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Original Research Article

Maternal Serum Alpha-Fetoprotein as a Biomarker for Placental Adherence in Low-Lying Placenta: A Prospective Observational Study at a Tertiary Care Centre in Eastern India

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Abstract

Background: Placenta accreta spectrum (PAS) is a potentially life-threatening obstetric condition associated with severe maternal hemorrhage, hysterectomy, intensive care admission, and adverse neonatal outcomes. Early diagnosis remains challenging, particularly in resource-limited settings where advanced imaging modalities are not readily available.

Objectives: To evaluate maternal serum alpha-fetoprotein (MSAFP) as a biomarker for placental adherence in women with low-lying placenta and to assess associated fetomaternal outcomes.

Materials and Methods: A prospective observational study was conducted in the Department of Obstetrics and Gynaecology, Rajendra Institute of Medical Sciences (RIMS), Ranchi, over one year. Sixty antenatal women with ultrasonographically documented low-lying placenta or placenta previa in the third trimester were included. Maternal serum AFP levels were measured by ELISA and correlated with intraoperative findings and fetomaternal outcomes.

Results: Among 60 women studied, 8 (13.3%) had PAS. Mean MSAFP levels were significantly higher among PAS cases compared to non-PAS cases (731.92 ± 421.37 ng/mL vs. 155.53 ± 69.73 ng/mL; $p<0.001$). Elevated MSAFP (>250 ng/mL) was observed in 100% of PAS cases compared with only 7.7% of non-PAS cases. Placenta accreta accounted for 62.5% of PAS cases, placenta increta 12.5%, and placenta percreta 25%. All PAS cases underwent cesarean hysterectomy. Maternal morbidity was significantly higher in PAS cases, including ICU admission, bladder injury, and vesicovaginal fistula. One maternal death and one early neonatal death were reported.

Conclusion: MSAFP is a promising, inexpensive, and easily accessible biomarker for the early identification of PAS in women with low-lying placenta. Its incorporation into antenatal risk assessment may facilitate timely referral and improve maternal and neonatal outcomes.

Keywords: Maternal Serum Alpha-Fetoprotein, Placenta Accreta Spectrum, Placenta Previa, Placental Adherence, Biomarker, Maternal Morbidity.

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Introduction

Placenta accreta spectrum encompasses placenta accreta, increta, and percreta, characterized by abnormal trophoblastic invasion into the myometrium. The incidence of PAS has increased worldwide, primarily due to rising cesarean section rates. PAS is associated with massive obstetric hemorrhage, cesarean hysterectomy, maternal

intensive care admission, and increased perinatal morbidity.

Prenatal diagnosis is essential for improving maternal outcomes. Ultrasonography and MRI are established diagnostic modalities; however, MRI availability remains limited in many developing regions. Maternal serum alpha-fetoprotein (MSAFP), a fetal glycoprotein produced by the fetal liver and yolk sac, has emerged as a potential biochemical marker for PAS. Elevated MSAFP levels may result from disruption of the fetomaternal interface and leakage of AFP into maternal circulation. Given the need for affordable screening tools in resource-constrained settings, this study evaluated the role of MSAFP as a biomarker for placental adherence in women with low-lying placenta.

Aims and Objectives

Aim: To analyse maternal serum alpha-fetoprotein levels as a biomarker for placental adherence in low-lying placenta.

Primary Objective: To determine the relationship between elevated MSAFP levels and placenta accreta spectrum.

Secondary Objective: To analyse fetomaternal outcomes in women with elevated MSAFP levels and placental adherence.

Materials and Methods

Study Design: Prospective observational study.

Study Duration: One year.

Study Centre: Department of Obstetrics and Gynaecology, Rajendra Institute of Medical Sciences (RIMS), Ranchi, Jharkhand.

Sample Size: 60 antenatal women.

Sample Size Formula: Sample size was calculated using comparison of proportions with 80% study power and 5% alpha error.

Inclusion Criteria: Antenatal women with ultrasonographically documented low-lying placenta or placenta previa.

Exclusion Criteria

- Placental abruption.
- Hydatidiform mole.
- Local causes of vaginal bleeding.
- Ovarian tumors producing AFP.
- Fetal neural tube defects.
- Major congenital anomalies.
- Abdominal wall defects.

Intervention Plan: Venous blood samples were collected during the antepartum period. MSAFP estimation was performed using ELISA. Findings were correlated with intraoperative diagnosis and fetomaternal outcomes.

Data Analysis: Statistical analysis was performed using SPSS version 21. Continuous variables were compared using Student's t-test, while categorical variables were analyzed using Chi-square and Fisher's exact tests. A p-value <0.05 was considered statistically significant.

Results

Table 1: Prevalence of Placenta Accreta Spectrum

Diagnosis	Frequency	Percentage
Without PAS	52	86.7%
With PAS	8	13.3%
Total	60	100%

Brief Discussion: The prevalence of PAS was 13.3%, which is consistent with previous studies conducted among women with placenta previa and low-lying placenta.

Table 2: Mean MSAFP Levels

Group	Mean AFP (ng/mL)	SD	P-value
Non-PAS	155.53	69.73	<0.001
PAS	731.92	421.37	

Brief Discussion: MSAFP levels were significantly elevated among PAS cases, supporting its potential role as a biomarker for placental adherence.

Table 3: MSAFP and PAS

AFP Level	Non-PAS	PAS
<250 ng/mL	92.3%	0%
>250 ng/mL	7.7%	100%

Brief Discussion: All PAS cases demonstrated elevated AFP levels, indicating excellent sensitivity in identifying placental adherence.

Table 4: Distribution of PAS Types

PAS Type	Frequency	Percentage
Placenta Accreta	5	62.5%
Placenta Increta	1	12.5%
Placenta Percreta	2	25.0%

Brief Discussion: Placenta accreta was the most common form of PAS, similar to previously published literature.

Table 5: Maternal Morbidity

Morbidity	PAS Cases
ICU Admission	50%
Bladder Injury	12.5%
Vesicovaginal Fistula	12.5%
Maternal Mortality	12.5%

Brief Discussion: PAS was associated with substantial maternal morbidity, emphasizing the need for early diagnosis and planned management.

Table 6: Fetal Outcome

Outcome	PAS
NICU Admission	37.5%
Early Neonatal Death	12.5%
Stable Outcome	50%

Brief Discussion: PAS adversely affected neonatal outcomes, largely due to preterm birth and operative delivery.

Discussion

The present study demonstrated a significant association between elevated maternal serum AFP levels and placenta accreta spectrum. PAS was identified in 13.3% of women with low-lying placenta, comparable to studies by Verma et al. and Jashanjot Kaur et al. The mean MSAFP level in PAS cases was nearly five times higher than in non-PAS cases. This finding corroborates observations by Zelop et al., Kupferminc et al., Verma et al., Hassan et al., and Wang et al., all of whom reported elevated AFP concentrations in women with placental adherence. The biological basis for elevated AFP levels likely relates to disruption of Nitabuch's membrane and increased permeability of the placental barrier, allowing AFP leakage into maternal circulation.

Importantly, all PAS cases in the present study exhibited elevated MSAFP levels, and all required cesarean hysterectomy. These findings underscore the strong predictive value of AFP in identifying patients at risk of severe placental invasion. Maternal morbidity was substantial, with ICU admission occurring in half of PAS cases. Bladder injury, VVF formation, and one maternal death further highlight the seriousness of the condition. Neonatal morbidity was also increased, with higher NICU admissions and one early neonatal death.

In resource-limited regions where MRI availability is restricted and specialist ultrasonography expertise may be scarce, MSAFP offers a cost-effective and readily accessible screening tool.

Limitations

1. Single-center study.
2. Small number of PAS cases.
3. MRI correlation could not be performed in all participants.
4. Limited generalizability to larger populations.
5. Further multicenter studies are required to validate AFP cutoff values.

Conclusion

Maternal serum alpha-fetoprotein is a valuable biomarker for detecting placenta accreta spectrum among women with low-lying placenta. Elevated MSAFP levels were strongly associated with placental adherence, cesarean hysterectomy, maternal morbidity, and adverse neonatal outcomes. Incorporating MSAFP estimation into antenatal evaluation may facilitate early diagnosis, timely referral, and improved clinical outcomes, particularly in resource-constrained settings.

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