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RESEARCH ARTICLE

COMPARISON BETWEEN DOPPLER AND NON-STRESS TEST IN PREGNANT WOMEN WITH OLIGOHYDRAMNIOS FOR ASSESSMENT OF PERINATAL OUTCOME AT POST-DATE PREGNANCY

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Abstract

High-risk pregnancies, especially with oligohydramnios, significantly increase infant mortality and morbidity. Obstetrics focuses on preventing complications, with Doppler and Non-Stress Test (NST) being key in assessing fetal health. Oligohydramnios, varying in incidence and severity, can lead to diverse perinatal outcomes, including increased cesarean sections rate and fetal pulmonary complications. The study aims to compare the value of fetal doppler ultrasound and fetal non-stress test in prediction of perinatal outcome in oligohydramnios at post-date pregnancy. This cohort study was conducted at Al-Elwiya Maternity Teaching Hospital from 1st January to 1st December 2023, including 100 post-date pregnant women with oligohydramnios. Exclusions include active labor, contraindications to vaginal delivery, and refusal to participate. Data collection covered demographics, medical history, surgical history, physical exams, Doppler ultrasound findings, and non-stress tests. Outcomes for both mother and neonate, including delivery type, complications, and neonatal health, were recorded, ensuring ethical considerations and confidentiality. This study classified post-date pregnant women with oligohydramnios into four groups based on NST and Doppler results. Group 1 (reactive NST, normal Doppler) comprised 32%, Group 2 (normal NST, abnormal Doppler) 26%, Group 3 (abnormal NST, normal Doppler) 30%, and Group 4 (both abnormal) 12%. It found significant differences in delivery modes, with more cesarean sections in Groups 2 and 4. Neonatal Intensive Care Unit (NICU) admissions and Intrauterine Growth Restriction (IUGR) incidence varied notably across groups, highlighting the importance of these tests in predicting adverse perinatal outcomes. NST and Doppler effectively assess perinatal outcomes in oligohydramnios, guiding delivery methods and NICU admissions, and highlighting variable risks.

Introduction:-

Oligohydramnios can be defined as amniotic fluid volume < 5% for gestational age, Amniotic Fluid Index (AFI) < 5 cm or maximal deepest pocket < 2 cm. Single deepest pocket (SDP) is the best method for diagnosing oligohydramnios however, most studies evaluating adverse outcomes utilize AFI[(1)]. At 10 weeks of pregnancy, the

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average Amniotic Fluid (AF) volume is 20 mL, at 22 weeks it's 630 mL, and at 28 weeks it's 770 mL. There is not much of an increase or decrease in volume between weeks 29 and 37 of pregnancy. The average volume of AF drops precipitously after 39 weeks, to just 515 mL at 41 weeks. Consistent with the higher prevalence of oligohydramnios in post-date pregnancies, AF volume decreases by 33% per week as the pregnancy progresses past its due date[2]. Oligohydrominas are more common in the last trimester [3].Post-date or post-mature pregnancy is a condition where a pregnancy extends beyond the usual 40 weeks or 280 days from the last menstrual period. It is typically defined as a pregnancy that extending past the estimated delivery date(EDD) which is also known as due date(at 40weeks gestation). Understanding the various aspects of post-date pregnancy is crucial for managing the potential risks and complications associated with this condition[4].The post mature infant presents a unique appearance. Features include wrinkled, patchy, peeling skin; a long, thin body suggesting wasting; and advanced maturity in that the infant is open-eyed, unusually alert, and appears old and worried. Skin wrinkling can be particularly prominent on the palms and soles. The nails are typically long. Most post mature infants are not technically growth restricted because their birth weight seldom falls below the 10th percentilefor gestational age. On the other hand, severe growth restriction—which logically must have preceded completion of 42 weeks—may be present[5].The investigation for different causes of oligohydrominasby speculum examination (nitrazine test), a plane ultrasound scan may be useful for assessing the oligohydrominas, doppler assessment is recommended in the case of a fetus with suspected placental insufficiency-related oligohydramnios, especially in the presence of growth restriction[6] and MRI may be of assistance in cases where oligohydramnios prevents proper Ultrasound (US) visualization[7].The non-stress test (NST) is a widely utilized, non-invasive procedure carried out during pregnancy to assess the baby's health. It is particularly beneficial in high-risk pregnancies or in conditions such as oligohydramnios, where monitoring the fetus's wellbeing becomes crucial[8].Pregnancies affected by oligohydramnios typically require more frequent NSTs to keep a close eye on the baby's health and allow for prompt intervention if necessary. The test, in conjunction with other diagnostic instruments and clinical evaluations, helps medical staff make educated decisions about the treatment of the mother and child in these circumstances[9].Doppler velocimetry is a fast, non-invasive method that helps doctors monitor and care for high-risk pregnancies by providing important information about the fetus' hemodynamic state[10].Doppler studies of the umbilical artery (UA) and middle cerebral artery (MCA) provide useful information for diagnosing hemodynamic changes happening in response to fetal hypoxia and anemia because of the data they provide about perfusion of the fetoplacental circulation and specific fetal organs[11].In situations of oligohydramnios, Doppler indices can be used to assess the fetal condition and guide clinical therapy[10].Therefore the study aims to compare the value of fetal doppler ultrasound and fetal non-stress test in prediction of perinatal outcome in pregnant with oligohydramnios at post-date pregnancy.

Material And Methods:-

This was a cohort study that was conducted in the Department of Obstetrics and Gynecology at Al-Elwiya Maternity Teaching Hospital during a period extended from1st of January 2023 to 1st of December 2023.The study included 100 women who presented to outpatient clinic at Al-Elwiya Maternity Teaching Hospital. The study inclusion post–date pregnant women with documented oligohydramnios, while the study exclusion; patients with medical illness(pre eclampsia,chronic and gestational diabetes), post-date with active phase of labor, obstetrical indication for c section other than oligohydrominas, women without oligohydramnios, refusal to participate, APH (antepartum hemorrhage). Before to gathering data, each patient gave their verbal consent, and the information was anonymized. Names were deleted, and identifying numbers were used instead. Every piece of information is kept private on a laptop with a password, and the data is only utilized for study. The Council of Iraqi Board of Medical Specialization gave its permission. Al-Elwiya Maternity Teaching Hospital's Department of Obstetrics and Gynecology's approval and agreement were obtained. The following information were gathered from each participant, demographics including: age and socioeconomic level, past history, a standard physical examination was conducted on each participant, each participant underwent plain Ultrasound (using Canon Xario 200G) to assess AFI&SDP, Each participant underwent a Doppler ultrasonography (using Canon Xario 200G) to assess the blood flow in the brain and umbilical cord. In the form of resistive indices (RI) and pulsatility indices (PI) of umbilical artery (UA) and middle cerebral artery (MCA). All observations were noted, including any anomalies or concerns anda non-stress test was conducted (using PHILIPS Avalon FM30) on each participant to monitor the fetal heart rate changes in response to its movements.The study also kept track of a woman's gravidity, parity, history of miscarriages(last menstrual period thenEDD), and gestational age at the time of the study. Asking the patient about early current pregnancy ultrasound. Both initial participant interviews and patient records were used to get this data. Then reporting perinatal outcome by collecting the mother's outcomes following the birth which included collected on the mother's outcomes following the birth. As well as collecting the newborn's outcomes. This included Apgar scores at

1 and 5 minutes, birth weight, any immediate complications (such as respiratory distress or need for resuscitation), neonatal morbidity and mortality rates, and whether neonatal intensive care unit admission was necessary. The duration of any required Neonatal Intensive Care Unit (NICU) stay was also recorded

Statistical analysis

Statistical Package for Social Sciences (SPSS) version 26 was used to analyze the data. The ranges, the standard deviation, and the mean of the data.Presenting categorical data as frequencies and percentages. Two-tailed ANOVA was performed. Chi Square test for categorical data. P value less than 0.05 considered statistically significant.

Findings

In the assessment of perinatal outcomes at post-date pregnancy associated with oligohydramnios, the study delineated four distinct groups based on the results of Non-Stress Tests (NST) and Doppler studies. Group 1, which represented individuals with reactive NST and normal Doppler findings, comprised 32% of the study population, totaling 32 subjects. Group 2 included those with normal NST results but abnormal Doppler readings, accounting for 26% of the cohort, with 26 subjects. Group 3 was characterized by abnormal NST results paired with normal Doppler studies, encompassing 30% of the participants, which corresponded to 30 individuals. Finally, Group 4, the smallest group, included subjects with both NST and Doppler results deviating from the norm, making up 12% of the population with a count of 12. These divisions underline the variability in testing outcomes within the context of oligohydramnios in post-date pregnancies and suggest a spectrum of perinatal risk profiles, (Figure 1).

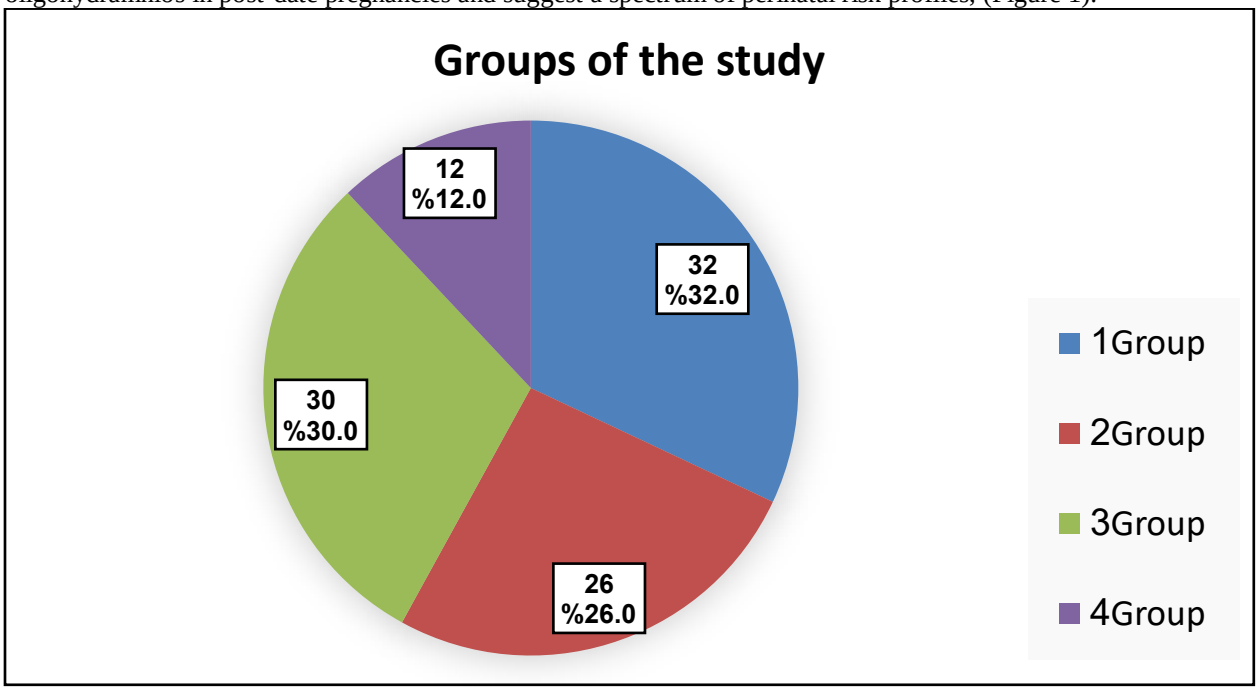

Figure 1:- Distribution of the study groups.

The demographic characteristics of the subjects were closely examined across the four groups. In terms of age distribution, the youngest cohort (<20 years) was relatively evenly distributed among Groups 1 through 3, but Group 4 had a slightly higher percentage (25%). The 20-30 years age group formed the largest proportion of Groups 1, 2, and 3, with percentages ranging from 42.3% to 56.7%, but was less represented in Group 4 at 25%. Individuals over 30 years were most prevalent in Group 4 (50%), followed by Groups 1 and 2 (both 40.6%), and least in Group 3 (36.7%). However, statistical analysis indicated no significant difference in age distribution across the groups (P=0.583), (Table 1).

RegardingBody Mass Index(BMI), those in the normal range (18.5-24.9) were least represented in Group 1 and most represented in Group 2. The overweight category (25-29.9) was most prevalent in Groups 1 and 2, while the obese category (≥30) saw a higher percentage in Group 3 (50%). The mean BMI was slightly higher in Group 3 compared to the other groups, yet these differences were not statistically significant (P=0.157), (Table 1).

Parity was also considered, with primiparas (first-time mothers) and multiparas (mothers who have given birth more than once) spread across all groups. Group 3 had the highest percentage of primiparas, while Group 2 had the highest for para 2. High parity (para 4) was most common in Group 4. Despite these variations, parity did not show a significant difference across the groups (P=0.96), (Table 1).

Overall, while there were observable trends in age, BMI, and parity across the groups, statistical analysis showed that these were not significant contributors to the differences in NST and Doppler outcomes in this study, (Table 1).

Table 2:- Distribution of participants demographics.

Variables		**Group 1**	**Group 2**	**Group 3**	**Group 4**	**P value**
		No. (%)	**No. (%)**	**No. (%)**	**No. (%)**	
Age group	<20 years	5 (15.6)	4 (15.4)	2 (6.7)	3 (25)	0.583
	20-30 years	14 (43.8)	11 (42.3)	17 (56.7)	3 (25)	
	>30 years	13 (40.6)	11 (42.3)	11 (36.7)	6 (50)	
	Mean ±SD	27.66 ±7.05	26.46 ±7.24	27.27 ±5.69	26.83 ±8.01	0.925
BMI group	18.5-24.9	6 (18.8)	9 (34.6)	6 (20)	4 (33.3)	0.071
	25-29.9	17 (53.1)	14 (53.8)	9 (30)	5 (41.7)	
	≥30	9 (28.1)	3 (11.5)	15 (50)	3 (25)	
	Mean ±SD	27.82 ±2.7	26.48 ±2.89	28.13 ±3.05	26.98 ±3.16	0.157
Parity	Primi	5 (15.6)	5 (19.2)	7 (23.3)	2 (16.7)	0.960
	Para 1	6 (18.8)	4 (15.4)	6 (20)	3 (25)	
	Para 2	7 (21.9)	9 (34.6)	9 (30)	2 (16.7)	
	Para 3	7 (21.9)	5 (19.2)	5 (16.7)	2 (16.7)	
	Para 4	7 (21.9)	3 (11.5)	3 (10)	3 (25)	

The study further investigated the mode of delivery across the different groups. Group 1 favored vaginal delivery, with a significant majority (87.5%) delivering vaginally and only a small fraction (12.5%) undergoing cesarean sections. In contrast, Group 2 had the highest rate of cesarean deliveries, at 76.9%, with vaginal deliveries accounting for 23.1%. Group 3 also had a majority of cesarean deliveries (60%), but not as pronounced as Group 2. Group 4 had marked rate ofCesarean Section (C/S) (66.7%), with vaginal deliveries at 33.3%. The statistical analysis revealed that the mode of delivery was significantly associated with the group classifications (P < 0.0001), indicating that NST and Doppler findings may be influential in determining the mode of delivery, (Table 2).

Table 2:- Distribution of maternal outcome according to the groups of the study.

Variables		**Group 1**	**Group 2**	**Group 3**	**Group 4**	**P value**
		No. (%)	**No. (%)**	**No. (%)**	**No. (%)**	
Mode of delivery	Caesarean	4 (12.5)	20 (76.9)	18 (60)	8 (66.7)	**<0.0001**
	Vaginal	28 (87.5)	6 (23.1)	12 (40)	4 (33.3)	

The rate of NICU admissions varied significantly among the groups. Group 1 had the lowest NICU admission rate at 3.1%. In contrast, Group 4 exhibit the highest rate of NICU admission at 83.3% followed by Group2 with 76.9%. Group 3 maintained a lower rate at 16.7%. The variation in NICU admission rates was also statistically significant (P < 0.0001), suggesting a strong association between the NST and Doppler findings of each group and the likelihood of NICU admission, (Table 3).

These results highlight the importance of NST and Doppler evaluations in predicting adverse perinatal outcomes, with particular emphasis on the elevated risks associated with Groups 2 and 4, (Table 3).

Table 3:- Distribution of neonatal outcome according to the groups of the study.

Variables		Group 1	Group 2	Group 3	Group 4	P value
		No. (%)	No. (%)	No. (%)	No. (%)	
NICU	Yes	1 (3.1)	20 (76.9)	5 (16.7)	10 (83.3)	**<0.0001**
	No	31 (96.9)	6 (23.1)	25 (83.3)	2 (16.7)	

The Appearance, pulse, grimace, activity, respiratory (Apgar) scores, which assess the immediate postnatal condition of the newborns, were significantly different across the four study groups. For Apgar score (Apgar1), taken one-minute post-birth, Group 1 had the highest mean score of 6.66 with a standard deviation (SD) of ±1.23. Group 3 had a slightly lower mean score of 5.92 (SD ±1.32), and Group 2 had the lowest mean score of all the groups at 5.13 (SD ±1.2). Group 4 had a mean score of 6 (SD ±1.41). These differences were statistically significant with a P value of less than 0.0001, indicating a strong association between NST and Doppler findings and the initial Apgar score at 1 minute, (Table 4**Error! Reference source not found.**).

Apgar score at 5 minutes, assessed at five minutes after birth, followed a similar trend. Group 1 again had the highest mean score of 8 (SD ±1.55), while Group 3 had a mean of 7.04 (SD ±1.61), and Group 2 had a mean of 6.33 (SD ±1.24). Group 4 had a mean Apgar2 score of 6 (SD ±1.41). The P value for the second Apgar score was also less than 0.0001, confirming significant differences between the groups, (Table 4).

These Apgar scores at 1 minute suggest that newborns from Group 1, with reactive NST and normal Doppler, had a more favorable immediate postnatal condition compared to the other groups. Group 2, characterized by abnormal Doppler, had the lowest Apgar scores, potentially reflecting more significant perinatal stress. While after 5 minutes the lowest Apgar score was reported in cases with abnormal both Doppler and NST studies, (Table 4).

Table 4:- Distribution of Apgar score according to the groups of the study.

Variables	Group 1	Group 2	Group 3	Group 4	P value
	Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
Apgar 1	6.66 ±1.23	5.13 ±1.2	5.92 ±1.32	6 ±1.41	**<0.0001**
Apgar 5	8 ±1.55	6.33 ±1.24	7.04 ±1.61	6 ±1.41	**<0.0001**

The data regarding the role of Non-Stress Test (NST), Doppler studies, and combined testing in predicting the need for NICU admission reveal distinct strengths and weaknesses for each method. Doppler studies stand out with an impressive sensitivity of 83.3%, indicating a high capability for correctly identifying infants who will require NICU care. This makes Doppler particularly informative for early intervention, as it ensures that most infants in need are identified. Its high positive predictive value (PPV) of 78.9% also suggests that a significant majority of the positive test results are true positives, indicating a reliable test for anticipating NICU admissions, (Table 5).

On the other hand, the combined testing strategy boasts the highest specificity at 96.9%, which is critical for reducing the likelihood of false positives — in other words, it accurately identifies most infants who will not require NICU care. Its PPV is equal to that of Doppler alone, suggesting that when combined testing indicates a need for NICU admission, the prediction is highly reliable, (Table 5).

While the NST alone shows lower sensitivity and specificity compared to Doppler and combined testing, its value cannot be disregarded. It has a moderate negative predictive value (NPV) of 63.8% and the lowest accuracy at 52%, which indicates a relatively higher chance of missing infants who might need NICU care and misclassifying those who do not, (Table 5).

In terms of overall in formativeness for predicting NICU admission, Doppler studies are the most reliable single test, evidenced by their high sensitivity and accuracy. However, the combined approach, while less sensitive, provides a high degree of certainty in its predictions, as shown by its high specificity and PPV. This suggests that using a combined approach may be the most prudent strategy in clinical settings where it is crucial to minimize both false positives and false negatives. The combination of NST and Doppler studies can complement each other, potentially

offering a balanced and comprehensive assessment to inform clinical decision-making regarding NICU admissions, (Table 5).

Table 5:- The role of NST, Doppler tests separately and combined in prediction of need of NICU admission.

Parameters	NST	Doppler	Combined
Sensitivity (%)	41.7	83.3	27.8
Specificity (%)	57.8	87.5	96.9
Positive predictive value (%)	35.7	78.9	83.3
Negative predictive value (%)	63.8	90.3	70.5
Accuracy (%)	52	86	72

The current study had four clearly separate groups by utilizing the outcomes of NST and Doppler investigations(in 100 post-date pregnant women). This distinction was essential to comprehending the range of prenatal hazards connected to oligohydramnios. Notably, our study showed that groups with abnormal results—whether from the Doppler, NST, or both—were substantially more likely to have elevated hazards, such as higher rates of caesarean sections and NICU admissions.

The current study was homogeneously distributed in regard to the maternal age, BMI, and parity. With no statistical difference among these variables, thus eliminating the effect of these factors on the final outcomes.

It is worth noting that previous studies showed that: advancing maternal age, higher BMI, and parity associated with adverse maternal and fetal outcomes as suggested by Glick et al[12], Snehlata et al[13], and Eugene et al[14] respectively.

Regarding mode of delivery, cases of abnormal Doppler study was associated with the highest rate of C/S, next to it were cases with combined abnormal Doppler and NST studies, and finally were cases of abnormal NST. These findings suggest that Doppler study had higher association with the prediction of the requirement of C/S. Subramanian et al[15] [55] found that cases of isolated Doppler abnormality were associated with higher rate of C/S.

This stratification aligns with the intrinsic diagnostic capabilities of these modalities. Doppler ultrasound, with its focus on fetalhemodynamics, particularly the umbilical artery, cerebral arteries, and ductusvenosus, provides a critical assessment of placental insufficiency and fetal hypoxia as suggested by Meler et al[16]. These conditions, often undetectable by NST as suggested by Baschat et al[17], are well-documented precursors to adverse perinatal outcomes, necessitating a more interventional approach, often culminating in C/S. Contrastingly, NST, though valuable, primarily offers insight into short-term fetal reactivity and heart rate patterns, which, while indicative of acute fetal distress, may not singularly warrant immediate surgical intervention. Such findings underscore the imperative role of Doppler in not just surveillance but also in guiding the mode of delivery, reflecting its sensitivity in detecting clinically significant pathophysiologies that necessitate a C/S for optimal perinatal outcomes[18].

The Apgar scores at 1 minute indicating that newborns from Group 1, with reactive NST and normal Doppler, had a more favourable immediate post natal condition compared to other groups align with recent findings. This outcome can be attributed to the fact that reactive NST and normal Doppler studies are generally associated with better fetal oxygenation and less distress, leading to higher Apgar scores. In contrast, Group 2, characterized by abnormal Doppler, had the lowest Apgar scores, potentially reflecting more significant perinatal stress. This is consistent with research suggesting that abnormal Doppler findings, indicative of compromised fetal blood flow, can be a predictor of adverse neonatal outcomes Saber et al[19]. After 5 minutes, the lowest Apgar score was reported in cases with abnormal both Doppler and NST studies. This further substantiates the critical nature of combined fetal monitoring in predicting and managing perinatal risks. Abnormal findings in both tests indicate a heightened risk for perinatal asphyxia and other complications, leading to lower Apgar scores at 5 minutes Mughal et al[20].

The data regarding the role of Non-Stress Test (NST), Doppler studies, and combined testing in predicting the need for NICU admission reveal distinct strengths and weaknesses for each method. Doppler studies stand out with an impressive sensitivity of 83.3%, indicating a high capability for correctly identifying infants who will require NICU care, Singh et al[21] found the sensitivity of doppler study to be 71.42% while NST only 25%. This makes Doppler particularly informative for early intervention, as it ensures that most infants in need are identified. Its high positive predictive value (PPV) of 78.9% also suggests that a significant majority of the positive test results are true

positives, indicating a reliable test for anticipating NICU admissions, Robindro et al[22] found that PPV of doppler study to be 78.12% while NST 69.23%, while in the current study the PPV of NST was 35.7%.

On the other hand, the combined testing strategy boasts the highest specificity at 96.9%, which is critical for reducing the likelihood of false positives — in other words, it accurately identifies most infants who will not require NICU care. Its PPV is more than Doppler alone, suggesting that when combined testing indicates a need for NICU admission, the prediction is highly reliable. This relationship was poorly investigated by previous studies making this finding novel in the current study.

While the NST alone shows lower sensitivity and specificity compared to Doppler and combined testing, its value cannot be disregarded. It has a moderate negative predictive value (NPV) of 63.8% and the lowest accuracy at 52%, which indicates a relatively higher chance of missing infants who might need NICU care and misclassifying those who do not. While Anjum et al[23] found sensitivity of NST to be 72.34%, specificity of 60.38% PPV 61.82% and NPV of 71.11% although these values were higher from the current study yet it still not reaching to the level of standing alone as screening or diagnostic tool.

In terms of overall informativeness for predicting NICU admission, Doppler studies are the most reliable single test, evidenced by their high sensitivity and accuracy. However, the combined approach, while less sensitive, provides a high degree of certainty in its predictions, as shown by its high specificity and PPV. This suggests that using a combined approach may be the most prudent strategy in clinical settings where it is crucial to minimize both false positives and false negatives. The combination of NST and Doppler studies can complement each other, potentially offering a balanced and comprehensive assessment to inform clinical decision-making regarding NICU admissions.

Conclusion:-

The study showed significant association of abnormal NST and abnormal doppler studies in increased rate of C/S(in post- date pregnancy).Doppler studies proved most reliable for predicting NICU admission with high sensitivity and positive predictive value, while NST alone showed lower efficacy.Combining NST and Doppler enhanced specificity, suggesting a balanced approach in clinical decision-making for NICU admissions is most effective(in post-date pregnancy).

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Ethical Clearance:

Prior to gathering data, each patient gave their verbal consent, and the information was anonymized. Names were deleted, and identifying numbers were used instead. Every piece of information is kept private on a laptop with a password, and the data is only utilized for study.

Ethical approval

Was taken form ministry of Health committed in Iraq.

Conflict of Interest:

The author declares that shehas no conflict of interest.

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