Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/2t3de331

IMPACT OF OLIGOHYDRAMNIOS ON THE FETO-MATERNAL OUTCOME - A RETROSPECTIVE STUDY AT A TERTIARY CARE CENTER

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ABSTRACT

Background: The incidence of oligohydramnios is 1-5%.Oligohydramnios is associated with increased maternal and fetal morbidity. Barcelona criteria stages Fetal Growth Restriction into four categories, but does not consider amniotic fluid volume as a parameter for obstetric decision-making. This study aims to assess the possibility of oligohydramnios (low AFI scores) as an independent risk factor.

Methods: This study group was divided into three subgroups. The first group was women with AFI<5cm, second group with AFI 5-8 cm (borderline), and third group is AFI>8cm. Women with AFI > 8cm were controls. A study group of 160 women meeting the inclusion criteria from January 2020 to January 2023 was created. A comparative analysis was done.

Results: Oligohydramnios group had higher rate of induction of labor (66.7%) as compared to borderline AFI (41%) and normal AFI (43.9%). A statistically significant difference was observed in indications of emergency cesarean section among the 3 groups. Out of 40 neonates who were admitted in NICU, 47.5% had respiratory distress, 15% had birth asphyxia, neonatal jaundice (15%), hypoglycemia (10%), neonatal sepsis (7.5%), Meconium aspiration (2.5%), hypothermia (2.5%).

Conclusion: As independent risk factor for a, AFI can be used to predict poor feto-maternal outcome and can help in initiating timely intervention in Medical centers where the expertise for the Doppler studies is unavailable.

Keywords: Oligohydramnios, Borderline Oligohydramnios, Fetal Growth Restriction.

INTRODUCTION

The incidence of oligohydramnios is 1-5%. Maternal illness, i.e., hypertension, pre-eclampsia, abnormalities of twinning, drug intake, are associated with oligohydramnios.[1]

Oligohydramnios can be associated with increased risk of induction of labor, operative interventions, and adverse fetal outcomes such as congenital fetal abnormalities, premature rupture of membranes,

uteroplacental insufficiency, growth restriction, meconium aspiration, prematurity, fetal hypoxia, acidosis, post-datism, and chronic abruptio placentae. The sequel of long-standing oligohydramnios include pulmonary hypoplasia, Potter's syndrome, club foot, club hand, and dislocation of hip.[2]

Barcelona criteria brief

Fetal Growth Restriction is staged into four categories:

1. Mild placental insufficiency-diagnosed as EFW<3rd centile (OR) Umbilical Artery pulsatility index (UA PI)>95th centile (OR) Middle cerebral artery pulsatility index (MCA PI) <5TH centile (OR) Uterine artery pulsatility index (USA PI)>95TH centile.
2. Severe placental insufficiency-Diagnosed if UA absent end-diastolic flow is present (OR) Reverse Aortic isthmus (AoI) velocity.
3. Low suspicious fetal acidosis-Diagnosed if UA reversal of end-diastolic velocity (REDV) is present (OR) Ductus venosis PI (DV-PI)>95 centile.
4. High suspicion fetal acidosis-diagnosed if DV reversal flow is present (OR) computerized cardiotocography CTG shows <3ms fetal heart rate decelerations.[2]

According to Barcelona criteria, amniotic fluid volume is not considered a parameter for obstetric decision-making. This study aims to assess the possibility of oligohydramnios (low AFI scores) as an independent risk factor for poor feto-maternal outcome irrespective of Doppler changes. If established as an independent risk factor for a poor feto-maternal outcome, AFI can be used to predict it and can help in initiating timely intervention in Medical centers where the expertise for the Doppler studies is unavailable.

AIMS AND OBJECTIVES

1. To study incidence of oligohydramnios in our institute
2. To study maternal factors leading to oligohydramnios
3. To study maternal morbidity associated with oligohydramnios like caesarean section or operative vaginal delivery
4. To study the perinatal outcome
5. To study the congenital anomalies associated

MATERIALS AND METHODS

Study Subjects: Humans

Study Design: A Retrospective study

Study Duration: 3 years

Study Place: Department of Obstetrics and Gynecology, All India Institute of Medical Sciences, Raipur.

Study Population

Singleton pregnancies with oligohydramnios-cases
Singleton pregnancies without oligohydramnios –controls
The first group included women with AFI<5cm. The second group included women with AFI 5-8 cm (borderline), and the third group was AFI>8cm. Women with AFI > 8cm will be considered as controls.

Inclusion Criteria

1. Singleton pregnancy
2. Gestational age 24-32 and >32 weeks
3. Intact membranes at the time of admission

Exclusion Criteria

1. Premature rupture of membranes (PROM)
2. Women with medical disorders including cardiovascular, renal, liver, and connective tissue disorder.
3. Women with antepartum hemorrhage-placenta previa, abruptio placentae
4. Previous classical cesarean section/hysterotomy/myomectomy.

Sample Size Calculation

$$N = \frac{\left(Z_{\alpha/2}\sqrt{2p(1-p)} + Z_{1-\beta}\sqrt{p1(1-p1)p2(1-p2)}\right)^2}{(p_1 - p_2)^2}$$

Where p_1 and $p_2$are the percentage of patients having meconium-stained liquor in oligohydramnios (0.2254) and borderline (0.1212)

P= average of proportions (0.2254 + 0.1212/2 = 0.173)

$Z_{\alpha/2}$= 1.96 at 95 % confidence interval

$Z_{1-\beta}$= 0.84 at 80% power

Statistical analysis was carried out using statistical packages for SPSS 20 for windows (SPSS Inc., Chicago, IL, USA). Continuous and categorical variables was expressed as mean ± SD and percentages, respectively. Categorical variables were compared using the Chi-square test. Continuous variables were compared using one-way ANOVA. Logistic regression was used to see the association of oligohydramnios with the factors associated. Two-sided p values were considered as statistically significant at $p<0.05$.

Patient demographics and clinical history was noted from discharge summaries and entered in the case record proforma (CRP). General, systemic and obstetric examination, investigations mentioned in hospital records was entered in the CRP. Serial ultrasound evaluations for AFI, SDP, EFW/AC, and Doppler indices, including uteroplacental blood flow, stage of fetal growth restriction, and other fetal surveillance parameters like Biophysical profile Non stress test or Contraction stress test was evaluated. Serial assessments of AFI values following oral or intravenous hydration therapy was noted. Risk factors for oligohydramnios were evaluated. Other maternal parameters which were studied include Gestational age at deliver, Mode of onset of labour (spontaneous /induced), Mode of delivery (Normal/cesarean), Cesarean section (elective/emergency), Presence of postpartum hemorrhage. The parameters of neonatal outcome noted from hospital records .Data collected was analyzed in the three subgroups. A comparative analysis between the cases and the controls was done to assess whether low AFI values are a risk factor for poor maternal and neonatal outcome. The independence of low AFI values as a risk factor was assessed by logistic regression analysis. A receiving operator curve (ROC) analysis was done to determine the AFI value below which it has the maximum association with poor feto-maternal outcome.

RESULTS

Pre pregnancy BMI in kg/m²	**Group A (AFI<5cm) N (%)**	**Group B (AFI 5-8 cm) N (%)**	**Group C (AFI >8cm) N (%)**	**Total N (%)**	**P value**
<18.5	4(20)	11(32)	16(17.8)	31(19.4)	0.98
18.5 – 24.9	15(75)	34(68)	62(68.9)	111(69.4)	
25 – 29.9	1(5)	5(10)	12(13.3)	18(11.2)	
≥30	0(0)	0(0)	0(0)	0(0)	
Total	20(100)	50(100)	90(100)	160(100)	
Table 1: Distribution according to Pre-Pregnancy Body Mass Index (BMI) Groups					
p=0.98-not significant					

As per table 1, Majority of the study participants 111(69.4%) had BMI between 18.5 – 24.9 kg/m², 31(19.4%) had a BMI <18.5. 15(75%) of study participants in Group A had BMI in the normal range. Only 4(20%) had low BMI IN group A and 11(32%) and 16(17.8%) had low BMI in Group B and Group C.

There was no statistically significant difference in pre-pregnancy BMI among the 3 groups of study participants.

Weight gain (in kgs)	**Group A (AFI<5cm) N (%)**	**Group B (AFI5-8cm) N (%)**	**Group C (AFI>8cm) N (%)**	**Total N (%)**	**P value**
<9kg	12(80)	13(26)	18(20)	43(26.9)	0.003
9-11Kg	8(40)	18(36)	25(27.8)	51(31.9)	
>/12Kg	0(0)	19(38)	47(52.2)	66(41.2)	
Total	20(100)	50(100)	90(100)	160(100)	
Table 2: Distribution According to Weight Gain during Current Pregnancy					
P.003-significant					

As per Table 2, Larger number of the study participants 47(52.25%) had weight gain of ≥12 kgs followed by 25(27.8%) had weight gain of 9-11 Kgs. But 12(80%) of study participants in Group A had less than normal weight gain i.e. <9kgs weight gain during their pregnancy. This indicates that there is lesser weight gain during pregnancy in women with oligohydramnios as compared to those without. Fisher's Exact test applied to assess statistical difference and this difference was observed to be statistically significant.

Gestational age at delivery in weeks	**Group A (AFI<5cm) N(%)**	**Group B (AFI 5-8 cm) N(%)**	**Group C (AFI >8cm) N(%)**	**Total N(%)**	**P value**
28-33+6	0(0)	0	1(1.2)	1(0.6)	0.17
34-36+6	5(25)	4(8)	12(13.3)	21(13.1)	
37-39+6	13(65)	43(86)	63(70)	119(74.4)	
40-40+6	2(10)	3(6)	14(15.5)	19(11.9)	
Total	20(100)	50(100)	90(100)	160(100)	
Table 3: Comparison in Terms of Gestational Age at Delivery					
*Fisher's exact test p=0.17-not significant					

As per table 3, in majority of the study participants i.e. 63(70%), gestational age at delivery was between 37 and 39+6 weeks with 13(65%), 43(86%) and 63(70%) belonging to group A, B and C respectively. Only 1(1.2%) woman of group C delivered between 28-33+6 weeks. Total 21(13.1%) study subjects delivered between 34-36+6 weeks and 19(11.9%) between 40-40+6 weeks. No statistically significant difference was observed in gestational age at delivery among the 3 groups of study participants.

Group	**Induced N(%)**	**Spontaneous N(%)**	**Total N(%)**	**P Value**
Group A	13(65)	7(35)	20(100)	0.002
Group B	20(40)	30(60)	50(100)	
Group C	39(43.3)	51(56.7)	90(100)	
Total	72(45)	88(55)	160(100)	
Table 4: Comparison in Terms of Mode of Onset of Labor				
*Chi-square test p=0.002 significant				

As per table 4, Total 72(45%) participants had induced labor while 88(55%) had spontaneous labor. Rate of induction of labor was found to be significantly higher in group A 13(65%) as compared to group B 20(40%) and C 39(43.3%). Chances of Spontaneous labor was more in group C participants 51(56.7%) and relatively lesser in group A 7(35%). This observation indicates that rate of labor

induction increases as AFI decreases. Chi-square test was applied to assess statistical differences. The p-value was 0.00, indicating significant difference in mode of onset of labor between the 3 groups.

Intrapartum CTG changes	**Group A (AFI<5cm)**	**Group B (AFI 5-8 cm) N(%)**	**Group C (AFI >8cm) N(%)**	**Total N(%)**	**P value**
Cat 1	6(30)	25(50)	49(54.4)	80(50)	0.129
Cat 2	14(70)	20(40)	33(36.7)	67(41.9)	
Cat 3	0(0)	5(10)	8(8.9)	13(8.1)	
Total	20(100)	50(100)	90(100)	160(100)	
Table 5: Comparison in Terms of Intrapartum CTG Changes					
*Fisher's Exact test p=0.129 not significant					

As per Table 5 Half of the subjects 80(50%) had Category 1 CTG during labor followed by 67(41.9%) had Category 2 changes. Only 13(8.1%) had category 3 CTG. Amongst group A, 14(70%) participants had category 2 CTG changes during labor and none had category 3. In group B, 50(100%) subjects had abnormal CTG (Cat 2 20(40%) and 5(10%) cat 3) while in group C, 49(54.4%) had category 1 CTG and only 45.6% had abnormal CTG 33(36.7%) cat 2 and 8(8.9%) cat 3. This observation indicates that decreased liquor is associated with abnormal CTG changes during labor. However, this difference in intrapartum CTG changes among the 3 study groups was not statistically significant.

Mode of delivery	**Group A (AFI<5cm) N(%)**	**Group B (AFI 5-8 cm) N (%)**	**Group C (AFI >8cm) N (%)**	**Total N (%)**	**P value**
Vaginal delivery	7(35)	22(44)	48(53.4)	77(48.1)	0.47
LSCS	12(60)	26(52)	39(43.3)	77(48.1)	
Instrumental delivery	1(5)	2(4)	3(3.3)	6(3.8)	
Total	20(100)	50(100)	90(100)	160(100)	
Table 6: Comparison in Terms of Mode of Delivery					
*Fisher's exact test p=0.47 not significant					

As per Table 6, Almost equal number of study participants 77(48.1%) and 77(48.1%) had vaginal delivery and LSCS respectively and only 6(3.8%) participants needed instrumental vaginal delivery. In group A, larger number of participants 12(60%) underwent emergency LSCS as compared to group B and C, 26(52%) and 39(43.3%) respectively. Number of participants having successful vaginal delivery was more in group C 48(53.4%) than group A 7(35%). This observation indicates higher cesarean section rate amongst patients having decreased AFI. However, this difference in mode of delivery among the 3 groups was not statistically significant.

Groups	**<1.5kg N (%)**	**1.5-2.5Kg N(%)**	**>2.5Kg N(%)**	**Total N(%)**	**P-value**
Group A	3(15)	16(80)	1(5)	20(100)	0.07
Group B	1(2)	43(86)	6(12)	50(100)	
Group C	2(2.3)	74(82.2)	14(15.5)	90(100)	
Total	6(3.8)	133(83.1)	21(13.1)	160(100)	
Table 7: Comparison in Terms of Birth Weight					
*Fisher's exact test p=0.07-not significant					

Majority of neonates 133(83.1%) had birth weight between 1.5 and 2.5 kg i.e. they fell into low-birth weight category. Among 20 patients of group A; 16(80%) had a very low birth weight (VLBW) and only 3(15%) neonate had extremely low birth weight and 1(5%) had a normal birth weight. Similarly, among 50 participants of group B; majority i.e. 43(86%) had neonates of very low birth weight and only 6(12%) had normal birth weight neonates. Even in 90 group C neonates, similar results were

observed. Out of 90, 74(82.2%) were of VLBW, 2(2.3%) were ELBW and 14(15.5%) were of normal birth weight. No statistically significant difference was observed in birth weight of neonates between 3 groups of study participants.

	Groups	Mean ± SD	Test value	P value
APGAR Score at 1 min	Group A Group B Group C	8.27+-0.7 8.46+-0.6 8.44+-0.6	0.95	0.62
APGAR Score at 5 min	Group A Group B Group C	9.27+-0.7 9.41+-0.7 9.37+-0.7	0.59	0.74
Table 8: Comparison in Terms of Apgar Score at 1 Minute and 5 Minute after Birth				

The mean APGAR score at 1 minute of birth among Group A, B and C neonates were 9.27 ± 0.7, 9.41 ± 0.7, 9.37 ± 0.7 respectively. There was no statistically significant difference observed in APGAR score at 1 minute of birth between 3 groups of study participants.

Group	Admitted to NICU N(%)	NOT Admitted to NICU N(%)	Total	P value
Group A	6(30)	14(70)	20(100)	0.94
Group B	12(24)	38(76)	50(100)	
Group C	24(26.6)	66(73.4)	90(100)	
Total	50(31.3)	110(68.7)	160(100)	
Table 9: Comparison in Terms of Rate of NICU Admission				
*Fisher's Exact test P value=0.94 Not significant				

Comparison of neonatal intensive care unit (NICU) admission rate among 3 groups of study participants is depicted in Table 15 and GRAPH 15. Majority of neonates 110(68.7%) did not need NICU admission. Only 24(26.6%) needed admission in NICU in Group C. 6 out of 20 neonates (30%) in group A, 12 out of 50(24%) in group B and 24 out of 90 (26.6%) in group C needed neonatal ICU admission with in first 7 days after birth. No statistically significant difference was observed in NICU admission rate among the 3 groups of study participants.

DISCUSSION

There have been many proposed guidelines and protocols in literature on the management of FGR but not many of them take the role of amniotic fluid volume into consideration. This study sought to ascertain whether amniotic fluid volume is associated with adverse perinatal outcome in FGR fetuses. A total of 152 women with FGR were recruited and followed up till delivery and their outcome were analyzed in 3 groups as per their Amniotic Fluid Index (AFI).

In our study, maximum i.e. 41(45.5%) participants were in the age group 26-30 years. The minimum and maximum age were 18 and 40 years respectively but among the women having oligohydramnios. There was no statistically significant difference in age among our participants. Apel Sarid et al.[3] found in their study that mothers with FGR and oligohydramnios were relatively younger.[3]

Apel Sarid et al.[3] found in their study that mothers with FGR and oligohydramnios were relatively younger.[3] Gravidity and parity have been studied as factors influencing adverse pregnancy outcomes. In our study, majority of the participants >90% were "primigravida". There was no statistical significant difference in parity among 3 groups. Krishna Jagatia et al.(2013) 93 in their studies on maternal and fetal outcome in oligohydramnios found that oligohydramnios is more prevalent in primigravida.[4] A study by Bhagat et al.[5] reported 68% incidence of oligohydramnios among nulliparous though the association was not statistically significant.[5]

In our study, majority of the study participants 111(69.4%) had normal BMI i.e. between 18.5 – 24.9kg/m². 80% of participants of oligohydramnios group also had BMI in the normal range. Only 2 had low BMI (<) and 1 had BMI in the range of overweight. There was no statistically significant difference in the pre-pregnancy BMI among the 3 groups.

FGR is found to have association with low pre-pregnancy BMI as per many studies but there are not much studies in literature that show any association of low pre pregnancy BMI with decreased amniotic fluid volume.

We, in our study found the mean weight gain of 8.23±1.16kg, 10.83±2.69kg and 11.52±2.94 kg in the group with oligohydramnios, borderline AFI and normal AFI respectively. Median weight gain was 8(7-9) kg, 10(9-13) kg and 12(9-14) kg respectively for above 3 groups. Mean weight gain was observed to be lowest in oligohydramnios group as compared to those with borderline liquor and normal liquor. There was a statistically significant difference in weight gain during current pregnancy among the 3 groups. Bhagat found a significantly lower maternal weight gain among oligohydramnios group in their study on AFI and perinatal outcome.[5] 36% women of oligohydramnios group and only 8% of non-oligo group had <10 kg weight gain during the pregnancy. In our study, almost all the participants (98.7%) had stage 1 FGR at the time of recruitment. Only 2 had stage 2 FGR and both had oligohydramnios. A statistically significant difference was observed in the stage of FGR among the 3 groups as per AFI at recruitment. This lower number of women with stage 2 or more FGR can be explained by the fact that majority of women with stage 2 or more FGR were having severe pre-eclampsia or any other serious medical illnesses because of which they were excluded from our study. When groups as per AFI at delivery were compared, we observed that 2 women of oligohydramnios group having stage 2 FGR at recruitment remained as stage 2 till delivery but their liquor improved to borderline and normal range because of treatment received. However, another one woman of oligo group had progressed from stage 1 to 2 during her follow-up. No statistically significant difference was observed in the stage of FGR at the time of delivery among the 3 groups. However, we could not find any study comparing the stage of FGR at recruitment or showing their progression of stage till delivery among oligo and non oligo groups. In literature, majority of studies had compared among groups as per AFI at delivery but we compared the outcome variables among groups as per AFI at recruitment and delivery both. In our study, Oligohydramnios group had higher rate of induction of labor 72(45 %) as compared to those with borderline AFI (40%) and normal AFI (39%). Chances of Spontaneous labor was more in participants with normal liquor volume (56.7%) and relatively lesser in oligohydramnios group 7(35%). This represents that rate of labor induction increases as AFI decreases. The p-value was 0.00, indicating statistically significant difference in mode of onset of labor between the 3 groups. Then we compared the rate of induction of labor among 3 groups as per their AFI at the time of delivery. Oligohydramnios (57.7%) and borderline AFI (53.8%) groups had higher rate of labor induction as compared to those with normal AFI (40%). This shows that more number of induction of labor is being done as AFI decreases. Spontaneous onset and progress is often being allowed when AFI is normal. However, the difference in mode of onset of labor among 3 groups of was not found to be statistically significant. Rezaie Kahkhaie K et al 2014.1 also found that the rate of Induction of labor was 3.22 times greater in oligohydramnios.[6] It was 42% in oligo group as compared to only 12.6% in non-oligo group. Magnan EF et al got similar results from their cohort study and reported that there was an increased risk of labor induction, intrauterine growth restriction and preterm delivery in pregnancies complicated with oligohydramnios. Amniotic fluid index and intrapartum CTG changes: In our study, when we compared the CTG changes among groups as per AFI at recruitment, we found that maximum abnormal CTG were seen in oligohydramnios group (73.3%) followed by borderline AFI (51.3%) and normal AFI group (44.9%) respectively. 55.1% women with normal AFI had category 1 CTG during labor. This concludes that decreased liquor is associated with abnormal CTG changes during labor. However, this difference was not statistically significant. While comparing between the groups as per AFI at delivery, it was observed that, 65.3%,51.3% participants of oligo and borderline AFI group respectively had abnormal CTG, while 56.2% of women with normal liquor had category 1 CTG and only 43.9% had abnormal CTG (36% cat 2 and 7.9% cat 3). This shows that decreased liquor is associated with abnormal CTG changes

during labor. Tongsong et. al.[7] concluded from their study that AFV was a reliable predictor of intrapartum fetal distress with sensitivity , specificity , positive and negative predictive values of 84%, 83.41%, 36.84% and 97.84% respectively.[7] we found that majority of oligohydramnios (88.8% cat 2) and borderline AFI group (55% cat 2 and 25% cat 3) participants underwent emergency CS due to abnormal CTG, but only 44.1% of normal AFI group had CS due to CTG abnormalities. (37.2% cat 2 and 6.9% cat 3). This observation indicates that number of CS due to intrapartum fetal distress increases as liquor volume goes on decreasing. A statistically significant difference was observed in indications of emergency cesarean section among the 3 groups as per their AFI at recruitment. While comparing groups as per AFI at delivery, we observed that majority of oligohydramnios (88.2% cat 2) and borderline AFI group (31.6% cat 2 and 31.6% cat 3) women underwent emergency CS due to abnormal CTG changes, but only 44.4% of normal AFI group had CS due to CTG abnormality (38.8% cat 2 and 5.6% cat 3). This concludes that cesarean section rate due to fetal distress increases as AFI decreases. The difference in cesarean section indications among 3 groups was statistically significant. We found that out of 40 neonates who were admitted in NICU, almost half of them 19(47.5%) had respiratory distress followed by 6(15%) had HIE i.e. birth asphyxia and neonatal jaundice in 6 (15%). 4(10%) neonates had hypoglycemia on day 1 or day 2 of birth and 3(7.5%) neonates developed neonatal sepsis. Meconium aspiration was present in 1(2.5%) neonate and 1(2.5%) neonate developed hypothermia few times after birth.

CONCLUSION

Fetal growth restriction (FGR) and low amniotic fluid index have been the focus of significant research due to their potential impact on on perinatal outcomes, several studies have reported the association between these two factors. We have observed that AFI is predictor of fetal tolerance in labour and its decrease is associated with abnormal fetal heart rate intrapartum. Relatively large number of women were found to have their labour induced or underwent caesarean section due to CTG abnormalities intrapartum as compared to other two participants. Also their neonates were observed to have relatively prolonged NICU stay and serious complications. In conclusion we recommend further research to the specific mechanisms linking AFI to adverse perinatal outcome in the context of FGR and to determine the optional clinical management based on these findings. Monitoring AFI may offer valuable prognostic information and help in the management of pregnancies. We recommend further research to better estimate the association to incorporate oligohydramnios as a parameter in Barcelona Protocol while managing pregnancies with fetal growth restriction.

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