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Changes in Serum Calcium and Phosphate in Pregnant Women with Prolonged Labour in Enugu State University Teaching Hospital, Enugu, Nigeria

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***Abstract*— Changes in serum total calcium, ionized calcium and inorganic phosphate were studied in 210 pregnant women in Enugu State University Teaching Hospital, Enugu, Nigeria.**

Among the subjects, 70 were at term, 70 in early normal labour and 70 in prolonged labour (More than 12 hours of labour for primigravida and 8 hours for multigravida) and they were grouped into three for study in the order stated respectively. The pregnant women were within the age group of 20 and 39 years. Group 1(70 at third trimester without labour) was used as control to group 2 (70 in early normal labour that ended in normal delivery), group 2 was used as control to group 3 (70 in prolonged labour that ended in normal delivery). Serum calcium, ionized calcium and inorganic phosphate were analysed using Ion-Selective Electrode (ISE) technique. There was no significant decreases in the total calcium, ionized calcium and inorganic phosphate levels for pregnant women at active labour that ended normal delivery ($p>0.05$) when compared with pregnant women at term without labour. There were significant decreases in the serum levels of total calcium, ionized calcium and inorganic phosphate of pregnant women with prolonged labour that ended in normal delivery ($p>0.05$), when compared with pregnant women in active labour that ended in normal delivery. There were progressive decreases in the serum levels of total calcium, ionized calcium and inorganic phosphate of pregnant women at term without labour, pregnant women in active labour that ended in normal delivery and pregnant women with prolonged labour that ended in normal delivery. However, the significant decreases were only observed in pregnant women with prolonged labour ($p<0.05$). This work also agrees that there is an inverse relationship between total calcium and calcium ion levels and labour duration.

***Index Terms*— Calcium, ionized calcium, Inorganic Phosphate, Prolonged labour .**

I. INTRODUCTION

Prolonged labour could be said to be the inability of a woman to proceed with child birth on time upon going into labour. Generally there is no clear definition of prolonged labour and confusion of terms used by different authors remain (Jeremiah et al, 2012, Lawson et al, 1965). Prolonged labour typically lasts for 20 hours for primapara or primagravidae and over 12 hours for multip area or multigravidae(Khanel et al, 2016). The codes of diagnosis and prevalence of prolonged labour can vary in different regions but it is more common in developing countries (Abouzihr et al, 1996). This may be due to lack of adequate health care delivery facilities, poor nutrition, poverty (stoke, 1991), and socio cultural factors that oppose orthodox antenatal care and delivery (wall, 1998). In most sub-Saharan African countries, it has become a major public health problem, where huge scarce public resources are being used to manage this highly preventable obstetric problem and its associated complications (Eljoud et al, 2001; Melah et al, 2003). A number of reasons have been advanced for high prevalence of this problem in Nigeria including ignorance, poverty, poor public transport system and inefficient shealth institutional facilities and management (Malah et al, 2003).

Also, the incidence of this problem is likely to be high in rural communities, where these contributing factors are not only more but are influenced by adverse cultural/religious believes and where birth labour were conducted by untrained personnels (Jeremiah etal, 2012, Emmanuel and Mengiste, 2003; Abusiatti and Udoma, 2009).

In stating the etiology of prolonged labour, it is pertinent to note that primiparous women are more at risk of complications of pregnancy and child birth than the multiparous women (Konje et al, 1992).

Anatomically, many studies that examined anthropometric measures as predictors of fetomaternal disproportion provided evidence that the shorter a woman is , the more likely is significant disproportion between the fetus and the maternal pelvis, which results in prolonged labour (Burges 2013,Dujardin, et al, 1996). The obstetric significance of particular height needs to be relatedto patient genetic background (Moller, et al, 1997). Soft tissue factors/tumors, full bladder, full rectum, vaginalseptum, fetus size, prominent spines or sacrum and narrow pubic arch are parts of anatomical features involved in labour. Although these conditions including psychological and will-power status come to play, this work is mainly interested and emphatic on changes associated with calcium and phosphate with prolonged labour for correlation with medical advice and management to prevent prolonged labour.

There is paucity of recent work and information on the electrolyte changes and biochemical predictors of prolonged labour. However, it was reported that the concentration of ionized calcium inhibits the myometrial response to oxytocin (Gao's, et al, 2009). Oxytocin, a hormone of the posterior pituitary gland exerts central and peripheral actions on the

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uterine myometrium and plays an essential role in the mechanism of perturitions and lactation. It acts through its receptors, the number of which increase in the uterus towards labour (Gimp and Feheraghoz, 2001). Lack of calcium intake during pregnancy may result to lack of serum calcium level in pregnancy and that is one of the causes of uterine inertia during child birth; hence, prolonging labour (Gao's et al, 2001, Wattimury, et al, 2003). It was reported that total serum calcium and calcium ion level in hypotonic uterine inertia were lower than the levels present in normal labour (Waltimury, 2013).

Elctrolytes such as Bicarbonates, Calcium, chlorides, potassuim, sodium etc are substances that become ions in solution and acquire the capacity to conduct impulses (Houston, et al 2008). While normal calcium level during labour promts the uterine muscle out of uterine inertia, potassium, the main electrolyte found in the bodys intra cellular fluid and stored in the muscle fibres along with glycogen, plays a key role of transporting glucose into the muscle cells (Armstrong, et al, 1999). As the glycogen is broken down to supply glucose to the uterine muscle energy for contraction, potassuim also interacts with both soduim and chloride to control fluid and electrolyte balance and assists in the conduction of nerve impulses required for uterine contraction during labour (Brouns, 1992, Armstrong et al, 1999).

When glycogen breaks down to supply energy for prolonged labour muscle cells including uterine cells release potassuim from the cells. Hyperkalemia in prolonged labour and poor excretion by the kidney or poor fluid management are disorders essociated with cardiopulmonary arrests capable of increasing mortality rate in prologned labour. (Armstrong, et al, 1999).

Apart from other implications of prolonged labour such as infections of the uterine tract, secondary amenorrhea, haemorrhage and ruptured uterus, electrolyte derangement have been noted to increase fetal risk of infection, fetal and maternal morbidity and mortality(Konje, et al, 1992).

II. MATERIALS AND METHODS

This study was done at Enugu State University Teaching Hospital, Park Lane, Enugu State of Nigeria. A total of two hundred and ten (210) subjects in the age group between twenty (20) and thirty nine (39), were used in the study. The subjects included both primagravidas and multigravidas. Written and informed consents were obtained from both the ethical committee of the University Teaching Hospital and the individual subjects respectively. The women were grouped into three: Group 1 included seventy (70) women at their third trimester term. Group 2 included seventy (70) women who had normal labour which ended in normal delivery, while Group 3 were seventy (70) women whose labour had lasted for twelve hours and above which ended in normal delivery.

Group 1 was used as control to group 2 women where as group 2 women were used as control to group 3 women.

Blood Collection

Veinous blood was collected and allows to detract for serum. Necessary precausions were taken to ensure accuracy of electrolyte results, such as ensuring that blood specimen was collected within very few seconds after tourniquet application and that specimen was separeted from the blood cells and analysed within one hour of collection. This is to avoid falselyincreased result of calcium.

III. ANALYTICAL METHODS.

Serum calcium, ionized calcium and phospate were analysed using ion selective electrode (ISE) technique. In this technique, the membrane electromotive force is determined by the difference in concentraction of the ion in the test solution and the internal filling solution. This follows the principle of potentionmetry, in which the transducer or sensor converts the activity of specific ion dissolved in solution into an electric potential. The difference in potential that exist between an indicator electrode and reference electrode is measured (Buck and Linder, 1994; Baker and YUQIN, 2006; Dimeski et al, 2010).

The ability to provide sensitive, reliable and inexpensive measurements of these clinically important analytes on small sample volumes in biological samples within a very short time frame has made ISE techniques essential in clinical Laboratory analysis (Dimeski et al, 2010).

Data Analysis

These were done using student's t-test for comparism of two groups of results and anova for comparism of three groups of results at 95% level of significance ($P<0.05$).

RESULT

The results obtained from the research work are as shown in the table below;

Table 1

Parameters	**Group 1:pregnant women at term without labour (control) n:70. Mean ± SD**	**Group2: pregnant women at labour that ended in normal delivery n:70. Mean ± SD**	**P.Value**
Total calcuim	2.37±0.15	2.10 ±0.33	0.001
Ionized calcuim	1.19 ± 0.4	1.15 ± 0.07	0.001
Phosphate (inorganic)	1.37 ± 0.17	1.24 ± 0.13	0.001

Table 2

Parameters	Group 2: Pregnant women at active labour that ended in normal delivery n:70. Mean ± SD	Group 3: pregnant women with prologed labour that ended in normal delivery n:70. Mean ± SD	P.Value
Total calcuim (mmol/l)	2.10 ±0.33	1.83 ±0.28	0.001
Ionized calcuim (mmol/l)	1.15± 0.07	1.09± 0.06	0.001
Phosphate (inorganic) (mmol/l)	1.24± 0.13	0.97± 0.20	0.001

Table 3

Parameters	Group 1:pregnant women at term without labour (control) n:70. Mean ± SD	Group 2: Pregnant women at labour that ended in normal delivery n:70. Mean ± SD	Group 3: pregnant women with prologed labour that ended in normal delivery n:70. Mean ± SD	P.Value
Total calcuim (mmol/l)	2.37±0.16	2.16±0.33	1.83 ± 0.28	0.001
Ionized calcuim (mmol/l)	1.19 ± 0.41	1.14 ± 0.07	1.09 ± 0.07	0.001
Phosphate (inorganic) (mmol/l)	1.37 ± 0.17	1.24 ± 0.13	0.97 ± 0.20	0.001

Table 1 shows mean and standard deviation of total serum calcium, ionized calcium and inorganic phosphate of pregnant women, at term without labour (Group 1) and pregnant women at active labour that ended in normal deliver (Group 2). There was no significant decreases in the total calcium, ionized calcium and inorganic phosphate level for pregenant women at active labour that ended in normal delivery (P>0.05), when compared with pregnant women at term without labour

Table 2 shows the mean and standard deviation of serum total calcium, ionized calcium and inorganic phosphate obtained from pregnant women at active labour that had normal delivery compared with pregnant women with prolonged labour that ended in normal delivery. There were significant decreases in serum level of total calcium, ionized calcium and inorganic phosphate of pregnant women with prolonged labour that ended in normal delivery when compared with pregnant women in active labour which eneded in normal delivery (P<0.05)

Table 3 shows the mean and standard deviation of the electrolytes stated, obtained from pregnant women at term without labour, pregnant women in active labour that ended in normal delivery and pregnant women with prolonged labour that eneded in normal delivery. There were progressive decreases in the serum level of total calcium, ionized calcium and inorganic phosphate from pregnant women at term without labour, pregnant women in active labour that ended in normal delivery and pregnant women with prolonged labour that ended in normal delivery. However, the significant decreases in total calcium, ionized calcium and organic phosphate were only seen in pregnant women with prolonged labour (P<0.05)

IV. Discussion

Prolonged labour is a major cause of maternal and perinatal mortality and morbidity, especially in developing countries where the incidence is high (Abouzhr et al, 1996). This study on the serum calcium, ionized calcium and phospate in pregnant women in active labour who had normal delivery within a normal period of labour and those who had prolonged labour with normal delivery was done to determine the changes in total serum calcuim, ionized calcuim and inorganic phosphate during the above named conditions and whether the knowledge of such changes could be used to reduce, manage or stop prolonged labour during child birth.

With reference to the result of this work in Table 1, there were no significant changes in total serum calcium, ionized calcium and inorganic phosphate of pregnant women at active labour who had normal delivery when compared with pregnant women at term without labour. This shows that although the pregnant women in active labour who had normal delivery experienced stress and uterine contraction, there was still enough uterine inertia, all forms of of calcuim and inorganic phosphate that supported adequate force to open the cervix, nerve transmission, vasoconstractions, vasodilation and muscle contractions to push the fetus out for normal delivery without elongation of labour.

However, the result of this work as seen in Table 2 shows that there were significant decreases in total serum calcium, ionized calcium and inorganic phosphate in the pregnant women with prolonged labour who had normal delivery when compared with pregnant women who had normal delivery within the normal labour period. It is known in cellular mechanisms that uterine constraction results from cascade of complex events of which oxytocin receptor (OTR) signaling is one of the recognised pathway at which receptor activation

triggers a number of signaling events to stimulate contractions, primarily by elevating intra cellular calcium (ca^{2+}). This also includes inositol-tris-phosphate mediated store calcium release, store operated calcium entry and voltage-operated calcum (ca^{2+}) entry (Arrow Smith, 2014). Calcium on the other hand binds to calmodulin and activates myosin light chain kinases that triggers the formation of active myosin complex in muscle cells, producing uterine muscle contraction (Arrow Smith, 2014, Adinma et,al, 2019). The significant low calcium, ionized calcium and phosphate in table 2 gave a crew to hypocontractility and longer duration of labour than normal in consonance to the biochemical and physiological theory mentioned above. This is in agreement with the works of Akhter et al, 2003, Achlia et, al 20 16 and Adinma, et, al 2019 which stated that women at third trimester had lower calcuim levels compared to non pregnant women and parturients who had adequate uterine contractions and higher calcuim levels than those who had hypotonic uterine contractions and that there is an inverse relationship between calcuim levels and labour duration. Hypocalcemic levels were associated with longer duration than shorter duration of labour (Adinma et,al, 2019). Decrease in inorganic phosphate observed in this work (Table 2), may be as a result of reduced calcuim level which usually triggers the release of Parathyroid hormone which reduces serum inorganic phosphate by stimulating the kidneys to remove inorganic phosphate through the urine, resulting to reduced level of phosphate in the blood stream.

Table3 showed that there were progressive decreases in serum levels of total serum calcium, ionized calcium and inorganic phosphates judging from their respective values in pregnant women at active normal labour duration and pregnant women with prolonged labour. These agree with previous work done by Wattimury, et at, 2013, which showed that the total serum calcium and calcium ions in hypotonic uterine inertia were lower than the levels present in normal labour and pregnant women at labour without term.

This work in agreement with some other previous works reveals that regular requests for serum total calcium, ionzed calcium and inorganic phosphate on pregnant women at term without labour and pregnant women at term with on set of labour symptoms shall help obstetricians to prevent the risks accociated with prolonged labour due to hypocalcemia and hypophosphatemia. This work also agrees with the research report that there is an inverse relationship between total calcium, calcium ion levels and labour duration. Hypocalcaemic levels of calcium were associated with longer duration of labour while shorter duration of labour were associated with normocalcemia (Wattimury et al, 2013, Adillia et al, 2015 and Adinma et al, 2019).

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