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ORIGINAL ARTICLE

Calcium and Bone Disorders in Pregnancy and Post-Partum Assessed through Radiological Imaging

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ABSTRACT

Aim: To determine the calcium and bone disorders in pregnancy assessed through radiological imaging.
Study design: Prospective study.
Place and duration of study: Department of Radiology, Chandka Medical College Hospital, Larkana from 1st July 2022 to 31st December 2022
Methodology: One hundred pregnant women were enrolled. The blood calcium levels were assessed through serum calcium at these stages through 3 cc blood withdrawal. Dietary intake of calcium was also assessed through food frequency charts. Urinary-excretion of calcium was analyzed through cross-linked N-telopeptides (NTx) type I collagen. Each participant was assessed at 3 points including baseline assessment at 1st trimester, then at 2nd trimester and finally at post-partum 4 weeks. At the 2nd trimester ultrasound bone measurement was conducted at distal radius. Quantitative ultrasound was used for this purpose. In the post-partum women, a radiological imaging including DEXA (Dual-energy X-ray absorptiometry) bone scan was performed.
Results: The mean age was 26.9±5.5 years. The mean pregnancy was 2.0±1.1 while the mean number of children was 0.9±0.7. The previous months of breast feeding as mean were 6.8±7.9. The calcium intake from food as well as serum calcium levels was below recommended levels in women during their pregnancy and post-delivery. Through the quantitative ultasound and bone density DEXA scan images presented obvious osteoporotic changes in bone density. There were 24% had 2.5 or less meant osteoporosis formation.
Conclusion: Women often lead to calcium deficiency during gestation and lactation and thus chances of musculoskeletal disorders escalate manifolds. Radiological imaging can facilitate in detecting these calcium deficiencies.
Keywords: Hemostasis, Regulation, Pregnancy, Mineral absorption

INTRODUCTION

Adult skeleton of human body is primarily composed of calcium along with some other substantially important minerals. Approximately 99% of the body' calcium maintained throughout the life unless ovarian failure and during gestation period. Reproductive periods of lactation and pregnancy also altered bone density in women predominantly due to calcium requirement of neonate or developing fetus. Placenta transfers maternal calcium to the fetus whereas hormonal changes direct the supply of calcium to the breast milk. Calcium hemostasis during pregnancy is marginally different from other minerals to fulfil the calcium demand both for fetus and mother[1-5].

At the time of birth, 30g of calcium is present in neonate and that amount is achieved in third trimester of the pregnancy. Increased calcium demand by the neonate may be met by augmented intestinal absorption of calcium of maternal skeleton. The intestinal calcium sorption pay a major contribution to the neonate calcium level. Total calcium level falls in pregnant women mainly due to hemo-dilution related to low albumin. Few hormones also play significant contribution in calcium hemostasis during pregnancy. Parathormone (PTH), is one of the most important hormone which regulate calcium level in bone and blood. Modern immuno-metric assays showed that, PTH levels are considerably low during first trimester and then became normal during rest of the pregnancy. Another hormone, calcitonin, also involved in calcium level regulation in blood though studies showed that hormone not relatively show any significant contribution on calcium regulation during pregnancy[6-8].

Pregnancy is a condition in which hormonal, vascular and biochemical changes results in various musculoskeletal disorders including acute genital tract disorders, pelvic brim, axial skeleton stress, joint disruption, neurologic compression and hematogenous infections. Pregnancy also worsens underlying health conditions such as rheumatism, vascular malformation and desmoid tumors[9-11]. In present study, calcium and bone disorders were assessed through radiological imaging. This study will prove significant contribution in evaluation of health outcomes during and after the gestational period.

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MATERIALS AND METHODS

This prospective study was conducted at Department of Radiology, Chandka Medical College Hospital, Larkana from 1st July 2022 to 31st December 2022 and 100 cases of pregnant women enrolled. The sample size was calculated through Australian Statistical Bureau Sample Size calculator. It applied 80% power of test, 5% of margin of error and 95% Confidence of Interval. The patient's clinical, demographic history was completely documented on a well-structured questionnaire. The pregnant women who visited for antenatal visit were preliminary assessed for their calcium levels. Those pregnant women who were already suffering from hypocalcemia, autoimmune disorders were not included in the study. The age was between 18-45 years. The blood calcium levels were assessed through serum calcium at these stages through 3 cc blood withdrawal. Dietary intake of calcium was also assessed through food frequency charts. Urinary-excretion of calcium was analyzed through cross-linked N-telopeptides (NTx) type I collagen. Each participant was assessed at 3 points including baseline assessment at 1st trimester, then at 2nd trimester and finally at post-partum 4 weeks. At the 2nd trimester ultrasound bone measurement was conducted at distal radius. Quantitative ultrasound was used for this purpose. In the post-partum women a radiological imaging including DEX A(Dual-energy X-ray absorptiometry) bone scan was performed. Adual-energy x-ray absorptiometry was applied after the patient was made to lie on back of padded table. If the patient was taking any calcium supplement, then she was requested to stop taking it prior 24-48 hours of the test. A T score of -1.0 or greater was considered normal while between -1.0 and -2.5 meant low bone density (osteopenia) with a risk for developing osteoporosis. A T score of -2.5 or less meant osteoporosis formation. Data was analyzed

using SPSS version 26.0. Chi square test was used with a significance of p value <0.001 for the purpose of analyses.

RESULTS

The mean age of women was 26.9±5.5 years. The mean number of pregnancies they already had was 2.0±1.1 while the mean number of children was 0.9±0.7. The previous months of breast feeding as mean were 6.8±7.9. The body mass index value within months of gestation and post-partum did not change significantly, however with a higher trend towards post-partum time. The calcium intake from food as well as serum calcium level was below recommended levels in women during their pregnancy and post-delivery (Table 1).

Serum calcium levels in first trimester 8.8-10.6 mg/dl, second trimester 8.2–9 mg/dl and third trimester 8.2-9.7 mg/dl. The adjusted and un-adjusted values of first trimester calcium supplementation as well as third trimester and 1 month post-partum were analyzed. In the unadjusted calcium was related with an average decrease of 15.2, 16.2, and 20.1% in NTx concentrations within the 2nd and 3rd trimesters as well as post-partum one month respectively (P≤ 0.001). The resultant visit however specified covariate adjusted decrease in estimated values as 13.7, 15.5 and 19.1% (P ≤ 0.001) respectively (Table 2).

The bone density DEXA scan showed images with obvious osteoporotic changes in bone density of women. Some also presented with severe deficiency of calcium levels from diet as well as in blood (Fig. 1). The quantitative ultrasound also presented with demineralization and osteopenia in some cases (Fig. 2). There were 41% those cases which showed normal bone density scan while 35% has a level between -1.0 and -2.5 meant low bone density (osteopenia) and 24% had 2.5 or less meant osteoporosis formation (Fig. 3).

Table 1: Mean of age, clinical history and serum calcium levels (n=100)

Variable	1st Trimester	2nd Trimester	Post-Partum	P value
Age (years)	26.9±5.5			--
No . of pregnancies	2.0±1.1			--
Number of children	0.9±0.7			--
Previous breast feeding months	6.8±7.9			--
BMI (kg/m^2)	25.8±3.5	26.1±4.5	26.9±5.1	0.78
Energy intake (kcal/day)	1888	1862	1860	0.85
Calcium intake (mg/day)	1108	1083	1096	0.81
Serum Calcium level	8.1	8.1	7.9	0.54

Table 2: Calcium supplementation effect on NTx

Variable	Adjusted		Un Adjusted	
	%Δb	p-value	%Δb	p-value
1st trimester	15.2	0.001	13.7	0.001
3rd trimester	16.2	<0.001	15.5	<0.001
1 month postpartum	20.1	<0.001	19.1	<0.001
Average	16.7	<0.001	15.6	<0.001

Fg. 1: Images of DEXA scan showing normal bone (A) verses osteoporotic bone (B)

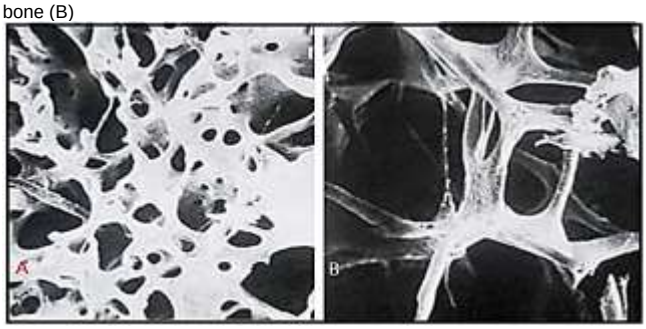


Fig. 2: Quantitative USG result showing bone demineralization

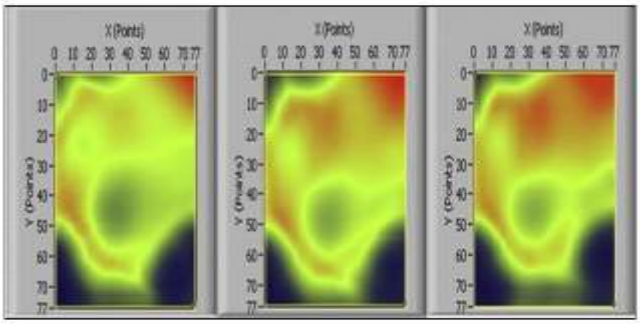
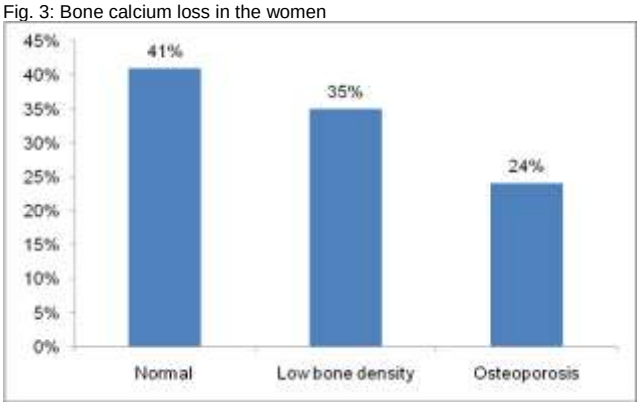


Fig. 3: Bone calcium loss in the women



DISCUSSION

Calcium regulation and hemostasis is vital especially during pregnancy to meet the demand of mother and developing fetus. Considerable decline in serum calcium level is observed during third trimester when maternal calcium level considerably declines to meet the demand of increased calcium level by the fetus.[12-14] In the present study, radiological imaging was used to assess the bone and calcium related disorders among pregnant females.

Musculoskeletal and bone disorders tendency becomes higher during gestational period. Many factors aids in the progression of these disorders in pregnant females including calcium deficiency, hormonal alteration which influence calcium regulation and absorption, vitamin D deficiency, poor calcium take in diet and elevated calcium demand to fulfill the need of fetus. Studies also suggest slight change in bone mineral content in pregnant women[15,16].

American College Of Gynecologist & Obstetricians Committee recommended following practices that needs to be follow in diagnostic imaging procedures during pregnancy. Magnetic resonance imaging and ultrasonography are generally regarded as safe but it should be prudently use when patient needs certain medical benefit. Gadolinium as a contrast agent should be avoided in pregnant female unless it is expected to improve maternal or fetal outcome. After gadolinium administration, breastfeeding should not be avoided in infants. Radiation exposure through nuclear medicine, computed tomography and radiography should not be avoided for a pregnant female with few exceptions[17-21].

CONCLUSION

Maternal adaptations vary significantly between lactation and pregnancy to meet the demand of the developing fetus. Increased intestinal calcium sorption during pregnancy is the main maternal adaptive mechanism to fulfil the demand of higher calcium requirement. Women often lead to calcium deficiency during

gestation and lactation and thus chances of musculoskeletal disorders escalate manifolds. Radiological imaging can facilitate in detecting these calcium deficiencies. This transient period needs to be properly evaluated that require detailed understanding and accurate diagnosis of bone problems by radiologists.

Conflict of interest: Nil

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