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Original Article

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A Case Control Study to Evaluate the Association between Primary Cesarean Section for Dystocia and Vitamin D Deficiency

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ABSTRACT

Background: Milder forms of vitamin D deficiency could be responsible for poor muscular performance causing dysfunctional labor. The aim of our research was to study the association between vitamin D deficiency and primary cesarean section.

Materials and Methods: This was a case control study. Forty six women who delivered by primary cesarean section with dystocia as primary or secondary indication after 37 weeks of gestation were taken as cases and a similar number of women who delivered vaginally were taken as controls. Vitamin D deficiency was diagnosed when the serum 25(OH)D level was ≤20 ng/ml and this was compared between cases and controls.

Results: Median serum (OH) vitamin D levels was 23.3ng/ml among women who delivered by cesarean section and 26.2ng/ml among controls (p=0.196). Baseline characteristics were similar in both groups except for a strong association between Body Mass Index (BMI) and cesarean section, (29.7kg/m^2 in cases and 25.9kg/m^2 in controls p=0.001) seen in multivariate analysis. Vitamin D deficiency was seen in 34.8% of cases and 21.7% of controls (p=0.165).

Conclusion: This small case control study did not show a significant association between vitamin D deficiency and primary cesarean section.

Keywords: Dystocia, Failure to progress

INTRODUCTION

Rising cesarean section rates is a concern both globally [1] and in India [2]. It is well known that reducing the primary cesarean section would be the most effective strategy to reduce cesarean section rates. Dystocia is a common indication for primary cesarean sections [3] and several factors may contribute to dystocia. Malformed pelvis, a manifestation of vitamin D deficiency was a well-known cause of dystocia and was responsible for a marked increase in cesarean sections in the early 19th century [4]. Although rickets virtually disappeared with the discovery of vitamin D, recent reports suggest a re-emergence of osteomalacia [5,6] with milder forms of deficiency, both in developed and developing nations. Hence, there is now a lot of interest in vitamin D deficiency and its acute and chronic manifestation [7,8]. Women with vitamin D deficiency may not have any significant symptoms. Poor muscular performance [9,10] is an established manifestation of vitamin D deficiency. Serum calcium status which is regulated by vitamin D could play an important role in both skeletal and smooth muscle function which may in turn contribute to dysfunctional labor. Maternal calcium status has been shown to play a role in initiation of labour [11] Metabolism of vitamin D in pregnancy is still not well understood [12]. However, adequate vitamin D is essential for maternal and fetal health and may prevent adverse outcomes. Vitamin D receptors are present in skeletal muscle [13] and vitamin D deficiency could affect muscle mass and strength in young women [14,15]. Research using data from National Health and Nutrition Examination Survey 2005-2006 (NHANES) [16] showed a decreased risk of pelvic floor disorders for women with 25(OH)D levels of 30ng/dl or more. Thus, it could be speculated that vitamin D deficiency decreases strength of pelvic musculature which then could contribute to fetal malrotation and malposition or inability of the mother to push and deliver vaginally. Few studies have been done to study the association of primary lower segment cesarean section (LSCS) for dystocia with vitamin D deficiency with conflicting results. Two cohort studies [17,18] showed an association between vitamin D and primary caesarean section and three other studies [19-21] did not find this association.

AIM

Thus the aim of this study was to assess the association between maternal levels of vitamin D and primary cesarean section in a South Indian population.

MATERIALS AND METHODS

This study was done in a large tertiary care centre in South India which has about 14,000 deliveries per year. After approval by the Institutional Review Board (IRB, Min.No: 6936 dated 30.09.2009) women were recruited in the months of August and November 2010. Women eligible for the study were those women who underwent LSCS for dystocia as primary or secondary indication after 37 completed weeks. Dystocia was defined as abnormally slow labor progress [22]. Women with multiple pregnancy, intra-uterine growth retardation (IUGR), placenta previa, women on extra multivitamins or vitamin D supplement and previous LSCS were excluded. The controls were post natal women who delivered vaginally after 37 completed weeks within 72 hours of recruitment of a case. Thus 46 women who had a primary LSCS for dystocia and agreed to participate in the study after written informed consent were recruited as cases and a similar number of women who delivered normally were taken as controls. They had their demographic, clinical and dietary data entered into a proforma and a sample of venous blood collected and sent for serum 25(OH)D assay within 72 hours of delivery. The blood samples were analysed for serum 25(OH)D levels by electro-chemi-luminescence immune-assay, on a Elecsys 2010 analyser using Roche Diagnostics GmbH cobas® kit. Vitamin D deficiency was diagnosed when the serum 25 (OH)D level was ≤ 20ng/ml [7].

The sample size was calculated to be 45 assuming a difference of 30% [18] in the prevalence of vitamin D in the cases and control to obtain a power of 80% and a 5% level of significance.

The difference in vitamin D levels and associated factors between cases and controls was analysed using Chi square test or Fisher's-exact test, Students t-test or Wilcoxon rank test. Multivariate logistic regression was used with LSCS as dependent variable and age, religion, socio-economic status, BMI, birth weight and vitamin D levels as independent variables. All statistical analyses were carried out using STATA Statistical software version 13.1.

RESULTS

During the study period in the months of August 2010 and November 2010 there were 2081 deliveries and primary LSCS rate was 20%. Out of 89 women who had LSCS for dystocia, 46 were recruited into the study.

A total of 92 samples were collected from the women in the labour ward and post natal wards. Of the 92 samples, 46 were of cases, that is, those who underwent primary cesarean section for dystocia and the rest from 46 controls who delivered vaginally.

The ages of women [Table/Fig-1] in the cases and control groups were similar with mean range of 24-25 years. The percentage of Muslims was 8.7% in the cases and 6.5% in the control group. The number of Christians and Hindus together were 91.3% in the cases and 93.5% in the controls.

The number of graduates among cases and controls were 56.5% and 54.3% respectively. Mean height was 155.4cm in the cases and 157.2 cm in the controls. The Body Mass Index (BMI kg/m^2) was significantly higher among the cases compared to controls (29.7 versus 25.9 p<0.001). Gestational age at delivery was similar in both groups. About 8-10% of women belonged to low social-economic status and it was similar in both groups. Mean birth weight was 2889.6 gm in the cases and 3009.2 gm in the controls. The percentage of vegetarians was around 52.2% to 56.5% and was similar in both groups. Women who drank atleast 100ml of milk per day and women on calcium supplements were similar in both groups. The haemoglobin levels were 11.9 and 11.6 gm/dl among cases and controls respectively and this was similar.

Variables	LSCS (n=46) (%)		Vaginal (n=46) (%)		p-value
Age (years), mean(SD)	25.8	(3.8)	24.3	(3.8)	0.057
Religion n (%)					
Christian	4.0	(8.7)	1.0	(2.2)	0.342[a]
Muslim	4.0	(8.7)	3.0	(6.5)	
Hindu	38.0	(82.6)	42.0	(91.3)	
Educationn (%)					0.834
Higher Secondary & below	20.0	(43.5)	21.0	(45.7)	
Graduates	28.0	(56.5)	25.0	(54.3)	
Height(cm), mean(SD)	155.4	(5.8)	157.2	(5.3)	0.127
BMI(kg/m^2) , mean(SD)	29.7	(3.7)	25.9	(3.9)	<0.001
Gestational Age(weeks)					0.063
37-38	8.0	(17.4)	12.0	(26.1)	
38-40	24.0	(52.2)	29.0	(63.0)	
>40	14.0	(30.4)	5.0	(10.9)	
Birth weight(g), mean(SD)	2889.6	(441.6)	3009.2	(543.9)	0.249
Socio Economic Status n(%)					
Low	4.0	(8.7)	5.0	(10.9)	0.863
Middle	13.0	(28.3)	11.0	(23.9)	
High	29.0	(63.0)	30.0	(65.2)	0.675
Diet					
Vegetarian	26.0	(56.5)	24.0	(52.2)	
Non-Vegetarian	20.0	(43.5)	22.0	(47.8)	
Milk intaken(%)					
Yes	38.0	(82.6)	38.0	(82.6)	>0.99
No	8.0	(17.4)	8.0	(17.4)	
Haemoglobin(g), mean (SD)	11.9	(0.9)	11.6	(1.4)	0.308

[Table/Fig-1]: Characteristics of study sample by mode of delivery
[a] p-value determined by Chi-square or Fisher's exact testand two sample t-test

Variables	LSCS (n=46)		Vaginal (n=46)		p-value
Vitamin D (ng/ml), median (interquartile range)	23.3 (18.2 – 31.2)		26.2 (20.5 – 31.1)		0.196[a]
Vitamin D n (%)					
<20 ng/ml	16	(34.8)	10	(21.7)	0.165
>=20 ng/ml	30	(65.2)	36	(78.3)	

[Table/Fig-2]: Outcomes
[a] Wilcoxon rank sum test

Variables	Odds Ratio (95%CI)		p-value
Age(years)	1.07	(0.93,1.22)	0.341
Religion:			
Muslim	1.24	(0.53,2.91)	0.622
Non-Muslim	Ref		
Socio Economic Status n(%)			
Low	Ref		
Middle	1.75	(0.29-10.62)	0.543
High	1.09	(0.20-5.93)	0.916
BMI(kg/m^2)	1.31	(1.13,1.52)	<0.001
Birth weight(g)	1.00	(0.99, 1.00)	0.620
Vitamin D			
<20ng/ml	2.31	(0.77, 6.92)	0.133
≥20ng/ml	Ref		

[Table/Fig-3]: Multiple Logistic regression analysis of factors associated with LSCS

The median vitamin D levels [Table/Fig-2] was 23.3ng/ml in the cases and 26.2 ng/ml in the controls. Vitamin levels of <20 ng/ml was seen in 16 cases and 10 controls (34.8% vs 21.7% p=0.165). The difference in vitamin D levels in the two groups was not statistically significant. Increased BMI was the only independent risk factor associated with cesarean section (OR=1.31,95%CI;1.13-1.52) (p=<0.001). In multi-variable logistic regression analysis controlling for religion, socio-economic status, BMI, birth weight [Table/Fig-3] women with vitamin D deficiency (<20 ng/ml) were almost 2.3 times as likely to have primary cesarean section as women without deficiency (OR=2.31(95CI;0.77-6.92) but not statistically significant. The median vitamin D level among Muslims was 21.2 ng/ml which was lower than the median vitamin D level of the total study population, but no statistical difference was seen. All the Muslims recruited into the study had vitamin D levels ≤30 ng/ml

DISCUSSION

Our study showed no significant difference in the number of women with vitamin D deficiency among cases and controls. These findings are comparable to a case control study done among Pakistani women in Karachi [19]. However, the observational study done by Merewood et al., [18] showed a four-fold increase in cesarean sections among women who had vitamin D deficiency. This study included all women who had primary cesarean section unlike our study and the study done in Pakistan where only women with dystocia as an indication for primary cesarean were taken as cases. A possibility of a confounder cannot be ruled out in the study by Merewood et al. It can be hypothesized that the increase in primary LSCS in women who had severe vitamin D deficiency in this study was due to an associated increase in preeclampsia which is definitely

known to increase primary cesarean section rates. Association between vitamin D deficiency and preeclampsia has been shown in several studies [23]. Vitamin D deficiency may be a marker of compromised immune system which in turn could be linked to pre-eclampsia [24] thus indirectly causing an increased risk for cesarean section. Another prospective observational study [17] also showed an increased incidence of caserean section for prolonged labor in women who had vitamin D deficiency. Two cross-sectional studies done in Spain [20] and another from Australia [21], like our study did not find any association between vitamin D and primary cesarean section. A salient secondary finding of our study was that there was a strong association between increased BMI and cesarean section which was seen with multivariate analysis. This has been seen in other studies [25-27]. All the other baseline characteristics were similar in both groups. Most of the women in our study belonged to the middle or upper socioeconomic class and vitamin D deficiency was seen in 35% of women who had cesarean section and 22% of women who delivered vaginally. The prevalence of vitamin D deficiency in this study group was similar to that seen in the study by Merewood et al., [18] but much lower than that seen in other studies done in this region [28].

Though we took 20ng/ml as the cut off to diagnose vitamin D deficiency as recommended by most experts [7], there is generally no consensus on this cut off. In fact, the study by Merewood et al., [18] took a cut off of 15ng/ml as the level to diagnose vitamin D deficiency and found 37% deficiency in women who had LSCS similar to the current study. Hollis et al., have recommended vitamin D levels less than 40ng/ml to diagnose deficiency in pregnancy [29]. Maternal levels of 25(OH) vitamin D is known to be the best biomarker of vitamin D deficiency [30] and this was used in our study to diagnose vitamin D deficiency.

We looked at vitamin deficiency among Muslims as it is the practice for Muslim women in our region to cover themselves with a black cloak, the 'purdah' which prevents any exposure to sunlight. Almost 50% of the Muslim women in our study were vitamin D deficient and all the others had vitamin D insufficiency. However, only 7% of the cases in our study were Muslims but this is a proportionate representation of the demography of our region. Similar low levels of vitamin D have been seen among Muslim women in many studies done in the past [21,31-33] where a similar practice of using a 'purdah' is common. It is possible that our study was not adequately powered to show a difference in vitamin D deficiency in both groups. We chose a small case control design to answer our research question as a pragmatic strategy to minimize cost and effort to complete the research with available funds. Conflicting results among studies may be due to differences in study design and heterogeneity of study population.

Role of vitamin D supplementation in pregnancy is not yet well established. Even if Vitamin D supplementation has been shown to increase vitamin D levels [34,35], its clinical significance is yet to be studied. Currently, screening for vitamin D deficiency is justified only in the context of research. Thus, there is a need for large well-designed studies that look at outcomes of vitamin D deficiency in pregnancy and benefits of vitamin D supplementation. While more information about vitamin D is being unraveled, it may be prudent to advice antenatal women to ensure atleast 20 minutes of morning sunshine between 10 am to 3 pm especially in our region where majority of the women are dark-skinned [36].

CONCLUSION

Thus, this small case control study could not show an association between vitamin D deficiency and primary caesarean section. However, since there is trend towards lower vitamin D levels in women who had primary caesarean section for dystocia, a larger well-funded multicenter study is warranted to answer this research question.

Declaration: This research study has been presented as a poster in RCOG 2014. (available at http://epostersonline.s3.amazonaws.com/rcog2014/rcog2014.1ca046c.NORMAL.pdf).

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