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Original Research Article

THE STUDY OF DOPPLER CHANGES IN OLIGOHYDRAMNIOS BEYOND 32 WEEKS AND THE ASSOCIATED MATERNAL AND FETAL OUTCOME

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Abstract

Background: Amniotic fluid is crucial for foetal growth, temperature maintenance, and infection prevention. The risk factors include gestational hypertension, postdatism, and anaemia. Abnormal Doppler velocimetry increases the incidence of perinatal complications. This study aimed to assess Doppler changes associated with oligohydramnios to study maternal and foetal outcomes in oligohydramnios beyond 32 weeks of gestation. **Materials and Methods:** This prospective study was conducted on 100 patients presenting with oligohydramnios, above 32 weeks, at Government Kilpauk Medical College Hospital, Chennai, from March 2020 to September 2020. A comprehensive general and obstetric history was obtained, followed by a sonographic examination to assess foetal well-being and amniotic fluid index (AFI). This study examined Doppler changes in oligohydramnios, including uterine, umbilical, and middle cerebral arteries and cerebroplacental ratio. **Result:** The majority were first-time mothers, with 60% having risk factors such as gestational hypertension, post-dated pregnancies, intrauterine growth restriction, anaemia, and gestational diabetes mellitus. 60% underwent lower segment caesarean section, 58% delivered at term, and 42% experienced preterm delivery. 56% of deliveries were girls, 44% were boys, and 32% required NICU admission. Major neonatal morbidities included meconium-stained liquid, respiratory distress, birth asphyxia, and sepsis. There was a statistically significant association between Doppler changes and maternal complications ($p < 0.001$), period of gestation ($p = 0.006$), neonatal morbidity ($p < 0.001$), low APGAR at birth ($p = 0.016$), and neonatal mortality ($p = 0.037$). **Conclusion:** Oligohydramnios necessitates antenatal evaluation, nutritional counselling, health education, biweekly Doppler studies, intrapartum surveillance, and continuous CTG monitoring to improve perinatal outcomes.

INTRODUCTION

Amniotic fluid plays a major role in foetal growth and development. Amniotic fluid cushions the foetus against external injuries. It maintains temperature and prevents infection during antenatal infection. During labor, the purpose of amniotic fluid is to spread uterine contractions evenly over the foetus. This most vital element, which protects and aids the baby's delivery when decreased, is called oligohydramnios. Oligohydramnios complicates approximately 1–2% of pregnancies. The sonographic diagnosis of oligohydramnios is usually based on an AFI of < 5 cm or a single deepest pocket of amniotic fluid below 2 cm. The most common cause of oligohydramnios is idiopathic. Maternal risk factors associated with oligohydramnios include gestational hypertension, postdatism, intrauterine IUGR, and anaemia. Doppler velocimetry measures blood flow in the maternal and foetal vessels. Abnormal Doppler velocimetry affects peripheral vasoconstriction and is associated with a higher rate of perinatal complications.[1-4]

Aim

This study aimed to assess Doppler changes associated with oligohydramnios to study maternal and foetal outcomes in oligohydramnios beyond 32 weeks of gestation.

MATERIALS AND METHODS

This prospective study was conducted on 100 patients presenting with oligohydramnios, above 32 weeks, at Government Kilpauk Medical College Hospital, Chennai, from March 2020 to September 2020. The study received approval from the institutional ethics committee before its initiation.

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Inclusion Criteria

The study included pregnant women at 32 weeks or more, with an amniotic fluid index of 5 cm or less, whether associated with Doppler changes, a single baby positioned head down, intact membranes, and the amniotic fluid index assessed through the four-quadrant technique upon admission, were eligible, provided they had accurate due dates or had undergone early ultrasound.

Exclusion Criteria

Pregnant women with an amniotic fluid index (AFI) greater than 5 cm and gestational age less than 32 weeks were eligible unless associated foetal malformations, ruptured membranes, malpresentation, multiple pregnancies, intrauterine death, unknown last menstrual period (LMP) or lack of an early scan, and a history of previous caesarean section were excluded.

A comprehensive general and obstetric history was obtained, followed by a sonographic examination to assess foetal well-being and amniotic fluid index (AFI). A curvilinear probe was used to divide the uterus into four equal quadrants, and the transducer was placed parallel to the maternal sagittal plane and perpendicular to the maternal coronal plane. The image was frozen at the deepest pocket of the amniotic fluid, and the summation of the four values provided the AFI. Patients were grouped according to AFI, and those with an AFI ≤5 cm were sent for a Doppler study. This study examined Doppler changes in oligohydramnios, including uterine, umbilical, and middle cerebral arteries and cerebroplacental ratio. The delivery outcomes of these oligohydramnios were also analysed, along with foetal outcomes. Doppler ultrasound examination was performed using a Duplex system with a 100HZ thump filter to eliminate Doppler shift frequencies.

The umbilical artery was assessed by pointing a probe towards the foetus through the abdomen and recording the flow velocity waveforms. Abnormal waveforms included an S/D Ratio > 3, reduced/absent end-diastolic flow, and reversed end-diastolic flow. The main branch of the uterine artery was detected by placing a probe above the Inguinal Ligament. The middle cerebral artery (MCA) was detected by magnifying the axial section of the brain, including the thalami and sphenoid bone wings. MCA vessels are often found with colour or power Doppler ultrasound overlying the anterior wing of the sphenoid bone near the base of the skull.

The maternal indications for termination include uncontrolled hypertension, abruption, deteriorating renal function, and Hellp syndrome. Foetal indications for termination include evidence of foetal distress, mode of delivery, gestational age at delivery, whether the delivery was induced or spontaneous, and adverse perinatal outcomes such as preterm delivery, birth weight below the mean for gestational age, Apgar score at 5 min, caesarean section, admission to the NICU, respiratory distress, hypoxic-ischaemic encephalopathy, intraventricular haemorrhage, necrotising enterocolitis, seizures, and neonatal death.

Statistical Analysis

The collected data were analysed using SPSS 21.0. Descriptive statistics frequency analysis and percentage analysis were used for categorical and continuous variables, and the mean and SD were used to describe the data. The Chi-Square test was used to determine the significance of the categorical data. An unpaired t-test was used to determine a significant difference between the bivariate samples in the independent groups (experimental and control groups).

Receiver operating characteristic (ROC) curves were drawn to determine the area under the curve (AUC) for differentiating the two groups. The cutoff value was calculated to achieve the highest average sensitivity and specificity. A probability value ≤0.05 was considered significant in all statistical tools. The experimental cases were followed up after two weeks and were assessed. A diagnosis of intrauterine growth retardation was confirmed. The patients were followed up until delivery for adverse perinatal events.

RESULTS

Of the 100 patients, 64% were age group–20-29 years, 22% were < 20 years, and 14% were aged >30. The mean age was 24.3 years. Regarding gestational age, 29% were found to be within 36 weeks, and 71% were >36 weeks.

Half of the participants were first-time mothers, while the other half were experienced mothers, with 36% being second-time mothers and 14% being third-time mothers. 60% of the patients had an associated risk factor in addition to oligohydramnios, often accompanied by additional risk factors, and were notably associated with gestational hypertension (GHTN) and post-dated pregnancies at 22% and 18%, respectively. Other associated risk factors included intrauterine growth restriction (IUGR) in 14% of the cases, anaemia in 4%, and gestational diabetes mellitus (GDM) in 2%.

Among the study population, 42% underwent induced labor, with the majority (60%) undergoing lower segment caesarean section (LSCS). Natural labor occurred in 36% of cases, and 4% involved instrumental deliveries, including 1% outlet forceps delivery and 3% vacuum-assisted delivery. Regarding delivery timing, 58% of the patients delivered at term, while 42% experienced preterm delivery [Table 1].

7% in nil liquor had abnormal Doppler changes, of AFI 1 cm, 5% in Doppler changes, of AFI 2 cm, abnormal Doppler changes were found in AFI 4%, of AFI 3 cm, 2% in Doppler changes, of AFI 4 cm, 3% in AFI 5 cm, and 2% in Doppler changes [Table 2].

56% of the deliveries resulted in girls, while 44% resulted in boys. Approximately 14% of the newborns had an APGAR score below 7/10 at 1 and

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5 min, and 86% had scores above 7/10. Notably, 32% of infants required admission to the Neonatal Intensive Care Unit (NICU). The main causes of neonatal morbidity include meconium-stained liquor, with 9% experiencing respiratory distress, 4% having birth asphyxia, and 3% developing sepsis.

Of the babies needing NICU admission, 24% required nasal oxygen, 6% required Continuous Positive Airway Pressure (CPAP), and 2% were connected to a mechanical ventilator. Of the 32% of patients admitted to the NICU, 96 survived and were discharged. In contrast, four babies under continuous neonatal care sadly died, with two succumbing to meconium aspiration syndrome on days 2 and 3 of life, one to respiratory distress syndrome on day 9, and another to severe perinatal hypoxia on day 11 [Table 3].

There was a statistically significant association between Doppler changes and maternal complications ($p < 0.001$), period of gestation ($p = 0.006$), neonatal morbidity ($p < 0.001$), low APGAR at birth ($p = 0.016$), and neonatal mortality ($p = 0.037$). However, there was no statistically significant association between labor induction and mode of delivery between the Doppler changes ($p=0.02$, $p=0.479$) [Table 4].

Table 1: Various distributions of the study population

		Frequency (%)
Parity	Primi	50(50%)
	Second gravida	36(36%)
	Third gravida	14(14%)
Maternal complications	IUGR	14(14%)
	Post-dated	18(18%)
	GHTN	22(22%)
	GDM	2(2%)
	Anemia	4(4%)
	Nil	40(40%)
Abnormal doppler changes	Umbilical artery decreased flow	12(12%)
	Umbilical artery absent flow	6(6%)
	Umbilical artery decreased flow, MCA increased	2(2%)
	Umbilical artery reversal of flow	3(3%)
	Nil	77(77%)
Induction of labor	Yes	42(42%)
	No	58(58%)
Mode of delivery	NVD	36(36%)
	LSCS	60(60%)
	Outlet	1(1%)
	Vaccum	3(3%)
Gestation	Term	58(58%)
	Preterm	42(42%)

Table 2: Amniotic fluid index

Amniotic fluid index	**Frequency (%)**	**Doppler changes**
0	9(9%)	7(7%)
1	11(11%)	5(5%)
2	24(24%)	4(4%)
3	9(9%)	2(2%)
4	26(26%)	3(3%)
5	21(21%)	2(2%)

Table 3: Comparison between the groups

		Frequency (%)
Gender	Male	44(44%)
	Female	56(56%)
Apgar	Yes	14(14%)
	No	86(86%)
Neonatal Morbidity	Respiratory distress	9(9%)
	Birth asphyxia	4(4%)
	MSL	16(16%)
	Sepsis	3(3%)
	Nil	68(68%)
Requirement of oxygen/ventilator	Ventilator	2(2%)
	Oxygen	24(24%)
	CPAP	6(6%)
	Nil	68(68%)
Perinatal Mortality	Babies survived	96(96%)
	Babies expired	4(4%)

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Table 4: Comparisons among the various distributions of the study population

		Doppler changes		P value
		Normal	Abnormal	
Maternal Complications	IUGR	2(2.6%)	12(52.2%)	<0.001
	Post-dated	15(19.5%)	3(13.0%)	
	GHTN	16(20.8%)	6(26.1%)	
	GDM	2(2.6%)	0	
	Anemia	3(3.9%)	1(4.3%)	
	Nil	39 (50.6%)	1(4.3%)	
Induction of labor	YES	35(45.5%)	7(30.4%)	0.2
	No	42(54.5%)	16(69.6%)	
Mode of delivery	NVD	30(39.0%)	6(26.1%)	0.479
	LSCS	43(55.8%)	17(73.9%)	
	Outlet	1(1.3%)	0	
	Vacuum	3(3.9%)	0	
Gestation	Term	39(50.6%)	19(82.6%)	0.006
	Preterm	38(49.4%)	4(17.4%)	
Neonatal morbidity	Respiratory distress	1(1.3%)	8(34.8%)	<0.001
	Birth asphyxia	4(5.2%)	0	
	MSL	14(18.2%)	2(8.7%)	
	Sepsis	0	3(13.0%)	
	Nil	58(75.3%)	10(43.5%)	
APGAR <7/10	Yes	7(9.1%)	7(30.4%)	0.016
	No	70(90.9%)	16(69.6%)	
Neonatal mortality	Babies survived	76(98.7%)	20(87.0%)	0.037
	Babies expired	1(1.3%)	3(13.0%)	

DISCUSSION

Oligohydramnios with AFI less than or equal to 5 cm can lead to an increase in perinatal morbidity and mortality. Under these conditions, there is an increased incidence of meconium-stained liquor, low Apgar scores, foetal distress, and abnormalities in foetal heart rate. In the present study, the women in the study group were in the age group of 24.31±5.30. In Similar studies by Chauhan et al., Zhang et al. and Magann et al., the mean maternal age was 23.6 ±6.5 years, 28.4 ±3.4 years and 23.8 ±5.7 years.[5-7]

The gestational age in the present study was 37.2±2.31 weeks. Similar studies by Zhang et al., Casey et al., Magann et al. and Hoskins et al. found that the mean gestational age was 38.1± 3.3 weeks, 37.5 ±2 weeks, 34.3 ±2.1 weeks and was 36.3 ±2 weeks respectively. These observations indicate that oligohydramnios is more common in the later stages of pregnancy. This is mainly due to reduced placental perfusion towards term as a result of physiological and pathological pregnancy changes.[8]

In our study, 50% were primi, 36% were second-gravida, and 14 were third-gravida. Similarly, in a study by Nilesh et al., the primi, second, and third gravida percentages were 42, 16, and 23%, respectively. This shows that oligohydramnios is more common in primi. In our study, the most common cause of oligohydramnios was idiopathic, followed by gestational hypertension (40 and 22% of cases, respectively). This is similar to the results obtained from a study conducted by Dalal et al., where the idiopathic cause was 50% and gestational hypertension was 44%.[9,10]

Our study observed that 77% of the subjects had a normal Doppler study result, and only 12% had decreased umbilical artery flow. Similar results were observed in the study by Dalal et al., in which 64% of the patients showed normal Doppler findings. The rate of delivery by caesarean section was 60%, and that by vaginal delivery was 40% in our study. The study done by Patil et al. showed that the incidence of caesarean section was 56% and that of normal delivery was 30%. Similar results were shown in a study by Vasanthamani et al., in which 65% underwent caesarean section and 35% underwent vaginal delivery. This shows a higher incidence of delivery via caesarean section in patients with oligohydramnios. In addition, one patient underwent forceps delivery, and a vacuum was applied to three patients.[11-13]

In our study, deliveries with a 5-minute APGAR score <7/10 were significantly higher, with 14% complicated with oligohydramnios. This proportion was similar to that in another study by Sriya et al., who documented 9.72% and higher (17.5%) in another study by Bansal et al. In our study, like other studies, thick meconium-stained amniotic fluid was noted in 16% of the study group. Chandran et al. and Sriya et al. showed 54%, 23.7%, and 38.88%, respectively. In a study by Grubb et al., 99% of women with oligohydramnios had meconium-stained fluids. Respiratory distress and birth asphyxia were noted in 9% and 4% of the study group, respectively.[14]

In our study, 24% of the neonates required oxygen, 6% required CPAP support, and 2% needed a ventilator. Rita et al. reported that 3.5% of neonates required a ventilator. This shows an increased incidence of neonatal ventilator requirement in oligohydramnios. There were four neonatal deaths in our study group, of which two died due to meconium aspiration syndrome, one on day 2 of life and the other on day 3 of life, and one due to severe perinatal hypoxia on day 11 of life. One patient with respiratory distress syndrome expired on day 9 of life.

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Chhabra et al. found a very high (87.7%) perinatal mortality in their study. Wolff et al. found that the perinatal mortality was 7.2%. Apel Sarid et al. found that their study's perinatal mortality was 9.9%. Chamberlin et al. calculated the gross and perinatal mortality rates in patients with decreased amniotic fluid volume and found them to be 188/1000 and 109/1000, respectively. Overall, there was a marked increase in perinatal mortality in oligohydramnios patients.[15-17]

CONCLUSION

Every case of oligohydramnios requires a careful antenatal evaluation. Proper counselling regarding nutrition and health education regarding strict foetal kick counts should be advised. A biweekly Doppler study should be performed in oligohydramnios with associated risk factors. The timing and mode of delivery should be based on Doppler studies to improve perinatal outcomes. Intrapartum foetal surveillance is the most important tool for identifying cord compression due to oligohydramnios. Continuous CTG monitoring during labor reduces perinatal morbidity by making earlier decisions, thereby improving perinatal outcomes.

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