Journal of Medical and Biomedical Sciences (2015) 4(3): 1-8

doi: http://dx.doi.org/10.4314/jmbs.v4i3.1

ORIGINAL ARTICLE

Ultrasound estimation of amniotic fluid and perinatal outcome in normotensive and pre-eclamptics at term in a Nigerian tertiary hospital

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Pre-eclampsia is a subtype of hypertensive disorder in pregnancy which is described as a disorder of widespread vascular endothelial malfunction and vasospasm that manifest clinically after 20 weeks gestation and can present as late as 4-6 weeks postpartum. However, the focus in modern obstetric care is on reduction of maternal and perinatal morbidity and mortality through preventive strategies. The objective of this study was to determine the usefulness of ultrasound scan measurement of the amniotic fluid indices in determining perinatal outcome in normotensive and pre-eclamptic paturients at term. This was an observational study involving 120 consenting pre-eclamptics and 120 normotensive women. An analysis of the measures of perinatal outcome in this study revealed a statistical significant difference when meconium stained liquor, route of delivery, fetal outcome and birth weight in pre-eclamptic women were compared with those of normotensive women. Ultrasound estimation of amniotic fluid in pre-eclamptic and normotensive paturients has been found to be useful in the management of these patients with the aim of improving perinatal outcome. Hence, there may be a need to include this in the protocol of management; however, randomized control trials will be needed to further justify the finding of this recommendation.
Journal of Medical and Biomedical Sciences (2015) 4(3), 1-8

Keywords: Pregnancy induced hypertension, perinatal outcome, blood pressure, Nigeria

INTRODUCTION

Hypertensive disorders of pregnancy is known to significantly contribute to maternal morbidity and mortality (Ikechebelu *et al.*, 2002; Igberase *et al.*, 2006; Shah *et al.*, 2009). It is particularly estimated that every year, Preeclampsia/eclampsia accounts for about 50,000 maternal deaths worldwide with most occurring in the developing countries of the world (Duley, 1992). When considered with other hypertensive disorders, it was also classified as the second most common cause of stillbirths and early neonatal death after prematurity and its related complications in these countries (Ngoc *et al.*, 2006). In Nigeria, Preeclampsia/eclampsia contributes significantly to maternal deaths with a wide range of between 27.5% and 40% of all maternal deaths (Adamu *et al.*, 2003; Igbafe *et al.*, 2004; Aboyeji *et al.*, 2007). In the developed world, the prevalence of preeclampsia is about 2% (Higgins *et al.*, 1997; Department of Health, 1998) whereas in the developing countries, prevalence ranges from 4% to 18% (Khedun *et al.*, 1997; Villar *et al.*, 2001). Research conducted in Nigeria revealed the prevalence was between 2.0 and 16.7% depending on the region of the country (Olopade *et al.*, 2008; Omole-Ohonsi *et al.*, 2008; Babalola *et al.*, 2009) while in a hospital based study in Lagos, the prevalence was found to be 7.6% (Anorlu *et al.*, 2005) whereas in another study involving nulliparous women the prevalence was

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4.13% (Olayemi *et al.*, 2010).

The existing literature on the use of ultrasound scan in antenatal testing and its benefits in reducing fetal injury or deaths are backed by the various levels of evidence i.e. from expert opinion to randomized controlled trials. The common end points used in these various studies to determine perinatal outcomes include caesarean section for fetal distress, meconium staining of amniotic fluid, birth weight, Apgar scores and admission into NICU (Magann *et al.*, 2000; Magann *et al.*, 2001; Morris *et al.*, 2003). It is worthy of note that these studies determine the usefulness of ultrasonographic measurements of amniotic fluid to predict perinatal outcome in post-dated pregnancies, pregnancy induced hypertension and intrauterine growth restriction and it was observed that there was a consistent association between a low ultrasound amniotic fluid measurements and poor fetal outcome (Magann *et al.*, 2001; Morris *et al.*, 2003).

Specifically, in patients with post-dated pregnancies, it was observed that Amniotic Fluid Index <5 was significantly associated with caesarean section for fetal distress in labour, umbilical cord arterial PH<7.0 at delivery and low Apgar scores (Morris *et al.*, 2003). Hence, the need to use strict definition of terms for the estimation of amniotic fluid volume is pertinent since it is important in prediction of perinatal outcome; Oligohydramnios is defined as Amniotic Fluid Index <5 and single largest pocket <2cm, whereas normal amniotic fluid index varies from 5-25 and single largest pocket from 2-8cm, values greater than these are termed polyhydramnios (Higgins *et al.*, 1997; Magann *et al.*, 2000; Magann *et al.*, 2001; Morris *et al.*, 2003). The primary goal of antenatal fetal testing is to identify fetuses at risk of intrauterine injury or death so that these adverse outcomes can be prevented (Signore *et al.*, 2009).

Methods of antenatal testing include sonographic assessment of amniotic fluid, fetal movement counting, cardiotocographic techniques like contraction stress test, non-stress test, biophysical profile, modified biophysical profile and Doppler velocimetry (Signore *et al.*, 2009). Newer emerging methods in the literature includes fetal physiology assessment which involves the use of fetal physiological and behavioural parameters like heart rate patterns, motor activity and sleep-wake cycle. Another emerging method is the fetal magnetoencephalography which aims to directly assess the fetal cortical and brain stem function (Signore *et al.*, 2009).

Other indications for antenatal testing according to literature search include preeclampsia and other hypertensive disorders of pregnancy, diabetes mellitus, intrauterine growth restriction, multiple pregnancies, prolonged pregnancy, previous history of unexplained stillbirth and a history of decreased fetal movement (Freeman *et al.*, 1982; Freeman *et al.*, 1985; Dicker *et al.*, 1988; Lagrew *et al.*, 1993; Devoe *et al.*, 1995; Kjos *et al.*, 1995; Baschat *et al.*, 2000).

Other research work also highlighted some other conditions like advanced maternal age, nulliparity, grand multiparity, conception achieved with assisted reproductive technologies and hereditary or acquired thrombophilias such as factor V leiden mutation (Alfirevic *et al.*, 2002; Dugoff *et al.*, 2004; Jackson *et al.*, 2004; Sibai, 2004; Aliyu *et al.*, 2005; Reddy *et al.*, 2006). The objective of this study was to determine the usefulness of ultrasound scan measurement of the amniotic fluid indices in determining perinatal outcome in patients who are normotensive at term and those with preeclampsia at term.

MATERIALS AND METHODS

Study Design

The design of the study was a prospective study carried out among pregnant women diagnosed with preeclampsia and normotensive controls at term between 1st October, 2012 to 31st January, 2013.

Study Setting

The study was carried out at the antenatal clinic, Obstetric emergency ward and the Labour ward of the department of obstetrics and gynaecology, University of Ilorin Teaching Hospital, Ilorin, Kwara State, Nigeria.

Participants
A total of 252 pregnant women were recruited for this study of which twelve (12) were rejected because they were incomplete. The remaining 240 pregnant women were sub-divided into 120 pre-eclamptics and 120 normotensive women.

Ethical Consideration
Ethical consideration was obtained from the Research Ethics Committee of the University of Ilorin Teaching Hospital, Ilorin, Kwara State, Nigeria before the commencement of this study. Participation in this study was voluntary and withdrawal at any point was allowed. Participants were assured of confidentiality and none of the questionnaires had the participant names on it. Written and verbal informed consent was obtained from each of the participant.

Determination of Sample Size
The prevalence of preeclampsia amongst pregnant women was found to be 7.6% in a study done at Lagos University Teaching Hospital, Nigeria (Anorlu *et al.,* 2005).

The minimum sample size for the study therefore was calculated using the following equation (Araoye, 2003).

$$n = \frac{z^2(1-p)p}{d^2}$$

n = 107.9 which is approximately 108

Considering the 10% non-response of 10.8 which is approximately 11, then the minimum sample size for this study is 108+11=119. Hence, a minimum sample size of 120 was chosen for the study i.e. 120 subjects and 120 controls.

Inclusion Criteria

Subjects: Pregnant Women at term with preeclampsia (pregnant women at thirty-seven to forty-two completed weeks with blood pressure greater than or equal to 140/90 mmHg on two or more occasions 4-6 hours apart with proteinuria of greater than 300 mg in 24 hours urine specimen or more than one plus proteinuria in dip stick specimen).

Controls: Pregnant women at term with normal blood pressures and normal urinalysis.

Exclusion Criteria
Pregnant women with; liquor drainage confirmed with a sterile speculum examination, with non-cephalic presenting fetus at term, twin gestation or other higher multiples, with fetus having gross congenital anomaly, complications in Pregnancy such as antepartum haemorrhage and preterm labour, history of background medical conditions such as diabetes mellitus, sickle cell disease, renal disorders and chronic hypertension, fetus has suffered intrauterine fetal death and those who refused to participate in the study were excluded from the study.

Data collection
Participants were taken for Ultrasound scan at the fetal assessment unit. The ultrasound scans were performed using an ALOKA ultrasound machine equipped with a 3.5 MHz transducer with patient lying supine on the examination couch. All measurements were in the vertical plane with the transducer kept parallel to the patients' longitudinal axis and perpendicular to the floor (Dicker *et al.,* 1988; Lagrew *et al.,* 1993).

The AFI was determined by dividing the maternal abdomen into four quadrants using the umbilicus and the linea nigra as reference markers, measurement of the deepest pool in each quadrant in centimeters was summed up to get the AFI (Dicker *et al.,* 1988; Lagrew *et al.,* 1993). A pool of amniotic fluid was defined as a column of fluid not containing any umbilical cord loop or fetal parts with the normal limits ranging from 2-8c m.

After delivery, the details of labour, delivery and neonatal outcome were retrieved. Perinatal outcomes were measured in terms of route of delivery, outcome of delivery, Apgar scores, neonatal deaths, meconium aspiration and birth weight. The other parameters noted were the need for emergency caesarean section on account of fetal distress, meconium staining of the amniotic fluid and the need for

admission into the NICU.

Statistical analysis

The data obtained was entered into Microsoft Excel and ported to SPSS version 20.0 for analysis. Data was presented as mean ± SD or percentages. Chi-square analysis was used to assess the influence of different variables on AFI and single largest pocket among groups. In all the statistical analysis, a value of $p<0.05$ was considered significant.

RESULTS

During the study period, 252 pregnant women were consented to participate in this study, 12 women dropped out and as such did not have their data analyzed. The 240 study participants was made up of 120 pre-eclamptic women at term who were the subjects and 120 normotensive women at term who were the controls (Figure 1 & 2).

Those with preeclampsia were further sub-divided into mild and severe preeclampsia, with 70% having mild preeclampsia and 30% having severe preeclampsia. The mean age amongst the pre-eclamptic women was 28.3±5.47 years and 52.5% of them were primiparous. An analysis of the measures

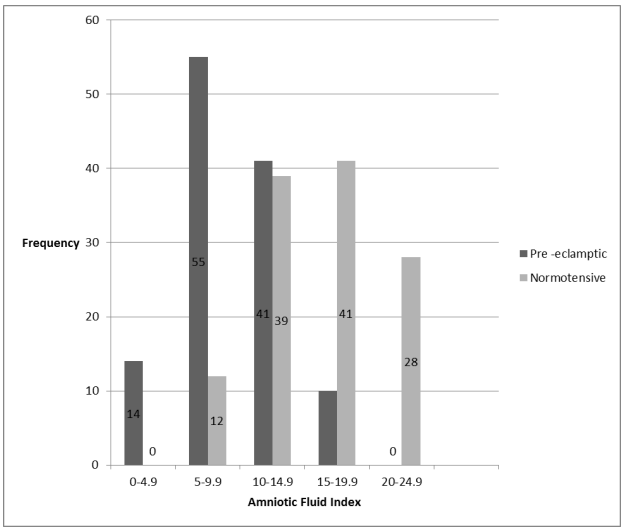

Figure 1:Barchart showing the pattern of Amniotic Fluid Index in preeclamptics and normotensive women at term.

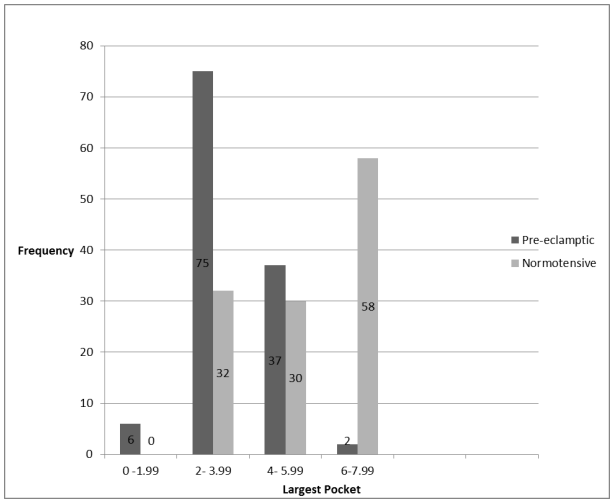

Figure 2:Barchart showing the pattern of Single largest pocket in preeclamptics and normotensive women at term.

of perinatal outcome in this study revealed a statistical significant difference when meconium stained liquor, route of delivery, fetal outcome and birth weight in pre-eclamptic women were compared with those of normotensive women. Twenty four (20%) of the pre-eclamptic women had fresh meconium passed in labour compared with six (5%) with similar finding amongst the normotensive women at term, this difference was statistically significant ($p<0.001$).

There was also a significant statistical increased risk of operative delivery amongst the pre-eclamptic women as 30.8% women with preeclampsia had caesarean section while no normotensive patients had caesarean section ($p<0.001$). Fetal distress was the indication for emergency caesarean section in nine (24.3%) of the pre-eclamptic women, while other indications included cephalopelvic disproportion and deep transverse arrest. Seven stillbirths were recorded amongst the pre-eclamptic women; while none was recorded in the control group, this difference was statistically significant ($p=0.007$). The mean birth weights amongst the normotensive and pre-eclamptic women were 3.29±0.28 kg and 3.06±0.61 kg respectively.

It was also observed that normotensive women had

no low birth weight babies whereas the seventeen pre-eclamptic women had low birth weight babies and this difference was statistically significant ($p<0.001$). Amongst the 240 subjects involved in this study, ultrasound estimation of amniotic fluid, showed that 107(44.6%) patients had single largest pocket of amniotic fluid in the range of 2.0-3.9cm,while 80 (33.3%) had AFI of 10.0-14.9cm, this was the largest category (Figure 1 & 2).

However, amongst the pre-eclamptic women, 75 (62.5%) had largest pocket in the range of 2.0-3.9 cm with a mean value of 3.33±1.05 cm whereas in the normotensive women it ranged between 6.0-7.9 cm accounting for the majority; 58(48.3%) and a mean of 5.44±1.72 cm. Nevertheless, the mean AFI for pre-eclamptic women was 9.09±2.99 cm, while in the normotensive women, it was 14.55±4.88 cm. A comparative analysis of amniotic fluid volume measurements using AFI and single largest pocket shows that AFI had a better statistical association with the various means of assessing perinatal outcome amongst the pre-eclamptics at term who participated in this study than single largest pocket.

DISCUSSION

Preeclampsia is known to be a major cause of maternal morbidity and mortality (Ikechebelu *et al.*, 2002; Igberase *et al.*, 2006; Shah *et al.*, 2009). It also contributes significantly to the incidence of stillbirth and early neonatal deaths (Ngoc *et al.*, 2006). The burden of preeclampsia is huge in the developing countries and any effort made to reverse the situation will go a long way in a positive approach towards achieving the MDG-4 and MDG-5. In this study, a total of 120 preeclamptics were consented of which 84(70%) had mild preeclampsia and 36(30%) had severe preeclampsia, this finding is similar to that observed by Sibai in a study which revealed that mild preeclampsia contributed to 75% of cases of cases and severe for the remaining 25% (Sibai, 2004).

There was a significant difference between booking status of preeclamptic women and normotensive controls. This emphasizes the important role in which antenatal care (ANC) could have in pregnant women in early detection and prompt management of complications. The later statement can be justified by the fact that, 78 (65%) of preeclamptic women and 114 (95%) of the normotensive women were booked.

The significant burden of perinatal mortality in preeclamptic mothers was demonstrated as there were seven stillbirth among neonates of preeclamptic women compared to the normotensive women category who had no report of stillbirth or early neonatal deaths. A similar finding of an increased incidence of adverse perinatal outcome was also demonstrated by Ngoc *et al.* (2006). There were no reports of early neonatal death amongst the 25 babies of preeclamptic mothers admitted in the nursery for low birth weight, perinatal asphyxia or meconium aspiration syndrome, this underscores the importance of neonatal care and the need to manage preeclamptic women and their baby(ies) in hospitals with standard neonatal facilities.

Placenta insufficiency is a known cause of adverse obstetric outcome. This pathology is reported in preeclampsia and it is responsible for the relative reduction in amniotic fluid volume (Magann *et al.*, 2000; Morris *et al.*, 2003). This could predispose a fetus to having an abnormal fetal heart rate rhythm and can manifest as fetal heart rate deceleration especially variable deceleration which could occur as a result of umbilical cord compression or even late deceleration in placenta insufficiency resulting from preeclampsia. Hence, a good intrapartum monitoring will be paramount to prevent an adverse perinatal outcome. However, it is worthy to mention that occasionally preeclampsia can occur as an acute event and in this instance the amniotic fluid volume is usually within normal limits and the risk of umbilical cord compression is significantly reduced (Morris *et al.*, 2003).

It was observed that when AFI and largest pocket were compared to perinatal outcome using the variables stated previously, AFI showed a more significant relationship than single largest pocket of amniotic fluid with perinatal outcome at term. The above findings were similar to those of Morris *et al.*

(2003) and Youssef *et al.* (1993). The observation by Nabhan *et al.* (2008) in a Cochrane review of an increased diagnosis of oligohydramnios by AFI but no single largest pocket of amniotic fluid was also demonstrated in this study. This was because, the use of AFI led to the diagnosis of oligohydramnios in 14 preeclamptic women as against the 6 preeclamptic women with oligohydramnios using the single largest pocket values (Figure 1 & 2). Another important observation that justifies the significance of AFI over single largest pocket was that four of the 14 (28.6%) preeclamptic women with AFI<5 had emergency caesarean section on account of fetal distress as against one of the 6 (16.7%) preeclamptic women who had caesarean section on account of fetal distress. This difference was statistically significant.

Sub-division of preeclamptic women into mild and severe preeclampsia revealed that the variables used in the assessment of perinatal outcomes in this study correlated better as preeclampsia worsens at term. Also, the more severe preeclampsia was, the more the likelihood for the need for abdominal delivery on account of fetal distress. This was because of the higher occurrence of fetal distress in labour amongst the patients with severe preeclampsia; 6 of the 36 (16.7%) women with severe preeclampsia compared to three of the eighty four (3.6%) women with mild preeclampsia.

From the overall data in this study, it is evident that both AFI and single largest pocket measurement on ultrasound were predictors of perinatal outcome in preeclamptics. However, AFI was found was found to have more significant statistical relationship with perinatal outcome, hence AFI could be said to be a better predictor of perinatal outcome in preeclamptics at term in our centre. The major advantage of AFI over single largest pocket is that it is more reproducible and has a less inter-observer variability unlike the measurement of the single largest pocket (Phelan *et al.*, 1985).

CONCLUSION

The findings from this study stresses on the significance of proper estimation of amniotic fluid using the AFI and single largest pocket in pre-eclamptic patients at term especially in developing regions of the world like Nigeria. Measurements of amniotic fluid in its appropriate values in centimeters is being advocated. This will enhance the use of ultrasound scan to predict perinatal outcome and help reduce perinatal morbidity and mortality. The proven superiority of AFI over single largest pocket justifies the need for a thorough ultrasound estimation of amniotic fluid volume and by extension the introduction of the modified fetal Biophysical profile over the previously existing Biophysical profile described by Manning and Co-workers. This study demonstrates the need for ultrasound estimation of amniotic fluid in patients with preeclampsia at term in order to improve the perinatal outcome in them especially in instances where the Doppler ultrasound machine is not readily available. To further enhance this recommendation, there will be need for larger community based studies and randomized controlled trials which will be more encompassing.

ACKNOWLEDGEMENTS

I wish to acknowledge the entire staff of the Department of Obstetrics and Gynaecology, University of Ilorin Teaching Hospital.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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ISSN 2026-6294