Research article

Borderline amniotic fluid index as a predictor of adverse perinatal outcomes

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Abstract

Objectives: To determine whether the borderline amniotic fluid index (bAFI) at term in low risk pregnancies is associated with adverse perinatal outcome

Method: A retrospective cohort study carried out over a period of 3 months. 303 uncomplicated pregnant women who delivered at term and who had amniotic fluid assessment in 4 days of delivery were recruited. An AFI of 5-10 cm was defined as borderline and an AFI of 10 cm-24 cm normal.

Intrapartum pathological cardiotocograph (CTG), meconium stained amniotic fluid (MSAF) at amniotomy or spontaneous rupture of membranes (SROM), instrumental vaginal delivery (IVD) or emergency caesarean delivery (CD) due to fetal distress, 5 min APGAR less than 7 and admission to the neonatal unit (NNU) were considered as the measures of adverse perinatal outcomes.

Results: Eighty three (27.0%) of the 303 subjects had borderline AFI. Statistically significant differences were observed between the proportions of patients in the two groups with regard to MSAF at amniotomy, (18.1% vs. 17.7%, RR 1.02, 95% CI 1.23 to 1.76, p= 0.01) or SROM (48.2% Vs 60%, RR 0.80, 95% CI 1.2 to 2.1), AVD or emergency LSCS due to fetal distress (P=<0.001 and P=0.01 respectively). Intra partum pathological CTG (4.8% vs. 1.4%RR 3.42, 95% CI 0.56 to 2.67, P= 0.10), and less than 7 APGAR at 5 minute after delivery (2.4% vs. 0.5%, RR 4.8, 95% CI 0.67to 2.83, p= 0.05),) were not statistically significant. Proportion of babies admitted to NNU were significantly higher with borderline AFI compared to normal AFI (15.7% vs. 5.5%, RR 2.85, 95% CI 1.06 to 2.32, p= 0.01)

Conclusions: Women with borderline AFV have a higher chance of their babies getting admission to the NNU immediately after delivery. Meconium stained amniotic fluid, non-reassuring CTG changes and interventions due to fetal distress, which were statistically significant, may contribute to above observation.

Key words: Borderline Amniotic Fluid Index, Adverse perinatal outcome, Low risk pregnancy Pathological CTG, Meconium stained Amniotic fluid, Fetal distress

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Introduction

Antenatal and intrapartum fetal surveillance is a fast evolving field aiming to reduce the adverse perinatal outcomes (APO)[1]. As the intra partum fetal monitoring and timely intervention reduces the incidence of neonatal morbidity and mortality abundant techniques for assessing fetal wellbeing have evolved significantly over the last few decades[1]. Widely accepted interventions compose are fetal heart rate monitoring (Auscultation and Cardiotocography), real time ultrasound guided fetal biometry, amniotic fluid volume, and Doppler blood floor assessment, biophysical profile and evaluation of fetal ECG with ST analysis and fetal scalp blood sampling[1,2].

Out of the above parameters real time clinical sonography plays a major role in assessing fetal wellbeing, to estimate fetal weight, Biophysical profile, and Amniotic fluid volume and Doppler studies[1,3]. Amniotic fluid volume is considered as an indirect, yet a dynamic parameter of feto-placental function mainly in the latter part of pregnancy[4]. The balance, between the passage of fetal urine, lung secretions and the volume swallowed by the fetus forms the amniotic fluid[1]. Even, the Dye-Dilution technique accurately measures the AFV, it is time consuming, invasive and depend on skilled personnel and laboratory facilities which persuade obstetrician to welcome indirect measures, generally clinical sonography[1,5].

A subjective assessment of AFV was introduced using the terms normal, reduced, absent or high in 1980. Since then variety of approaches to estimate AFV have been proposed and shown moderately effective which encompass amniotic fluid index (AFI), largest vertical pool (LVP), two diameter pocket measurements, largest transverse pocket (LTP)[1,6-8].

The AFI is a semi quantitative analysis of AFV introduced in1987, is the sum of the maximum pool depths in all four quadrants in the maternal abdomen[8]. This is a simple, acceptable, reproducible variable which is readily measurable with limited expertise[7].

The controversy regarding the best predictor of the APO between the LVP and the AFI, was over counted by the recent evidence that hardly prove any statistically significant difference among two variables[9].

Moreover, researches pointed out the superiority of the four quadrant sum (AFI) over the single deepest pocket technique in ultrasonographic identification of abnormal AFV which directed me to use AFI as main determinant of the AFV[10].

AFI is commonly used to define oligohydramnios, as the value of less than 5 cm (standard definition) or less than 8 cm (alternate definition)[11,12] and polyhydramnios which is greater than 25 cm (standard definition) or greater than 18 cm (alternate definition)[2,13].

Even the poor perinatal outcome with oligohydramnios is broadly discussed, less facts are available regarding the clinical significance of low borderline amniotic fluid volume with regard to adverse perinatal outcomes[11].

There were two recent evidences to define borderline amniotic fluid index (bAFI). A study conducted in Lahore by Shahida defined borderline values as AFI of 5-10 cm by using the five (5) cm value as lower limit by standard definition of oligohydroamnios[14]. In contrast, a research in Japan by Hashimoto used AFI of 8-12 cm as borderline using the alternate definition for oligohydroamnios[15]. AFI range of 5-10 cm was used as borderline value for the interventions used in Lahore study as it is widely accepted[14].

Recent evidence that suggests 16% of patients with low borderline AFI 5-8 cm will ultimately develop oligohydramnios within the next 4 days which insecure to consider the perinatal outcomes of borderline AFI and AFI of 10-25 cm are indistinguishable, if both conditions follow the identical management protocol in poor resource setting or is it necessary to offer an extra cover to the borderline AFI group[16-18].

Observation of meconium stained amniotic fluid (MSAF), which can be categorized into early light, early heavy and late passage. Out of which early heavy meconium stained amniotic fluid is proven to be associated with increase fetal and neonatal morbidity and death[19].

Then in the low resource setting, the borderline AFI group can be reclassified as intermediate risk group during intra partum period to increase vigilance to prevent APO.

Accordingly, the focus of the current study was to compare the APO in low risk term pregnancies with borderline amniotic fluid index (AFI 5-10 cm) and pregnancy with normal amniotic fluid index. (AFI 10-25 cm) and to determine a threshold level for amniotic fluid volume in low risk term pregnancies, predictive of adverse perinatal outcomes.

Method

A retrospective cohort study was carried out in University Obstetrics Unit Colombo South Teaching Hospital, Kalubowila, for duration of 3 months from June 2011. Ethical approval for the study was obtained from the Ethical Review Committee, Faculty of Medicine, University of Sri Jayewardenepura, Sri Lanka. All term pregnant patients admitted to antenatal ward (Ward 21) for confinement with the inclusion criteria were recruited into the study.

The Inclusion criteria were singleton pregnancy with a cephalic presentation, period of gestation of 37 weeks' completion and up to 41 weeks' completion, planned vaginal deliveries, spontaneous onset labour or planned induction of labour and the patients' whose AFI was assessed within 4 days of delivery. Patients with prelabour rupture of membranes, having any medical or obstetrics complications, suspected SGA and who are planned for elective caesarean section were excluded from the study.

Considering the prevalence of bAFI as 40%[14] and monthly admissions to the unit considered as 200 patients per month and to achieve 5% precision sample size calculated. Using consecutive continuous sampling method, 300 mothers were recruited to the study.

All subjects had to undergo trans abdominal ultra sound scans with real time equipment and a 3.5 MHz linear array transducer in order to assess the AFI (Toshiba® 2010) every 4th day until they go to labor according to the unit protocol.

Measurable adverse perinatal outcomes were,

1. Intrapartum fetal distress assessed by having a pathological CTG,
2. Observation of meconium stained amniotic fluid (MSAF).
3. Mode of delivery (Normal vaginal delivery, assisted vaginal delivery and EM/LSCS due to fetal distress),
4. APGAR score at 5 minutes,
5. Neonatal Unit admission within 24 hours of delivery.

The data collection was done during the postpartum stay within 24 hours of delivery. Pre tested data collection form was used and collected data was saved on to an electronic database. Statistical analysis was carried out using the statistical package for social sciences (SSPS) version 21. As the data were normally distributed the students t- test and chi square test were used to compare means and proportions respectively. P value 0.05 was considered to be statistically significant.

Results

303 patients were recruited into the study. Based on the AFI value subjects were categorized in to 2 groups. Patients with borderline AFI (5-10cm) were 83 and rest of the 220 was in the control group.

The distribution of the age of the study population ranged from 18 years to 41years. Out of the two groups the mean age of the group A was 28.3 years (SD ± 1.2Y) while the control group' was 27.6 years (SD ± 0.7Y).

The period of gestation was 274.7 days and 274.07 days for the group A and group B respectively. Further there were 45 primigravida in the concerned group and 124 in control group (Table 1).

Interventions carried out are shown below. (Table 2) 40 patients (48.2%) in group A had spontaneous onset of labour. In control group, there were 132 patients (60.0%) who were spontaneously laboured. In comparison, there was a statistically significant difference between two groups. (p=<0.001)

Total IOL rate was 43.2% during the period of study, in the low risk population in our unit. No significant difference observed in induction rates (p=0.40). Regarding the mode of onset of labour, there was a statistically significant difference on spontaneous onset of labour (p <0.001) between the two groups. Further number of deliveries, which did not need oxytocin, was statistically significant (p=0.0478).

Outcome measures during labour are shown in the Table 3. Majority had clear amniotic fluid at ARM in both groups (81.9% vs. 82.3%). Prevalence of meconium at ARM in low risk population was 17.7%.

There was a statistically significant difference in MSAF (p=0.01) between two groups but no significant difference in the pathological CTGs (p=0.10).

MOD is detailed in the table below. (Table 4) EM/LSCS and instrumental delivery rates, of this whole low risk population were 13.86% and 9.5% respectively. A total intervention for delivery due to fetal distress (AVD + EM/LSCS) was 11(13.2%) in group A and 18(8.2%) in group B and this observation was statistically significant. (EM/LSCS p = 0.016 and IVD p=< 0.001).

Table 1. Basic characteristics of the subjects

Variable	Group - A (N = 83)	Group - B (Control Group) (N = 220)
Mean age (95% CI) Years	28.3 (27.1 - 29.5)	27.6 (26.9 - 28.3)
Period of gestation (95% CI) Days	274.7 (273.4 - 276)	274.07 (273.2 - 275)
Prime Gravida (%)	45 (54.2)	124 (56.4)

Table 2. The interventions carried out

Variable	Group - A (N = 83)	Group - B (N = 220)	p value
Mode of onset of labour			
Spontaneous onset (%)	40 (48.2)	132 (60)	<0.001
Induction (%)	43 (51.8)	88 (40)	0.4015
Status of augmentation			
Oxytocin given (%)	75 (90.4)	193 (87.7)	0.2611
Oxytocin not given (%)	8 (9.6)	27 (12.3)	0.0478

Table 3. Outcomes during interventions

Outcome variable	Group - A (N = 83)	Group - B (N = 220)	p value
Amniotic fluid			
Clear (%)	68 (81.9)	181(82.3)	0.0557
Meconium (%)	15 (18.1)	39 (17.7)	0.0120
CTG			
Normal (%)	71 (85.5)	198 (90)	0.3513
Suspicious (%)	8 (9.6)	19 (8.6)	0.0319
Pathological (%)	4 (4.8)	3 (1.4)	0.1026

Table 4. Mode of delivery of the subjects (n = 303)

Mode of delivery and indications for interventions	Group - A (N = 83)	Group - B (N = 220)	p value
NVD (%)	65 (78.3)	167 (75.9)	0.1215
Interventions due to fetal distress			
Assisted vaginal delivery (%)	6 (7.2)	6 (2.7)	<0.001
EM/LSCS (%)	5 (6)	12 (5.5)	0.0160
Interventions done due to other reasons			
Assisted vaginal delivery (%)	5 (6)	12 (5.5)	0.0160
EM/LSCS (%)	2 (2.4)	23 (10.5)	0.2386

Neonatal outcome measures are demonstrated below. (Table 5) APGAR score at 5 minutes was less than 7 in 2.4% of babies in group A while it was 0.5% in group B and it is statistically insignificant. (p=0.05).

Table 5. Neonatal outcomes

Variable	Group - A (N = 83)	Group - B (N = 220)	p value
APGAR at 5 minutes			
≤ 7 (%)	2 (2.4)	1 (0.5)	0.0557
7 (%)	81 (97.6)	219 (99.5)	0.2224
NNU admission			
Admitted (%)	13 (15.7)	12 (5.5)	0.0120
Not Admitted (%)	70 (84.3)	208 (94.5)	0.4834
Mean Birth weight (kg)	2.8706	3.0928	0.04

Significant difference was observed with regard to NNU admission between two groups (p = 0.01). Mean birth weight of the newborn was 3.09 kg in group B while group A, newborn had mean birth weight of 2.8 kg. Difference observed was statistically significant (p=0.04).

A total of 26 (31.3%) in group A and 31 (14.1%) in group B had at least one of the main adverse perinatal outcomes considered in the study. (Ex; Interventions at delivery due to fetal distress, APGAR less than7 at 5 minute or NNU admission.)

Discussion

Estimation of amniotic fluid volume is an integral part of antenatal fetal surveillance, and in some centers it is a heavily weighted parameter[14]. The AFI has been validated as an accurate and reproducible technique for ultrasonography assessment of amniotic fluid volume. The purpose of this study was to evaluate the association of borderline AFV with APO. The prevalence of borderline AFI in this study population was 27.4% (83 out of 303) which is comparable with the other studies (Varies from 3-40%)[14].

The basic characteristics and interventions carried out were similar between borderline AFI and normal AFI group that eliminate probable compounding factors. The average period of gestation at delivery was 39 weeks (274 days) in this low risk cohort of patients. The overall induction rate was 43.2%. Though there was not a statistically significant difference between two groups (group A 51.8% and group B 40%, p=0.40) overall IOL rates were higher in borderline group. Comparing with the overall IOL rates in UK, which is 15-20% and Sri Lankan figures (35.5%), the IOL rate in this cohort is high. The causative factors for this high IOL rates can be attributed to the unit protocols, lack of patient's compliance and social factors etc.

The presence of meconium stained amniotic fluid is significantly associated with borderline AFI group. A previous study carried out on this topic in a Asian country had evaluated 70 patients with borderline AFI of 5-10cm in which, that could not elicit any statistically significant difference in MSAF between borderline and normal AFI groups although it was associated with oligohydroamnios[14].

The presence of, and the grading of meconium was a subjective assessment which is a controversial issue need to be discussed and beyond the scope of current study. Similar study confirmed that there was no statistical significant difference in intra partum fetal distress which is defined using pathological CTG between the two groups. According to the current study the prevalence of MSAF was 17.8% and intra partum severe fetal distress which is categorized in the presence of pathological CTG was only 2%. The presence of meconium even not associated with the pathological CTG, more subjects showed non reassuring CTG.

Assisted vaginal deliveries and emergency lower segment caesarian sections due to fetal distress showed a statistically significant association with borderline AFI. It is also proved by three previous studies even though one study compared low AFV with normal AFV[14,15]. Out of 83 borderline pregnant patients only 2 babies had an APGAR of ≤ 7 in 5 minutes. Similar finding was observed in other studies which were not statistically significant[14,15].

We observed statistically significant difference regarding the babies admitted to NNU between two groups (p=0.01). Main reasons for admissions were neonatal tachypnoea, pyrexia, jaundice and poor sucking. NNU entry due to maternal reasons and fetal anomalies were excluded from the study. Admissions for observations also considered in this study. On retrospective analysis of the babies the diagnoses were neonatal sepsis and meconium aspiration syndrome. But sub group analysis is needed in this group with regards to the diagnosis of these babies. Same observation was highlighted in other Asian studies[14,15].

Though it was not an objective in this study, it was noticed that the mean birth weight of the babies in two groups were significantly differed in which less birth weight was observed in borderline amniotic fluid index group even though this finding was not clinically significant. Mild late onset feto-placental dysfunction could be a probable causative factor for the birth weight difference that needs further evaluation.

Lower limit of normal value of AFI which is considered for interventions in our clinical setting is 5 cm. It is considered as a low cut-off point as it is the 2.5th percentile and less than 2 SD below the mean for all gestations[1,4]. Conversely a borderline AFI defined as 5 to 10 cm may represent up to the 25^{th}-30^{th} percentile at term.

In conclusion, there were statistically significant differences regarding MSAF, intra partum CTG changers (non reassuring) and interventions due to fetal distress in borderline AFV group than normal AFV group at term. Admission to NNU and low birth weight were also statistically significant in borderline amniotic fluid index group compared to normal group. Meconium aspiration and early neonatal interventions may be the possible reasons for significant NNU admissions which highlight us to be caution when managing the patients with borderline AFI.

A well-planned randomized control trial with significant power is needed to determine the lower threshold value

for borderline AFI to consider as a separate entity (AFI 5 to 10 cm) to do interventions with regards to adverse neonatal outcomes in poor resource setting.

Authors' contributions

JAJNJ was the principal author and conceived the topic for this manuscript and both GW and FRC have done the review. All authors have critically revised and approved the final version of the manuscript.

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Abbreviations

bAFI	-	Borderline amniotic fluid index
AFI	-	Amniotic fluid index
CTG	-	Cardiotocography
MSAF	-	Meconium stained amniotic fluid
SROM	-	Spontaneous rupture of membranes
IVD	-	Instrumental vaginal deliveries
LSCS	-	Lower segment caesarean section
CD	-	Caesarean section
NNU	-	Neonatal unit
APO	-	Adverse perinatal outcome
AFV	-	Amniotic fluid volume
LVP	-	Largest vertical pool
LTP	-	Largest transverse pool
MOD	-	Mode of delivery