Association of Amniotic Fluid Index (AFI) with Maternal and Perinatal Complications in Premature Rupture of Membranes

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Abstract

Background:
Premature rupture of membranes (PROM) at term complicates 8–10% of pregnancies and increases the risk of maternal and perinatal complications. Amniotic fluid index (AFI), a key indicator of fetal well-being, may influence delivery outcomes in PROM cases.

Objective:
The study evaluated the association between AFI levels and maternal-neonatal complications in term PROM patients.

Methods:
The prospective observational study included 126 pregnant women with the term PROM, grouped into two categories based on AFI values: Group A (AFI >5cm, n=76) and Group B (AFI <5cm, n=50). Latency period, mode of onset of labour, type of delivery, and maternal and neonatal complications were followed up in the participants.

Results:
Both groups had comparable demographic characteristics and latency duration. Group B (AFI <5cm) exhibited a significantly greater rate of labour induction (80% vs 52.6%, p=0.001) and caesarian section (86% vs 50%, p=0.002). Maternal and neonatal complications occurred significantly more often in Group B (62% vs 7.9%, p<0.001) and (62% vs 0.03%, p<0.001) respectively.

Conclusion:
In PROM patients, oligohydramnios (AFI <5cm) is significantly associated with augmented labour induction, caesarian delivery, and maternal and neonatal complications.

Keywords: PROM, AFI, Oligohydramnios, Caesarean delivery

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Introduction:

The term "premature rupture of membranes (PROM)", that is, spontaneous rupture of membranes before labor onset at or beyond 37 weeks of gestation, complicates approximately 8-10% of all pregnancies.[1] This common obstetric complication has significant clinical relevance due to its associated enhanced maternal and fetal morbidity in terms of infectious complications and umbilical cord compression episodes.[2] Amniotic fluid, the protective fluid surrounding the developing fetus, serves many critical functions like cushioning against external trauma, allowing fetal movement for the development of the musculoskeletal system, preventing compression of the umbilical cord, and antimicrobial protection.[3] The Amniotic Fluid Index (AFI), first described by Phelan et al in 1987, has become a standard ultrasonographic method for quantitative assessment of amniotic fluid volume.[4] An AFI of <5 cm is widely considered to be indicative of oligohydramnios, which is associated with poor

perinatal outcomes.[5] In PROM, residual amniotic fluid volume measurement is of particular clinical relevance. Following membrane rupture, the equilibrium between ongoing amniotic fluid production and leaking determines the residual volume, which may influence both management and pregnancy outcome.[6] While international recommendations propose delivery within 24 hours of PROM term to minimize infectious complications, the precise contribution of amniotic fluid volume on optimal management is not well defined.[7] Several surveys have analyzed the association of oligohydramnios with adverse outcomes in various stages of pregnancy.[8,9] Zhang et al demonstrated that isolated oligohydramnios is associated with a 3.2-fold increased risk for caesarean section because of fetal distress.[10] Similarly, Melamed et al indicated that low amniotic fluid in preterm PROM-complicated pregnancies was an excellent risk indicator for chorioamnionitis and early-onset neonatal sepsis.[11] However, studies that specifically address the influence of AFI values on the delivery outcome in terms of PROM are limited and have yielded conflicting results. Chamberlain et al reported that AFI <5 cm following PROM was associated with shorter latency periods and higher caesarean sections for fetal distress.[12] However, Mercer et al found no correlation between AFI and delivery outcomes in their investigation of the term PROM.[13] These conflicting findings highlight the need for more study on this clinically relevant question. The study aimed to explore maternal and perinatal complications in relation to AFI.

Method:

This prospective observational study was conducted over six months (26 August 2019 to 25 February 2020) at the Department of Obstetrics & Gynaecology, Dhaka Medical College, Dhaka. The study population comprised pregnant women at term (37 to 40 weeks of gestation) presenting with premature rupture of membranes (PROM) who met predefined inclusion and exclusion criteria. A total of 126 patients were enrolled using purposive sampling. Inclusion criteria included singleton pregnancy, cephalic presentation, adequate pelvis, and informed consent. Exclusion criteria included preterm PROM, clinical signs of chorioamnionitis on admission, previous caesarian or uterine surgery, malpresentation, intrauterine growth retardation, and maternal comorbidities such as preeclampsia, hypertension, or diabetes. Participants were then classified into two groups: Group A with normal AFI (>5 cm) and Group B with oligohydramnios (AFI <5 cm).Maternal and neonatal outcomes were recorded by using a structured questionnaire, including mode of delivery, latency period, infections, fetal distress, neonatal intensive care admission, and Apgar scores. Data analysis and entry were achieved by using SPSS version 26, with a significant value at $p<0.05$.

Results:

Table-I represented the demographic and baseline parameters of 126 study participants divided into two groups based on AFI values. Group A (n=76, 60.3%) included patients with AFI >5 cm, and Group B (n=50, 39.7%) included patients with AFI <5 cm. Both groups had comparable age distributions with the majority of the participants (60.5% in Group A and 60% in Group B) falling in the 20-30 years age group. The mean age was effectively the same between groups (29.1±5.2 vs 29.2±5.2 years). On a residence basis, 68.3% of all participants were urban and 31.7% were rural.

Table-I: Demographic and baseline characteristics of the study participants (N=126)

Demographics	Group-A (AFI >5 cm) (n=76)	Group-B (AFI <5 cm) (n=50)
Age (Years) no. (%)		
20–30	46(60.5)	30(60)
31–40	30(39.5)	20(40)
Mean Age	29.1±5.2	29.2±5.2

The distribution of the latency periods (intervals between rupture of membranes and delivery) was similar for both groups (p=0.204), and most patients delivered between 8-12 hours (63.2% in Group A vs 60% in Group B). However, there was a significant difference in the initiation of labor (p=0.001), in that Group B (AFI <5 cm) also had a significantly higher rate of induced labor (80%) compared to Group A (52.6%) (Table-II).

Table-II: Distribution and clinical management regarding AFI (N=126)

Variable	Group-A (AFI >5 cm) (n=76)	Group-B (AFI <5 cm) (n=50)
Latency period no. (%)		
6–8 h	20(26.3)	15(30)
8–12 h	48(63.2)	30(60)
>12 h	8(10.5)	5(10)
Total Cases	76(60.3)	50(39.7)
Onset of labour		
Spontaneous	36(47.4)	10(20)
Induced labour	40(52.6)	40(80)

Table-III indicated the mode of delivery and indications for caesarian section in both groups. The contrast is striking in delivery modes, with only 14% of patients in Group B delivered vaginally versus 50% in Group A. Caesarian section rates were radically higher in Group B (86%) compared to Group A (50%). The most frequent reason for caesarian delivery for both groups was fetal distress (57.8% in Group A and 65.1% in Group B).

Table-III: Mode of delivery and indications for caesarian section (N=126)

Mode of delivery	Group-A (n=76) no. (%)	Group-B (n=50) no. (%)
Vaginal	38(50)	7(14)
Caesarian section	38(50)	43(86)
Failure of induction / NPOL	9(23.7)	7(16.3)
Fetal distress	22(57.8)	28(65.1)
Chorioamnionitis	7(18.4)	8(18.6)

The data showed a startling disparity in maternal and neonatal complication rates. Maternal complications reported in 7.9% of Group A patients and 62% of Group B patients reporting difficulties. Wound infection was also highly prevalent within Group B (38%), with no single occurrence of this condition in Group A. Chorioamnionitis (16% compared to 6.57%), puerperal sepsis (6% compared to 1.31%), and postpartum haemorrhage (2% compared to 0%) were all more prevalent in Group B. And 62% of neonates in Group B presented with complications versus only 0.03% in Group A. Pneumonia (22%) and respiratory distress syndrome (20%) were the most common complications in Group B, followed by neonatal sepsis (8%) and hypoglycemia (8%). Group A, however, presented with few neonatal complications. This dramatic difference highlights the profound impact of amniotic fluid reduction on neonatal outcomes (Table-IV).

Table-IV: Maternal complications associated with AFI (N=126)

Complication	Group-A (n=76) no. (%)	Group-B (n=50) no. (%)
Maternal complications		
Chorioamnionitis	5(6.57)	8(16)
Wound infection	0(0)	19(38)
Puerperal sepsis	1(1.31)	3(6)
PPH	0(0)	1(2)
Total complications	6(7.9)	31(62)
Neonatal complications		
Pneumonia	1(0.01)	11(22)
RDS	1(0.0%)	10(20)
Neonatal sepsis	0(0)	4(8)
Hypoglycemia	1(0.01)	4(8)
Others	0(0)	2(4)
Total complications	3(0.03)	31(62)

Table-V specified significant differences in principal outcomes between groups, all of which are statistically significant ($p<0.001$-0.002). Maternal and neonatal complications were significantly higher in Group B (62% compared with 7.9% and 62% compared with 0.03%, respectively). Group B also had reduced vaginal delivery rates (14% compared with 50%) and induced labour rates (80% compared with 52.6%).

Table-V: Overview of key outcomes regarding AFI

Outcome category	Group-A	Group-B	p-value
Maternal complications	7.9%	62%	<0.001
Neonatal complications	0.03%	62%	<0.001
Vaginal delivery	50%	14%	0.002
Induced labour	52.6%	80%	0.001

Discussion:

In patients with premature rupture of membranes (PROM) at term, the current study showed a strong correlation between maternal-fetal outcomes and amniotic fluid index (AFI) values. According to our study, patients with oligohydramnios (AFI <5 cm) had a markedly higher risk of difficulties for both the mother and the newborn, as well as a higher number of caesarian deliveries, which is consistent with other previous studies.[14,15] While latency between rupture of membranes and delivery was equivalent across groups, the onset mode of labour differed significantly. Oligohydramnios women were more likely to have undergone labour induction (80% vs 52.6%, p=0.001), as Ekin et al noted that diminished amniotic fluid volume was associated with higher rates of induction.[16] Higher demand for induction would logically be an expression of the higher risk status of such pregnancies because clinicians resort to more active intervention when oligohydramnios is present. Dramatic variation in delivery modes between groups (86% rate of caesarean in oligohydramnios and 50% in normal AFI, p=0.002) was in keeping with several earlier studies. Zhang et al demonstrated that oligohydramnios increased the odds of caesarian delivery by 3.2 times, while Jagatia et al had 84% rates of caesarian among patients with AFI <5cm.[17,18] This high rate of caesareans primarily occured due to increased fetal distress, which was the most common caesarean reason in our oligohydramnios group (65.1%). Maternal complications were significantly different between groups (62% vs 7.9%, p<0.001). Specifically, infection of the wound in 38% of oligohydramnios patients and none in the normal AFI group was congruent with Melamed et al's study, confirming increased infectious morbidity in PROM patients with decreased amniotic fluid.[19] The neonatal outcomes were also mirrored in equally disturbing disparities, with complications happening in 62% of the oligohydramnios group and just 0.03% of the normal AFI group (p<0.001). The most common respiratory complications were pneumonia (22%) and respiratory distress syndrome (20%). The findings were in agreement with those of Peipert and Donnenfeld that oligohydramnios had 4.5 times increased odds of neonatal intensive care admission in PROM patients.[20]

The higher level of complications is likely to result from cord compression episodes, aspiration of infected amniotic fluid, and restricted fetal breathing activity affecting lung development. These findings have important clinical applications. To begin with, AFI measurement should be a routine part of PROM patient assessment since it provides valuable prognostic information. Moreover, patients with oligohydramnios should be subjected to increased maternal-fetal monitoring and, if the situation calls for it, expedited delivery to prevent subsequent complications.

Limitations:

The investigation bears the limitation of a modest sample size, which may influence the external validity of the results. A single-centre design may also result in institutional bias in management decisions and selection of intervention timing.

Conclusion:

This study firmly established that oligohydramnios (AFI <5cm) in term PROM patients had substantially higher rates of induction of labour, caesarian delivery, and maternal and neonatal complications. AFI measurement is a valuable prognostic tool in the management of term PROM, which may help healthcare professionals to identify high-risk patients early and thus closely monitor and treat them at the earliest. These findings suggest that AFI must be monitored routinely in all term PROM scenarios to optimize maternal and neonatal outcomes. Future studies would include more multicenter randomised controlled trials to establish optimal management policies for term PROM patients with oligohydramnios. There is a need for preventive care studies aimed at reducing maternal and neonatal morbidity in oligohydramnios.

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