

Changes In Serum Electrolyte, Urea and Creatinine in Pregnant Women with Prolonged Labour in Enugu State University Teaching Hospital, Enugu, Nigeria

Ugwuene, Francis O

Department of Medical Laboratory Science,
Enugu State University of Science and Technology (ESUT), Enugu, Nigeria

Ayogu, Martins O

Department of Medical Laboratory Science,
Enugu State University of Science and Technology (ESUT), Enugu, Nigeria

Nwobodo, Emmanuel I

Department of Medical Laboratory Science,
Enugu State University of Science and Technology (ESUT), Enugu, Nigeria

ABSTRACT

Prolonged labour or dystocia could be used to describe the inability of a woman to proceed with child birth on time upon going into labour. Changes in electrolyte, urea and creatine in pregnant women with labour and prolonged labour were studied in Enugu State University Teaching Hospital, using 210 pregnant women. Among the subjects, 70 were at term, 70 in early normal labour and 70 in prolonged labour. They were grouped into three for study in the order stated above respectively. The pregnant women were within the age groups 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 electrolytes, urea and creatinine were quantitatively analysed. Significant decreases were observed in Serum potassium, bicarbonate and significant increases in urea and creatinine of pregnant women at active labour that ended in normal delivery when compared with those of the pregnant women at term without labour. This work also showed a significant increase in Serum Potassium of pregnant women with prolonged labour when compared with pregnant women at active labour that ended in normal delivery ($P < 0.05$). There were progressive increases in Serum chloride, urea and creatinine while there were progressive decreases in Serum bicarbonate from pregnant women at term with labour to pregnant women with prolonged labour.

Keywords: Pregnant women, Prolonged Labour, electrolytes, urea and creatinine.

INTRODUCTION

The term prolonged labour or dystocia could be used to describe the inability of a woman to proceed with child birth on time upon going into labour. There is yet no clear definition of

prolonged labour or dystocia and confusion of terms used by different authors still remain [1, 2]. Prolonged labour typically lasts for 20 hours for prima parae or prima gravide [3].

The codes of diagnosis and prevalence of dystocia can vary in different regions but it is more common in developing countries [4]. This may partly be due to lack of adequate health care delivery facilities, poor nutrition, poverty [5], and socio-cultural factors that oppose orthodox antenatal care and delivery [6]. In most sub-Saharan African Countries, it has become a public concern and major public resources are being used to manage this highly preventable obstetric problem and its associate complications [7].

A number of reasons have been advanced for high prevalence of this problem in Nigeria, including ignorance, poverty, poor public transport system and deficient health institutional facilities and management [8].

Also, the incidence of this problem is likely to be high in the rural communities where those contributing factors are not only more but are influenced by adverse cultural and religious believes; and where birth labour is conducted by untrained personnel [1,9,10].

In stating the etiology of prolonged labour, it is pertinent to note that prima parous women are more at risk of complication of pregnancy and child birth than the muti parous women [11].

Anatomically, many studies that examined anthropometric measures as predictors of fetomaternal disproportion provides 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 [12,13]. The obstetric significance of particular height needs to be related to patient's genetic background [14]. Soft tissue factors (tumors, full bladder, full rectum, vaginal septum, fetus size, prominent spines or sacrum, 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 serum electrolyte, urea and creatinine changes with dystocia for correlation with medical advice and management to prevent dystocia or prolonged labour.

There is paucity of recent work and information on the electrolyte, urea and creatinine changes and biochemical predictors of dystocia. However, it was reported that the concentration of ionized calcium inhibits the myometrial response to oxytocin [15], a hormone of the posterior pituitary gland. It exerts central and peripheral actions on the uterine myometrium, and plays an essential role in the mechanism of parturition and lactation. It acts through its receptors, the number of which increases in the uterus towards labour [16]. Electrolytes such as bicarbonates, calcium, chloride, potassium, sodium etc are substances that become ions in solution and acquire the capacity to conduct impulses that may aid labour [17].

While normal calcium level during labour, prompts the uterine muscle out of uterine inertia, Potassium, the main electrolyte found in the body's intra cellular fluid and stored in the muscle fibres along with glycogen plays a key role of transporting glucose into the uterine muscle cells for contractile energy [18]. As glycogen is also broken down to supply glucose to the uterine muscle energy for contraction, potassium interacts with both sodium and chloride to control fluid and electrolyte balance which assists in the conduction of nerve impulses required for

uterine contraction during labour [19, 18,]. When glycogen is broken down to supply energy during prolonged labour, muscle cells, including uterine cells release potassium from the cells. Hyperkalemia in dystocia and poor excretion by the kidney or poor fluid management are disorders associated with cardiopulmonary arrests, capable of increasing mortality risk in dystocia [18].

Apart from other implications of dystocia such as infections of the uterine tract [11], secondary amenorrhea [20], haemorrhage and ruptured uterus, electrolytes derangements have been noted to increase fetal risk of infection, fetal and maternal morbidity and mortality.

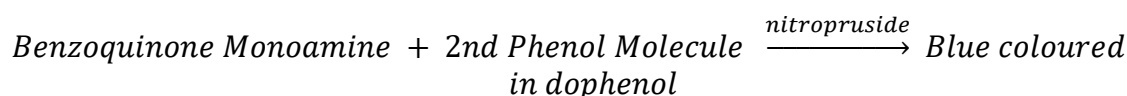
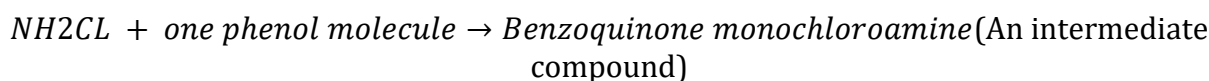
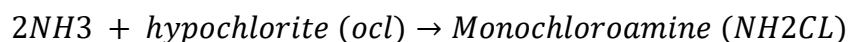
MATERIALS AND METHODS

This study was done at Enugu State University of Science and Technology, Parklane, Enugu State of Nigeria. A total of two hundred and ten (210) subjects in the age of twenty (20) and thirty-nine (39) years were used in the study. The subjects included both prima gravidae and multigravidae. Written and informed consents were obtained from both the ethical committee of the University Teaching Hospital and individual subjects. 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 beyond twelve hours who eventually ended in normal delivery Group 1 was used as control to group 2 women whereas group 2 women were used as control to group 3 women. Venous blood was collected and allowed to detract for serum collection. Necessary precautions were taken to ensure accuracy of electrolyte results, such as ensuring that blood specimen was collected within very few seconds after a tourniquet application and serum specimen was separated from the blood cells and analyzed within one hour of collection. This is to avoid falsely increased results of potassium, especially.

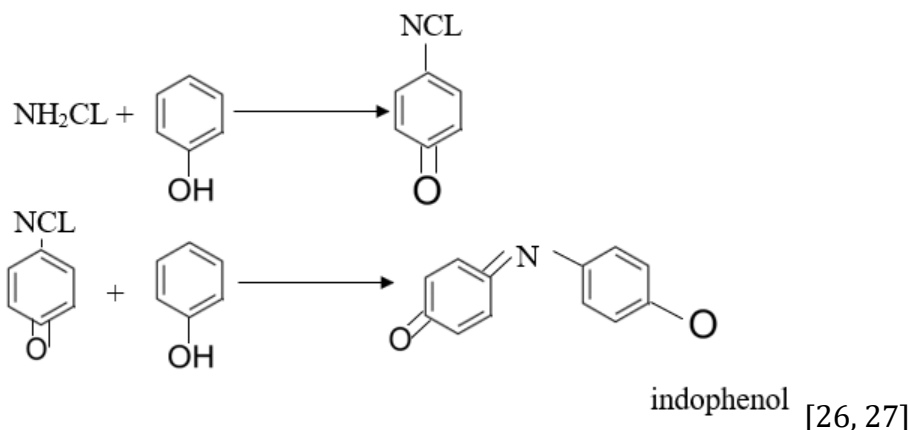
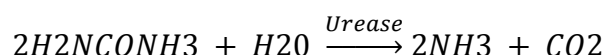
ELECTROLYTES: Potassium, chloride and sodium were analyzed using ion selective electrode (ISE) technique. In this technique, the membrane electromotive force is determined by the difference in concentration of the ion in the test solution and the internal filling solution. This follows the principle of potentiometry, 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. [21, 22, 23]. The ability to provide sensitive, reliable and inexpensive measurements of these clinically important analytes on small sample volume in a biological sample within a very short time frame has made ISE technique essential in clinical laboratory analysis [23].

UREA: Modified Berthelot method [24, 25] was used in the estimation of urea. This method uses the biochemical principle of hydrolyzation of urea to ammonia and carbondioxide by urease enzyme. The ammonia formed here further reacts with alkaline hypochlorite (Sodium hypochlorite) to form a monochloroamine which in turn further reacts with phenolic chromogens in the presence of a nitropruside (Sodium nitropruside) as a catalyst to form a blue coloured complex at 37oc incubation. The intensity of the coloured complex formed is directly proportional to the amount of urea present in the specimen. The nitropruside also enhances the intensity of the blue coloured complex. The intensity of the coloured complexed is determined by mathematically comparing the absorbance reading (optical density) of test and standard in spectrophotometer at a wavelength of 630 nanometer (nm).

REACTIONS: The stages of reaction are given as shown below.

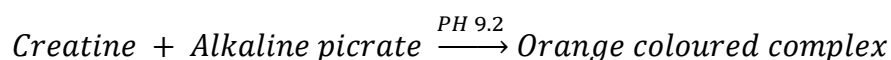


OR



Nitropruside played very important roles in this reaction to produce indophenol. It is said that the purpose of introducing nitropruside is to form aqua pentacynoferrate first, which serves as the coupling reagent to accelerate the reaction. It is therefore more appropriate to consider nitropruside as a reaction reagent rather than just a catalyst.

CREATININE: Jaffe Reaction for Alkaline Picrate method [28,29], was used for the quantitative estimation of serum creatinine. The biochemical principle of this analytical techniques is based on the fact that picric acid in alkaline medium reacts with creatinine to form an orange coloured complex with the alkaline picrate. The intensity of the colour formed is directly proportional to the amount of creatinine present in the Serum Specimen.



In their first systematic study of the chemistry of the Jaffe Reaction, Greenwald and Gross, 1925, suggested that the orange colour was due to a salt of creatinine, piaric acid and sodium hydroxide formed as a result of a keto-enol transformation in creatinine molecule. It should be

noted that beyond 15 minutes of incubation at room temperature, Jaffer reaction is not specific for creatinine

DATA ANALYSIS

These were done using student t- test for comparism of two group of results and anova for comparism of three group of results at 95% level of significance (Pc 0.05)

RESULT

The result obtained from the research work are as shown in the tables below.

Table 1

Parameters	Group 1: Pregnant women at term without labour (control) n=70 mean + SD	Group 2: Pregnant women at active labour that ended in normal delivery n = 70 mean+SD	P. Value
Sodium (mmol/L)	143.43 + 1.78	143.22 + 11.9	0.171
Potassium (")	143.43+ 0.44	3.57 + 0.17	0.001
Bicarbonate (")	25.51 + 1.64	23.48 + 1.34	0.035
Chloride (mmol/L)	103.89+ 1.29	104.29 + 1.45	0.461
Urea (mmol/L)	3.52+0.58	4.40+0.96	0.001
Creatinine(mmol/L)	37.03+6.36	41.18+7.9	0.932

Table 2

Parameters	Group 2: Pregnant women at active Labour that ended in normal delivery, n=70 mean + SD	Group 3: Pregnant women with prolonged labour that ended in nomal delivery, n = 70 mean+SD	P. Value
Sodium (mmol/L)	143.22 + 11.9	141.97 + 3.19	0.17
Potassium (mmol/L)	3.57+ 0.17	4.43 + 0.50	0.001
Bicarbonate (mmol/L)	23.48 + 1.34	22.18 + 0.95	0.035
Chloride (mmol/L)	104.29+ 1.45	105.43 + 1.63	0.461
Urea (mmol/L)	4.40+0.96	4.93+0.96	0.001
Creatinine(mmol/L)	41.18+7.9	81.33+13.05	0.932

Table 3

Parameters	Group 1: Pregnant women at term without Labour n=70 mean + SD	Group 2: Pregnant women at active labour that ended in normal delivery, n = 70 mean+SD	Group 3: Pregnant women with prolonged labour that ended in normal delivery, n = 70 mean+SD	P. Value
Sodium (mmol/L)	143.43 + 1.78	143.22 + 11.9	141.97 + 3.19	0.435
Potassium (mmol/L)	3.88+ 0.44	3.57 + 0.17	4.43 + 0.50	0.001
Bicarbonate (mmol/L)	25.51 + 1.64	23.48 + 1.34	22.18 + 0.96	0.001
Chloride (mmol/L)	103.89+ 1.29	104.29 + 1.45	105.43 + 13.05	0.001
Urea (mmol/L)	3.52+0.58	4.40+0.96	4.93+0.96	0.001
Creatinine(mmol/L)	38.03+6.36	41.18+7.9	81.33+13.05	0.001

Table 1 shows the mean and standard deviation of serum sodium, potassium, Bicarbonate, Chloride, Urea and creatinine obtained from pregnant women at term without Labour (Group 1) to compare with that of pregnant women at active Labour that ended in normal delivery (Group 2). There were significant decreases in potassium, Bicarbonate and significant increases in urea and creatinine ($P < 0.05$)

Table 2 shows the mean and standard deviation of pregnant women at active Labour that ended in normal delivery (Group 2) to compare with that of pregnant women with prolonged Labour that ended in normal delivery (Group 3). There were significant increases in potassium, creatinine and urea while there was significant decrease in Serum bicarbonate (<0.05)

Table 3 shows the mean and standard deviation of the electrolyte stated, urea and creatinine obtained from pregnant women at term without labour, pregnant women at active labour that ended in normal delivery and pregnant women with prolonged labour that ended in normal delivery. There were progressive significance increases in creatinine urea and chloride from pregnant women at term without labour, pregnant women at active labour to pregnant women with prolonged labour where the incidence is high [4,30]

DISCUSSION

Protracted and prolonged labour are major causes of maternal and perinatal mortality and morbidity, especially in developing countries. This study on the serum electrolyte, urea and creatinine 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 serum electrolyte, urea and creatinine during the above-named conditions and whether the knowledge of such changes could be used to manage, reduce or stop prolonged labour or dystocia during child birth.

Making reference to the result of this work; in Table 1, significant decreases were observed in serum potassium, bicarbonate and significant increases in urea and creatinine of pregnant women at active labour that ended in normal delivery when compared with those of pregnant women at term without labour. The decrease in potassium and bicarbonate could be traced to inefficient management of fluid and increase in secretion of adrenocorticotrophic hormone and cortisol in labour [31, 32]. Although optimal level of potassium in physiological amount is essential for muscle contraction for active labour, the possibility in such scenario is that other factors such as optimal levels of calcium and phosphate may have been sufficient enough to enable the active labour and normal delivery. [33, 34]. However, Yusuf et al, observed a significantly reduced serum potassium in hypertensive pregnant women compared with normal pregnant women (35). They therefore, as a result of this, proposed that such a decrease is a signal pathologic cause of hypertension in pregnancy, especially if accompanied with raised serum sodium.

There were significant increases in urea and creatinine. This may be suggestive of impaired renal function, because usually, glomerular filtration rate increase in pregnancy between 40-50%, evidenced in a decrease in serum urea and creatinine [36, 2011].

Table 2 showed a significant increase in serum potassium of pregnant women with prolonged labour when compared with pregnant women at the active labour that ended in normal

delivery. This was in contrast to serum potassium decrease in pregnant women at active labour when compared with that of pregnant women at term without Labour. Fluid and electrolyte changes are well documented in obstructed labour due largely to abnormal metabolic activities, prolonged starvation of patients from food and water, excessive uterine contractions and muscular activities. Hyperkalemia in this case is caused by increased potassium release from cells, impaired excretion by the kidney or poor fluid management in such labour in addition to the other reasons sortly mentioned above [37, 38]

Table 3 showed that there were progressive increases in serum chloride, creatinine and urea while there were progressive decreases in serum bicarbonate from pregnant women at term without labour that ended in normal delivery when compared with pregnant women with prolonged labour that ended in normal delivery. Although there were progressive increases in serum chloride the changes were not significant, thereby agreeing with non-significant changes in serum sodium seen in the same table. This is in consonance with the intracellular and extra cellular biochemical sequence of chloride and sodium levels in physiological and pathophysiological states.

The progressive increase in creatinine is agreement with the past works of Akinkugbe et al, oguntayo et al and Ekanem et al whose reports show that creatinine and urea rise in pregnancy and prolonged labour could be as result of water loss during labour and prolonged labour, increase in phosphokinase and muscle contraction during labour and prolonged labour and or impaired excretion by the kidney. [38,36,39]. The progressive decreases in bicarbonate in labour and prolonged labour still points to the reason that there is progressive inefficient fluid management and increase in secretion of adeno corticotropic hormone and cortisol in labour and prolonged labour which invariably cause reduction in serum bicarbonate.

CONCLUSION

By this work in labour and prolonged labour there were progressive increase in serum urea and creatinine, progressive decrease in serum bicarbonate and increase in serum potassium in prolonged labour. For these reasons morbidity and mortality are recurrent in labour and prolonged labour.

RECOMMENDATION

This work therefore recommends a regular check on fluid and electrolyte, urea and creatinine status of pregnant women in labour for better management possible prevention of prolonged labour and mortality.

References

Jeremiah I and Nwagu V (2012). The pattern of obstructed labour among parturients in a tertiary hospital in southern Nigeria. Port Harcourt Medical Journal. Vol. 6 no. 1

Lawson J.B and Clin B (1965). Obstructed Labour. An international of obstetrics and gynaecology 72 (6) 877 – 880

Drennan k, Blackwell S and Sokol R.J (2008). Abnormal Labour: Diagnosis and Management. The Global Library of women's medicine. 1756-2228

Abouzahr C, Wadlaw T, Stanton C, Hill k (1996). "Maternal Mortality", *World Health Statistics Q*; 49: 77-88 & (1): 183-187.

Stoke U. (1991). Determinant of Maternal Mortality in the developing world. *Journal of Australia Obsteric and Gynaecology* 31(8): 8-16.

Wall L.L (1998). "Dead Mothers and injured wives. The social context of maternal morbidity and mortality among the Hausa of Northern Nigeria. *Journal study family plaaning*. 29(1)341-359.

Eljoud D.O, and Bouvier-colle MH (2001). Dystocia, a study of fits frequency and Risk factor in seven cities of West Africa. *International Journal of Gynecology and Obstetrics*. 74(2):171-178

Metah G.S, EL-Nafaty A.U. Massa A.A and Audu B.M (2003). Obstructed Labour: a public health problem in Gombe, Gombe State, Nigeria. *Journal of Obstetric and Gynecology*. 23(4): 369-373

Emmanuel G. and Mengiste M (2003). Obstructed Labour in Adigrat Zonal Hospital, Tigary Region Ethiopian *Journal of Health Development*. 17(3): 175-180

Abusiatt, A. M and Udoma E.J (2009). The unbooked pregnant woman: the experience from a rural tertiary hospital, south south Nigeria. *Global Journal Community Medicine* (1): 1-2

Konje J.C, Obisesan K.A and Ladipo O.A (1992). Obstructed Labour in Ibadan. *International Journal of Gynecology and Obstetrics* 39:17-21.

Burges U.A, (2013). Anthropometric measures as a predictor of cephalopelvic disaproportion. *Journal of Tropical Duct*, 199(7): 135-138

Dujardin B, Van custen R, Lambrechts T (1996). The value of Maternal height as a risk *Tropical Internal Health Journal*. 1(15): 510-521.

Moller B, LinMark G (1997). Short stature, an obstetric risk factor: comparis

Gao L, Cong B, Thang L and Nix (2009). Expression of the calcium. Activated potassium channel in upper and lower segment human myometrium *Journal of pregnant and parturition*. 9(1):1-9

Gimple G and Fehrenholz F (2001). The oxytocin receptor system: structure, Function regulation. *Physiology Rev*. 81(2)

Houston M.C, Harper KJ (2008). Potassium, Magnesium and Calcium: their roles in both cause and treatment of hypertension. *Journal of Clinical Hypertension (Greenwish)*: 10(73): 3-11.

Armstrong L.E and Epstein y (1999). Fluid electrolyte balance during labour and exercise concepts and misconception. *International Journal of sports and Nutrition*. 9(1):1-12

Brouns F (1992). Rationale for upper limits of electrolyte replacement during exercise. *International Journal of sports and Nutrition* 2(6):229-238

Bieler E.U and Schirabel T (1976). Pituitary and Ovarian function in Women with Vesicovaginal fistula after obstructed and prolonged Labour. *South African Medical Journal*. 5:257-266

Buck R.P and Linder E (1994). Recommendation for numeclature of ion selective electrode. *Pure and applied chemistry*: 66(12):2527-2536

Backer Eric and YUQIN (2006). Electrolyte sensors. *Analns Chemistry*; 78(12):3965-3984

Dimeski G, Badrick T and John A.S (2010) ion selective electrode interference, a review. *Journal of clinical chemistry Acta*; 411(1): 309-317

Kaplan L.A and Pesce A.J. (1989). Non protein nitrogenous compounds: in clinical chemistry, theory, analysis and correlation; 2nd Ed. 1021-1024

Chaney A.L and Marbacl E.P (1962). Concentration of calcium in serum and methods for its compensation. *Journal of clinical chemistry* 2:529-532

Chin W.T and Kroontje W (1961). Conductivity method of determination of urea. *Anal. of chemistry*. 33:1757-1760.

Digiogio J (1974). Non protein Nitrogenous constituents in clinical chemistry: principles and techniques. 2nd Ed. RJ Henry, DC cannon. JW Winkelmaneds New York.

Jaffe, RW (1886). Ueber den Niederschlag, Welchen Pikrinsaure. In normalem harnerzenzt ubereign neue reaction does kreatinins. *Journal Hoppe seylers physiological chemistry* 10:975-976.

Green wald I and Gross J (1925). The chemistry of Jaffe's reaction for creatinine, a red tautomer of creatinine picrate. *Journal of Biochemistry*. 39(3): 601-612.

Martey J.O, Djan J.O, Twums, Browne E.N, opoku S.A (1994). Maternal mortility and related factors in Ejisu District, Ghana. *East African Medical Journal*. 71(4):656-660.

Okogbenin S.A, Okonta P.I, Eigbeforh J, Okusanya B.O (2007). The demographic characteristics and health seeking behavior of unbooked patients in irua Specialist Teaching Hospital Nigerian *Journal of Medicine* 16(1):65-70.

Linling fan, Yuan Zhuang Wang U, Xinhui Liu Dan Liu, Bong Xiang, Min He, Zhaoyun Zhang, Yiming Li, Yongfei Wang, Xiaoming Zhu, Hongying Ye (2019). Association of hypokalemia with Cortisol and ACTH Lekel in Cushings disease *Anal. of New York Academy of science* 1463(1):60-60.

Arrow Smiths and Wrays (2014). Oxytocin; its mechanism of action and receptor signaling in the myometrium. *Journal of Neuroendocrinology* 26:365-369.

Adinma J.B, Oguaka V.N, Okafor U, Udigwe G.D, calcium level, uterine contractility and Labour in parturient Nigerian Igbo Women. *British Journal of Medical Research*. 3(5):1085-1093.

Yusuf M.N, Sali R, Sani A, Mosea M (2009). Estimation of serum zinc, sodium and potassium normotensure and hypertensive prima gravide pregnant women. *Tikrit Medical Journal* 15:13-16(Google Sclar)

Yusuf M.N, Salih R, Sami A & Mossa M (2009). Estimation of Serum Zinc, Sodium and Potassium in normotensive and hypertensive primagravide pregnant women. *Tikrit Medical Journal*; 15, 13-16 (Google Scholar)

Oguntayo B.O, Christopher G.A, Lugos M.D, Abdulahi S, Ogbonna G.A, Olabode A.O (2011). Serum urea and creatinine level in pregnant women attending Vom Christian Hospital, Vom, Nigeria. *Journal of Medical Laboratory Science*, Vol 20 N02 or 20(2):10-15.

Ekanem E.I, Umoiyoho A, and Inyang-out A (2012) study of electrolyte changes in patients with prolonged labour in Ekot Ekpeal, a Rural Community in Niger Delta Region of Nigeria. *Journal of Obstet Gynecol*, Dec 17.

Akinkugbe A, Adewoye H.O and Eneli A.C (1977). Biochemical changes in prolonged labour in the tropics. *British Journal of Obstetrics and Gynecology*; 84(11):855-858.