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Incidence of vitamin D levels in cord blood of newborns and correlation with maternal vitamin D

Dr. Neha Agarwal
Assistant Professor, department of paediatrics, Venkateshwara Institute Of Medical Sciences, Gajraula

Dr. Preeti Tandon
Assistant Professor, department of paediatrics, NC medical college
Corresponding author email: Aosp1011@gmail.com

***Abstract*---**Vitamin D deficiency is common in northern India but there are limited data in pregnant women and neonates. This study aimed to determine the prevalence of vitamin D levels in cord blood of newborns and the association with maternal vitamin D. A total of 50 pregnant women and their neonates were included. Clinical data and venous maternal blood for calcium,phosphate, albumin, alkaline phosphatase, magnesium, intact parathyroid hormone , and vitamin D were obtained on the day of labor. Cord blood was collected following delivery to evaluate vitamin D status of newborns. Mean serum maternal and cord blood 25 OHD levels were 25.42 ± 8.07 and 14.85 ± 5.13 ng/mL. The prevalence of vitamin D deficiency (25OHD < 12 ng/mL) and insufficiency (25OHD 12–20ng/mL) in cord blood of newborns were 20.2 and 69.1%,respectively. There was a significant correlation between maternal and cord blood vitamin D levels (P< 0.001). The factors associated with cord blood vitamin D deficiency were low maternal 25OHD level and no vitamin D supplement during pregnancy. Conclusion: There is a high prevalence of vitamin D deficiency among the neonates. Adequate prenatal vitamin D supplementation should be implemented as routine antenatal care.

***Keywords*---**vitamin D deficiency, cord blood, newborns, pregnancy.

Introduction

Vitamin D plays an important role in bone metabolism and maintaining bone health. The main sources of vitamin D in humans are from sunlight exposure and dietary intake[1].Several factors contribute to the vitamin D status, including aging,

the use of sunscreen, skin hyperpigmentation, and the sun intensity, including the season and the latitude [2].Although abundant ultraviolet B (UVB) exposure is available thoughout the year, vitamin D deficiency (VDD) remains a common problem in northern India [3] . Since 25-hydroxyvitamin D (25OHD) crosses the placenta, there is a strong correlation between maternal and cord blood 25OHDlevels [3-8]. Previous studies have reported a high prevalence of VDD in maternal serum and cord blood [9-13]. To the best of our knowledge, the prevalence of VDD among newborns has never been reported in India and the routine supplementation of vitamin D in pregnant women and newborns has not yet been established. Most previous studies have defined VDD as 25OHD levels of < 20 ng/mL; however, global consensus recommendations on the prevention and management of nutritional rickets have been recently established that define vitamin D deficiency and insufficiency as < 12 and 12–20 ng/mL, respectively [14] . We aim to evaluate the prevalence of VDD in the cord blood of newborns according to this definition and the association with the maternal vitamin D status.

Materials and Methods

Patients

A total of 50 pregnant women aged 18–45 years old and carrying a term singleton fetus and their neonates were enrolled in the study at U.P during October 2018 to April 2019. Term pregnancy was defined as 37–41 weeks of gestation. Infants that were admitted to the Neonatal Intensive Care Unit, and born with congenital malformation and syndrome were excluded. Pregnant women were asked for their sociodemographic data, multivitamin supplementation during pregnancy, and their use of sunscreen.The obstetric history and newborn data were obtained from the medical records. Venous maternal blood samples, for calcium, phosphate, albumin, alkaline phosphatase, magnesium, intact parathyroid hormone , and 25OHD were obtained on the day of labor. Cord blood was collected following delivery to evaluate the vitamin D status of the newborns.

Biochemical assays

The plasma levels of calcium, phosphate, magnesium, andalbumin were measured using an Automated Analyzer. Intact parathyroid hormone was measured using a chemiluminescent microparticle immunoassay . 25OHDwas analyzed using a chemiluminescent microparticle mmunoassay. All the hormonal assays were performed according to the manufacturers'protocols. Vitamin D deficiency was defined as25OHD < 12 ng/mL, insufficiency as 25OHD 12–20 ng/mL,and sufficiency as 25OHD > 20 ng/mL.

Stastical analysis

Statistical analysis was performed using SPSS version 22.Normally distributed data were expressed as the mean ± stan-dard deviation. We performed analysis of variance (ANOVA)and ChiPearson's correlation analysis was used to explore relationships. A P-value < 0.05 was considered significant.

Results

In total, 50 pregnant women, mean age 28.59 ±5.91 years, were included in the study. There were 20 primiparous (40%) and 30 multiparous women (60%). The mean gestational age was 38.6 ± 1.01 weeks. 24 women(48%) were taking vitamin D supplements during pregnancy with an average dose of 400 IU/day. The mean BMI before pregnancy was 22.42 ± 4.38 kg/m^2. There were 17 women(34%) reported to routinely use sunscreen. Of the newborns,25 (50%) were females and 43 (86%) were classified as appropriate for their gestational age. The mean birth weight and length were 3096.38 ± 374.3 g and 52.04 ± 1.92 cm,respectively.

The mean serum maternal and cord blood 25OHD levelswere 25.42 ± 8.07 and 14.85 ± 5.13 ng/mL, respectively. On average, the serum cord blood 25OHD level accounted for 57% of the maternal 25OHD level. The prevalence of vitamin D deficiency and insufficiency in newborns, defined as25OHD < 12 and 12–20 ng/mL, were 20.2 and 69.1%, respec-tively. There was a significant correlation (P<0.001) between the maternal and cord blood vitamin D levels .There was no association between the vitamin D level in cordblood with the birth weight (P= 0.86), birthlength (P= 0.51), and head circumference (P=0.33).When comparing between the groups, the mothers of infants with a deficient or insufficient level of vitamin D in cordblood had a lower 25OHD level.

The lowest percentage of maternal supplementation was found in the deficient group. There was no difference in the maternal levels of calcium, phosphate, magnesium, and intact parathyroid hormone. The birth weight and length were not different between the groups. Mothers supplemented with vitamin D demonstrated a higher 25OHD level. In the group of mothers supplemented with vitamin D during pregnancy (n=24), vitamin D insufficiency was noted in 4 mothers (16.6%) and 20 neonates (83.3%). Although the 25OHD levels in cordblood were not different, the prevalence of cord blood VDD was significant lower in the supplemented group.

Discussion

To the extent of our review, this is the first study in north India evaluating the vitamin D status in cord blood using the definition and diagnosis of global consensus recommendations on the pre-vention and management of nutritional rickets and the association with maternal vitamin D status. Our study showed a high prevalence of VDD and insufficiency in the cord blood of new-borns and a significant correlation between maternal and cordblood vitamin D levels. A total of 20.2% of these newborns had VDD and 69.1% had vitamin D insufficiency, despite 49% of their mothers reporting the use of multivitamin supplementsduring pregnancy. Several studies have evaluated the vitamin D status in cord blood.

In a study in Brazil, 29.2% of the infants tested had VDD and 51.3% had vitamin D insufficiency at birth[15]. A large cohort study from the Netherlands also showed a high prevalence of VDD in neonates (46%), especially among those with a non-European ethnic background. Another study from India showed a large proportion of neonates (95.7%) had hypovitaminosis D (serum 25OHD < 20

ng/mL) [16] . In our study, the maternal 25OHD level and use of vitamin D supplements during pregnancy were associated with the vitamin D status in neonates. A large study in Canada reported that the key factors associated with the neonatal 25OHD level were maternal age, dairy intake, supplement use, and 25OHD level[17].

Marshall et al. reported that a younger maternal age and an increased number of pregnancies were associated with cordblood vitamin D deficiency or insufficiency [18]. Another study also found that the risk factors of VDD in newborns were thematernal 25OHD and alkaline phosphatase levels .Exposure to sunlight is the main source of vitamin D andsunscreen use could contribute to VDD . However, our data showed no association between VDD and sunscreen use. Thisis similar to the study in Brazil, which reported that sun expo-sure and the use of a sunscreen were not associated with VDDin women and newborns [18] . Our study showed no significant differences in the maternal levels of calcium, phosphate, magnesium, and intact parathyroid hormone between vitamin D-deficient and sufficient mother; however, there was a trend that low vitamin D levels in the mother lead to higher PTH values as is observed in other studies.

In the present study, the use of vitamin D supplements decreased the prevalence of cord blood VDD but not vitamin D insufficiency. Despite taking vitamin D supplements during pregnancy, cord blood VDD was found as 6.5% and vitamin D insufficiency was noted as 19.6% in mothers and 84.8% intheir neonates. These could be due to an inadequate dose of vitamin D since the average dose of vitamin D intake in our subjects was only 400 IU/day. Recently, global consensus guidelines have recommended that pregnant women should receive 600 IU/day of vitamin D .Sufficiency limit of 25OHD is still debated.

The Endocrine Society recommends that 25OHD value of 30 ng/mL should be the actual lower normal limit for adults, whereas the Institute of Medicine defines this limit as 20 ng/mL. Our study showed that mean maternal 25OHD levels of the newborns with deficient,insufficient, and sufficient vitamin D status were 15.3, 26.6, and37.1 ng/mL, respectively. Also, mean 25OHD level of 14.8 ng/mL in cord blood is about 57% of maternal level. These data suggest that maternal 25OHD level should be above 30 ng/mLfor sufficient vitamin D status in newborns and maternal25OHD level greater than 20 ng/mL seems to be adequate for preventing cord blood vitamin D deficiency.

Conclusion

Serum 25OHD level of 20 ng/mL might be the lower normal limit for general population, but based on the results of our study, we might propose that this limit should be at least 30 ng/mL for pregnant women that must supply their offspring.We acknowledge the potential limitations of our study.First, our study was conducted only in an urban area thus could not represent the overall population. Second, we did not evaluate the adherence of taking multivitamin supple-ments and did not record the dietary vitamin D intake.

Finally we did not collect all the maternal data that may correlate with cord blood vitamin D status, including maternal skin color and sunlight exposure. However,

it is unlikely that these factors will have overly affected the results because all the studied mothers were of the same ethnicity and the sunlight exposure data obtained from the questionnaires may be inaccurate be-cause they self-reported information and therefore there was apossibility of recall bias.

Ethical clearance- Taken from ethical committee of institution
Source of funding- Self
Conflict of Interest – Nil

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