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Investigation of the Association of Preeclampsia with Oligohydramnios using Ultrasound in Pregnant Women during 32-36 Weeks of Gestation: A Cross-Sectional Study

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ABSTRACT

Background: Pre-eclampsia is a significant cause of maternal and perinatal morbidity. Oligohydramnios, marked by reduced amniotic fluid volume, is a critical obstetric condition that can complicate pregnancies with pre-eclampsia, leading to adverse fetal outcomes.

Objective: To determine the association between pre-eclampsia and oligohydramnios in pregnant women during 32-36 weeks of gestation using ultrasound.

Methods: A cross-sectional study was conducted at the University of Lahore Ultrasound Clinic, involving 245 pregnant women. Inclusion criteria included women in their third trimester with diagnosed oligohydramnios. Ultrasound was used to measure the amniotic fluid index (AFI) and echogenicity. Data were analyzed using SPSS version 25.0, with descriptive statistics and chi-square tests to assess correlations between hypertension, AFI, and echogenicity. A p-value <0.05 was considered significant.

Results: Of the 245 participants, 30.2% had hypertension, and 77% of those had oligohydramnios (p=0.002). Highly echogenic amniotic fluid was observed in 15.9%, significantly associated with oligohydramnios (p=0.0451).

Conclusion: Oligohydramnios is significantly associated with pre-eclampsia and increased fetal morbidity, necessitating close fetal monitoring and timely interventions. Clinical audits are essential for ensuring high-quality healthcare delivery, especially in surgical settings. Operation theater notes in urological surgeries are crucial for patient safety, postoperative care, and medico-legal purposes. However, their quality is often suboptimal.

Keywords: Pre-eclampsia, oligohydramnios, amniotic fluid index, fetal morbidity, gestational hypertension, ultrasound, pregnancy complications, maternal health

INTRODUCTION

Pre-eclampsia is a complex, multisystem disorder that occurs during pregnancy and is characterized by the onset of hypertension and proteinuria, often accompanied by organ dysfunction. It typically develops after 20 weeks of gestation in women with previously normal blood pressure levels, and if left untreated, it can result in serious maternal and fetal complications, including eclampsia, which is marked by seizures (1, 2). Globally, pre-eclampsia is one of the leading causes of maternal and perinatal morbidity and mortality, affecting 5-7% of all pregnancies (3). The condition is also associated with long-term health risks for both the mother and the child, such as an increased likelihood of cardiovascular disease and kidney dysfunction (4, 5). In developing countries, pre-eclampsia poses a significant burden on healthcare systems due to limited resources and access to specialized care. Given the complexity of the condition, early detection and timely management are essential to mitigate its severe consequences on both maternal and fetal health (6).

Oligohydramnios, characterized by a reduced volume of amniotic fluid, is another critical obstetric condition that significantly influences perinatal outcomes. Amniotic fluid plays a vital role in fetal development by providing protection and enabling normal growth. The volume of this fluid can serve as a clinical indicator of fetal well-being, with reduced levels often reflecting compromised fetal perfusion and increased risk of adverse outcomes, such as intrauterine growth restriction (IUGR), fetal distress, and birth asphyxia (7, 8). Oligohydramnios complicates approximately 0.5% to 5% of all pregnancies and is more prevalent in cases with hypertensive disorders, particularly pre-eclampsia (9). In such pregnancies, diminished renal perfusion leads to reduced urine output from the fetus, further decreasing the amniotic fluid volume and compounding fetal risks (10). It has been reported that oligohydramnios is more likely to occur in pregnancies complicated by pre-eclampsia, contributing to the likelihood of premature delivery,

prolonged labor, and increased cesarean section rates due to umbilical cord compression or uteroplacental insufficiency (11, 12).

The relationship between pre-eclampsia and oligohydramnios presents a unique clinical challenge. While both conditions are independently associated with increased perinatal morbidity and mortality, the co-occurrence of these conditions significantly exacerbates fetal risks. In pregnancies complicated by pre-eclampsia, the assessment of amniotic fluid volume through ultrasound becomes a critical component of maternal and fetal surveillance. Reduced amniotic fluid volume is an indicator of fetal distress and requires close monitoring to guide clinical decisions on the timing and mode of delivery (13, 14). Despite the known associations between pre-eclampsia and oligohydramnios, there is a need for more focused research to clarify the extent of their interrelationship and its impact on fetal outcomes, particularly in the context of gestational age between 32 and 36 weeks, when both conditions often present (15).

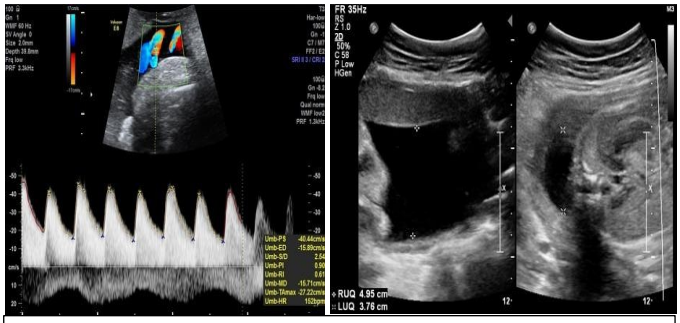

Figure 1: Low and High level of amniotic fluid at 33 weeks of pregnancy respectively.

This study was conducted to investigate the association between pre-eclampsia and oligohydramnios in pregnant women during 32-36 weeks of gestation using ultrasound as a diagnostic tool. By exploring this relationship, the study aims to contribute to a better understanding of how the co-existence of these conditions impacts fetal health and to provide evidence for more effective fetal surveillance and intervention strategies. Understanding the dynamics of this association is essential for optimizing clinical management in pregnancies complicated by both pre-eclampsia and oligohydramnios, with the goal of improving perinatal outcomes (16)

MATERIAL AND METHODS

A cross-sectional observational study was conducted at the Ultrasound Clinic, University of Lahore, to investigate the association between pre-eclampsia and oligohydramnios in pregnant women between 32 and 36 weeks of gestation. The study population consisted of 245 pregnant females, selected using a convenience sampling technique. The participants included women in their third trimester who were diagnosed with oligohydramnios, and they represented a variety of age groups. The inclusion criteria for the study were pregnant women in the specified gestational period with a confirmed diagnosis of oligohydramnios through ultrasound. Patients with multiple gestations, fetal anomalies, or premature rupture of membranes were excluded from the study to avoid confounding factors. The assessment of amniotic fluid volume was performed using ultrasound machines, including the Toshiba Xario, Mindray DC7, Esoate Mylab20, and Mindray Z5, equipped with a convex transducer of 3-6 MHz. Amniotic fluid index (AFI) was measured by dividing the uterus into four quadrants, with the deepest, unobstructed vertical pocket in each quadrant measured in centimeters. The transducer was positioned parallel to the longitudinal axis of the patient and perpendicular to the floor. The four pocket measurements were then summed to calculate the AFI, which was correlated with the largest pocket measured on ultrasound. All ultrasound assessments were performed by certified radiologists who followed standardized procedures.

Data collection was carried out by trained researchers, and informed written consent was obtained from all participants before their inclusion in the study. The consent process and study protocol adhered to the ethical standards set forth by the Declaration of Helsinki and were approved by the institutional ethics review board. Patient confidentiality was strictly maintained throughout the study.

The primary variables of interest were the presence of pre-eclampsia, amniotic fluid volume, and amniotic fluid echogenicity. Pre-eclampsia was diagnosed based on clinical criteria, including elevated blood pressure and proteinuria, as per the American College of Obstetricians and Gynecologists (ACOG) guidelines. The echogenicity of the amniotic fluid was assessed using ultrasound and classified as mildly, moderately, or highly echogenic, depending on the density of the fluid. The correlation between amniotic fluid volume and both pre-eclampsia and echogenicity was analyzed.

Data analysis was performed using SPSS version 25.0. All quantitative variables, including age, AFI, and gestational age, were reported as mean ± standard deviation (SD), while qualitative variables were reported as frequencies and percentages. Crosstabulations were constructed to explore associations between categorical variables, such as the relationship between pre-eclampsia and oligohydramnios, as well as amniotic fluid volume and echogenicity. The chi-square test was used to determine the significance of associations, and a p-value of less than 0.05 was considered statistically significant.

RESULTS

Total of 245 pregnant women between 32 and 36 weeks of gestation were enrolled in this study. The mean age of participants was 27.49 years (SD ± 4.77), with a minimum age of 18 years and a maximum age of 42 years. The study included 209 patients (85.3%) with single gestation and 36 patients (14.7%) with twin gestation, as shown in Table 1. Descriptive statistics for age, amniotic fluid index (AFI), gestational age, and parity are presented in Table 2. The mean AFI was 6.16 cm (SD ± 4.81), and the mean gestational age was 34.13 weeks (SD ± 1.33). The mean parity was 1.47 (SD ± 0.84). The results demonstrate that oligohydramnios is significantly associated with pre-eclampsia and hypertension, as well as with higher echogenicity of amniotic fluid, particularly in the context of hypertensive disorders in pregnancy.

Table 1: Frequency Distribution of Gestation

Gestation Type	Frequency	Percent
Single	209	85.3%
Twin	36	14.7%
Total	245	100%

Table 2: Descriptive Statistics

Variable	Minimum	Maximum	Mean	SD
Age (years)	18.000	42.000	27.486	4.7749
AFI (cm)	1.000	29.000	6.163	4.8144
Gestational Age	31.000	36.000	34.127	1.3292
Parity	0.000	5.000	1.473	0.8422

The presence of hypertension was found in 74 (30.2%) of the 245 patients, while 171 (69.8%) were non-hypertensive. Out of the 74 hypertensive patients, 57 (77%) had oligohydramnios, and only 17 (23%) had adequate AFI. Among the non-hypertensive patients, 92 (53.8%) had oligohydramnios and 74 (43.3%) had adequate AFI. A significant correlation was observed between hypertension and amniotic fluid volume ($p = 0.002$), as shown in Table 3.

Table 3: Hypertension and Amniotic Fluid Volume Crosstabulation

Hypertension	Adequate AFI	Oligohydramnios	Polyhydramnios	Total (%)	P-value
No	74	92	5	171 (69.8%)	
Yes	17	57	0	74 (30.2%)	0.002
Total	91 (37.1%)	149 (60.8%)	5 (2.0%)	245 (100%)	

The echogenicity of amniotic fluid was evaluated, with 39 patients (15.9%) showing highly echogenic amniotic fluid, 68 (27.8%) showing mildly echogenic fluid, and 138 (56.3%) showing moderately echogenic fluid. Of the patients with highly echogenic fluid, 34 had oligohydramnios, and 5 had polyhydramnios. Among those with mildly echogenic fluid, 31 had oligohydramnios, while 37 had adequate AFI. In the group with moderately echogenic fluid, 84 patients had oligohydramnios, and 54 had adequate AFI. A statistically significant correlation was observed between amniotic fluid volume and its echogenicity ($p = 0.0451$), as shown in Table 4

Table 4: Amniotic Fluid Echogenicity and Volume Crosstabulation

Amniotic Fluid Echogenicity	Adequate AFI	Oligohydramnios	Polyhydramnios	Total (%)	P-value
Highly Echogenic	0	34	5	39 (15.9%)	
Mildly Echogenic	37	31	0	68 (27.8%)	
Moderately Echogenic	54	84	0	138 (56.3%)	0.0451
Total	91 (37.1%)	149 (60.8%)	5 (2.0%)	245 (100%)	

DISCUSSION

The current study reinforced findings from earlier research, particularly in relation to maternal demographics, amniotic fluid index (AFI), and associated complications like pre-eclampsia. The mean maternal age in this cohort, 27.486 ± 4.7749 years, aligned closely with the data reported by Tiemo et al. and Altınbas et al., who noted maternal ages of 26.6±4.5 and 27.6±4.7 years, respectively (6,7). Additionally, the parity distribution did not show significant differences between cases and controls, indicating that maternal age and parity were consistent with previously documented trends in populations with comparable risk profiles.

The amniotic fluid index in this study, with a mean of 6.163 ± 4.8144 cm, was similar to Tiemo et al.'s findings (5 ± 4.5 cm in patients with AFI <5) (6). This consistency highlights the relevance of AFI as a key parameter in evaluating oligohydramnios and its potential effects on pregnancy outcomes. Importantly, our study found that oligohydramnios was more prevalent in cases of hypertensive disorders, particularly when it manifested in the early third trimester (28 to 31.9 weeks) compared to later gestation periods. This association is noteworthy as it underscores the higher risk of pregnancy complications in this group, consistent with previous studies that have demonstrated a significant relationship between oligohydramnios and pre-eclampsia (17,18).

Our findings also corroborated previous evidence linking pre-eclampsia and oligohydramnios to adverse outcomes. In our cohort, 42.1% of oligohydramnios cases had pre-eclampsia, closely matching the rates found in earlier studies by Thangaratinam et al. (41.46%) and Snydal et al. (41%) (17,18). This reinforces the critical need for vigilant fetal surveillance in pregnancies complicated by both conditions. The association between oligohydramnios and poor fetal outcomes, particularly in terms of low birth weight and low Apgar scores, was similarly supported by Rabie et al.'s findings in complex pregnancies, which included those complicated by hypertensive disorders (15).

One unique contribution of this study was the detailed assessment of the relationship between amniotic fluid volume and echogenicity. Hyperechogenic amniotic fluid, particularly in the late third trimester, was frequently observed, though it presents a diagnostic challenge due to its potential association with vernix, meconium, or blood. While the presence of vernix is typically benign, distinguishing it from more concerning etiologies such as meconium or blood is essential for appropriate management. The study emphasized that routine prenatal management should not be altered solely based on the presence of hyperechogenic AF, as it is not always a reliable marker of fetal distress. However, further evaluation through amniocentesis or amnioscopy may be warranted in specific cases to avoid complications such as infections or preterm labor.

Strengths of the study included its robust sample size and the use of reliable diagnostic methods to assess both AFI and echogenicity. However, the study was limited by its cross-sectional design, which restricted the ability to infer causality. Additionally, the single-center setting may limit the generalizability of the findings to broader populations. Future studies should aim to incorporate longitudinal designs and multi-center cohorts to enhance the strength of evidence regarding the relationship between amniotic fluid parameters and pregnancy outcomes.

In summary, this study reaffirmed the critical role of amniotic fluid volume as an indicator of fetal well-being, particularly in high-risk pregnancies complicated by oligohydramnios and hypertensive disorders. Given the significant associations with adverse maternal and fetal outcomes, careful monitoring and timely intervention are essential. Recommendations for clinical practice include the regular assessment of AFI, particularly in pregnancies complicated by pre-eclampsia, and the cautious interpretation of hyperechogenic AF to avoid unnecessary interventions. Further research should explore strategies to optimize outcomes in pregnancies with oligohydramnios, focusing on early identification and tailored management approaches.

CONCLUSION

Oligohydramnios is significantly associated with pre-eclampsia and increased fetal morbidity, necessitating close fetal monitoring and timely interventions. Clinical audits are essential for ensuring high-quality healthcare delivery, especially in surgical settings. Operation theater notes in urological surgeries are crucial for patient safety, postoperative care, and medico-legal purposes. However, their quality is often suboptimal.

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