ORIGINAL RESEARCH

Studying amniotic fluid index and labor admission test on term high-risk pregnancy and their association with perinatal and labor outcomes

Dr. Jyothi

Assistant Professor, Department of Obstetrics and Gynaecology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India

Corresponding Author
Dr. Jyothi
Assistant Professor, Department of Obstetrics and Gynaecology, Gadag Institute of Medical Sciences, Gadag, Karnataka, India
Email: drjyothipatil09@yahoo.in

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ABSTRACT
Background: There is substantial literature data concerning role of LAT and AFI in assessing fetal and perinatal outcomes. However, existing literature data is scarce for studies done with combination of both the parameters. **Aim:** The present study aimed to assess the association of amniotic fluid index and labor admission test on the prevention and prediction of perinatal and labor outcomes in term high-risk pregnancies. **Methods:** The present study assessed 200 high-risk pregnant females admitted to the labor room in a gestation period of ≥37 weeks in labor. On admission, history was taken for all the subjects followed by general physical examination, P/V and P/A examination to assess labor stage after which subjects were sent for ultrasonography to measure AFI and LAT. The study also assessed neonatal outcomes from the condition at discharge, if the neonate needed NICU admission and APGAR scores. Maternal parameters assessed were the color of the liquor, cesarean delivery indications, maternal complications, and mode of delivery. **Results:** The study results depicted a statistically significant significance for LAT and AFI with $p<0.001$. Decreased AFI has a higher association with equivocal and pathological and normal AFI had more of normal CTG with $p<0.001$. Reduced AFI has a significant association with meconium staining of the liquor, and increased chance of NICU admission of neonate with $p<0.001$. A similar association was seen in the mode of delivery, NICU admission, APGAR score, and LAT. **Conclusions:** The present study concludes that the amniotic fluid index and labor admission test are noninvasive and simple tests that can serve as a tool for screening high-risk obstetric females in labor with better-reported accuracy.
Keywords: amniotic fluid index, high-risk pregnancy, intrapartum fetal surveillance, Labour admission test, perinatal outcome

INTRODUCTION

Surveillance of the fetus during labor in a female falls under preventive care which is a vital aspect of public health care. The goal of intrapartum fetal surveillance is to identify potential decomposition in the fetus and to allow the effective and timely intervention for the prevention of perinatal mortality or morbidity including neonatal death, stillbirth, neonatal hypoxic ischemic encephalopathy, and/or perinatal asphyxia. Monitoring of the fetus during labor helps in the identification of a fetus at risk of damage from hypoxia that allows appropriate intervention which further helps in the optimization of perinatal outcomes.[1]

LAT (labor admission test) was introduced as a test for screening in early labor for detection of compromised fetuses on admission and for triage and selection of females that need continuous fetal electronic monitoring during labor. LAT is one of themost widely utilized primary tests to assess fetal well-being at term in labor at admission time as it is an easily done and interpreted, non-invasive, inexpensive, and simple test.[2]

A record of uterine activity and fetal heart rate is assessed using a cardiotocograph for nearly 20 minutes on admission to the labor ward and is considered a labor admission test. A normal LAT pattern includes baseline variability of 5-25 beats per

minute and a minimum of 2 accelerations in 20 minutes. The test results for LAT are divided into categories including pathological, equivocal, and normal following the RCOG guidelines.[3]

Amniotic fluid performs several vital functions in fetus and embryo development. At term, the normal amniotic fluid range is 600-800ml. Assessment of amniotic fluid on ultrasound has vital implications in obstetric care and is presently an integral part of assessing fetal well-being. AFI or amniotic fluid index is a sonographic and semi-quantitative assessment of amniotic fluid volume assessed as the sum of 4 quadrants of deepest vertical amniotic fluid pockets in the gravid uterus. It is a non-invasive assessment done by measuring pockets of amniotic fluid in a single largest vertical pocket or four quadrants. At term, AFI gradually decreases to a mean of 8.37cm. [4]

Excess amniotic fluid volume is correlated to aneuploidy and fetal anomalies and less volume results in IUGR (intrauterine growth restriction) and renal anomalies. In the later stages of pregnancy, it is a vital component for assessing fetal death, operative delivery, meconium passage, intrapartum fetal distress, and perinatal outcomes. Various literature studies were done on LAT and AFI in fetal and perinatal assessment as individual parameters, however, existing literature data is scarce on a combination of these two factors.[5] Hence, the present study aimed to assess the association of amniotic fluid index and labor admission test on prevention and prediction of perinatal and labor outcomes in term high-risk pregnancy.

MATERIALS AND METHODS

The present prospective observational study aimed to assess the association of amniotic fluid index and labor admission test on the prevention and prediction of perinatal and labor outcomes in term high-risk pregnancies. The study subjects were from the Department of Radiodiagnosis of the Institute. Verbal and written informed consent were taken from all the subjects before participation.

The study assessed 200 high-risk pregnant females admitted in the labor room or emergency room of the Gynecology Department of the Institute at ≥37 weeks of gestation within the defined study period in the outpatient or emergency department. Inclusion criteria for the study were subjects will all-term high-risk pregnancies including renal disease, hypertension, diabetes mellitus, Rh negative, hydramnios, oligohydramnios, bad obstetric history, gestational diabetes mellitus, IUGR, hypertensive, and postdated pregnancies. Exclusion criteria for the study were subjects undergoing elective LSCS, acute hypoxic state as placenta previa, cord prolapse, and abruptio placentae, congenital anomaly of the fetus, PROM, and multiple pregnancies.

After admission, a detailed history was recorded for each female including medical history, obstetric history, menstrual history, antenatal care, parity, and age of the subjects followed by general physical examination. Per vaginal and per abdominal assessment was also done to assess the labor stage after which subjects were sent for ultrasonography for assessing labor admission test and amniotic fluid index.

In LAT, for 20 minutes, tracing was taken with subjects in semi-lateral position in labor using a CTG (cardiotocography) machine. The activity of uterine muscle and fetal heart rate was assessed with CTG in continuous recording on thermal paper. The FHR traces assessed were categorized as pathological, equivocal, and normal based on RCOG guidelines. Categorization for CTG components following RCOG guidelines (Table 1).

Depending on the categorization of the individual features, fetal heart rate parameters by RCOG are divided as normal (reactive)- A CTG where all 4 features are in the reassuring category, equivocal- – A CTG where one feature is in the non-reassuring category, and pathological- A CTG where 2 or more features are in non-reassuring category or 1 or more feature is in the abnormal category. Following LAT, subjects with equivocal and reactive trace were intermittently monitored by auscultation for one minute every 30 minutes in the first labor stage and every 5 minutes in the second labor stage after contraction, or a repeat test was performed after 4 hours if delivery was not done. In subjects with ominous tracing, the appearance of significant variables, or prolonged decelerations and decelerations, delivery was delayed by instrumental or operative intervention based on the labor stage.

AFI assessment was done using ultrasound and measured by division of the uterus into four imaginary quadrants. The deepest, unobstructed, vertical pocket of fluid was measured in each quadrant in centimeters. Measurement of four pockets was added to measure AFI. Following AFI measurement, 3 groups were made as AFI<5, 5-8, and >8 cm. Subjects were assessed throughout the labor till delivery. The study also assessed neonatal outcomes from the condition at discharge, if the neonate needed NICU admission and APGAR scores. Maternal parameters assessed were the color of the liquor, cesarean delivery indications, maternal complications, and mode of delivery.

The data gathered were analyzedstatistically using SPSS (Statistical Package for the Social Sciences) software version 24.0 (IBM Corp., Armonk. NY, USA) for assessment of descriptive measures, Student t-test, ANOVA (analysis of variance), and Chi-square test. Pearson correlation coefficient was used to assess correlation in various parameters. The results were expressed as mean and standard deviation and frequency and percentages. The p-value of <0.05 was considered.

RESULTS

The present prospective observational study aimed to assess the association of amniotic fluid index and

labor admission test on the prevention and prediction of perinatal and labor outcomes in term high-risk pregnancies. The present study assessed 200 high-risk pregnant females admitted to the labor room in a gestation period of ≥37 weeks in labor. The majority of the study subjects were in the age range of 21-25 years with 50% subjects. The mean age of study subjects was 25.17±3.42 years. There were 38% and 62% females as multiparous and primigravida respectively. 61% and 39% of pregnancies were in 37-40 and >40 weeks POG (period of gestation). For risk factors in study subjects,most common risk factor was postdatism in 39% (n=78) subjects followed by PIH in 17% (n=34) subjects, Rh negative status in 10% (n=20), oligohydramnios in 7% (n=14), PIH, IUGR, and diabetes in 6% (n=12) subjects each, and BOH, postdated oligohydramnios, and PIH, oligohydramnios in 5% (n=10) subjects each (Table 2).

For LAT and AFI, Lat was pathological, equivocal, and normal in 7% (n=14), 19% (n=38), and 74% (n=148) study subjects respectively (Table 3). AFI of <5, 5-8, and >8 in 17% (n=34), 13% (n=26), and 70% (n=140) study subjects respectively (Table 4). For correlation of study parameters, normal was LAT significantly higher for AFI >8, equivocal for AFI <5 and >8, and pathological for >8 AFI with p<0.001.For meconium liquor, clear liquor was significantly higher in AFI >8 and meconium-stained in AFI <5 subjects with p<0.001. Normal delivery was higher for AFI >8, instrumental for AFI 5-8, and LSCS for AFI<5 subjects with p<0.001.Apgar score < 7 was significantly higher in AFI <5 subjects and >7 in AFI >8 subjects with a significant difference and p<0.001. NICU stay was significantly higher in subjects with AFI <5 with p<0.001 (Table 5).

The study results showed that for the correlation of LAT to APGAR score, delivery mode, and NICU admission in study subjects, higher subjects with LSCS delivery had normal and equivocal LAT, higher subjects with instrumental delivery had normal LAT, and the highest number of subjects with normal delivery had normal LAT which was statistically significant with p<0.001. Concerning NICU admission in study neonates, a significantly higher number of neonates admitted to NICU had equivocal LAT followed by normal LAT and pathological LAT with p<0.01. Concerning Apgar scores at 1 minute, Apgar scores>7 were significantly higher in subjects with normal LAT and <7 were significantly higher in subjects with equivocal LAT followed by pathological LAT showing a statistically significant difference with p<0.001 (Table 6).

Concerning the diagnostic assessment of AFI and admission test for prediction of perinatal outcomes, the pathological test had accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity of 92.4%, 98.4%, 28.4%, 93.4%, and 66.5% respectively showing significant results with p<0.001. Admission test suspicious has accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity of 79.4%, 98.4%, 5.24%, 80%, and 50% respectively which was non-significant with p=0.367. For AFI <5, accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity were 85%, 98.6%, 17.63%, 85.4%, and 75% respectively which was significant with p=0.01 (Table 7).

Table 1: Categories for CTG components following RCOG guidelines

Features	Reassuring	Non-reassuring	Abnormal
Baseline fetal heart rate	110-160	100-109 161-180	<100 >180
Variability bpm (beats per minute)	>5	<5 for >40 but <90 min	<5 for >90 min
Decelerations	None	Early deceleration Variable deceleration Single prolonged Deceleration <3 min	Persistent late decelerations Variable/single prolonged deceleration >3 min
Accelerations	Present >15 bpm	Absence in acceleration in normal CTG of uncertain significance	Absence of accelerations in otherwise normal CTG of uncertain significance

Table 2: Risk factors in study subjects

High-risk factors	Number (n)	Percentage (%)
PIH, oligohydramnios	10	5
Postdated Oligohydramnios	10	5
Diabetes	12	6
BOH	10	5
Rh-negative	20	10
PIH	34	17
PIH, IUGR	12	6

Oligohydramnios	14	7
Postdatism	78	39

Table 3: LAT (labor admission test) in study subjects

LAT	Number (n)	Percentage (%)
Pathological	14	7
Equivocal	38	19
Normal	148	74
Total	200	100

Table 4: AFI (Amniotic fluid index) in study subjects

AFI	Number (n)	Percentage (%)
<5	34	17
5-8	26	13
>8	140	70
Total	200	100

Table 5: Correlation of study parameters concerning LAT and AFI in study subjects

Variables	AFI						p-value
	<5		5-8		>8		
	(n=34)	%	n=26	%	n=140	%	
LAT							
Normal	8	23.5	18	69.2	122	87.1	**<0.001**
Equivocal	18	53	4	15.4	16	11.4	
pathological	8	23.5	4	15.4	2	1.4	
Meconium liquor							
Clear	8	23.5	18	69.2	122	87.1	**<0.001**
Meconium	26	76.5	8	30.8	18	12.9	
Delivery mode							
Normal	2	5.9	10	38.5	116	82.9	**<0.001**
Instrumental	6	17.6	2	77	8	5.7	
LSCS	26	76.5	14	53.8	16	11.4	
Apgar score							
<7 (n=36)	20	55.6	12	33.3	4	11.11	**<0.01**
>7 (n=164)	14	8.5	14	8.5	136	82.2	
NICU stay							
No	6	17.6	16	61.5	132	94.3	**<0.001**
Yes	28	82.4	10	38.5	8	5.7	

Table 6: Correlation of LAT to APGAR score, delivery mode, and NICU admission in study subjects

LAT	Normal n (%)	Equivocal n (%)	Pathological n (%)	Total	p-value
Delivery mode					
LSCS	22 (39.3)	22 (39.3)	12 (21.4)	56	**<0.001**
Instrumental	10 (62.5)	4 (25)	2 (12.5)	16	
Normal	116 (90.6)	12 (9.4)	0	128	
NICU admission					
Yes	14 (30.4)	22 (47.8)	10 (21.8)	46	**<0.001**
No	134 987)	16 (10.4)	4 (2.6)	154	
APGAR score at 1 min					
>7	148 (9.24)	12 (7.31)	4 (2.43)	164	**<0.001**
<7	8 (22.2)	18 (50)	10 (27.8)	36	

Table 7: Diagnostic assessment of AFI and admission test for prediction of perinatal outcomes

Parameters	Accuracy	NPV	PPV	Specificity	Sensitivity	p-value
Pathological	92.4	98.4	28.4	93.4	66.5	**<0.001**
Admission test suspicious	79.4	98.4	5.24	80	50	0.367
AFI <5	85	98.6	17.63	85.4	75	**0.01**

DISCUSSION

The present study assessed 200 high-risk pregnant females admitted to the labor room in a gestation period of ≥37 weeks in labor. The majority of the study subjects were in the age range of 21-25 years with 50% subjects. The mean age of study subjects was 25.17±3.42 years. There were 38% and 62% females as multiparous and primigravida respectively. 61% and 39% of pregnancies were in 37-40 and >40 weeks POG (period of gestation). For risk factors in study subjects, most common risk factor was postdatism in 39% (n=78) subjects followed by PIH in 17% (n=34) subjects, Rh negative status in 10% (n=20), oligohydramnios in 7% (n=14), PIH, IUGR, and diabetes in 6% (n=12) subjects each, and BOH, postdated oligohydramnios, and PIH, oligohydramnios in 5% (n=10) subjects each. These data and findings were comparable to the previous studies of Rahman H et al[6] in 2012 and Khandelwal S et al[7] in 2010 where authors assessed high-risk pregnant females with data and risk factors comparable to the present study in their respective studies.

It was seen that for LAT and AFI, Lat was pathological, equivocal, and normal in 7% (n=14), 19% (n=38), and 74% (n=148) study subjects respectively. AFI of <5, 5-8, and >8 in 17% (n=34), 13% (n=26), and 70% (n=140) study subjects respectively. For correlation of study parameters, normal was LAT significantly higher for AFI >8, equivocal for AFI <5 and >8, and pathological for >8 AFI with p<0.001. For meconium liquor, clear liquor was significantly higher in AFI >8 and meconium-stained in AFI <5 subjects with p<0.001. Normal delivery was higher for AFI >8, instrumental for AFI 5-8, and LSCS for AFI<5 subjects with p<0.001. Apgar score < 7 was significantly higher in AFI <5 subjects and >7 in AFI >8 subjects with a significant difference and p<0.001. NICU stay was significantly higher in subjects with AFI <5 with p<0.001. These results were consistent with the findings ofKhandelwal S et al[8] in 2010 and Bhagat M et al[9] in 2014 where AFI and LAT reported by the authors in their studies were comparable to the results of the present study.

The study results showed that for the correlation of LAT to APGAR score, delivery mode, and NICU admission in study subjects, higher subjects with LSCS delivery had normal and equivocal LAT, higher subjects with instrumental delivery had normal LAT, and the highest number of subjects with normal delivery had normal LAT which was statistically significant with p<0.001. Concerning NICU admission in study neonates, a significantly higher number of neonates admitted to NICU had equivocal LAT followed by normal LAT and pathological LAT with p<0.01. Concerning Apgar scores at 1 minute, Apgar scores>7 were significantly higher in subjects with normal LAT and <7 were significantly higher in subjects with equivocal LAT followed by pathological LAT showing a statistically significant difference with p<0.001. These findings were in agreement with the results of Umber A[10] in 2209 and Magann EF et al[11] in 2007 where the correlation of LAT to APGAR score, delivery mode, and NICU admission similar to the present study was also reported by the authors in their respective studies.

For the diagnostic assessment of AFI and admission test for prediction of perinatal outcomes, the pathological test had accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity of 92.4%, 98.4%, 28.4%, 93.4%, and 66.5% respectively showing significant results with p<0.001. Admission test suspicious has accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity of 79.4%, 98.4%, 5.24%, 80%, and 50% respectively which was non-significant with p=0.367. For AFI <5, accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity were 85%, 98.6%, 17.63%, 85.4%, and 75% respectively which was significant with p=0.01. These results correlated with the findings of Maiti JD[12] in 2013 and Morris JM et al[13] in 2003 where agnostic assessment of AFI and admission test for prediction of perinatal outcomes reported comparable accuracy, NPV (negative predictive value), PPV (positive predictive value), specificity, and sensitivity in their study subjects as in the results of the present study.

CONCLUSIONS

Within its limitations, the present study concludes that the amniotic fluid index and labor admission test can be used as a non-invasive and simple test that can serve as a tool for screening high-risk obstetric females in labor with better-reported accuracy. Future longitudinal studies with larger sample sizes and longer monitoring are needed to reach a definitive conclusion.

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