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Original research article: Clinical efficacy and reliability of amniotic fluid index (AFI) as labour admission test in correlation to perinatal outcome

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Abstract
Background: Ideal Labour admission test (LAT) is the tool to identify labouring mothers at risk for adverse perinatal outcome so as to strategise and manage course of labour. Amniotic fluid index (AFI) is an important factor in biophysical profile during antenatal foetal surveillance. The present study is undertaken to determine the efficacy and reliability of Amniotic fluid index as LAT and it's relation to perinatal outcome.
Material and Methods: This Two years prospective observational study where 500 cases fulfilling exclusion and inclusion criterias were included. The AFI was calculated for all patients in active labor by USG and grouped into ≤ 5 (GpA), 6-8(Gp B), ≥ 9 (Gp C). After confinement, details of the labor, delivery and neonatal outcome were recorded to derive conclusion.
Results: Among 500 cases, 43(8.6%) were in Gp A, 153(30.6%) in Gp B, rest 304 (60.8%) were in Gp C category.
Gp A had significantly high nonreactive NST in 33(76.7%),Meconium stained liquor in 32(74.4%%), emerency LSCS in 34 (79%) cases in comparison to 38.6%, 41.2% and 22.2% in Gp B and further low in Gp C.
Significant neonatal morbidity, in terms of low Apgar score <7 at 1 and 5 Min in 34(79.1%) 17(39.5%, with 38(88.4%),neonates requiring NICU admission were observed in Gp A which were significantly higher in comparison to other groups.
The Sensitivity and specificity of Oligohydramnios in predicting foetal outcome was 59.1% and 75%, while its PPV and NPV was 62.8% and 85%
Conclusion: AFI is a valuable and reliable tool as admission test for predicting labour and perinatal outcome. In presence of oligohydramnios (AFI ≤ 5), is associated signinificantly with increase operative delivery for foetal distress and perinatal morbidity. Determination of AFI can be used as an adjunct to other fetal surveillance methods.

Keywords: Amniotic fluid index, Labour admission test, NST, perinatal outcome

Introduction
Modern obstetrics is concerned with the health and wellbeing of both the mother and the unborn child. Recognition of a fetus at risk for death or damage in utero, quantifying the risk, balancing the fetal risk against the risk of neonatal complications from immaturity, and determining the optimal time and mode of intervention are the cornerstones of modern perinatal medicine [1].
The goal of intrapartum fetal surveillance is to detect potential fetal decompensation and to allow timely and effective intervention to prevent perinatal morbidity or mortality such as perinatal asphyxia, neonatal hypoxic ischemic encephalopathy, stillbirth and neonatal death [2].
Labour admission test is a means to identify patients who may require caesarean delivery for a non-reassuring fetal heart rate tracing during labor and this avoid delivery of a depressed newborn [3]. The theoretic benefit of such a test is that it can identify patients whom antepartum risk factors are missed and triage patients in a busy labor and delivery site with limited resources – cardiotocography for 20 minutes [3], response to vibroacoustic stimulation [4], doppler scans of umblical artery [5], and sonographic assessment of amniotic fluid [6] are 4 diagnostic modalities that have been used to the assessment of fetal wellbeing on admission. Of these 4 tests, the evaluation of the amniotic fluid is the most frequently used. Amniotic fluid volume is an important parameter in the assessment of fetal wellbeing. Oligohydramnios occurs in many high risk conditions and is associated with poor perinatal outcome [7].
Amniotic fluid index (AFI), a semiquantitative ultrasound measure used to denote the volume of amniotic fluid, was first described in 1987 by Phelan *et al* [8].

Many studies have shown an increased risk of intrapartal fetal distress in parturient women with oligohydramnios,as identified by ultrasound examination. The exact pathophysiologic mechanism of oligohydramnios has not been defined, but one likely explanation is an increased risk of umblical cord compression during uterine contractions. Links have been found between decreased amniotic fluid volume and stillbirths, fetal anomalies, abnormal FHR tracings in labor, increase in caesarean section for fetal distress, and possibly fetal acidosis [9, 10]. The purpose of the present study is to evaluate Amniotic fluid index as an admission test to the labour ward for predicting meconium staining, caesarean for fetal distress, low apgar scores and perinatal outcome in women with low risk pregnancy.

Aims & Objectives

1. To study the efficacy of Amniotic fluid index as a labor admission test and it's corelation to perinatal outcome

Materials and Methods

This prospective study was conducted at Obstetrics and Gynaecology department of Tertiary care hospital. The study participants included 500 booked antenatal women registered at Obstetrics and Gynaecology department with gestational age 37 to 42 weeks admitted in active labor from May 2012- Apr 2014. A total of 500 pregnant females fulfilling the eligibility criteria were included in the study after taking prior informed consent.

Inclusion Criteria

Non anomalous singleton gestation in active labour with vertex presentation and intact membranes between 37 to 42 weeks gestation.

Exclusion Criteria

a. Multiple pregnancies
b. Congenital anomalies
c. Premature rupture of membranes
d. Post-datism
e. Previous LSCS
f. High risk pregnancies – Hypertensive disorders, Diabetes mellitus, cardiac diseases

A detailed history was taken and a clinical examination was performed and gestational age was assessed from menstrual age or ultrasound in early pregnancy. Informed written consent was obtained from all women before they were included in the study.

The AFI was calculated for all patients who came in active labor as per four quadrant technique by Phelan *et al*. (1987) by US scanner Toshiba (Siemens) equipped with a 3.5 MHz linear transducer. By transabdominal ultrasonography AFI index was measured by four-quadrant technique by dividing the uterus into four quadrants, The transducer was placed on the maternal abdomen along the longitudinal axis. The vertical diameter of the largest amniotic fluid pocket in each quadrant was measured with the transducer head held perpendicular to the foot. These measurements were summed in centimetre and the result was recorded as the amniotic fluid index (AFI). On the basis of AFI, all women divided into 3 groups:

Group A: Oligohydramnios was defined as an amniotic fluid index ≤ 5 cm (n = 43).

Group B: Borderline Oligohydramnios as an amniotic fluid index 6 to 8 cm (n = 153)

Group C: Normal amniotic fluid volume as an amniotic fluid index ≥ 9 (n = 304)

Labour was monitored as per labour room protocol of continuous intrapartum surveilance with CTG monitor to detect foetal deceleration.

Fetal heart rate and tocodynamometer trace recorded by cardiotocographic machine, ASPEN FETAL MONITOR- F1 PLUS, was obtained for each women in labour after AFI asessment. Baseline FHR, beat to beat variability, acceleration and deceleration were observed. Variable deceleration or late deceleration or prolonged bradycardia were the indicators of foetal distress and these had influenced the pattern of management towards caesarean section. Following fetal heart rate traces were recorded with one hour intervals, until all findings remained normal.

After the confinement, details of the labor, delivery and neonatal outcome were recorded.

The outcome measures were CTG changes, presence of meconium, mode of delivery, apgar score at 1 and 5 mins, need for admission to neonatal unit and perinatal mortality.

Statistical Analysis

All the collected data was entered in Microsoft Excel sheet. It was then transferred to SPSS ver. 17 software for statistical analysis. All the Quantitative data was presented as mean and standard deviation and compared using student's t-test. Qualitative data was presented as frequency and percentage and analysed using chi-square test (Fisher's exact test was used in case of 2x2 contingency tables). P-value of < 0.05 was considered as significant. Sensitivity and Specificity of screening tests like AFI was also calculated.

Results

The present study was conducted in the Obstetrics and Gynaecology department at tertiary care hospital for the period of 2 years from May 2012 to Apr 2014, where patients at term pregnancy in labor were studied, following at which we arrived at these conclusions**.**

Out of 500 patients, maximum number of patients (279) belonged to 26-30 years constituting 55.8%.The Mean age of subjects was 26.71 ± 3.49 years. Most of the females were in 38-40 weeks of gestation (90.6%). Mean Gestational Age was 39.7 years.

Table 1: Distribution of Patients according to gravidity and AFI Class

AFI Class	Gravidity		Total
	Multi	Primi	
≤ 5	11	32	43
	25.6%	74.4%	100.0%
6-8	77	76	153
	50.3%	49.7%	100.0%
≥ 9	157	147	304
	51.6%	48.4%	100.0%
Total	245	255	500
	49.0%	51.0%	100.0%
p-value: < 0.05			

As per table 1,out of 500 patients, patients with AFI≤ 5 were 43. Among 43 patients, majority of them were primigravidas 32(74.4%) and rest is multigravidas 11(25.6%). There is statistical significance of low AFI with Gravidity p-value<0.05)

Table 2: Distribution of Patients according to NST results and AFI Class

AFI Class	NST		Total
	NR	R	
≤ 5	33	10	43
	76.7%	23.3%	100.0%
6-8	59	94	153
	38.6%	61.4%	100.0%
≥ 9	69	235	304
	22.7%	77.3%	100.0%
Total	171	329	500
	34.2%	65.8%	100.0%
p-value: < 0.001			

In table 2, among 500 cases, 43 women were with AFI ≤ 5. Among 43 women, 33 (76.7%)had non-reactive NST. 59(38.6%) out of 153 women with AFI 6-8 had non-reactive NST. There is statistical significance of low AFI with non-reactive NST (p-value: < 0.001)

Table 3: Distribution of Patients according to colour of liquor and AFI Class

AFI Class	Liquor		Total
	Clear	Meconium	
≤ 5	11	32	43
	25.6%	74.4%	100.0%
6-8	90	63	153
	58.8%	41.2%	100.0%
≥ 9	247	57	304
	81.3%	18.8%	100.0%
Total	341	159	500
	68.2%	31.8%	100.0%
p-value: < 0.01			

In Table 3, among 500, 43 women had AFI ≤5. Out of 43, 39(90.7%) of them had meconium stained liquor. Out of 153 women with AFI 6-8, 63(41.2%) women had meconium stained liquor. There is statistical significance of low AFI with meconium stained liquor (p< 0.01).

Table 4: Distribution of Patients according to Mode of delivery and AFI Class

AFI Class	Mode of Delivery			Total
	FTND	LSCS	Forceps/Vacuum	
≤ 5	5	34	4	43
	11.7%	79%	9.3%	100.0%
6-8	88	34	31	153
	57.5%	22.2%	20.3%	100.0%
≥ 9	234	33	37	304
	77.0%	10.9%	12.2%	100.0%
Total	322	109	69	500
	64.4%	21.8%	13.8%	100.0%
p-value: < 0.01				

As per Table 4, out of 43 women with AFI ≤ 5, 34(79%) had caesarean deliveries and 4(9.3%) had Instruemental delivery. 34(22.2%) women out of 153 with AFI 6-8 had caesarean deliveries. There is statistical significance of low AFI with LSCS due to fetal distress (p value < 0.01).

Table 5: Distribution of Neonates according to Birth Weight

AFI Class	Birth Weight (Gram)			Total
	1000-2000	2000-3000	>3000	
≤ 5	5	27	11	43
	11.6%	62.8%	25.6%	100%
6-8	10	76	67	153
	6.5%	49.7%	43.8%	100%
≥ 9	5	106	193	304
	1.6%	34.9%	63.5%	100%
Total	20	209	271	500
	4%	41.8%	54.2%	100%
p-value: < 0.01				

In Table 5, Out of 43 women with AFI ≤ 5, 5 (11.6%) Baby had Birth wt. between 1-2 Kg, 27 (62.8%) between 2-3 Kg and rest 11(25%) were >3Kg. In contrast 10(6.5%), 76(49.7%), 67(43.8%) in AFI 6-8 Group and 20(4%), 209(41.8%) and 271(54.2%) I AFI≥ 9 Group respectively.

Table 6: Distribution of Patients according to APGAR at 1 and 5 minute and AFI Class

	APGAR at 1			APGAR at 5	>7	Total
AFI Class	<7	≥7	Total	<7		
≤ 5	34	9	43	17	26	43
	79.1%	20.9%	100.0%	39.5%	60.5%	100.0%
6-8	35	118	153	1	152	153
	22.9%	77.1%	100.0%	0.7%	99.3%	100.0%
≥ 9	20	284	304	2	302	304
	6.6%	93.4%	100.0%	0.7%	99.3%	100.0%
Total	89	411	500	20	480	500
	17.8%	82.2%	100.0%	4.0%	96.0%	100.0%
p-value: < 0.01						

As per table 6, out of 43 babies born from mothers with AFI ≤ 5, 34(79.1%) had Apgar score <7. Among 153 babies born from mothers with AFI 6-8, 35(22.9%) babies had Apgar score <7. There is statistical significance of low AFI with Apgar score <7 at 1 Min (p value < 0.01).

Out of 43 babies, born from mothers with AFI ≤ 5, 17(39.5%) babies had Apgar score <7. Among 153 babies, born to mothers with AFI 6-8, only 1(0.7%) baby had Apgar score <7. There is also a statistical significance of AFI with APGAR at 5 Minute. (p value < 0.01).

Table 7: Distribution of Patients according to NICU admission/ Outcome and AFI Class

AFI Class	NICU Admission		Total	Outcome		Total
	No	Yes		Satisfactory	Unsatisfactory	
≤ 5	5	38	43	41	2	43
	11.6%	88.4%	100.0%	95.3%	4.7%	100.0%
6-8	73	80	153	152	1	153
	47.7%	52.3%	100.0%	99.3%	0.7%	100.0%
≥ 9	219	85	304	304	0	304
	72.0%	28.0%	100.0%	100.0%	0.0%	100.0%
Total	292	208	500	497	3	500
	58.4%	41.6%	100.0%	99.4%	0.6%	100.0%
p-value: < 0.01						

In Table 7, out of 43 babies, born to mothers with AFI ≤ 5, 38(88.4%) had NICU admissions. Among 153 babies, born to mothers with AFI 6-8, 80(52.3%) had NICU admissions. There is statistical significance in low AFI and NICU stay of the neonate (p value – <0.01).

A total of three neonatal deaths (due to sepsis, meconium aspiration syndrome and birth asphyxia) were observed in the study and 02 of them had AFI ≤ 5. The association was statistically significant. ($p < 0.05$)

Table 8: Efficacy of AFI for predicting Perinatal outcome

Parameter	Sensitivity	Specificity	PPV	NPV	p-value
Low AFI (<9)	59.1%	75.0%	62.8%	72.0%	< 0.001

Above table shows AFI <9 has 59.1% Senstivity, 75.0% Specificity, 62.8% Positive predictive value(PPV) and 72.0% Negative predictive value (NPV) which is statistically signinificant.

Discussion

The present study was conducted in the Department of Obstetrics and Gynecology in tertiary care centre for a period of 2 years. The objective of the study was to determine the efficacy of Amniotic fluid index (AFI) as a labor admission test and it's relation to perinatal outcome.

Oligohydramnios in the antepartum period has been associated with intrauterine growth restriction, post-dated pregnancy and abnormal antepartum foetal heart rate patterns. Amniotic fluid volume is known to reduce with advancing gestational age. Thus it seems logical to evaluate amniotic fluid volume in the early intrapartum period as a predictor of foetal morbidity.

Meconium stained amniotic fluid has been implicated as a factor influencing fetal well-being during the intrapartum and postpartum periods. Presence of meconium in amniotic fluid in cephalic presentation was of great concern even to the midwives and obstetricians of old age. Patients included in the present study were from low risk group admitted in labour.

Maximum number of patients (279) belonged to 26-30 years age group constituting 55.8%, while 33.4% and 10.8% were below 26 and above 30 years respectively. The Mean age of subjects was 26.71 ± 3.49 years

In the present study, 67.4% of mothers in study group fall in the gestational age between 39- 40 weeks. Mean Gestational Age was 39.7 years. Similar observation of Mean Gestational Age was recorded by Miller [11], 39.82, Rosario *et al.* [12] 39.62 and Krebs *et al.* [13] 40.04 weeks.

There is statistical significance of AFI with gravidity. In the present study, we observed 55.10% women, who had AFI less or equal to 5 were primigravidas. This is comparable with Manning FA, Hill LM, Platt LD, [14].

In the present study, the incidence of non reassuring heart rate among severe oligohydramnios (AFI≤ 5 cm) was 76.7%. This is relatively high in comparison with study conducted by Umber *et al.* [15] 52.7%, and Sriya R *et al.* [16] 41.55% but comparable with Chandra P *et al.* [17] 69.23%).

There is statistical significance of low AFI with meconium stained liquor. In the present study, the incidence of meconium stained liquor with AFI less or equal to 5 was 74.4%. This is high in comparison with Rutherford *et al.* study [18] 54%, Sriya R *et al* [16] 38.88%, Sarno *et al.* [9] 41.9%

There is statistical significance of low AFI with mode of delivery. With low AFI there is increasing chance of operative delivery (p value < 0.001). In the present study incidence of Caeserean delivery was 79% in severe oligohydramnios (AFI ≤ 5) group. This is high in comparison to study conducted by Sriya R *et al.* [16], (43.05%) and Guin *et al.* [19], (42.8%), Casey *et al.* [20] 51%, but comparable with study by Visvalingam G *et al.* [21] 75.6%. This high rate may be part of overall increase in operative Caeserean rate and clientele pressure.

In present study, incidence of Apgar score <7 at 1 and 5 mins was 79.1% and 39.5% respectively in AFI<5. This is high in comparison to other studies. Chandra P *et al.* [17], Sriya R *et al.* [16], Umber A *et al.* [15],

In the present study the incidence of NICU admissions among severe oligohydramnios (AFI ≤ 5) was 88.4%. with similar result by Sriya R *et al.* [16] 88.8% and 8.2% in the study by Baron C *et al.* [10].

In present study, incidence of perinatal deaths with severe oligohydramnios was 4.7%.whereas Casey *et al.* [20] studies recrded at 6.4%.

The Sensitivity and specificity of Oligohydramnios in predicting foetal outcome was 59.1% and 75%, while its PPV and NPV was 62.8% and 85%. It has a significant association with perinatal outcome. (P value - <0.001).Similar study by Yajisi A *et al.* [22], Morris *et al.* [23] reported Sensitivity and specificity 27.2%, 97.5% and 11.5% & 92% respectively.

Summary and Conclusion

In conclusion, AFI measurement is a valuable admission test for detecting fetal distress in labor requiring cesarean section. In presence of oligohydramnios, the occurrence of non-reactive NST, thick meconium stained liquor, development of fetal distress, the rate of LSCS, low 5 min Apgar score, perinatal morbidity and mortality are more. Determination of AFI can be used as an adjunct to other fetal surveillance methods. It helps to identify those infants at risk of poor perinatal outcome.

Statement on conflict of interest: Nil

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