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Original Article

A Prospective Comparative Study of Modified Biophysical Profile in Women with Normal Pregnancies and Oligohydramnios and their Perinatal Outcome

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Abstract

Aims and Objectives: The aim of the study was to compare role of modified BPP in predicting perinatal outcomes in oligohydramnios versus normal pregnancies.

Materials and Methods: This study was a prospective cohort study which consisted of 280 singleton pregnant women, out of which 140 were diagnosed with oligohydramnios. The patients were evaluated with a modified biophysical profile (MBPP) to analyze maternal and perinatal outcome.

Results: When MBPP is normal, it gives reassurance that the fetal status is good with the good perinatal outcome and decreased maternal morbidity. About 78.5% of patients had a normal vaginal delivery with 2% NICU admission and no neonatal death. When both parameters of MBPP are abnormal then there was an increased maternal and perinatal morbidity. About 88% had lower segment cesarean section (LSCS), with 65% having NICU admission and 2 neonatal death. Individually oligohydramnios patients having normal non-stress test also had relatively increased perinatal and maternal morbidity. In this study, 55% had LSCS and 16% NICU admission but no neonatal death. In broader outlook, oligohydramnios had adverse maternal and perinatal outcome when compared with low-risk pregnant women.

Conclusion: MBPP is an effective method of antepartum fetal surveillance test in oligohydramnios in predicting perinatal outcome.

Key words: Amniotic fluid index, Modified biophysical profile, Non-stress test, Oligohydramnios

INTRODUCTION

Pregnancy as a high-risk event was first recognized in 1901 by Ballantyne in his paper titled "A plea for pre-maternity hospital."[1]

Antenatal fetal surveillance is directed at identifying fetuses of the high-risk pregnancy group which is at risk of suffering intrauterine hypoxia with resultant damage, including death. The process of birth is the most dangerous journey an individual undertakes.[2]

A healthy Newborn is the goal of every expectant mother and her clinician. In India, about 0.75 million neonates die every year, the highest for any country in the world. The current perinatal mortality rate of India (2013) is 26 per 1000 births. It ranges from 16 per 1000 births in urban areas to 28 per 1000 births in rural areas.[3]

The various methods antepartum fetal testing according to ACOG 2014 are:[4]

- Subjective
  - Daily fetal movement count/Cardiff count to 10
  - Movements
  - Objective
  - Biophysical profile – (BPP)

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- Electronic fetal monitoring- non-stress test (NST)
- Contraction stress test
- Modified BPP – (MBPP)
- Umbilical and uterine artery Doppler ultrasound.

The American College of obstetrics and gynecology and the American Academy of Pediatrics (2016) have concluded that MBPP test as predictive of fetal well-being as other approaches to biophysical fetal surveillance.[5]

The original BPP by Manning *et al.*[6] needs 2 phase testing by ultrasound and external Doppler monitor to record the fetal heart rate (FHR). The complete BPP is more cumbersome, time-consuming, and is more expensive.

The MBPP suggested by Nageotte *et al.* combines NST and amniotic fluid index (AFI).[7]

Here NST is used as a short-term marker and AFI as a long-term marker of placental function. It is easier to perform and less time consuming than complete BPP.[8]

Amniotic fluid plays an important role in fetal health and development. Amniotic fluid allows for proper growth and development of the fetal lung and musculoskeletal system, has bacteriostatic, anti-inflammatory, and thermoregulatory functions.[9]

ACOG 2016 defines oligohydramnios is as AFI of 5 cm or less at term a single deepest pocket of amniotic fluid below 2 cm.[10]

Oligohydramnios can be associated with fetal congenital anomalies and intrauterine growth restriction (IUGR); it is usually proportional to the degree of IUGR and indicated placental dysfunction. Oligohydramnios can also cause asymmetrical fetal growth, contracture of joints, and hypoplasia of fetal lungs by decreasing the lung expansion due to compression of the fetal abdomen, which limits the movement of fetal diaphragm and decreases the flow of the amniotic fluid into and out of the fetal lung. It is associated with FHR abnormalities, cord compression, poor tolerance of the labor by the fetus, and low APGAR scores with poor perinatal outcome.[11]

Hence, in this study, MBPP is used as a method of antepartum surveillance test in oligohydramnios cases to study its effectiveness in predicting perinatal outcome.

MATERIALS AND METHODS

The present study was a prospective cohort study conducted in the department of obstetrics and gynecology of tertiary hospital from November 2017 to October 2020. Consecutive pregnant women of >36 weeks of gestation admitted to the hospital and giving consent to participate were included in the study. A detailed history including age, parity, body mass index (BMI), booking status, and obstetric history was noted. Thorough clinical examination was done. The volume of amniotic fluid was measured according to the four-quadrant technique described by Phelan *et al.*[12] With the patient in supine position, uterus was divided into four equal quadrants by two imaginary lines. An AFI of >5 was considered normal and ≤5 as abnormal. The last observation of MBPP was compared with the outcome of pregnancy.

The NST was performed with cardiotocogram. Recording of FHR, fetal movements, uterine contractions were done. The trace was considered as reactive if more than 2 fetal movements with the acceleration of more than or equal to 15 beats/min lasting for more than or equal to 15 s, with good beat-to-beat variability and no decelerations. If the reactive pattern was not recorded within 20 min period, the fetus was stimulated with the administration of a glucose-containing beverage and the test continued for another 20 min period. If there is no reactivity in this extended period, the trace was deemed non-reactive.

Patient's admission charts, labor ward records, operating notes, and nursery sheets were reviewed. Information regarding trial of labor was available from labor ward records. Operative findings were noted down from operative notes and neonatal data were collected from nursery sheets. Indication for CS noted down. Mode and indication of delivery were recorded. Nature of amniotic fluid was noted and classified into meconium stained, clear, absent, and blood mixed.

Inclusion Criteria Cases

The following criteria were included in the study:

- All pregnant women diagnosed with oligohydramnios confirmed by ultrasound after 36 weeks
- Primigravida and multigravida will be included
- Patients who are booked or unbooked
- Singleton pregnancy with cephalic presentation
- Non-anomalous fetus
- Patients conceiving through assisted reproductive technology techniques.

Controls

Normal singleton pregnant women with normal AFI and normal NST with no risk factors such as GDM, hypertension, pre-eclampsia, eclampsia, heart disease, thyroid disorders, placenta abnormalities, previous lower segment cesarean section (LSCS), chronic connective tissue disorders, cholestasis, asthma, and autoimmune disorders.

Exclusion Criteria

The following criteria were excluded from the study:

- Pregnant women with gestational age <36 weeks
- Multiple pregnancies
- Pregnant women with risk factors such as eclampsia, GDM, asthma, and autoimmune disorders.

Sample Size

Around 4000 cases come to the hospital per year, out of which 80–85 patients had oligohydramnios over a period of 5 years. Now using Raosoft formula with a 95% confidence interval (CI) and 5% margin error, the sample size is 140 for 2 years.

$$y = Z\,[c/100]\,2r\,[100-r]$$

$$n = Ny\,[N-1]\,E\,2 + y$$

$$E = \text{sqrt}\,[(N-n)y/n(N-1)]$$

Sample size n
Margin of error E (5%)
N is the population size
R is the fraction of response
Z [c/100] is the critical value for CI c (95%).

Total number of patients with confirmed oligohydramnios was 140. Among them, 80 patients had reactive NST and the rest 60 patients had non-reactive NST. These were considered as cases. The rest did not fulfill the inclusion criteria.

For every single case of oligohydramnios, one case of normal MBPP was selected after fulfilling inclusion criteria to compare the obstetric and perinatal outcome.

Total 140 cases were selected out of which:

- 60 cases which had oligohydramnios with non-reactive NST, termed as Group I
- 80 cases with oligohydramnios who had reactive NST were termed as Group II
- 140 controls with normal AFI and normal NST termed as Group III.

Data on neonatal outcome under the following parameters noted:

- Respiratory distress at birth
- Asphyxia (APGAR score at 1 min and 5 min)
- NICU admission
- Birth weight
- Neonatal death
- Need for resuscitation.

The perinatal outcome is considered abnormal[13] if any of the following was present:

1. Antepartum/Intrapartum fetal distress
2. Apgar score at 5 min <7
3. Admission in NICU for >24 h
4. Perinatal death.

All the five criteria of APGAR scoring[14] were taken as shown in table and the following analysis of APGAR score was made.

Apgar score of 7–10 normal, 6–4 mild asphyxia, 0–3 severe asphyxia.

Fetal distress was mainly evaluated in terms of fetal bradycardia, tachycardia, repetitive variable decelerations, and late decelerations.[15]

RESULTS AND OBSERVATIONS

A total of 280 pregnant women were included in the study and the following observations were made.

No significant difference was seen in the age distribution between Group I, II, and III ($P > 0.05$). Mean value of age of patients in Group I was 27.83 ± 3.85 years, in Group II was 27.86 ± 3.77 years, and in Group III was 28.06 ± 4.58 years [Table 1].

No significant difference was seen in the BMI between the three groups ($P > 0.05$). Mean value of BMI in Group I was 25 ± 2.56 kg/m^2, in Group II was 25.08 ± 2.34 kg/m^2, and in Group III was 25.02 ± 1.69 kg/m^2 without any significant difference between them [Table 1].

No significant difference was seen in the gravida and parity between Group I, Group II, and Group III ($P > 0.05$). Majority of patients in all the groups were multigravida; 66.67% in Group I, 71.25% in Group II, and 70.71% in Group III [Table 1].

Gestational age, according to last menstrual period (LMP) and ultrasonography (USG), was significantly different

Signs	0	1	2
Respiratory effort	Absent	Slow, irregular	Good cry
Heart rate	Absent	Slow, below 100	>100
Muscle tone	Flaccid	flexion of extremities	Active body movements
Reflex irritability	No response	Minimum response to stimulation	Prompt response to stimulation
Color	Pale	Pink body, blue extremities	Complete pink

between the three groups (*P* value <.05). Mean value of gestational age on LMP and on USG was significantly higher in Group III followed by Group II and was significantly lower in Group I [Table 1].

Significant difference was seen in the mode of delivery between Group I, Group II, and III ($P < 0.05$) Mode of delivery was LSCS in 88.33% of the patients in Group I as compared to 55% and19.29% of patients in Group II and Group III, respectively [Table 2].

A significant difference was seen amniotic fluid between the groups ($P < 0.05$). About 97.14% of the patients in Group III had clear amniotic fluid as compared to 71.25% in Group II and 26.67% in Group I. On the other hand, 38.33% of the patients had moisture sensitivity level (MSL) in Group I as compared to 8.75% in Group II and 2.14% in Group III [Table 3].

A significant difference was seen in the indication between all the three groups ($P < 0.0001$) 57.86% of the patients in Group III had spontaneous labor as compared to 22.50% in Group II and 0% in Group I. On the other hand, around 50% of patients had either failed induction of labor/fetal distress in Group I [Table 4].

A significant difference was seen in the distribution of mode of delivery between Group I+II as compared to Group III ($P < 0.05$), 78.57% of patients had normal vaginal delivery in Group III as compared to 26.43% of patients in Group I +II. Hence, it can be concluded that patients in Group III had significantly higher chances of normal delivery as compared to Group I+II [Table 5].

A significant difference was seen in the distribution of nature of amniotic fluid between Group I+II as compared to Group III ($P < 0.05$). About 97.14% of patients had clear liquor in Group III as compared to 52.14% of patients in Group I+II [Table 6].

A significant difference was seen in the indication of delivery between Group I+II as compared to Group III ($P < 0.05$). About 57.86% of patients had spontaneous labor in Group III as compared to 12.86% of patients in Group I +II [Table 7].

A significant difference was seen in the distribution of the APGAR score between the two Group I+II versus Group III ($P < 0.05$). About 34.29% of the patients had APGAR score <7 at 1 min and 25% of the patients had APGAR score <7 at 5 min in Group I+II as compared to 1.43% and 0.71% in Group III, respectively [Table 8].

A significant difference was seen in the distribution of the birth weight between Group I+II and III ($P <$

Table 1: Demographic distribution of study participants

Age distribution in years	Group			Total	*P* value	I versus II	I versus III	II versus III	Key
	I (*n*=60)	II (*n*=80)	III (*n*=140)						
20-25	19 (31.67%)	25 (31.25%)	43 (30.71%)	87 (31.07%)	0.544*	0.983*	0.356*	0.382*	*Chi-square test
26–30	29 (48.33%)	38 (47.50%)	56 (40.00%)	123 (43.93%)					#Kruskal–Wallis test
31–35	12 (20.00%)	17 (21.25%)	41 (29.29%)	70 (25.00%)					@Mann–Whitney test
Mean ± Std. dev.	27.83±3.85	27.86±3.77	28.06±4.58	27.95±4.20	0.623#	0.84@	0.414@	0.448@	
Median (IQR)	28 (25–30)	29.5 (27–30)	30(28–32)	29(24.5–30.5)					
Body mass index (kg/m^2)									
Mean ± Std. dev.	25±2.56	25.08±2.34	25.02±1.69		0.913#	0.795*	0.652*	0.942*	#Kruskal–Wallis test
Median (IQR)	25(23–26)	25(24–26)	25(24–26)						*Mann–Whitney test
Gravida									
Primi	20 (33.33%)	23 (28.75%)	41 (29.29%)	84 (30.00%)	0.814	0.692	0.688	0.944	*Chi-square test
Multi	40 (66.67%)	57 (71.25%)	99 (70.71%)	196 (70.00%)					
Parity									
0	23 (38.33%)	24 (30.00%)	42 (30.00%)	89 (31.79%)	0.593	0.264	0.457	0.781	*Chi-square test
1	27 (45.00%)	31 (38.75%)	62 (44.29%)	120 (42.86%)					
2	9 (15.00%)	23 (28.75%)	34 (24.29%)	66 (23.57%)					
3	1 (1.67%)	2 (2.50%)	2 (1.43%)	5 (1.79%)					
Gestational age in weeks									
Last menstrual period Mean ± Std. dev.	37.6±1.61	38.45±1.49	39.28±1.27		<0.0001*	0.001#	<.0001#	0.0001#	*Kruskal–Wallis test
Last menstrual period Median (IQR)	37 (36.143–38)	38 (37–40)	39.29 (38.143–40)						#Mann–Whitney test
Ultrasonography Mean±Std. dev.	35.7±2.37	36.77±2.21	37.97±1.33		<0.0001*	0.003#	<0.0001#	0.0001#	
Ultrasonography median (IQR)	36 (34–37.429)	37.07 (36–38.214)	38 (37.143–39)						

Table 2: Comparison of mode of delivery between Group I, II, and III

Mode of delivery	Group (%)			Total (%)	*P* value	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)					
LSCS	53 (88.33)	44 (55.00)	27 (19.29)	124 (44.29)	<0.0001*	<0.0001*	<0.0001*	<0.0001*
Normal vaginal delivery	5 (8.33)	32 (40.00)	110 (78.57)	147 (52.50)				
vaginal delivery with forceps	2 (3.33)	4 (5.00)	3 (2.14)	9 (3.21)				
Total	60 (100.00)	80 (100.00)	140 (100.00)	280 (100.00)				

*Chi-square test. LSCS: Lower segment cesarean section

Table 3: Comparison of nature of amniotic fluid between Group I, II, and III

Nature of amniotic fluid	Group (%)			Total	*P* value	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)					
Absent	20 (33.33)	13 (16.25)	0 (0.00)	33 (11.79)	<.0001*	<.0001*	<.0001*	<.0001*
Blood mixed	1 (1.67)	3 (3.75)	1 (0.71)	5 (1.79)				
Clear	16 (26.67)	57 (71.25)	136 (97.14)	209 (74.64)				
Moisture sensitivity level	23 (38.33)	7 (8.75)	3 (2.14)	33 (11.79)				
Total	60 (100.00)	80 (100.00)	140 (100.00)	280 (100.00)				

*Chi-square test

Table 4: Comparison of indications of delivery between Group I, II, and III

Indications	Group (%)			Total (%)	*P* value	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)					
2nd stage arrest	0 (0.00)	4 (5.00)	5 (3.57)	9 (3.21)	<0.0001*	0.001*	<0.0001*	<0.0001*
Abruption placenta	2 (3.33)	3 (3.75)	1 (0.71)	6 (2.14)				
Chorioamnionitis	1 (1.67)	1 (1.25)	0 (0.00)	2 (0.71)				
Failed induction of labor	14 (23.33)	19 (23.75)	13 (9.29)	46 (16.43)				
Fetal distress	16 (26.67)	14 (17.50)	7 (5.00)	37 (13.21)				
Forceps delivery	0 (0.00)	0 (0.00)	2 (1.43)	2 (0.71)				
Induction of labor	2 (3.33)	7 (8.75)	7 (5.00)	16 (5.71)				
Induction of labor for Doppler changes	2 (3.33)	1 (1.25)	0 (0.00)	3 (1.07)				
Intrauterine growth restriction with reverse Doppler	3 (5.00)	0 (0.00)	0 (0.00)	3 (1.07)				
Maternal request	2 (3.33)	0 (0.00)	1 (0.71)	3 (1.07)				
NPOL	7 (11.67)	3 (3.75)	3 (2.14)	13 (4.64)				
Pre-labor rupture of membranes	11 (18.33)	10 (12.50)	20 (14.29)	41 (14.64)				
Spontaneous labor	0 (0.00)	18 (22.50)	81 (57.86)	99 (35.36)				
Total	60 (100.00)	80 (100.00)	140 (100.00)	280 (100.00)				

*Chi-square test

Table 5: Comparison of mode of delivery between Groups I+II and III

Mode of delivery	Group (%)		Total (%)	*P* value
	I+II (*n*=140)	III (*n*=140)		
LSCS	97 (69.29)	27 (19.29)	124 (44.29)	<0.0001
Normal vaginal delivery	37 (26.43)	110 (78.57)	147 (52.50)	
Vaginal delivery with forceps	6 (4.29)	3 (2.14)	9 (3.21)	
Total	140 (100.00)	140 (100.00)	280 (100.00)	

LSCS: Lower segment cesarean section

0.05). About 23.57% of the patients in Group I+II had birth weight ≤2500 g as compared to only 0% in Group III. It can be concluded that the birth weight was significantly lower in Group I+II as compared to Group III [Table 9].

A significant difference was seen in the NICU admission distribution between Group I+II and III ($P < 0.05$). About 37.14% of patients in Group I+II required NICU admission as compared to only 2.14% of the patients in Group III [Table 10].

No significant difference was seen in the distribution of the neonatal death between Group I+II as compared to Group III ($P > 0.05$). Neonatal death was seen in only 1.43% of the patients in Group I+II and 0% in Group III [Table 11].

Table 6: Comparison of nature of amniotic fluid between Groups I+II and III

Nature of amniotic fluid	Group (%)		Total (%)	*P* value
	I+II (*n*=140)	III (*n*=140)		
Absent	33 (23.57)	0 (0.00)	33 (11.79)	<.0001
Blood mixed	4 (2.86)	1 (0.71)	5 (1.79)	
Clear	73 (52.14)	136 (97.14)	209 (74.64)	
Moisture sensitivity level	30 (21.43)	3 (2.14)	33 (11.79)	
Total	140 (100.00)	140 (100.00)	280 (100.00)	

Table 7: Comparison of indication of delivery between Groups I+II and III

Indications	Group (%)		Total (%)	*P* value
	I+II (*n*=140)	III (*n*=140)		
2nd stage arrest	4 (2.86)	5 (3.57)	9 (3.21)	<.0001
Abruptio placenta	5 (3.57)	1 (0.71)	6 (2.14)	
Chorioamnionitis	2 (1.43)	0 (0.00)	2 (0.71)	
Failed induction of labor	33 (23.57)	13 (9.29)	46 (16.43)	
Fetal distress	30 (21.43)	7 (5.00)	37 (13.21)	
Forceps delivery	0 (0.00)	2 (1.43)	2 (0.71)	
Induction of labor	9 (6.43)	7 (5.00)	16 (5.71)	
Induction of labor with Doppler changes	3 (2.14)	0 (0.00)	3 (1.07)	
Intrauterine growth restriction with reverse Doppler	3 (2.14)	0 (0.00)	3 (1.07)	
Maternal request	2 (1.43)	1 (0.71)	3 (1.07)	
NPOL	10 (7.14)	3 (2.14)	13 (4.64)	
Pre-labor rupture of membranes	21 (15.00)	20 (14.29)	41 (14.64)	
Spontaneous labor	18 (12.86)	81 (57.86)	99 (35.36)	
Total	140 (100.00)	140 (100.00)	280 (100.00)	

Table 8: Comparison of APGAR between Groups I+II and III

APGAR	Group		Total	*P* value
	I+II (*n*=140)	III (*n*=140)		
At 1 min				
<7	48 (34.29%)	2 (1.43%)	50 (17.86%)	<0.0001*
≥7	92 (65.71%)	138 (98.57%)	230 (82.14%)	
Mean±Std dev	7.12±1.33	8.19±0.75	7.65±1.2	<0.0001#
Median (IQR)	7 (6–8)	8 (8–9)	8 (7–9)	
At 5 min				
<7	35 (25.00%)	1 (0.71%)	36 (12.86%)	<0.0001*
≥7	105 (75.00%)	139 (99.29%)	244 (87.14%)	
Mean±Std dev	7.72±1.37	8.79±0.75	8.26±1.23	<0.0001#
Median (IQR)	8 (6.500–9)	9 (8–9)	8.5 (8–9)	

*Fisher's Exact test. #Mann–Whitney test

Table 9: Comparison of birth weight between Groups I+II and III

Birth weight (in grams)	Group		Total	*P* value
	I+II (*n*=140)	III (*n*=140)		
≤2500	33 (23.57%)	0 (0.00%)	33 (11.79%)	<0.0001*
>2500	107 (76.43%)	140 (100.00%)	247 (88.21%)	
Mean ± Std. dev.	2659.64 ± 405.99	2921.65±159.73	2790.65 ± 334.75	<0.0001#
Median (IQR)	2800 (2560–2901)	2901(2807–2990)	2899(2700 - 2980)	

*Fisher's Exact test, #Mann–Whitney test

DISCUSSION

Oligohydramnios pregnancies need to be identified so that appropriate surveillance and timely intervention can be employed and thus bring down the rate of perinatal morbidity and mortality.[11]

The best method is the one, which aims at identifying the fetus, which is at risk but still in an uncompromised state and requires immediate intervention.

The incidence of potentially preventable perinatal death following a negative MBPP was <1/1000 tested high-risk pregnancies.[16]

Table 10: Comparison of NICU admission >24 h between Group I+II and III

NICU admission >24 h	Group (%)		Total (%)	*P* value
	I+II (n=140)	III (n=140)		
No	88 (62.86)	137 (97.86)	225 (80.36)	<0.0001*
Yes	52 (37.14)	3 (2.14)	55 (19.64)	
Total	140 (100.00)	140 (100.00)	280 (100.00)	

*Fisher's exact test

Table 11: Comparison of neonatal death between Groups I+II and III

Neonatal death	Group (%)		Total (%)	*P* value
	I+II (*n*=140)	III (*n*=140)		
No	138 (98.57)	140 (100.00)	278 (99.29)	0.498*
Yes	2 (1.43)	0 (0.00)	2 (0.71)	
Total	140 (100.00)	140 (100.00)	280 (100.00)	

*Fisher's exact test

Table 12: Comparison of birth weight between Group I, II, and III

Birth weight (in grams)	Group			Total	*P* value	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)					
≤2500	22 (36.67%)	11 (13.75%)	0 (0.00%)	33 (11.79%)	<.0001*	0.002*	<0.0001#	<0.0001#
>2500	38 (63.33%)	69 (86.25%)	140 (100.00%)	247 (88.21%)				
Mean±Std. dev.	2515.95±448.41	2767.41±335.28	2921.65±159.73	2790.65±334.75	<0.0001@	0.0001$	<0.0001$	0.0001$
Median (IQR)	2678 (2285–2835)	2820 (2679–2956)	2901 (2807–2990)	2899 (2700–2980)				

*Chi-square test, #Fisher's exact test, @Kruskal–Wallis test, $Mann–Whitney test

Table 13: Comparison of APGAR between Group I, II, and III

APGAR	Group			Total	*P* value	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)					
At 1 min								
<7	33 (55.00%)	15 (18.75%)	2 (1.43%)	50 (17.86%)	<0.0001*	<0.0001*	<0.0001$	<0.0001$
≥7	27 (45.00%)	65 (81.25%)	138 (98.57%)	230 (82.14%)				
Mean ± Std. dev.	6.48±1.26	7.6±1.19	8.19±0.75	7.65±1.2	<0.0001#	<0.0001@	<0.0001@	0.0004@
Median (IQR)	6 (6–7)	8 (7–9)	8 (8–9)	8 (7–9)				
At 5 min								
<7	28 (46.67%)	7 (8.75%)	1 (0.71%)	36 (12.86%)	<0.0001*	<0.0001*	<0.0001$	0.004$
≥7	32 (53.33%)	73 (91.25%)	139 (99.29%)	244 (87.14%)				
Mean±Std. dev.	7.08±1.57	8.2 ± 0.97	8.79±0.75	8.26±1.23	<0.0001#	<0.0001@	<0.0001@	<0.0001@
Median (IQR)	7 (6–8)	8 (8–9)	9 (8–9)	8.5 (8–9)				

*Chi-square test, $Fisher's exact test, #Kruskal–Wallis test, @Mann–Whitney test

Table 14: Comparison of NICU admission >24 h between Group I, II, and III

NICU admission >24 h	Group (%)			Total (%)	*P* value	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)					
No	21 (35.00)	67 (83.75)	137 (97.86)	225 (80.36)	<0.0001*	<0.0001*	<0.0001#	0.0002#
Yes	39 (65.00)	13 (16.25)	3 (2.14)	55 (19.64)				
Total	60 (100.00)	80 (100.00)	140 (100.00)	280 (100.00)				

*Chi-square test, #Fisher's exact test

During the period of study, the total number of deliveries was 4000 per year. Among them, 140 patients (1.7%) were oligohydramnios at term.

In the present study, the mean age group was 26–30 years. Group 1 was 27.83 years, Group 2 and Group 3 were 27.86 years and 28.06 years, respectively, but the difference in mean age was not statistically significant ($P > 0.05$). A study by Raparthy and Sunithae[11] showed most of the patients belonging to the age group between 21 and 25 years (53%).

Table 15: Comparison of neonatal death between Group I, II, and III

Neonatal death	Group (%)			Total (%)	I versus II	I versus III	II versus III
	I (*n*=60)	II (*n*=80)	III (*n*=140)				
No	58 (96.67)	80 (100.00)	140 (100.00)	278 (99.29)	0.182*	0.089*	-
Yes	2 (3.33)	0 (0.00)	0 (0.00)	2 (0.71)			
Total	60 (100.00)	80 (100.00)	140 (100.00)	280 (100.00)			

*Fisher's exact test

The majority of patients were multigravida in Group I, II, and III in the present study, 66.67%, 71.25%, and 70.71%, respectively [Table 1]. This was not statistically significant ($P = 0.81$). In a study by Sowmya,[17] majority patients were primigravida (46%). Parity is not significantly related to MBPP score in all groups of patients.

Mean gestational age was 37.6, 38.4, and 39.2 weeks in Group I, II, and III according to LMP. Twenty-two patients in Group I and 18 patients in Group II had IUGR, which was confirmed by USG [Table 1]. The gestational age among the three groups was comparable was statistically significant. A similar study by Sowmya[17] in her study stated majority gestational age was 36–37 weeks (43%).

In the present study, 88% of patients had C section when both the parameters of MBPP (Group I) was abnormal compared to 55% when NST was reactive (Group II) and 19.29% when both parameters were normal (Group III). This was statistically significant with $P < 0.0001$ [Table 2]. Similar findings were quoted by Raparthy and Sunithae[11] that the mode of delivery in the study group with respect to the last MBPP result showed that when MBPP was normal with respect to both parameters (37 cases), the incidence of LSCS and vaginal delivery among these were 11 (29.72%) and 26 (70.27%), respectively. When the MBPP is abnormal with respect to both parameters (4 cases), all the 4 (100%) had LSCS. When the MBPP is abnormal with respect to AFI (3 cases), 1 case (33.33%) had LSCS and 2 cases (66.66%) had vaginal delivery.

In a broader outlook, patients with oligohydramnios (Group I + II) had had a high rate of LSCS (69.29%) compared to normal low-risk term pregnancies (19.2%) [Table 5]. Similarly, Dalal and Malhotra,[18] in his study, quoted 41% underwent LSCS.

In the present study, during delivery among 60 patients with both abnormal MBPP (Group I), 38.3% patients had MSL and 33% had absent amniotic fluid compared to 8% and 16%, respectively, in Group II. When both parameters (Group III) were normal, 2% had MSL [Table 3]. This was statistically significant ($P < 0.0001$). In a study by Swetatara and Rashmi,[19] all 9 (100%) cases with both parameters abnormal had thick meconium-stained liquor and 3 (4%) cases of the 68 cases with both normal parameters had thick meconium stained liquor. Thus, it is seen that the incidence of perinatal morbidity with respect to meconium is increased when both MBPP parameters were abnormal, and more so when NST abnormal compared to AFI abnormal when individual parameters were considered.

Rabie *et al.*[20] stated that there was no difference in the rate of MSL in isolated oligohydramnios but increased the chance of meconium aspiration syndrome.

In this study, in oligohydramnios, 21.43% and 23.57% had MSL and absent liquor, respectively [Table 6]. A similar finding was quoted by Sriya and Singhai[21] who had meconium-stained liquor about 54% in her study.

In the present study, among all indications of delivery, it was observed that fetal distress was most common, with 26.67% when both parameters of MBPP were abnormal, of which all cases were delivered by LSCS, compared to 14%, when NST was reactive (Group II). In Group III, 7% of patients had fetal distress. 23.3% had failed induction in Group I, and this was seen even in patients under Group II (23%) compared to 9% in controls (Group III). Around 11% in Group I did not progress in labor compared to 3% in controls (Group II), thereby suggesting liquor playing an important role in induction and progress of labor. Spontaneous labor was more common in Group III (57%) compared to 18% in Group II and none of the patients were observed to undergo spontaneous labor when both the parameters were abnormal (Group I). These findings were statistically significant ($P < 0.0001$) [Table 4]. A study by Maurya and Kushwah[22] supported the above observations, stated that number of LSCS for fetal distress was more, that is, 7 (23.3%) when NST pattern was non-reactive as compared to reactive NST pattern, that is, 6 cases (7.5%).

In the present study, a total (21.43%) of patients with oligohydramnios had a higher rate of fetal distress compared to 7% in normal low-risk pregnancies, similarly naval physical and oceanographic laboratory were more common in oligohydramnios (7.14%) compared to normal pregnancies (2.14%) [Table 7]. A similar finding was stated by Das[23] in his study that out of 25 women (50%) that

developed fetal distress in the study group, 22 (44%) of them underwent C section and 3 (6%) had a forceps delivery.

In the present study, low birth weight was seen higher in Group I (36.67%) compared to Group II (13.75%). None of the babies in Group III were low birth weight. This was statistically significant ($P < 0.05$) [Table 12]. This may be because IUGR is associated with oligohydramnios. Similar studies were quoted by Maurya and Kushwah,[22] 23.3% had birth weight <2 kg. When NST was non-reactive and (11.3%) had birth weight <2 kg when NST was reactive.

In a present study among oligohydramnios, 23.5% had low birth weight and no low birth babies were seen in the control group [Table 9]. This was statistically significant ($P < 0.05$). A study by Shah *et al.*[24] stated 48% of oligohydramnios was associated with low birth weight babies.

Neonatal complications were analyzed on several parameters, including APGAR at 1 min and 5 mins with a score 6 or less at 5 min being associated with bad prognosis and NICU admission.

In the present study, APGAR <7 at 1 min in Group I, II, and III was (55%, 18.7%, and 1.4%) respectively and at 5 min (46.7%, 8.7%, and 0.71%) respectively, thereby suggesting low and no improvement in APGAR score at 5 min in babies of Group I compared to II and III [Table 13]. This was statistically significant ($P < 0.0001$). Sowmya[17] stated that 3 out of 5 patients had APGAR <7 when MBPP was abnormal.

Overall, patients with oligohydramnios had lower APGAR at 1 and 5 min (34.2% and 25%), respectively, when compared to controls (1.43% and 0.71%), l respectively [Table 8]. Similarly, in a study by Mohammed and Jahangir,[25] APGAR <7 at 1 min and 5 min were 38% and 10%.

NICU admission rate was significantly higher in babies born in Group I ($P < 0.05$). In the present study, NICU admission rate was 65% compared to 16.25% in Group II and 2.14% in Group III [Table 14]. Raparthy and Sunithae,[11] in her study suggested, in the last MBPP, when both the parameters were abnormal, 100% of the cases had NICU admission, whereas when only AFI is abnormal, 75% of the cases had NICU admission, thereby suggesting MBPP as a predictor of perinatal morbidity.

Oligohydramnios itself is a predisposing factor for rising NICU admission. In this study, 37.14 % babies were admitted in NICU compared to 2.14% in Group III [Table 10]. In a study by Shah *et al.*,[24] a total of 41% of newborns were admitted in the neonatal ward (NICU) for morbidities.

Despite the best possible interventions and care, 2 newborns in Group I died. Both due to severe birth asphyxia with absent liquor, whereas no neonatal deaths were seen in Group II and Group III [Table 15]. This was not statistically significant ($P = 0.1$). Raparthy and Sunithae,[11] in her study, observed that there were 2 (3.33%) perinatal mortalities.

Overall in the present study, both neonatal deaths occurred in patients in oligohydramnios babies [Table 11]. Both the death was statistically non-significant ($P = 0.4$). Das[23] stated in his study that there were 4 deaths in oligohydramnios group, which was non-significant ($P = 0.1$).

CONCLUSION

MBPP is an easier, less time consuming, cost-effective, and patient compliant test.

- When MBPP is abnormal, it indicates that the fetus may be compromised or increased incidence of perinatal morbidity as well as mortality
- When considered individually, abnormal AFI was associated with an increased incidence of perinatal morbidity
- MBPP can be used as a method of antepartum fetal surveillance test to predict perinatal outcome and provide timely intervention in oligohydramnios pregnancies
- MBPP is a quicker and easier method for fetal antenatal surveillance
- In the presence of oligohydramnios, the occurrence of non-reactive NST, LSCS, meconium-stained liquor, fetal distress, low APGAR scores, low birth weight, and perinatal morbidity is high
- Determination of AFI can be used as an adjunct to other fetal surveillance methods. It helps to identify infants that are at risk of poor perinatal outcome.

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