomy. It was allowed to clot for 45-60 minutes at room temperature and serum was separated at 3000rpm for 5 minutes. Aliquot serum sample of 25 µL was taken for serum 25- OH vitamin D (total) analysis.

Laboratory assessment of serum vitamin D levels

A solid phase enzyme linked immunosorbent assay (ELISA)(DRG International, Inc, USA), based on the principle of competitive binding was used for the determination of serum 25-OH vitamin D (total) levels of the individuals. Absorbance was measured at 450 nm.25-OH vitamin D (total) levels were estimated against a standard curve.

Results and Discussion

Among 90 participants, 48.9 % were males and 51.1 % were females with a mean age of 44.6 ± 16.6 in the total population.

Table 1. Mean serum 25-OH vitamin D (total) levels of study subjects

	Mean serum vitamin D concentration (ng/mL)		
Subjects	**Test**	**Control**	**P value**
Male	24.6 ±3.18	28.8 ±6.90	0.012
Female	20.9 ±5.88	30.8 ±12.66	0.001
Total	22.7 ± 5.17	29.8±10.20	0.0001

**Data were represented as Mean ± SD (n = 45) and p values < 0.05 is considered as significant.*

According to Table 1, there was a significant difference of 25-OH vitamin D (total) levels between both control male and female groups ($p \leq 0.01$, $p \leq 0.001$) compared to the test groups.

Although Sri Lanka is a tropical country with adequate sunlight, which is known to be the major pathway of synthesis of vitamin D in the skin, there is a significantly low levels of 25-OH vitamin D (total) (Hypovitaminosis D) in test females which was 20.9 ± 5.88 ng/mL and test males where concentration was 24.6 ± 3.18 ng/mL (Reference value: Females – 30. 2 ng/mL (mean age – 55 yrs); Reference values: Males – 26.1 ng/mL (mean age-58 yrs). Our study indicated that only 32 % (n = 7) of male test population had 25-OH vitamin D (total) level in normal range, whereas none of the females in the affected group were in the normal range. However, among control males, higher percentage (63. 6 %) had normal 25-OH vitamin D (total) levels when compared to control female group, where only 26 % of females in the control group were within normal levels. However, there is only 30 % among total study population had 25-OH vitamin D (total) level within normal range.

It is stated that vitamin D plays a role in different biological processes that involve in bone metabolism and affect proliferation and differentiation of wide variety of cells. Studies carried out in other countries confirms the presence of vitamin D in the disc cells, modulate sulphate concentrations also determines the degree of proteoglycan sulphation emphasizing the importance of the role of vitamin D in disc morphology [1][4]. Accordingly, osteomalacia is a common metabolic disorder associated with low vitamin D levels which eventually leads to softening of bones. Lower back pain associated with osteomalacia has been documented as a major symptom [5]. Therefore, low levels of 25-OH vitamin D (total) could have led to abnormalities in both mineralization of vertebra and in the sulphation of inetrvertebral disc altering its stability leading to herniation and degeneration of the affected discs promoting back pain.

On the other hand, vitamin D also plays a pivotal role as neurosteroid hormone, given its protective role against detoxification pathways and neurotoxicity. Therefore, vitamin D has an important role in maintaining disc cell balance protecting the disc cells from toxic agents [2]. Significant difference ($p \leq 0.0001$) of 25-OH vitamin D levels in the test when compared to controls groups can affect neurotoxicity causing imbalance in detoxification pathways in disc cell. This results in toxic damage to disc cells leading to disc degeneration and herniation. Studies have also proven that vitamin D also plays a role in down regulating inflammatory cytokines that induces the pain and role of cytokines in the pathogenesis of lumbar disc herniation are also well documented [2]. Hence, the hypovitaminosis D in the affected test group could have been a contributing factor to the pain in disc herniated subjects.

Conclusion

Present study confirms that there is a significant difference in serum 25 OH-vitamin D (total) levels in lumbar disc herniated subjects. As such this study highlights the importance of assessing serum vitamin D levels in patients suffering from lower back pain and also recommends oral therapy with vitamin D to those with symptoms. Even though Sri Lanka is in the tropical region low vitamin D in both control and test highlights an important fact the need of improving vitamin D level.

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References

[1] J.E. Mayer et al., Genetic polymorphisms associated with intervertebral disc degeneration. The Spine Journal, 2013. 13(3): p. 299-317.

[2] M. Sedighi and A. Haghnegahdar, Role of vitamin D 3 in Treatment of Lumbar Disc Herniation—Pain and Sensory Aspects: Study Protocol for a Randomized Controlled Trial. Trials, 2014. 15(1): p. 373-383.

[3] A. Mithal et al., Global vitamin D status and determinants of hypovitaminosis D. Osteoporosis international, 2009. 20(11): p. 1807-1820.

[4] A. Colombini et al., FokI polymorphism in the vitamin D receptor gene (VDR) and its association with lumbar spine pathologies in the Italian population: A case-control study. 2014.

[5] S. Al Faraj and K. Al Mutairi, Vitamin D deficiency and chronic low back pain in Saudi Arabia. Spine, 2003. 28(2): p. 177-179.