

To Study the Association of Low Amniotic Fluid Index and Adverse Perinatal Outcomes in Third Trimester of Pregnancy

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ABSTRACT

Background and objectives: Amniotic fluid is the complex fluid surrounding the fetus *in utero* and gives a low resistance environment needed for the growth and development of the fetus. Clinical estimation of amniotic fluid volume forms a major part of the fetal assessment and outcome of pregnancy. A strong association between oligohydramnios and increased lower segment cesarian section (LSCS) rates and low birth weight exists. As very few studies have looked into perinatal outcomes and AFI, we conducted a study wherein we measured the amniotic fluid index (AFI) in mothers between 28 and 40 weeks of gestational age (GA) and looked into its association with maternal and perinatal outcomes.

Methods: This was a descriptive observational study on 108 patients in the Department of Obstetrics and Gynaecology, St. Johns Medical College and Hospital, Bengaluru, Karnataka, India over a period of 2 years and we studied the association of AFI on maternal and perinatal outcomes. The data were collected from 6 November 2019 to 1 October 2021. Written and informed consent was obtained from patients agreeing to participate in the study. Ethical approval was obtained from the institutional ethics committee before the start of the study. Maternal and fetal outcomes were studied in the study subjects.

Results: This clinical study was conducted over a duration of 2 years on 108 pregnant women in the third trimester at St. John's Medical College and Hospital, Bengaluru, Karnataka, India. Nine patients were diagnosed with oligohydramnios. Hence, the prevalence of oligohydramnios was 8.3% in the study group. The most common presenting complaint or need for admission was safe confinement 48 (44.4%), followed by abdominal pain 40 (37%) and oligohydramnios 6 (5.6%). Majority of the pregnancies had a GA of 37–40 weeks (74.1%). The most mode of delivery was by LSCS (100%) in the AFI <5 cm group. In the AFI <5 cm group, 7 neonates had birth weight 2.5–4 kg.

Conclusion: Mode of delivery by LSCS seems to benefit the neonates in terms of lower incidence of non-reactive non-stress test (NST), low chance of meconium-stained liquor (MSL) and intrauterine death (IUD). Prompt decision for LSCS, even in the induced patients who are planned for vaginal delivery, is essential in preventing fetal morbidity such as MSL, fetal distress, and neonatal intensive care unit (NICU) admission.

Keywords: Amniotic fluid index, Low risk pregnancy, Oligohydramnios, Perinatal outcome.

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INTRODUCTION

Amniotic fluid is the complex fluid surrounding the fetus *in utero*.¹ Amniotic fluid gives a low resistance environment needed for the growth and development of the fetus.² Amniotic fluid also has antibacterial properties that protect the fetus.² It also helps in fetal lung growth, gastrointestinal development, and protects the umbilical cord from compression.³ Phelan et al. introduced the four-quadrant method to assess AFI.² Studies have shown that a single deep vertical pocket measurement is a method of choice for the measurement of AFI.⁴ Volume of amniotic fluid below the fifth percentile is known as oligohydramnios.¹ Oligohydramnios can also be defined as less than 500 mL at 32–36 weeks or AFI less than 5 cm in term gestation. Clinical estimation of amniotic fluid volume forms a major part in the fetal assessment, directing to the outcome of pregnancy.² Amniotic fluid index forms a major component in assessing the biophysical profile on ultrasound evaluation to monitor fetal wellbeing.²

Oligohydramnios is associated with pregnancy complications, perinatal mortality, and congenital anomalies.² Modern obstetrics deals with the wellbeing of both mother and fetus, and recognizing the risk factors early to prevent the death of the fetus or morbidity to mother and fetus.⁵ Oligohydramnios has been associated with an NST, increase cesarean rates because of fetal distress, low appearance, pulse, grimace, activity, and respiration (APGAR) scores, meconium aspiration, low birth weight, admission to neonatal NICU,

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birth asphyxia, and increased risk of perinatal infection, increased induction of labor, stillbirths, and fetal acidosis due to placental insufficiency.^{1–4} Literature review has shown pregnant women at 37–40 weeks of gestation with no obstetric/medical complications, with a mean AFI of 4.14 cm had a higher chance of anticipation of non-reactive NST, when compared with patients with normal AFI (mean: 10.14 cm).⁶

In India, patients with low AFI in low-risk pregnancies between 36 and 40 weeks of gestation are not known to be significantly associated with adverse maternal outcomes in terms of mode of delivery by LSCS or MSL. However, reports suggest low AFI, that is below 7, had more NICU admissions and low birth weight in an

Indian setting.⁷ Indian women at 34–41 weeks of gestation with low AFI, that is below 5 cm, have been observed to have higher C-section rates done because of fetal distress and low birth weight (2.5 kg).⁵

Contrary findings with relation to low AFI and perinatal complication have also been reported in some study groups, wherein low AFI of <5 cm is associated with abnormal NST but not with an increased rate of C-section delivery, meconium-stained fluid, low APGAR scores, or NICU admission.^{1,8}

As very few studies have looked into the perinatal outcomes and AFI in the early third trimester, we conducted a study wherein we measured the AFI in mothers between 28 and 40 weeks of GA and looked into its association with maternal and perinatal outcomes.

Aims

To study the association between oligohydramnios in the third trimester (28–40 weeks of gestation) and maternal outcomes.

METHODS

Study Design

This was a descriptive observational study on 108 patients in the Department of Obstetrics and Gynaecology (OBG), St. Johns Medical College and Hospital, Bengaluru, Karnataka, India over a period of 2 years and we studied the association of AFI on maternal and perinatal outcomes. The data were collected from 6th November 2019 to 1st October 2021. Written and informed consent was obtained from patients agreeing to participate in the study. Ethical approval was taken at the beginning of the study (IEC No. 314/2019). Demographic data such as age, obstetric score, gestational period (calculated from last menstrual period if the early scan and the dates are corresponding, if not, first trimester scan expected date of delivery was considered), and presenting complaints were noted. Blood pressure monitoring (using mercury sphygmomanometer in right arm supine position), proteinuria using dipstick method, and other laboratory values were noted. Antenatal scans after 28 weeks were analyzed to look into the AFI and based on AFI patients were classified as <5 or >5 AFI. Neonatal outcomes were also looked into based on NICU stay and outcomes. Ethical approval was obtained from the institutional ethics committee before the start of the study. The following information on maternal and fetal outcomes was studied.

Maternal Variables

The number of antenatal visits, assessment of fetal growth, and any symptoms such as pain abdomen, bleeding, or leaking per vagina were documented. Blood investigations were documented. Pregnancy outcomes such as need for induction, mode of delivery were noted. Treatment of patients during the antenatal period, intrapartum and postpartum period was studied.

Fetal Variables

Neonatal outcomes such as APGAR scores, NICU admission, birth weight, stillbirths, and birth asphyxia was evaluated.

Statistical Analysis

The data were entered and analyzed using Statistical Package for Social Sciences (SPSS), version 20. Quantitative data variable expressed by using mean and standard deviation and qualitative data variables in patients with AFI less than 5 cm and those with 5 cm or higher were compared using Student's *t*-test and Chi-squared

test/Fischer's exact test. Such comparisons were made in all patients involved in the study. The *p*-value less than 0.05 was considered as significant. The demographic and baseline variables were analyzed using descriptive statistics. Continuous variables were assessed for normality and summarized as mean (\pm SD). Categorical variables were analyzed using Chi-squared test. A *p* < 0.05 was considered significant for all the tests.

Sample Size

As per Kapoor et al., 20,187 AFI below 7 cm and above 7 cm were reported and reflected adverse perinatal outcomes of low birth weight, and a higher chance of NICU admissions. Using this information in 5% level of significance and 80% power of the required sample size was below 100; hence, we assumed the sample size of 100. The following formula was used to determine the sample size:

$$n = 2 (Z_1 - x/2) + Z(1 - \beta)^2 a^2/d^2$$

$$\text{Sigma } (\Sigma) = \text{full SD}$$

α = Difference between two groups' means

$Z_1 - \beta$ = Z value for corresponding power (80%)

$Z_1 - x/2$ = Two-sided value for corresponding α (5%)

Trial subject's age group: Age range from 18 to 45 years.

RESULTS

This clinical study was conducted over a duration of 2 years on 108 pregnant women in the third trimester at St. John's Medical College and Hospital, Bengaluru, Karnataka, India. Nine patients were diagnosed with oligohydramnios. Hence, the prevalence of oligohydramnios was 8.3% in the study group. The most common presenting complaint or need for admission was safe confinement 48 (44.4%), followed by abdominal pain 40 (37%) and oligohydramnios 6 (5.6%).

Obstetric history: In our study population, 15.3% had a history of prior abortion and 56.48% had history of previous LSCS.

Table 1 shows the age distribution of the study population. The population was divided into three groups. Most patients were in the age group of 21 to 30 years (71.3%). Twenty patients were more than 31 years of age and eleven patients were less than 20 years of age. Out of 108 patients in our study population, there were more primigravidae (62.03%) in comparison to multigravidae 26.85%, and 11.1% were grand multigravidae. Majority of the pregnancies had a GA of 37–40 weeks (74.1%); 15.7% had a GA of 34.1–36.6 weeks and 8.3% of the study population were over 40 weeks of gestation. Only 1.9% of the pregnancies were in the 28–34 weeks of gestation. A total of 62% of the study population were educated beyond 10th standard, 17.6% had an educational status of graduate level.

The study population shows majority of the patients belong to class II socioeconomic status 55.6%, followed by 38% in class I. A total of 5.6 and 0.9% patients belonged, respectively, to classes III and IV. There were no patients in the class V group. Table 1 shows that, it was seen that 9 patients out of 108 pregnant women had oligohydramnios of AFI <5 cm and majority (91.7%) had an AFI >5 cm. Forty-two patients of the study population were induced. Twenty-four patients (22.22%) were induced with prostaglandin E2 (PGE2), ten patients were induced with E1+E2 (9.25%). Eight patients (8.08%) were induced with Prostaglandin E1 (PGE1). The most common mode of delivery was LSCS (74.1%); 21.3% had a full-term vaginal delivery and 3.7% had a preterm vaginal delivery. One patient (0.9%) had an instrumental forceps delivery.

Table 1: Demography of the study population

Variables		Total (N = 108)	Percentage	
Age (years)	<20 years	11	10.2	
	21–30 years	77	71.3	
	>31 years	20	18.5	
Obstetric score	Primigravidae	67	62.03	
	Multigravidas	29	26.85	
	Grand multigravidas	12	11.11	
GA (weeks)	28–34 weeks	2	1.9	
	34.1–36.6 weeks	17	15.7	
	37–40 weeks	80	74.1	
	>40.1 weeks	9	8.3	
Educational status	<10th standard	67	62.0	
	11th and 12th standards	22	20.4	
	Graduate	19	17.6	
Modified BG prasad's socioeconomic classification. ⁹				
6,574 and above	Class I	41	38.0	
	3,287–6,573	Class II	60	55.6
	1,972–3,286	Class III	6	5.5
	986–1,971	Class IV	1	0.9
	985 and below	Class V	0	0
AFI	AFI <5 cm	9	8.3	
	AFI >5 cm	99	91.7	
Mode of induction (n = 42)	E ₁	8	(7.40)	
	E ₂	24	(22.22)	
	E ₁ + E ₂	10	(9.25)	
	No induction	66	(61.11)	
Mode of delivery of the study population	LSCS	80	74.1	
	FTVD	23	21.3	
	PTVD	4	3.7	
	Forceps delivery	1	0.9	
Birth weight	<2.5 kg	27	25	
	2.5–4 kg	79	73.1	
	>4 kg	2	1.9	
NICU Admission	Yes	22	20.4	
	No	86	79.6	

Table 2: Mode of delivery by LSCS of the study population

Variable	Total (N)	LSCS	
		Emergency LSCS	Electives LSCS
AFI <5 cm	9 (100%)	7 (77.77%)	2 (22.22%)
AFI >5 cm	71 (100%)	44 (61.97%)	27 (38.02%)

Table 2 shows that, in the AFI <5 cm group, seven mothers (77.77%) had an emergency LSCS and two mothers (22.22%) had an elective LSCS. The birth weight of the neonates born in this study group is shown in the above Table 1. Most of the neonates were of birth weight of 2.5–4 kg (73.1%). A total of 25% of the neonates were less than 2.5 kg and 1.9% were more than 4 kg.

In Table 1, among the neonates born in this study population, 20.4% of the neonates required NICU admission. Nearly 80% of the neonates did not require intensive care. There were no cases of stillbirths or early neonatal deaths seen in the study population.

Table 3 shows most mothers in the AFI <5 cm group were aged between 21 and 30 years. It is also seen that three mothers were in the age group above 31 years. One mother was below 20 years of age. There was no statistically significant association between maternal age and AFI <5 cm, with a *p*-value of 0.378. Table 3 shows that most mothers who had AFI <5 cm 5 (55.5%) were primigravidae, in comparison to multigravidas 3(33.3%). Similar distribution is seen in the group with normal AFI. Therefore, the above table shows no statistically significant association between obstetric score and AFI <5 cm with a *p*-value of 0.876.

Table 3: Associations of AFI and outcome of pregnancy

Variable	Total (N)	Age			p-value		
		<20 years	21–30 years	>31 years			
AFI <5 cm	9 (100%)	1 (11.1%)	5 (55.55%)	3 (33.33%)	0.378 ^a		
AFI >5 cm	99 (100%)	10 (10.10%)	72 (72.72%)	17 (17.17%)			
Obstetric score	Total (N)	Prime gravida	Multigravida	Grand multigravida	p-value		
AFI <5 cm	9 (100%)	5 (55.55%)	3 (33.33%)	1 (11.11%)	0.876 ^a		
AFI >5 cm	99 (100%)	62 (62.62%)	26 (26.26%)	11 (11.11%)			
GA	Total (N)	28–34 weeks	34.1–36.6 weeks	37–40 weeks	>40 weeks	p-value	
AFI <5 cm	9 (100%)	1 (11.11%)	2 (22.22%)	6 (66.66%)	0 (0%)	0.172 ^a	
AFI >5 cm	99 (100%)	1 (1.01%)	15 (15.15%)	74 (74.74%)	9 (9.09%)		
BG prasad's classification ⁹	Total (N)	Class I	Class II	Class III	Class IV	p-value	
AFI <5 cm	9 (100%)	3 (33.33%)	6 (66.66%)	0 (0%)	0 (0%)	0.859 ^a	
AFI >5 cm	99 (100%)	38 (38.38%)	54 (54.54%)	6 (6.06%)	1 (1.01%)		
Mode of induction	Total (N)	No Induction	E ₁	E ₂	E ₁ + E ₂	p-value	
AFI <5 cm	9 (100%)	8 (88.88%)	0 (0%)	0 (0%)	1 (11.11%)	0.221 ^a	
AFI >5 cm	99 (100%)	58 (58.58%)	8 (8.08%)	24 (24.24%)	9 (9.09%)		
Mode of delivery	Total (N)	LSCS	FTVD	PTVD	Forceps	p-value	
AFI <5 cm	9 (100%)	9 (100%)	0 (0%)	0 (0%)	0 (0%)	0.336 ^a	
AFI >5 cm	99 (100%)	71 (71.71%)	23 (23.23%)	4 (4.04%)	1 (1.01%)		
Mode of delivery LSCS	Total (N)	Yes	No			p-value	
AFI <5 cm	9 (100%)	9 (100%)	0 (0%)			0.108 ^a	
AFI >5 cm	99 (100%)	71 (71.71%)	28 (28.28%)				
Birth Weight	Total (N)	<2.5	2.5–4	>4			p-value
AFI <5 cm	9 (100%)	2 (22.22%)	7 (77.77%)	0 (0%)			1.000 ^a
AFI >5 cm	99 (100%)	25 (25.25%)	72 (72.72%)	2 (2.02%)			
NICU Admission	Total (N)	No	Yes			p-value	
AFI <5 cm	9 (100%)	7 (77.77%)	2 (22.22%)			1.000 ^a	
AFI >5 cm	99 (100%)	79 (79.79%)	20 (20.20%)				
APGAR score at 1 minute	Total (N)	<5	6–7	>8			p-value
AFI <5 cm	9 (100%)	0 (0%)	2 (22.22%)	7 (77.77%)			1.000 ^a
AFI >5 cm	99 (100%)	8 (8.08%)	25 (25.25%)	66 (66.66%)			
APGAR score at 5 minutes	Total (N)	<5	6–7	>8			p-value
AFI <5 cm	9 (100%)	0 (0%)	0 (0%)	9 (100%)			1.000 ^a
AFI >5 cm	99 (100%)	3 (3.03%)	5 (5.05%)	91 (91.91%)			

^aFisher's Exact, statistically significant at alpha = 5%, and $p < 0.05$

Most mothers (six mothers) who had AFI <5 cm were in the 37–40 weeks of gestation. It is also seen that two mothers were in the GA of 34.1–36.6 weeks. Similar results were seen in the AFI >5 cm study group. Hence, the association between GA and AFI <5 cm was not statistically significant, with a p -value of 0.172.

Table 3 shows in the AFI <5 cm group, six mothers belonged to the class II socioeconomic status and three mothers belonged to class I.⁹ No statistically significant association was found between socioeconomic status and AFI <5 cm with a p -value of 0.859. In Table 3 for the AFI <5 cm group, only one patient had induction with E1 and E2. Table 3 shows no statistically significant association between mode of induction and AFI <5 cm with a p -value of 0.221. Table 3 shows that all 9 mothers with AFI <5 cm had LSCS as the mode of

delivery. In the AFI >5 cm study group, 71.71% had LSCS, followed by 23.23% who had full term vaginal delivery (FTVD) and 4.04% who had preterm vaginal delivery (PTVD). There was not statistically significant association between mode of delivery and AFI <5 cm ($p = 0.336$). Table 3 shows that all nine mothers with AFI <5 cm had LSCS as the mode of delivery. Seventy-one patients in the AFI >5 cm group had a LSCS. Table 3 shows no statistically significant association between LSCS and AFI <5 cm with a p -value of 0.108.

Table 3 shows that in the AFI <5 cm group, 7 neonates had birth weight of 2.5–4 kg. Two neonates had birth weight below 2.5 kg. No statistically significant association was found between birth weight and AFI <5 cm with a p -value of 1.000. Table 3 shows that two neonates of mothers with AFI <5 cm had NICU admission due

to respiratory distress syndrome monitoring. There is no statistically significant association between NICU admission and AFI <5 cm, with a *p*-value of 1.000.

Table 3 shows that 7 neonates of mothers in the AFI <5 cm group had APGAR score greater than 8 at 1 minute of life. Two neonates had APGAR score of 6–7 at 1 minute of life. There was no statistically significant association between APGAR score at 1 minute of life and AFI <5 cm with a *p*-value of 1.000. Nine neonates of mothers in the AFI <5 cm group had APGAR score above 8 at 5 minutes of life. No neonate had APGAR score <7 at 5 minutes of life. The association between APGAR score at 5 minutes of life and AFI <5 cm was not statistically significant (*p* = 1.000).

DISCUSSION

This descriptive observational study was conducted in the Department of Obstetrics and Gynaecology, St. Johns Medical College and Hospital, Bengaluru, Karnataka, India on 108 pregnant women who were admitted in the third trimester of pregnancy.⁹ This was over a period of 2 years. Moreover, ultrasound (USG) was done at admission and the AFI value was noted. Nine patients out of 108 patients had AFI <5 cm and thus the incidence of low AFI was 8.3% in the study group.¹⁰ We observed these patients up to delivery and studied their outcomes to see the implication of isolated oligohydramnios on pregnancy and neonatal outcomes.

Our study had an incidence of oligohydramnios of 8.3%, which was similar to a study by Lin et al.¹¹ (Table 4). Existence of similar presentation of oligohydramnios at term could be a reason for the patients of our study to exhibit similarity with the population studied by Lin et al.¹¹

Our study showed most patients with AFI <5 cm presented at 37–40 weeks of gestation. Similar findings were seen by Patel et al., Chauhan et al., and Garmel et al.^{9,12,13} This shows the prediction of AFI <5 cm to present at term and the need for strict antepartum fetal surveillance especially in the third trimester.^{14,15} Maternal age of the subjects in our study was seen to be in the range of 21–30 years which was similarly seen by Jagatia et al., Janas et al., and Chien et al.^{16–18}

In our study, LSCS rates were found to be 100% in patients with AFI <5cm, as our institution is a tertiary care center catering to high-risk pregnancies. Sardana et al., Noor et al., Kumar et al., and Elsandabesee et al. found rates of LSCS less than 50%.^{9,19–21} Although their rates of caesarean section were low when compared to our study, the studies mentioned in Table 5 show high rates of caesarean section with respect to their study population.^{9,19–21} Kumari et al. also showed high rate of LSCS in their study population.²³

They reported fetal distress as one of the major indications for LSCS.^{9,19–21} In our study, cephalopelvic disproportion was the major indication for LSCS, and the other indications were non-progress of labor and previous LSCS. Our study shows that 22.2% of the babies born to the mothers with oligohydramnios had low birth weight. Kumari et al., in their study, identified that in the AFI <5 cm group, 60% of the patients delivered low birth weight babies of below 2.5 kg.^{22,23} Similar findings were seen by Saxena et al.²⁴

In our study, 22.2% of the babies in the below 5-cm AFI group were admitted to NICU. Kumar et al., Thobbi VA et al., and Chidanandaiah et al. reported NICU admissions in the range of 38–40% due to fetal distress, birth asphyxia, and meconium aspiration.^{21,25,26}

Kahkhaie et al. documented 1% of NICU admissions in the neonates born to mothers with AFI <5 cm.²⁷ In our study, the

Table 4: Comparison of incidence of oligohydramnios for AFI <5 cm

Incidence	AFI <5 cm
Elsandabesee et al. ⁹	24%
Hill et al. ¹⁰	0.43%
Lin et al. ¹¹	9%
Our study	8.3%

Table 5: Comparison for GA of presentation of AFI <5 cm

AFI <5 cm	GA
Patel et al. ¹²	39–40 weeks
Chauhan et al. ¹³	36.3 ± 4.6 weeks
Garmel et al. ¹⁵	37 weeks
Ghosh et al. ¹⁵	36.9 weeks
Our study	37–40 weeks

neonates born to mothers with AFI <5 cm had good APGAR scores at 5 minutes and no neonate scored below 7 due to good intrapartum monitoring and immediate resuscitation. The low incidence of poor APGAR scores of below 7 was seen in studies reported by Zosangpuii et al., Umber.^{28,29} Vasanthamani et al. and Thobbi et al. showed APGAR scores of below 7 at 5 minutes of life of 11 and 10%, respectively.^{25,30}

All studies describe the need for regular monitoring with a good neonatal resuscitation facility in the management of deliveries complicated with AFI <5 cm. Our study showed that there was no case of stillbirth in AFI <5 cm group due to vigilant monitoring. In the study done by Nancy et al., the rate of still birth was 2%.³¹ A total of 1.3% of stillbirth was documented by Sharma et al.³² This shows that good antenatal monitoring of oligohydramnios determines the outcomes of the baby, especially in the perinatal period.

CONCLUSION

This study concludes that there is no association of low AFI and adverse perinatal outcomes in the third trimester of pregnancy. Although the overall prevalence of isolated oligohydramnios is low, its detection by routine USG as early as 28 weeks of gestation warrants thorough assessment and vigilant monitoring. Mode of delivery by LSCS seems to benefit the neonates in terms of lower incidence of non-reactive NST, low chance of MSL and IUD. Prompt decision for LSCS even in induced patients who were planned for vaginal delivery is essential in preventing fetal morbidity such as MSL, fetal distress, and NICU admission. A strict antepartum surveillance and proper management improves maternal and perinatal outcome. An isolated oligohydramnios warrants regular antenatal fetal surveillance and timed termination of pregnancy, even though it is not associated with adverse perinatal outcomes.

LIMITATIONS

The study could have included a larger sample size.

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