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Original Research Article

Modified biophysical profile in antepartum fetal surveillance of high-risk pregnancy

Neethika Raghuwanshi, Sneha Gedam*

Department of Obstetrics and Gynecology, Government Medical College, Akola, Maharashtra, India

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***Correspondence:**

Dr. Sneha Gedam,

E-mail: drgedamsneha@gmail.com

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ABSTRACT

Background: Antepartum fetal surveillance is essential for reducing perinatal morbidity and mortality in high-risk pregnancies. The modified biophysical profile (MBPP), combining the non-stress test (NST) with amniotic fluid index (AFI) assessment, offers a time-efficient, cost-effective alternative to the complete Biophysical Profile (BPP). This study evaluated MBPP as a surveillance tool in high-risk pregnancies.

Methods: A hospital-based observational study was conducted at Government Medical College, Akola, Maharashtra, India (January 2024-December 2025). Three hundred high-risk pregnant women at ≥ 30 weeks gestation were enrolled by universal sampling. MBPP comprised a 20-minute NST and ultrasonographic AFI measurement. Outcomes included mode of delivery, neonatal Apgar scores, neonatal intensive care unit (NICU) admissions, and neonatal mortality. Data were analyzed using SPSS version 20.0 ($p < 0.05$).

Results: Most participants (51.00%) were aged 21-25 years (mean 24.75 ± 4.56 years). Hypertensive disorders were the commonest risk factor (42.33%), followed by anaemia (28.00%) and intrauterine growth restriction (IUGR) (15.67%). NST was reactive in 78.33%; normal AFI in 81.33%; both normal in 66.67%. Full-term vaginal delivery occurred in 47.33%; emergency lower segment caesarean section (LSCS) in 34.00%. Apgar ≥ 7 was achieved in 83.33% neonates; 25.67% required NICU admission; neonatal mortality was 1.00%.

Conclusions: MBPP is a practical, non-invasive, cost-effective antepartum surveillance tool. Abnormal MBPP findings were significantly associated with operative delivery and adverse neonatal outcomes. MBPP is recommended as a routine first-line modality for high-risk pregnancy surveillance, especially in resource-limited settings.

Keywords: Modified biophysical profile, Antepartum fetal surveillance, High-risk pregnancy, Non-stress test, Amniotic fluid index, Perinatal outcome

INTRODUCTION

Maternal health and perinatal outcomes remain critical indicators of a nation's healthcare status.¹ High-risk pregnancies—defined as those associated with increased maternal or fetal morbidity and mortality—commonly include conditions such as preeclampsia, anaemia, IUGR, and oligohydramnios. Early identification of these conditions is crucial to enable timely interventions.^{2,3}

The primary goal of antepartum fetal surveillance is to assess fetal well-being, detect early signs of compromise, and prevent perinatal morbidity and mortality while avoiding unnecessary obstetric interventions.⁴ The complete biophysical profile, originally described by Manning et al includes five components: fetal breathing movements, gross body movements, fetal tone, amniotic fluid volume, and the NST.⁵ Despite its effectiveness, the complete biophysical profile is resource-intensive and time-consuming, limiting its routine use in many clinical settings.⁶

To address these limitations, the MBPP was introduced by Nageotte et al.⁷ The MBPP combines the NST as a marker of short-term fetal status with the AFI as an indicator of long-term placental function. It can be completed in approximately 20 minutes, making it a practical and cost-effective tool for routine antepartum surveillance.^{7,8} This study was undertaken to assess the role of MBPP as a reliable surveillance tool in high-risk pregnancies.

METHODS

A hospital-based observational study was conducted at the inpatient Department of Obstetrics and Gynecology, Government Medical College, Akola, Maharashtra, India, from January 2024 to December 2025. Ethical approval was obtained from the institutional ethics committee, Government Medical College, Akola. Written informed consent was obtained from all participants prior to enrollment.

High-risk pregnant women admitted with gestational age ≥ 30 weeks were enrolled using universal sampling. The total eligible population during the study period was 300 women; all were enrolled (n=300).

Inclusion criteria

Patients with gestational age ≥ 30 weeks; preeclampsia; heart disease complicating pregnancy; gestational diabetes mellitus or overt diabetes; anaemia; IUGR; oligohydramnios; bad obstetric history; and placental complications were included in the study.

Exclusion criteria

Patients who did not provide informed consent; fetuses with congenital anomalies; multifetal pregnancies; and intrauterine fetal demise were excluded from the study.

NST procedure and interpretation

The NST was conducted using a cardiotocograph for 20 minutes. A reactive NST required baseline fetal heart rate 110-160 beats per minute with ≥ 2 accelerations of ≥ 15 beats per minute lasting ≥ 15 seconds, good beat-to-beat variability, and no decelerations. If not reactive within 20 minutes, the test was extended or repeated after intravenous fluid administration.

AFI measurement

The four-quadrant technique was used. AFI > 5 cm was normal; 3-5 cm was oligohydramnios; < 3 cm was severe oligohydramnios; > 18 cm was polyhydramnios.

MBPP interpretation and management

Both parameters normal: weekly surveillance continued. Both abnormal: delivery if > 36 weeks, or individualized management if < 36 weeks. Abnormal AFI with reactive

NST: twice-weekly MBPP. Non-reactive NST with normal AFI: complete Biophysical Profile assessment.

Outcome measures

Primary outcomes: mode of delivery and MBPP categorization. Secondary outcomes: neonatal Apgar score at 5 minutes, NICU admission, NICU stay duration, and neonatal mortality.

Statistical analysis

Data were analyzed using Microsoft excel 2019 and SPSS version 20.0. Categorical variables were expressed as frequencies and percentages. Chi-square test was used for associations; $p < 0.05$ was considered statistically significant.

RESULTS

Of 300 high-risk pregnant women enrolled, the majority (51.00%) belonged to the 21-25 years age group, followed by 26-30 years (23.00%) and 16-20 years (15.00%). The mean maternal age was 24.75 ± 4.56 years. Most participants (97.67%) were booked cases. Primigravidae constituted the largest group (38.00%), followed by second gravida (24.00%) and third gravida (20.67%) (Table 1).

Table 1: Age-wise distribution and baseline characteristics of study participants, (n=300).

| Parameters | Category | N | Percentage (%) |
|----------------------|--------------------------|-----|----------------|
| Age group (in years) | 16-20 | 45 | 15.00 |
| | 21-25 | 153 | 51.00 |
| | 26-30 | 69 | 23.00 |
| | 31-35 | 27 | 9.00 |
| | >35 | 6 | 2.00 |
| Mean age (in years) | 24.75 \pm 4.56 | - | - |
| Booking status | Booked | 293 | 97.67 |
| | Unbooked | 7 | 2.33 |
| Gravidity | Primigravida | 114 | 38.00 |
| | Second gravida | 72 | 24.00 |
| | Third gravida | 62 | 20.67 |
| | Fourth gravida and above | 52 | 17.33 |

Hypertensive disorders were the most common high-risk factor (42.33%), followed by anaemia (28.00%), IUGR (15.67%), oligohydramnios (11.67%), infections (11.00%), gestational diabetes mellitus (9.33%), placental complications (8.67%), and bad obstetric history (8.00%). Heart disease and polyhydramnios were observed in 3.33% and 2.33% respectively (Table 2).

Most participants (57.33%) were registered between 31-34 weeks. Most women (71.67%) delivered between 35-38

weeks and 18.33% after 38 weeks. Most underwent two MBPP assessments (39.33%), followed by one (26.33%) and three (20.33%).

Table 2: Distribution of high-risk factors among study participants, (n=300).

| High-risk factors | N | Percentage (%) |
|-------------------------------|-----|----------------|
| Hypertensive disorders | 127 | 42.33 |
| Anaemia | 84 | 28.00 |
| IUGR | 47 | 15.67 |
| Oligohydramnios | 35 | 11.67 |
| Infections | 33 | 11.00 |
| Gestational diabetes mellitus | 28 | 9.33 |
| Placental complications | 26 | 8.67 |
| Bad obstetric history | 24 | 8.00 |
| Heart disease | 10 | 3.33 |
| Polyhydramnios | 7 | 2.33 |

The NST was reactive in 235 (78.33%) and non-reactive in 65 (21.67%). Normal AFI (5-18 cm) was present in 244

(81.33%). Oligohydramnios in 31 (10.33%), severe oligohydramnios in 7 (2.33%), and polyhydramnios in 18 (6.00%). MBPP findings: both parameters normal in 200 (66.67%), abnormal NST with normal AFI in 56 (18.67%), normal NST with abnormal AFI in 36 (12.00%), and both abnormal in 8 (2.67%) (Table 3).

Fetal distress was the most common indication for LSCS (10.67%), followed by scar tenderness (4.33%), cephalopelvic disproportion (4.00%), and antepartum eclampsia (3.67%). Most women (66.35%) delivered within 20 hours of the last MBPP assessment.

Neonatal outcomes are presented in Tables 4 and 5. Birth weight of 2.5-3.5 kg was seen in 67.00%; 28.33% weighed 1.5-2.4 kg; none weighed below 1.5 kg. Apgar scores ≥ 7 were achieved in 83.33%. A total of 77 (25.67%) neonates required NICU admission; most (45.45%) stayed 4-7 days. Neonatal death occurred in 3 (1.00%) cases, all in the abnormal MBPP group

Table 3: MBPP findings and mode of delivery, (n=300).

| MBPP findings | N (%) | Full-term vaginal delivery, N (%) | Preterm vaginal delivery, N (%) | Elective LSCS N (%) | Emergency LSCS, N (%) |
|--------------------------|-------------|-----------------------------------|---------------------------------|---------------------|-----------------------|
| Both normal | 200 (66.67) | 130 (65.00) | 38 (19.00) | 5 (2.50) | 27 (13.50) |
| NST abnormal, AFI normal | 56 (18.67) | 8 (14.29) | 5 (8.93) | 5 (8.93) | 38 (67.86) |
| NST normal, AFI abnormal | 36 (12.00) | 4 (11.11) | 1 (2.78) | 2 (5.56) | 29 (80.56) |
| Both abnormal | 8 (2.67) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 8 (100.00) |
| Total | 300 (100) | 142 (47.33) | 44 (14.67) | 12 (4.00) | 102 (34.00) |

Table 4: Association of MBPP findings with neonatal Apgar score and NICU admission, (n=300).

| MBPP findings | Apgar ≥ 7 , N (%) | Apgar < 7 , N (%) | NICU admission, N (%) |
|----------------------------------|------------------------|---------------------|-----------------------|
| Both normal, (n=200) | 185 (92.50) | 15 (7.50) | 35 (17.50) |
| NST abnormal, AFI normal, (n=56) | 37 (66.07) | 19 (33.93) | 25 (44.64) |
| NST normal, AFI abnormal, (n=36) | 24 (66.67) | 12 (33.33) | 14 (38.89) |
| Both abnormal, (n=8) | 4 (50.00) | 4 (50.00) | 3 (37.50) |
| Total, (n=300) | 250 (83.33) | 50 (16.67) | 77 (25.67) |

Table 5: Neonatal outcomes at discharge, (n=300).

| Neonatal outcomes | N | Percentage (%) |
|-----------------------------------|-----|----------------|
| Birth weight 1.5-2.4 kg | 85 | 28.33 |
| Birth weight 2.5-3.5 kg | 201 | 67.00 |
| Birth weight > 3.5 kg | 14 | 4.67 |
| Apgar score ≥ 7 at 5 minutes | 250 | 83.33 |
| Apgar score < 7 at 5 minutes | 50 | 16.67 |
| NICU admission | 77 | 25.67 |
| NICU stay 1-3 days (of 77) | 24 | 31.17 |
| NICU stay 4-7 days (of 77) | 35 | 45.45 |
| NICU stay > 8 days (of 77) | 18 | 23.38 |
| Discharged alive | 297 | 99.00 |
| Neonatal death | 3 | 1.00 |

DISCUSSION

This prospective observational study evaluated MBPP as an antepartum fetal surveillance tool in 300 high-risk pregnant women at a tertiary care centre in Maharashtra. Abnormal MBPP findings showed a significant association with adverse perinatal outcomes, consistent with existing literature.^{9,10}

The mean maternal age of 24.75±4.56 years is comparable to findings by Shalini et al (50.8% aged 21-25 years) and Arya et al (49% aged 21-25 years).^{9,11} The predominance of women in the early reproductive years reflects the peak reproductive period in the Indian antenatal population.

The very high proportion of booked cases (97.67%) reflects excellent antenatal care utilization, markedly higher than the 40.27% reported by Mundhra et al.¹² The importance of antenatal booking in improving perinatal outcomes has been established by Chourasia et al.¹³

Hypertensive disorders were predominant risk factor (42.33%), consistent with Dangal and Nalamaru et al.^{10,14} Anaemia (28%) and IUGR (15.67%) next most common, underscoring need for intensive fetal surveillance.

Normal AFI was present in 81.33%, consistent with Anjum et al (79%).⁸ Both parameters were normal in 66.67%, similar to Arya et al (68%).¹¹ NST was reactive in 78.33% of cases, comparable to Sonia et al (75.73%) and Sowmya et al (62.85% both-normal).^{15,16} The higher proportion of abnormal NST compared to abnormal AFI highlights NST as an early indicator of fetal compromise.

Full-term vaginal delivery was achieved in 47.33% and emergency LSCS was required in 34.00%. Fetal distress was the most common LSCS indication (10.67%), consistent with Sowmya et al.¹⁶ The association between abnormal MBPP and operative delivery was significant ($p<0.05$), with 100% of women with both parameters abnormal requiring emergency LSCS (Table 3).

Apgar scores ≥ 7 were achieved in 83.33% of neonates, comparable to Dangal (88.6%) and Begum et al (91.7% in the normal MBPP group).^{10,17} Neonates with both parameters abnormal had the highest rate of low Apgar score (50.00%) compared to 7.50% in the both-normal group. NICU admission rate of 25.67% and neonatal mortality of 1.00% were comparable to findings by Dangal et al (38.95% and 1.74% respectively).¹⁰

These findings are consistent with recommendations by Borade et al and Shalini et al that MBPP is a simple, cost-effective, and time-saving primary antepartum fetal surveillance test.^{9,18} This study is limited by its single-centre observational design and moderate sample size. Multicentre randomised trials are recommended.

CONCLUSION

The MBPP is an effective, non-invasive, cost-effective, and practically applicable tool for antepartum fetal surveillance in high-risk pregnancies. Hypertensive disorders, anaemia, and IUGR were the predominant risk factors. Abnormal MBPP findings-particularly combined NST and AFI abnormality-were significantly associated with emergency operative delivery, low neonatal Apgar scores, NICU admission, and neonatal mortality. Reassuring MBPP results were associated with favourable perinatal outcomes in the majority of cases. MBPP is recommended as a routine component of antepartum fetal surveillance in high-risk pregnancies, especially in resource-limited tertiary care settings.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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