British Journal of Bio-Medical Research Vol.03, Issue 05, Pg.1085 -1093, September - October 2019

Available Online at http://www.bjbmr.org

BRITISH JOURNAL OF BIO-MEDICAL RESEARCH

Cross Ref DOI: https://doi.org/10.24942/bjbmr.2019.569 Volume 03, Issue 05, Sept - October 2019

ISSN:2456-9739

Research Article

Serum Calcium Levels, Uterine Contractility And Labour In Parturient Nigerian IGBO Women

Adinma J.I.B[1], Oguaka V.N[2], Okafor C.I[1], Udigwe G.O[1], Adinma Obiajulu-ND[1], Edet MM[3]

[1]Department of Obstetrics and Gynaecology, Nnamdi Azikiwe University and Teaching Hospital, Nnewi, Anambra State, Nigeria.

[2]Department of Human Biochemistry, Nnamdi Azikiwe University, Nnewi Campus, Anambra State.

[3]Center for Health and Allied Legal Demographical Development, Research and Training, Nnamdi Azikiwe University, Awka.

ARTICLE INFO

Article History:
Received on 04th Sept 2019
Peer Reviewed on 15th Sept 2019
Revised on 11th October 2019
Published on 28th October 2019

Keywords:
Serum calcium, uterine contractility, progress and duration of labour, parturient women

ABSTRACT

Background: Reports have it that serum calcium levels are lower in parturient women with uterine hypotonia.

Objective: To determine the relationship between serum calcium, uterine contractility and the progress/duration of labour in parturient Nigerian Igbo women.

Methodology: A cohort study of 140 consecutive consenting parturient women at NAUTH, Nnewi, involving the assessment of serum calcium levels and measurement of uterine contractility by clinical methods and tocodynamometer. Labour progress, duration and mode of delivery were also recorded. Data analysis was performed using SPSS version 21. Comparison of variables employed Pearson's Chi square test, analysis of variance (ANOVA), and Mann Whitney test, with p-value <0.05 at 95% confidence interval considered to be statistically significant.

Results: The mean serum ionized calcium of the population was 1.10±0.26mmol/L. Only 1 (0.71%) participant had hypercalcaemia; 74 (52.86%) had eucalcaemia, and 65 (46.43%) had hypocalcaemia. There was no significant difference in the mean serum ionized calcium between participants with adequate uterine contractions and those with uterine hypotonia (P = 0.483). Mean serum calcium was higher among the participants with good labour progress (1.12±0.22mmol/L) compared to those with poor progress (1.06±0.32mmol/L). Participants with labour duration <3hrs had higher mean serum calcium levels (1.13±0.23mmol/L) than those ≥12 hours (0.60±0.31mmol/L). Calcium were lower for assisted vaginal delivery, (1.03±0.15mmol/L) compared to spontaneous vertex (1.12±0.29mmol/L) and caesarean (1.12±0.18mmol/L) deliveries

Conclusion: This study shows that optimal serum calcium level minimizes uterine atony. There is need to explore this towards the prediction and management of labour dystocia.

Corresponding Author: *Prof. J.I.B Adinma, Department of Obstetrics and Gynaecology, Nnamdi Azikiwe University and Teaching Hospital, Nnewi, Anambra State, Nigeria.*

INTRODUCTION

The entire process of labour and delivery depend on the three participant in the mechanism of labour viz; the powers, the passages, and the passenger[1]. These must interact favourably for a successful vaginal delivery. Uterine contractile activity is important in varied reproductive functions including sperm and embryo transport, implantation, menstruation, gestation and parturition. Abnormal contractility could be responsible for common disorders like infertility, implantation failure, dysmenorrhoea, endometriosis, spontaneous miscarriage or preterm birth[2] and plays a key role in poor progress of labour and dysfunctional labour commonly from uterine hypotonia which is a major cause of emergency caesarean sections (in 25% of cases)[3].

Adequate understanding of the mechanisms that generate and modulate uterine contractility is needed if progress is to be made in the prevention and treatment of problems in labour[3]. Dysfunctional labour usually results from uterine hypocontractility which is the most common cause of protraction and/or arrest disorders in the first stage of labour. Uterine hypocontractility refers to uterine activity that is either not sufficiently strong or not appropriately coordinated to dilate the cervix and expel the fetus.

A number of cellular mechanisms are involved in the regulation of the human myometrial activity and these are modulated by hormonal and mechanical signals[1]. Uterine contraction results from cascade of complex events of which oxytocin receptor (OTR) signalling is one of the recognized pathway[4]. Receptor activation triggers a number of signalling events to stimulate contraction, primarily by elevating intracellular calcium (Ca^{2+}). This includes inositol-tris-phosphate - mediated store calcium release, store-operated Ca^{2+} entry and voltage-operated Ca^{2+} entry[4]. Calcium on the other hand binds to Calmodulin and activates the myosin light chain kinases that trigger the formation of actin-myosin complex in muscle cells producing muscle contraction. Agents that antagonize or reduce the availability of calcium like magnesium (magnesium sulphate) and calcium channel blockers are well established agents for tocolysis[5]. Calcium therefore plays a central role in the regulation and control of uterine contractile activities.

It is noteworthy that calcium as important as its role is in uterine contractility has not received as much attention as it ought to. For instance, there is paucity of human studies on the correlation between serum calcium levels and uterine contractility in labour[6,7]. The reverse is true of animal studies. The use of parenteral calcium either alone or alongside parenteral oxytocin in the management of labour dystocia caused by uterine hypotonia especially in demonstrated cases of hypocalcaemia is an age long practice among the veterinarians[8]. There are too few human studies that have tried to assess the level of calcium and uterine contractility in parturient women. A possible role for calcium during initiation of labour was adduced to by Papandreou et al[9]. who found significantly higher levels of serum calcium in patients who delivered vaginally compared to those who delivered by scheduled caesarean section at term[9]. In addition, Wattimury et al found that the total serum and ionized calcium levels are lower in parturients with hypotonic uterine inertia compared to those without uterine inertia[7]. This study has been undertaken among parturient women in southeastern Nigeria to determine serum calcium levels, and its relationship with uterine contractility together with labour progress, duration and mode of delivery of the fetus.

SUBJECTS AND METHODS:

A cohort study conducted on parturient women in labour at the labour ward of Nnamdi Azikiwe University Teaching Hospital, Nnewi, south east Nigeria from March 1st to June 12th, 2016. Ethical approval for the study was obtained from the ethics committee of Nnamdi Azikiwes University Teaching Hospital, Nnewi. Consecutive, consenting patients who met the

inclusion criteria were recruited at the diagnosis of active phase labour. Only parturient women who presented at term with live, singleton in cephalic presentation and spontaneous labour onset without any confounding medical and obstetric variables were included in the study. Those who presented in second stage of labour or with cephalopelvic disproportion were excluded. Parturient women with confounding obstetric variables like scarred uterus, polyhydramnios, obvious fibroids in pregnancy or obstetric disorders like abruptio placenta and placenta praevia were also excluded. Other exclusion criteria were co-existing medical disorders like hypertensive disorders, known diabetes mellitus, HIV seropositivity etcetera.

After recording the patients' socio-demographic data, the labour was monitored using the partograph. The uterine contractility was determined both by subjective clinical assessment and more objectively using external probes by tocodynamometer. The progress and the duration of labour as well as mode of delivery were also recorded. Following the recruitment of a patient into the study, 5ml of blood sample was drawn by antecubital vein phlebotomy once a diagnosis of active phase labour was made on vaginal examination. The specimen so collected was transferred to a plain centrifuge tube and allowed to clot at room temperature. The clotted specimen was centrifuged for 15 minutes at 3,000 revolutions per minute (rpm) and the serum (supernatant) transferred into another plain specimen bottle with a pipette and stored in a deep freezer at -20°C until ready for analyses.

The serum sample so collected was analysed for total and ionized calcium content using "CornIey" Electrolyte Analyzer which is a fully automated system that operates on the basic principles of ion-selective electrode.

The data obtained were processed and analysed using the Statistical Package for Social Sciences (SPSS) version 21.0. Continuous variables were expressed as means and standard deviations. The serum calcium levels of the participants with adequate uterine contraction was compared to those who had uterine hypotonia. The same comparison was done between the participants with good progress against those with poor progress of labour and also for the different mode of deliveries. Pearson's Chi square test, analysis of variance (ANOVA), and Mann Whitney t-test were employed where relevant to compare variables and test for significance. P value <0.05 at 95% confidence interval was considered statistically significant.

RESULTS:

Out of 385 parturient women who presented to the labour ward within the study period, 143 met the inclusion criteria and were recruited, while 3 dropped out (attrition of 2.14%). The remaining 140 participants were followed up and the data collected were analysed.

Table 1 shows the biosocial characteristics of the participants. The mean age of participants was 29.36±4.99 years. Only 2(1.4%) of the participants were aged below 20 years while the 25-29years age range has the highest number of participants 52(37.1%). Most of the participants were married 138(98.6%). Upto 43(30.7%) of the participants were nulliparous. As high as 82 (58.6%) were either primiparous or multiparous; while only 15(10.7%) were grand multiparous women. The median parity of the participants was 1. More than half (54.3%) of the participants presented in labour between 39 and 40 weeks of gestation, 32.1% presented at 37 to 38 weeks of gestation, while 13.6% presented at 41 to 42 weeks of gestation. The median gestational age at presentation was 39 weeks and a mean of 39.1±1.28 weeks. Upto 74 (52.9%) of the participants had tertiary education, while 43.6% and 3.6% stopped at secondary and primary levels of education respectively.

Table 1: Distribution by biosocial characteristics of the participants

CHARACTERISTICS	FREQUENCY	PERCENTAGE
Age (in years)		
<20	2	1.4
20-24	20	14.3
25-29	52	37.1
30-34	47	33.6
≥35	19	13.6
Total	140	100.0
Marital Status		
Married	138	98.6
Single	2	1.4
Others	0	0
Total	140	100.0
Parity		
0	43	30.7
1-4	82	58.6
≥5	15	10.7
Total	140	100.0
Gestational Age		
37-38	45	32.1
39-40	76	54.3
41-42	19	13.6
Total	140	100.0
Educational Level		
Primary	5	3.6
Secondary	61	43.6
Tertiary	74	52.9
Total	140	100.0

The mean ionized calcium of the participants was 1.10±0.26 mmol/L. Only 1 (0.71%) participant had hypercalcaemia (serum ionized calcium >1.5 mmol/L) while 74 (52.86%) had eucalcaemia (serum ionized calcium of 1.1 – 1.5 mmol/L), and 65 (46.43%) had hypocalcaemia (serum ionized calcium < 1.1 mmol/L) - figure 1.

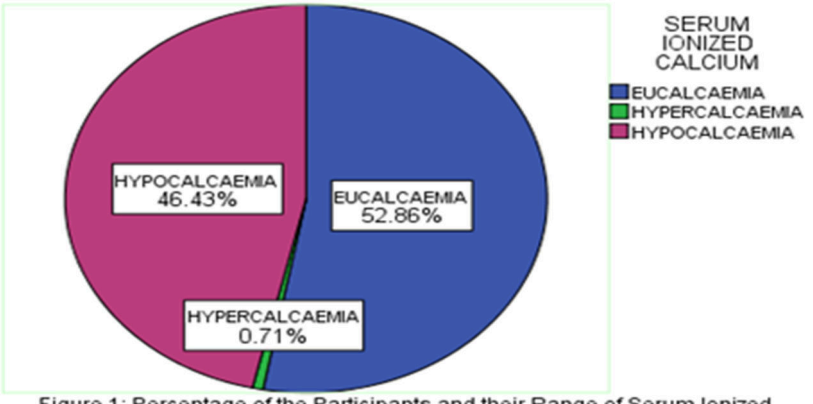

Figure 1: Percentage of the Participants and their Range of Serum Ionized Calcium

Using the clinical assessment for uterine contractions, eighty-six (61.4%) patients had adequate uterine contractions while 54 (38.6%) had uterine hypotonia at recruitment. The 54(38.6%) parturient that had hypotonia had mean ionized calcium level of 1.09±0.26 while the 86(61.4%) that had Normotonia had mean serum ionized calcium level of 1.12±0.27. None of the participants had hypertonia. The relationship was not statistically significant. The tocographic assessment of uterine contractions showed that 91 (65.0%) participants had optimal uterine contractions (200-300 Montevideo units) while 49 (35.0%) had sub-optimal (<200 Montevideo units) uterine contractions at recruitment. Similarly, 49 (35.0%) parturient that had TCG recording of <200 montevideo unit had mean ionized calcium level of 1.10 ±0.23; the 91(65%) parturient that had TCG recording of 200-300 montevideo units had mean ionized calcium recording of 1.11±0.32. No parturient had TCG record >300 montevideo units. Again this relationship was not statistically significant (p>0.05)

Table 2: Distribution by clinical and cardiotocographic assessment of uterine contraction for mean serum ionized calcium of the participants

Characteristics	**Number**	**Mean serum ionized calcium**	**p-value**	**Level of significant**
Clinical Assessment of Uterine Contraction				
Hypotonia	**54**	**1.09**±0.26	**0.502**	**Not significant**
Normotonia	**86**	1.12±0.27		
Hypertonia	**0**	**-**		
Tocographic Assessment of Uterine Contraction				
<200 Montevideo Units	**49**	1.10±0.23	**0.944**	
200 – 300 Montevideo Units	**91**	1.11±0.32		**Not significant**
≥300 Montevideo Units	**0**	**-**		

The distribution by rate of cervical dilatation, and duration of active phase labour for mean ionized serum calcium levels of the participants is shown in table 3. Parturient with cervical dilation less than 1cm/hr 49(35%), had mean serum ionized calcium level of 1.06±0.32 while parturient with cervical dilatation greater than 1cm/hr 91 (65%) had mean serum calcium level of 1.12±0.22. The difference was statistically significant at p=0.001. In general there was a reduction in mean serum ionized calcium level with increased duration of active phase of labour. Parturient with duration of active phase of labour of <3hrs 40 (28.6%)had mean serum ionised calcium levels of 1.13±0.23; 3-8hrs, 77(55.0%)- 1.13±0.27; > 8 to <12hous, 19(13.6%)-1.05±0.16, and ≥12 hours, 4(2.9%) -0.60±0.31.

Table 3: Distribution by rate of cervical dilatation, and duration of active phase labour for mean ionized serum calcium levels of the participants

Characteristic	Number	Mean Serum Ionized Calcium (mmol/L)	p-value	Level of significant
Rate of cervical dilatation (cm/hr)				
<1	**49**	1.06±0.32	**0.01**	**Significant**
≥1	**91**	1.12±0.22		
*Mann-Whitney test				
Duration of active phase labour (in hours)				
<3 hours	40	1.13±0.23		
3-8 hours	77	1.13±0.27	**0.000**	**Significant**
> 8 to <12	19	1.05±0.16		
≥12 hours	4	0.60±0.31		
F-test			**6.291**	
*Analysis of variance (ANOVA)				

The distribution by the mode of delivery of the parturient for serum levels of ionized calcium is shown in table 4. Ninety-seven (69.3%) participants had spontaneous vertex delivery while 25 (17.9%) and 18 (12.9%) had assisted vaginal delivery and caesarean section respectively. Those who delivered by caesarean section had the highest mean serum ionized calcium of 1.12±0.18 mmol/L in comparison to those who had assisted vaginal/instrumental delivery whose mean serum ionized calcium was 1.03±0.15 mmol/L and those who had spontaneous vertex delivery with mean serum ionized calcium of 1.12±0.29 mmol/L. There was no statistical difference in the serum ionized calcium in labour among the participants irrespective of the eventual route of delivery (P = 0.262).

Table 4: Distribution by the mode of delivery of the parturient for serum levels of ionized calcium

Mode of delivery	Number	Percent	Mean serum ionized calcium level (mmol/l)	p-value	Level of significance
Spontaneous vertex delivery	97	69.3	1.12±0.29	0.262	
Assisted vaginal delivery	25	17.9	1.03±0.15		Not significant
Caeserean Section	18	12.9	1.12±0.18		

DISCUSSION:

The prevalence rate of hypocalcaemia among parturient women in this study was relatively high at 46.4%. A much higher value was however reported from a study conducted in Pakistan where Hassan et al observed a prevalence rate, as high as 80.0% among pregnant women between 37-41 weeks of

gestation[10]. They however noted that majority of the patients had less than the recommended dietary allowance of calcium throughout their pregnancy, a factor that was not taken into consideration in this study. A previous report had found a generally lower level of calcium among women in the third trimester of pregnancy compared to non-pregnant controls[11]. A report from North western Nigeria indicated much lower level of hypocalcemia, 1.3% among pregnant, and puerperal women, in contrast to the relatively higher level observed in this study, conducted among women in Southeastern Nigeria[12].

Using both clinical and tocographic assessment of uterine contractions, this study revealed that paturient who had adequate uterine contractions at recruitment had a higher mean serum calcium than their counterparts who had hypotonic uterine contractions. Although these differences were not statistically significant, the mean serum ionized calcium of participants with hypotonic uterine contractions was in the sub-physiologic range (hypocalcaemia) while that of participants with adequate uterine contractions was in the physiologic range (eucalcaemia). Other investigators – Wattimury et al and Adilia et al working independently, had similarly found significantly higher mean serum calcium levels in those with adequate uterine contraction than in those with hypotonic uterine contraction[7,13]. The subtle difference between the observations from this study and that of Wattimury et al[7] and Adilia et al[13] may be attributable to the subjectivity of the methods employed in determination of the uterine contractility in both studies. None of the studies employed intrauterine pressure catheter which is the gold standard in the determination of uterine contractility. There may therefore have been a high likelihood of influence of external factors such as maternal anterior abdominal wall fat, maternal position, the skill of the operator etcetera on both clinical and tocographic assessment of uterine contractions in the parturient women.

The tocodynamometer was employed in this study in a bid to improve the objectivity of the assessment of uterine contractions. The ideal instrument for this measurement would have been the use of internal probes which incidentally was not available for the study.

Adilia and co-workers reported that the accuracy, specificity and sensitivity of maternal serum calcium levels to predict uterine inertia in labour were 85.0%, 100.0% and 71.4% respectively. They also showed that the risk of hypotonic uterine inertia in labour is 4.17 times higher in those with serum calcium levels of ≤8.5mg/dl (2.13mmol/l)[13]. The role of calcium on uterine contractions during labour has further been demonstrated from animal studies where it has been proven that administration of drugs that cause depletion in serum calcium level invariably result in the restriction of uterine contractions[14]. This study has shown a statistically significant difference in the mean level of serum calcium of parturient with good progress of labour (cervical dilatation ≥1cm/hr) compared to those with poor progress in labour (cervical dilatation <1cm/hr). This agrees with previous studies[7,13]. Further studies may be necessary in this area to determine whether or not serum calcium may be used to predict parturient who may have normal progress in labour and those that may have poor progress. Furthermore, achieving and maintaining eucalcaemia in labour may become one of the strategies to be utilized by obstetricians to prevent and/or manage labour dystocia from uterine hypotonia. This study reveals a relationship between the mean serum calcium levels of the parturient women and the duration of their labour. There is an inverse relationship between calcium levels and labour duration. Hypocalcaemic levels of calcium were associated with longer duration of labour while shorter duration of labour were invariably associated with normocalcemia. Wattimury et al[7] and Adillia et al[13] had also made similar observation.

Studies have shown that hypocalcaemia can decrease uterine response to oxytocin action[15]. This is because optimal uterine contractility may fail to be achieved with oxytocin augmentation without efforts to correct the

hypocalcaemia. Further exploration of these findings may potentially lead to strategies in preventing poor progress of labour and by extension prolonged labour (from uterine hypocontractility) and its consequences.

The mode of delivery of the parturient in this study with respect to serum calcium levels present an interesting picture. Although there was no statistically significant difference in serum calcium levels with respect to the three modes of delivery – caesarean section, spontaneous vertex delivery, and assisted vaginal delivery, it is important to note that serum calcium levels were within normal range for both caesarean section and spontaneous vertex deliveries -1.12±0.18mmol/l and 1.12±0.29mmol/l respectively, but within hypocalcemic range (1.03±0.15mmol/l) in parturient that had assisted vaginal delivery. It is therefore tempting to suggest that the hypocalcemia in the latter parturient may have induced uterine hypotonia sufficient to stall the natural process of labour, resulting in the need for assisted vaginal delivery. A previous report had observed a lower serum calcium level in patient with elective caesarean section compared to those with normal vaginal delivery[9]. Bansal and Sarlah[16] had reported a case of emergency caesarean section due to respiratory acidosis – induced uterine hypotonia. Our findings, and the latter two observations unequivocally highlight the role of serum calcium levels on pregnancy outcome in respect of mode of delivery.

CONCLUSION:

The findings in this study underscore the importance of calcium in human physiology, and in this context labour. This study suggests that optimal serum calcium is important in the progress and duration of labour. Further studies on serum calcium in labour are necessary such that serum calcium level determination may be one of the parameters used to predict labour dystocia from uterine atony. Furthermore, achieving and maintaining eucalcaemia in labour may become one of the strategies to be utilized by obstetricians to prevent and/or manage poor progress of labour from uterine hypotonia, which may in turn reduce the need for the administration of uterotonic agents to parturient women in labour.

REFERENCES:

1. Calder AA. Normal labour: In Dewhurst's Textbook of Obstetrics and Gynaecology, Blackwell Publishing, Seventh Edition, 2007, 46-68.

2. Aguilar HN, Mitchell BF. Physiological pathways and molecular mechanisms regulating uterine contractility. Human Reproduction Update, 2010; 16(6): 725-744.

3. Wray S. Insights into the uterus. Expphysiol, 2007; 92(4): 621-631.

4. Arrowsmith S, Wray S. Oxytocin: Its mechanism of action and receptor signalling in the myometrium. Journal of Neuro-endocrinology, 2014; 26: 365-369.

5. Goldenberg RL. The management of preterm labor. High-Risk Pregnancy Series: An expert's view. American College of Obstetricians and Gynecologists, 2002; 100, 5(1): 1020-1037.

6. Tribe R.M. Regulation of myometrial contractility during pregnancy and labour: are calcium homeostatic pathways important? ExpPhysiol, 2001; 86(2): 247-254.

7. Wattimury J, Permadi W, Armawan E. Total serum level of calcium and ion calcium is lower in hypotonic uterine inertia. Indones J ObstetGynecol, 2013; 1(3): 145-148.

8. Pamela AD. Medical management of complications affecting delivery (whelping). In Canine Reproduction, 2001: part 3.http://www.labbies.com/reproduction3.htm. Accessed August 1st, 2016.

9. Papandreou L, Chasiotis G, Seferiades K, Thanasoulias NC, Dousias V, Tsanadis G, Stefos T. Calcium levels during initiation of labour. Eur Journal ObstetGynecolReprodBiol, 2004; 115(1): 17-22.

10. Hassan TJ, Ibrahim K, Sadiqua N. Dietary and serum calcium in pregnant women. JPMA, 1991 41: 278-279.

11. Akhter K, Rahman MS, Ahmed S, Ahmed A, Alam SM. Serum calcium in normal

pregnant women. Mymensingh Med J. 2003; 12(1): 55-7.
12. Katung GK, Akande TS. The prevalence of hypocalcemia in pregnancy and peurperium in northwestern Nigeria. Tropical Journal of Obstetrics and Gynaecology, 2016; 33(1): 27-31.
13. Adillia L, Anwar AD, Purwara BH, Tjahyadi D, Madjid TH, Susiarno H, Effendi JS. Serum calcium and magnesium levels ratio in patients with and without hypotonic uterine inertia. American Journal of Research Communication, 2015, 3(2): 1-11. www.usa-journals.com.Accessed August 1st, 2016.
14. Guyton AC, Hall JE. Textbook of medical physiology. 11th edition. Saunders Elsevier; 2006: 92-100.
15. Emuveyan EE. Physiology and management of labour. In Comprehensive Obstetrics in the Tropics, Asante and Hitscher printing press ltd, 2002; 59-67.
16. Bansal T, Sarla H. Hyperventilation causing symptomatic hypocalcaemia during labour in a parturient, Egyptian Journal of Anaesthesia, 2013; 29: 333-335.

How to cite this article:
Adinma J.I.B, Oguaka V.N, Okafor C.I, Udigwe G.O, Adinma Obiajulu-ND, Edet MM . ***Serum Calcium Levels, Uterine Contractility And Labour In Parturient Nigerian Igbo Women.*** **Br J Bio Med Res , Vol.03, Issue 05, Pg.1085 -1093, September - October 2019. ISSN:2456-9739 Cross Ref DOI : https://doi.org/10.24942/bjbmr.2019.569**

Source of Support: Nil **Conflict of Interest:** None declared.