Vitamin D and Hip Fractures: Indian Scenario

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In this issue of JAPI, Khadgawat et al have documented vitamin D deficiency (VDD) in patients with fragility fractures of the hip and their follow up for 1 year.

Various important issues pertaining to Asian Indians are put forth, viz younger age at onset of fracture (mean: 62.2 years), prevalent VDD (mean: 9.9ng/ml; 96.7%), with inadequate sun exposure (in 34.8%patients) and calcium and Vit. D supplements (in 11.62%). Follow up for 1year was available in 60.46% of whom 42.3% died in one year underscoring the importance of preventing hip fractures.

Hip fractures are a major health problem in a developing country like India. They cause profound physical impairment, reduction in quality of life, admission to institutional care and also mortality especially in the elderly. The Indian population appears particularly vulnerable to the problem of osteoporosis and hip fractures.¹ Risk factors for osteoporosis that have been described include female sex, low body mass index, old age, positive family history, early menopause or amenorrhea, smoking, sedentary lifestyle, poor calcium intake and VDD.²³

It has been shown that hip fractures occur a decade earlier in Indians in comparison with western Caucasian counterparts.¹ The life expectancy at birth in 2003 was 61.8 years for Indian males and 63.5 years for Indian females and as it shows an upward trend, increasing proportion of our population would face these problems.

When the amount of calcium available from the diet is insufficient, such as in VDD, calcium is withdrawn from bone, mainly from cortical bone which decreases bone strength and contributes to the pathogenesis of osteoporosis and predisposes a patient to fragility fractures. Although secondary hyperparathyroidism, muscle weakness, and osteomalacia are generally more notable in cases of VDD, these conditions can be associated with vitamin D insufficiency also. India is located between 8.4 and 37.61N latitude with the majority of its population living in regions with ample sunlight throughout the year Nonetheless, there are numerous reports of widespread VDD(<20ng/ml)/insufficiency(20-30ng/ml) in India, which include various socioeconomic groups, ages, both genders and different ethnicities, rural and urban areas as well as different profession.⁵

Most of the studies showed circulating 25 hydroxy vitamin D3 [25(OH) D] levels well below 50 nmol/L (20ng/ml). Many studies showed that rural populations, esp. males (children and older adults), had slightly higher 25(OH)D levels presumably due to higher sun exposure.³ Dietary vitamin D was measured in only two of the studies, and it was extremely low in both upper and lower socioeconomic groups and in urban as well as rural populations.⁶⁷ Some of these studies have reported biochemical osteomalacia characterized by increased parathyroid hormone, reduced bone mineral density of the spine, femur and forearm and bone deformities.⁸ Postmenopausal women residing in Southern India showed varying degrees of vitamin D status.⁵ These ranged from severely deficient to just adequate with 52% of the population showing a mean level of 37.5 nmol/L (15ng/ml), a conservative cut-off level for VDD. None of these women had serum 25(OH) D concentrations in the optimal range. Strong association between body exposure to sun and 25(OH) D levels in India have been documented very recently. For example, Sahu et al. have shown greater sun exposure among boys especially in summer months resulting in higher serum 25(OH) D levels.⁹ Goswami et al. have shown much higher serum 25(OH) D in soldiers with longer sun exposure than in physicians, nurses, and pregnant women.¹⁰ Similar observation was noted by Zargar et al. among farmers compared with government employees, people who spend most of the time inside their homes/offices, medical professionals and students.¹¹ This calls for educating people about the relationship between safe sun exposure and optimal vitamin D levels. Even this might not be sufficient as evidenced by the fact that more than 70% of the farmers had VDD [<50 nmol/L; (20ng/ml)], with an average sun exposure of 25.1 h/wk.¹² VDD may also be due to darker skin pigmentation in most Indians, which is known to be an effective sunscreen blocking vitamin D synthesis. Skin types classified according to the level of melanin, the sun blocking pigment, require different durations of sun exposure to synthesize the same amount of vitamin D. The majority of Indians range in skin type from IV to V and may require from two to three times longer exposure duration than lighter skinned Europeans (types I, II and III) to synthesize the same level of vitamin D.¹² This may be hampered by the traditional dress code in India. Goswami et al.¹⁰ showed that people without pigmentation had lower serum 25(OH) D levels in winter months and attributed this to the clothing covering most of their body surface (90%), thus limiting the sun exposure. Social and religious customs that require people to wear concealing clothing, veiling and traditional attire, such as the “Burqa”, “salvar kameez” and sari significantly prevents sun exposure.¹¹,¹²,¹³ The role of increasing pollution in the metropolis cannot be overemphasized which blocks the ultraviolet B rays.¹²

Puri et al.⁴ have shown that school girls from lower socioeconomic strata in Delhi had slightly better serum 25(OH) D than those from upper socioeconomic strata, because 28% of their body surface was exposed to sun for about 45 min/day, compared with 15% body surface exposed to 25 min/day in the higher socioeconomic group. Awumey et al. also reported altered vitamin D metabolism in cultured skin fibroblasts from Indians.¹⁴

In the latest review² the following preventive measures were suggested to combat VDD and its ill effects; namely sunlight exposure at least 30 minutes/day, good dietary calcium and Vit D intake, food fortification with Vit D, avoid use of sun screens with SPF greater than 6 and promoting outdoor activities of the elderly and aged.
Vitamin D Deficiency and Risk of Hip Fractures

Over 90% of fractures occur after a fall and fall rates increase with age and poor muscle strength or function. Thus, a benefit of vitamin D on both fall and fracture prevention is of significant clinical importance. In humans, several lines of evidence support a role of vitamin D in muscle health. First, proximal muscle weakness is a prominent feature of the clinical syndrome of VDD. VDD myopathy includes proximal muscle weakness, diffuse muscle pain, and waddling gait. Second, vitamin D receptor (VDR) is expressed in human muscle tissue and its activation may promote de novo protein synthesis in muscle. Finally, suggesting a role of vitamin D in muscle development, mice lacking the VDR show a skeletal muscle phenotype with smaller and variable muscle fibers. Recent meta-analysis on fall prevention included 8 double-blind RCTs with predefined fall assessment throughout the trial period (n = 2426) and found significant heterogeneity by dose (low-dose: < 700 IU per day versus higher dose: 700–1000 IU per day; p-value 0.02) and achieved 25(OH)D level (< 60 nmol/l [24ng/ml] versus ≥ 60 nmol/l[24ng/ml]; p-value = 0.005) [12]. Higher dose supplemental vitamin D reduced fall risk by 19% (pooled relative risk [RR] = 0.81, 95%-CI: 0.71–0.92; n = 1921 from seven trials) versus a lower dose which did not (pooled RR = 1.10, 95%-CI: 0.89–1.35 from 2 trials) and also achieved serum 25(OH)D concentrations < 60 nmol/l[24ng/ml] did not reduce the risk of falling (pooled RR = 1.35, 95%-CI: 0.98–1.84). Notably, at the higher dose of 700–1000 IU vitamin D, this meta-analysis documented a 38% reduction in the risk of falling with treatment duration of 2 to 5 months and a sustained significant effect of 17% fall reduction with treatment duration of 12–36 months, and the benefit was independent of type of dwelling and age. Thus, benefits of 700–1000 IU vitamin D per day on fall prevention are rapid and sustained and include all subgroups of the senior population.

A programme of muscle strengthening and balance training, individually prescribed by a trained health professional in primary health care setting, reduces the frequency of falls in high risk community-dwelling older people. Assessment, advice, and facilitation of home environment modification, reduces the frequency of falls in high risk community-dwelling older people which is important as majority of the fall occurred at home especially in the bathroom, in the present study.

Recent meta-analysis on fracture prevention included 12 double-blind RCTs for non-vertebral fractures (n = 42,279) and 8 RCTs for hip fractures (n = 40,886), and, similar to the meta-analysis on fall prevention, it found significant heterogeneity for received dose of vitamin D and achieved level of 25(OH)D in the treatment group for hip and any non-vertebral fractures. No fracture reduction was observed for a received dose of 400 IU or less per day or achieved 25(OH)D levels of less than 75 nmol/l [30ng/ml]. Conversely, a higher received dose of 482–770 IU supplemental vitamin D per day reduced non-vertebral fractures by 20% (pooled RR = 0.80; 95%-CI: 0.72–0.89; n = 33,265 from 9 trials) and hip fractures by 18% (pooled RR = 0.82; 95%-CI: 0.69–0.97; n = 31,872 from 5 trials). Notably, subgroup analyses for the prevention of non-vertebral fractures with the higher received dose suggested a benefit in all subgroups of the older population, and possibly better fracture reduction with D3 (cholecalciferol) compared to D2 (ergocalciferol).

In developing countries calcium intakes are low (average of 344 mg), as compared to developed countries (average of 850 mg). The high phytate concentration present in commonly consumed Indian foods such as chapattis and legumes might be expected to increase the calcium requirement. Calcium balance studies in subjects living in such conditions are not yet available. There is increasing debate over whether Vit D alone or calcium and Vit D in combination are needed to prevent hip fractures due to the available conflicting findings in the literature with metaanalysis involving randomized control trial, open label trial, various doses of Vit D used, the treatment adherence and compliance to medications.

To optimize clinical efficacy especially in the Asian Indian setting, oral vitamin D 700–1000 IU/d should be complemented with calcium, using a dose of 1000–1200 mg/d of elemental calcium. Alternatively giving a oral bolus dose of Vit D (ergocalciferol) 600,000 IU in divided dosages over 4–5 weeks to normalize serum 25(OH) D level followed by 60,000IU once a month to maintain that level could be another option. Fortification of food (wheat flour/ Milk) could be an important step to correct VDD in community. Wheat flour is the major component of chapattis consumed by all ages, socioeconomic backgrounds and by the rural and urban populations. Others have shown the stability of vitamin D fortification of grain products to long shelf life, stability to high baking temperatures and excellent bioavailability and it being cost effective.

Because of its frequency, its ease of detection, its associated adverse outcomes, and the straightforward, inexpensive and effective means by which it can be treated, VDD/insufficiency should be sought especially when evaluating and treating osteoporotic, subjects. Finally, it should be remembered that treatment of VDD/insufficiency has two phases: 1) restoration of 25OHHD levels to more than 30 ng/ml (at least>20ng/ml); and 2) maintenance of the serum 25OHD in that range. The serum 25OHD is monitored annually to ensure sufficiency.

To summarise, VDD is rampant throughout India. Prevention of bone fractures requires modification of multitude of risk factors one of which is Vitamin D. Also, one cannot expect a single vitamin D concentration to be directly related to an outcome when that specific outcome (i.e., fracture risk) is the result of a lifetime exposure of risks and behaviours, only one of which is vitamin D. Therefore, clinicians should be aware of all of these issues when they request and interpret a vitamin D level.

References

4. Registrar General, India, SRS Based Abridged Life Tables. 1999-2003

6th DIPSI 2011 - Mumbai

6th National Conference
Diabetes in Pregnancy Study Group India (DIPSI)
will be held on the 26th and 27th February, 2011 at Mumbai

REGISTRATION DETAILS

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*Includes one night stay on twin sharing basis at the venue.

Check-in 26th February ‘11 after 1.00 p.m.; Check-out 27th February ‘11 before 12.00 noon
Residential registration fees does not include Room Service, Laundry, Phone bills, Beverages or any other items not specifically mentioned.

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PULMOCON ‘10

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