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CLINICAL SIGNIFICANCE OF THE PRESENCE OF AMNIOTIC FLUID ‘SLUDGE’ IN ASYMPTOMATIC PATIENTS AT HIGH RISK FOR SPONTANEOUS PRETERM DELIVERY

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ABSTRACT

Introduction: The aim of our study is to determine prevalence and clinical significance of the presence of amniotic fluid “sludge” among asymptomatic patients at high-risk for spontaneous preterm delivery.

Objective: To determine Clinical significance of the presence of amniotic fluid ‘sludge’ in asymptomatic patients at high risk for spontaneous preterm delivery.

Material and methods: In this study, 222 patients at high risk for spontaneous preterm delivery were evaluated for the presence of amniotic fluid sludge with ultrasonography at 26–30, and 32–38 gestational weeks; between July 2022 –December2022 in University Hospital. The primary outcomes were defined as preterm delivery before 34 weeks and preterm delivery before 37 weeks. The secondary outcome defined as preterm premature rupture of membranes (PPROM) prior to preterm delivery. Risk factors for preterm delivery defined as AFS, history of preterm delivery. And, these patients were followed up for their delivery weeks and pregnancy outcomes. We defined the high-risk group as the patients possessing one or more of the followings; a history of spontaneous preterm delivery, recent oligohydramnios, polyhydramnios, and amniotic fluid Sludge. Patients with multiple gestations, placenta Previa, fetal anomalies, or symptoms of preterm labor at first examination were excluded.

Results: In this study out of 222(100.0%) patients, 58(26.1%) patients had normal to mildly echogenic AFI echogenicity out of these 58 patients, 57 patients delivered preterm, and 1 patient delivered at term. 78(35.1%) patients had moderately echogenic AFI echogenicity out of these 78 patients, 69 patients delivered preterm and 9 patients delivered at term. 86(38.7%) patients had highly echogenic AFI echogenicity out of these 74 patients delivered preterm and 12 patients delivered at term. 86(38.7%) patients had sludge in amniotic fluid, 1 with adequate amniotic fluid, 4 with excessive amniotic fluid, 81 with scanty amniotic fluid and 136(61.3%) patients had no sludge in amniotic fluid but had adequate amniotic fluid. Out of which 113 (50.9%) patients had, normal delivery and 109(49.1%) patients delivered through C-section.

Conclusion: Ultrasound assessment of amniotic fluid plays a vital role in the evaluation of fetal well-being especially during the second and third trimesters. Changes in the amniotic fluid volume can affect the pregnancy as these are closely related to fetal anomalies. Our study has shown that an important risk factor for preterm delivery is the amniotic fluid sludge. In our population the prevalence of amniotic fluid sludge was 38.7% which indicates a high risk for preterm delivery. Thus this can be used an independent indicator of high risk pregnancies.

Keywords: Amniotic fluid amount, Amniotic fluid appearance, amniotic fluid ‘sludge’, spontaneous preterm delivery, SPD, premature rupture of membranes, PROM

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Introduction

Amniotic fluid is vital to the well-being of the fetus. It cushions the fetus from injury, helps prevent compression of the umbilical cord, and allows room for it to move and grow. The quantity of amniotic fluid at any time in gestation is the product of water exchange between the mother, fetus, and placenta, and is maintained within a relatively narrow range. Disorders of this regulatory process can lead to either polyhydramnios or oligohydramnios, in which too much or too little fluid exists, respectively.¹ In the early fetal period, AF volume and fetal size are related in a linear fashion. AF volume increases from about 25 ml at 10 weeks to about 400 ml at 20 weeks. During this period, AF composition is similar to fetal plasma.²

Preterm birth (PTB) affects a significant number of pregnancies and is associated with health, social, and economic consequences. To date, several parameters have been proposed as potential predisposing factors for PTB including history of spontaneous PTB, history of at least one mid-trimester pregnancy loss, previous surgical removal of part of the cervix, and uterine congenital anomalies.³ The term "amniotic fluid sludge" (AFS) refers to the presence of particles in the amniotic fluid near the cervix. Despite the fact that its prevalence has been linked to a higher risk of preterm birth.⁴

The sonographic finding of dense aggregates of particulate matter in the amniotic fluid close to the internal cervical os, known as amniotic fluid (AF) 'sludge', is associated with impending preterm delivery, microbial invasion of the amniotic cavity (MIAC), and histologic chorioamnionitis in patients with spontaneous preterm labor and intact membranes.⁵ Particulate matter in the amniotic fluid (AF) is present in about 4% of pregnancies during transvaginal ultrasound in the first and early second trimester.⁶ In the third trimester of pregnancy, free-floating particulate matter has been attributed to the presence of vernix and meconium, and is present in about 88% of pregnancies by 35 weeks. However, AFS is different from those findings because it always appears in close proximity to the internal os or within the cervical funneling.⁷ The sonographic finding of dense aggregates of particulate matter in the amniotic fluid close to the internal cervical os, known as amniotic fluid (AF) 'sludge', is associated with impending preterm delivery, microbial invasion of the amniotic cavity (MIAC), and histologic chorioamnionitis in patients with spontaneous preterm labor and intact membranes. Similar observations were recently reported among patients with a history of preterm delivery or threatened preterm labor.⁸

Intra-amniotic infection is sometimes chronic in nature. Indeed, accumulating evidence indicates that asymptomatic patients with a positive amniotic fluid culture at the time of mid-trimester amniocentesis have a higher risk of adverse pregnancy outcome including fetal loss and/or preterm delivery. To the extent that AF ‘sludge’ may represent clusters of bacteria and inflammatory cells.⁹ It is possible that the presence of AF ‘sludge’ will represent chronic intra-amniotic infection.¹⁰ Evolution of amniotic fluid volume is very important for predicting fetal well-being because abnormalities of amniotic fluid associate with fetal morbidity, mortality, and anomaly.¹¹ Sonographically detected echogenic amniotic fluid is rare, and its clinical relevance is not well understood. Meconium, blood, or vernix caseosa were been suggested as causes of extremely echogenic amniotic fluid.¹²

AF ‘sludge’ has been observed in some asymptomatic patients with risk factors for preterm delivery. However, the clinical implications of the presence of this ultrasonographic finding in these patients are unknown. The objective of this study was to determine the clinical significance of amniotic fluid ‘sludge’ in asymptomatic patients at high-risk for spontaneous preterm delivery.

Material and Methods

It was a cross-sectional analytical and observational study performed to determine clinical significance of the presence of amniotic fluid ‘sludge’ in asymptomatic patients at high risk for spontaneous preterm delivery. It included 222 patients. Convenient sampling technique was used. The duration of data collection was 4 months and data was collected from UOL Ultrasound Clinic Green Town. The inclusion criteria was Women in third trimesters who were expecting a singleton had their amniotic fluid volume assessed using ultrasound as part of an antepartum fetal health assessment that linked the amniotic fluid index to the single deepest vertical pocket measurement. The exclusion criteria was Women in their first trimester, as well as infertile women were excluded from this study. The ultrasound machines of Toshiba Xario, Mindray DC7, Esaote Mylab20 and Mindray Z5 were used.

Results

Two hundred and twenty-two patients met the inclusion criteria. The prevalence of AF 'sludge' in asymptomatic patients at high risk for spontaneous preterm delivery was 38.7% (86/222). Minimum age of patient was 18 years and fetus gestational age was 26 weeks. Maximum age of patient was 40 years and fetus gestational age was 40 weeks. Out of 222(100.0%) patients, 22 (9.9%) patients delivered at term and 200(90.1%) patients delivered preterm. Out of 222(100.0%) patients, 113 (50.9%) patients delivered normally and 109(49.1%) patients delivered through C-Section. 86(38.7%) patients had amniotic fluid sludge and 136 patients (61.3%) had not sludge in amniotic fluid. 58(26.1%) patients had normal to mildly echogenic amniotic fluid, 78(35.1%) patients had moderately echogenic amniotic fluid and 86(38.7%) patients had highly echogenic amniotic fluid.

Table 1- shows variables and their frequencies

Variables	Frequency Total patients (222)	Percentage
Mode Of Delivery		
C-Section	109	49.1%
Normal	113	50.9%
Amniotic Fluid Sludge		
No	136	61.3%
Yes	86	38.7%
Amniotic Fluid Echogenicity		
Highly echogenic	86	38.7%
Moderately echogenic	78	35.1%
Normal to mildly echogenic	58	26.1%

Table 2: Association of amniotic fluid volume and sludge code

Sludge Code	Amniotic_Fluid_Volume			
	Adequate	Excessive	Scanty	
0	136	0	0	136 (61.3%)
1	1	4	81	86 (38.7%)
	137(61.7%)	4(1.8%)	81(36.5%)	222

Table 2, shows the Association of amniotic fluid volume and sludge code. Out of 222(100.0%) patients, 86(38.7%)patients had sludge in amniotic fluid, 1 with adequate amniotic fluid, 4 with excessive amniotic fluid, 81 with scanty amniotic fluid and 136(61.3%) patients had not sludge in amniotic fluid but had adequate amniotic fluid.

ChiSquareTest

Chi-squared	217.817
DF	2
Significance level	P < 0.0001
Contingency coefficient	0.704

Amniotic fluid volume and sludge code shows a statistically significant association with value $P < 0.0001$.

Table3:Shows association of amniotic fluid echogenicity with amniotic fluid volume.

Amniotic_Fluid_Volume	Amniotic_Fluid_Echogenicity			
	Highly echogenic	Moderately echogenic	Normal to mildly echogenic	
Adequate	1	78	58	137 (61.7%)
Excessive	4	0	0	4 (1.8%)
Scanty	81	0	0	81 (36.5%)
	86(38.7%)	78(35.1%)	58(26.1%)	222(100.0%)

Table 3 shows association of amniotic fluid volume with amniotic fluid echogenicity. Out of 222(100.0%) patients, 137(61.7%) patients had adequate amniotic fluid out of these 137 patients, 1 patient had highly echogenic AFI echogenicity, 78 patients had moderately echogenic and 58 patients had normal to mildly echogenic AFI. Out of 222(100.0%) patients, 4(1.8%) patients had excessive amniotic fluid with highly echogenic AFI echogenicity and 81(36.5%) patients had scanty amniotic fluid with highly echogenic AFI echogenicity.

Chi-Square Tests

Chi-squared	217.817
DF	4
Significance level	P < 0.0001
Contingency coefficient	0.704

Amniotic fluid volume and amniotic fluid echogenicity shows a statistically significant association with value $P < 0.0001$.

Table 4 shows association between amniotic fluid echogenicity with term and preterm delivery

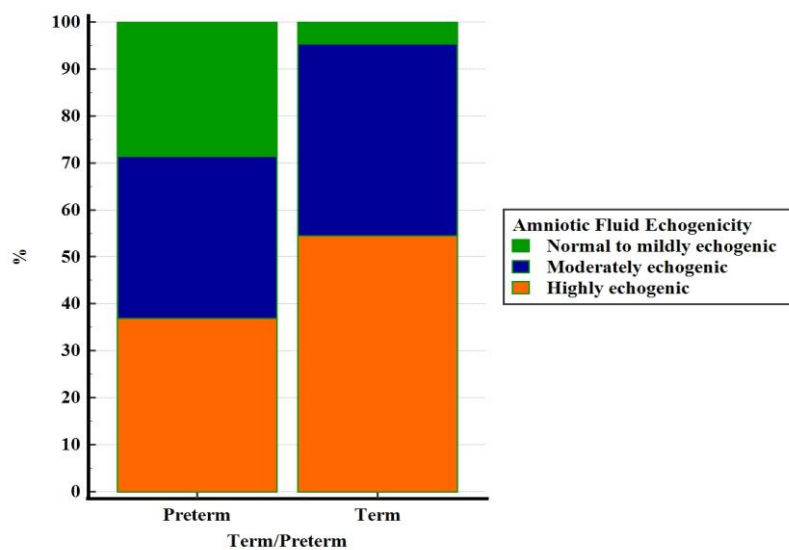
Amniotic_Fluid_Echogenicity	Term_Preterm		
	Preterm	Term	
Highly echogenic	74	12	86 (38.7%)
Moderately echogenic	69	9	78 (35.1%)
Normal to mildly echogenic	57	1	58 (26.1%)
	200(90.1%)	22(9.9%)	222

Table 4 shows association between amniotic fluid echogenicity with term and preterm delivery. It shows that out of 222(100.0%) patients, 58(26.1%) patients had normal to mildly echogenic AFI echogenicity out of these 58 patients, 57 patients delivered preterm, and 1 patient delivered at term. 78(35.1%) patients had moderately echogenic AFI echogenicity out of these 78 patients, 69 patients delivered preterm and 9 patients delivered at term. 86(38.7%) patients had highly echogenic AFI echogenicity out of these 86 patients delivered preterm and 12 patients delivered at term.

Chi-squared test

Chi-squared	6.160
DF	2
Significance level	P = 0.0460
Contingency coefficient	0.164

Association of AFI echogenicity and term and preterm delivery shows a statistically significant value P=0.0460.



Graph 1. Shows the association of Term/Preterm with amniotic fluid echogenicity.

Table 5 shows association of mode of delivery with sludge code

Mode_Of_Delivery	Sludge_Code		
	0	1	
C-Section	23	86	109 (49.1%)
Normal	113	0	113 (50.9%)
	136	86	222

Table 5 shows association of mode of delivery with sludge code. It shows that out of 222(100.0%) patients, 113(50.9%) patients delivered normal and these patients had not sludge in amniotic fluid. 109(49.1%) patients delivered through C section out of these 86 patients had sludge in amniotic fluid and 23 patients had not.

Discussion

The amniotic fluid is the most important thing in the evaluation of fetal well-being.¹³ Pregnancy assessment currently includes a serious and significant role for ultrasound assessment of amniotic fluid, which seems to have important consequences for obstetric care.¹⁴ Amniotic fluid assessment is crucial for assessing fetal viability, especially during the second and third trimesters. Variations in amniotic fluid in the third trimester affect 7% of all pregnancies, but have minimal impact on the fetus. The second trimester evaluation is crucial as changes in volume are linked to fetal anomalies and poor prenatal outcomes.¹⁵ Our study was designed to find out the clinical significance of the presence of amniotic fluid 'sludge' in asymptomatic patients at high risk for spontaneous preterm delivery by using ultrasound.

Cross-sectional Analytical study was performed. 222 patients who visited UOL Ultrasound Clinic Green Town. Women in third trimesters who were expecting a singleton had their amniotic fluid volume assessed using ultrasound as part of an antepartum fetal health assessment that linked the amniotic fluid index to the single deepest vertical pocket measurement were included. Minimum age of patient was 18 years and fetus gestational age was 26 weeks. Maximum age of patient was 40 years and fetus gestational age was 40 weeks.

Out of 222 patients, 22 (9.9%) delivered at term, while 200 (90.1%) delivered preterm, out of a total sample size of 222. Out of 222 patients, 113 (50.9%) delivered normally, while 49.1% delivered through C-section. Table 5 shows association between delivery mode and sludge code, with 86 having sludge in amniotic fluid. Sonographic findings of AF'sludge', dense particulate matter in amniotic fluid, are linked to preterm delivery, microbial invasion of the amniotic

cavity, and histologic chorioamnionitis in spontaneous preterm labor patients.¹⁶The study found that 38.7% of asymptomatic patients at high risk for preterm delivery had amniotic fluid sludge between 26 and 40 weeks of gestation, with asymptomatic patients with AF sludge having shorter ultrasound-to-delivery and ultrasound-to-preterm PROM intervals.

The study found that out of 222 patients, 26.1% had normal to mildly echogenic amniotic fluid, 35.1% had moderately echogenic fluid, and 38.7% had highly echogenic fluid. Amniotic fluid volume was associated with echogenicity. Out of 137 patients, 61.7% had adequate amniotic fluid, while 1.8% had excessive amniotic fluid with highly echogenic AFI echogenicity. 36.5% had scanty amniotic fluid with highly echogenic AFI echogenicity. Preterm birth and labour induction rates were significantly higher in women with borderline AFI than in the normal group, according to data from other research, which were consistent with findings from some other studies that had the similar outcomes.¹⁷⁻¹⁸ Out of 222 patients, 38.7% had sludge in amniotic fluid, while 61.3% had adequate amniotic fluid. Table 4 shows the association between amniotic fluid echogenicity and term and preterm delivery. Out of 58 patients, 26.1% had normal to mildly echogenic AFI echogenicity, 57 delivered preterm, and 1 delivered at term. Out of 78 patients, 35.1% had moderately echogenic AFI echogenicity, 69 delivered preterm, and 9 at term.

In conclusion, the present results indicate that AF 'sludge' is an independent risk factor for spontaneous preterm delivery and the prevalence of AF 'sludge' at between 26 and 40 completed weeks of gestation in this population of asymptomatic patients at high risk for preterm delivery was 38.7%.

CONCLUSION

Ultrasound assessment of amniotic fluid plays a vital role in the evaluation of fetal well-being especially during the second and third trimesters. Changes in the amniotic fluid volume can affect the pregnancy as these are closely related to fetal anomalies. Our study has shown that an important risk factor for preterm delivery is the amniotic fluid sludge. In our population the prevalence of amniotic fluid sludge was 38.7% which indicates a high risk for preterm delivery. Thus, this can be used an independent indicator of high-risk pregnancies.

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Fig 1: A patient with a gestational age of 37 weeks with scanty amniotic fluid but having AF sludge.

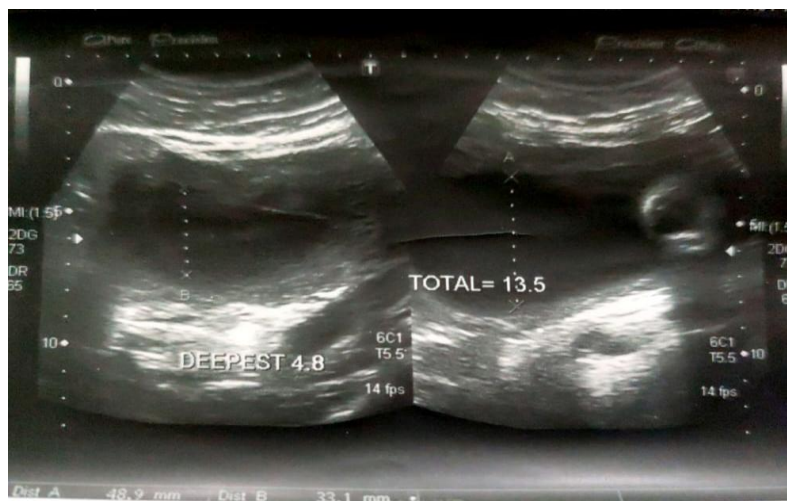


Fig 2: A patient with a gestational age of 36 weeks with adequate amniotic fluid but having AF sludge.