Study of Influence of Antenatal, Intranatal and Neonatal Factors on NICU Admissions in a Tertiary Hospital in Marathwada Region, Maharashtra, India

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Abstract:-
Background
Neonatal morbidity and mortality globally contribute to a major health burden, and also leads to rising economic burden. Factors leading to neonatal morbidity and subsequent NICU admissions, can be maternal or neonatal. Many of these factors are predictable in a given healthcare setting, and their prevention helps in improvement of neonatal healthcare.

Method
A total of 544 babies requiring NICU admissions, out of 4130 deliveries conducted at our institute, were analysed during a study period of 2 years (October 2018- October 2020). Various antenatal, intranatal and neonatal factors affecting the pattern of NICU admission in our tertiary care centre, were assessed.

Results
Most common antenatal factors leading to NICU admission were preterm labour, Bad Obstetric History in mothers, anemia and foetal growth restriction. Neonatal hyperbilirubinemia was noted to be the most common neonatal factor leading to NICU admisssion. Induction of labor with PGE2 gel was the most intervention leading to NICU admissions. Prematurity was the most common factor leading to neonatal mortality.

Conclusion
Modifiable risk factors when identified and acted upon, improve neonatal outcomes and reduce the stress and economic burden of NICU admissions. Mothers with previous pregnancy losses need to be more carefully monitored throughout pregnancy.

Keywords:- NICU admissions, neonatal morbidity, Prematurity, Neonatal Hyperbilirubinemia.

I. INTRODUCTION

Globally, neonatal health is now considered as a national priority and for long, has been included in the Government plans and schemes. The burden of neonatal morbidity and mortality remains a major health challenge, especially in developing countries. The neonatal period is the most vulnerable and vital time for a child's survival. The current birth rate for India in 2020 was 17.592 births per 1000 people.[1]

Globally, 2.4 million children died in the first month of life in 2019, approximately 6,700 neonatal deaths everyday.[2] A quarter of this global burden of neonatal deaths is contributed by India alone, the World's seventh largest economy, with 6,00,000 newborn deaths each year, with 25.4 deaths per 1,000 live births.[3] The rate of neonatal mortality and morbidity varies widely among the different states of India. According to the Sample Registration System data in 2017, 13 neonatal deaths occur per 1,000 live births in Maharashtra.

Prematurity, infections and birth asphyxia are the most common causes of neonatal morbidity. Besides the vulnerability of newborn, morbidity and mortality also depend upon the level of care. [4]

The various factors which lead to Neonatal Intensive Care Unit admissions include

- NEONATAL FACTORS
  - Prematurity,Low birth weight, IUGR
  - Birth asphyxia / Hypoxic Ischaemic Encephalopathy
  - Respiratory Distress Syndrome – low APGAR scores
  - Sepsis, Hyperbilirubinemia, Meconium Aspiration Syndrome
  - Congenital anamolies, Genetic defects
  - Hypothermia , hypoglycaemia
  - Pneumonia, diarrhea

- MATERNAL FACTORS
  - Parity, Mode of delivery
  - Pregnancy Induced Hypertension, Diabetes mellitus
  - Antepartum Haemorrhage – placenta previa, abruptio placentae
  - Anaemia, Heart disease, Thyroid disorders, Rh negative pregnancy
  - Oligohydramnios, Polyhydramnios, Bad Obstetric History
  - Multiple pregnancy, Previous LSCS, uterine anomalies
  - Liver diseases, viral infections

> Intranatal factors : induction of labour, foetal distress , Premature Rupture Of Membranes

Many of these factors which lead to Neonatal Intensive Care Unit admissions can be identified antenatally. They can be categorised under high risk pregnancy, providing improvised antenatal care with adequatefetal surveillance, so as to bring down the neonatal morbidity and NICU admissions. NICU admissions not only pose an economic burden to the parents but also to the institute's resources and manpower. It also adds to the parental stress andanxiety amongst family members.

A knowledge of causes of neonatal admissions in a given region and respective hospital, helps in proper strategizing of antenatal care plan and surveillance, better preparedness and synchronized team effort. Since our institute being a tertiary centre, caters a large number of high risk patients, we need to pick out the high risk factors commonly found, so that any revision in antenatal surveillance protocols can be formulated accordingly for a better neonatal outcome.

- AIM

To assess the maternal, foetal and iatrogenic factors leading to NICU admissions.

- OBJECTIVES:
  > Detection of antenatal and intranatal risk factors for NICU admissions.
  > To assess neonatal outcome.
  > To assess outcome of NICU admitted neonates.

II. MATERIALS AND METHODS

- **STUDY DESIGN** – Descriptive observational study

- **STUDY CENTRE–** MGM Medical College And Hospital, Aurangabad , Maharashtra.

- **STUDY PERIOD –** October 2018 – October 2020

- **SAMPLE SIZE – 544**

A. METHOD
Detailed antenatal , intrapartum and postpartum history was obtained from the mothers of the babies getting admitted to our NICU. Later, along with antenatal and intranatal factors , perinatal outcome was also analysed.

B. INCLUSION CRITERIA
Babies delivered at MGM Medical College and Hospital who are advised NICU admission at our own NICU or outside NICU,during the hospital stay of the mother.

C. EXCLUSION CRITERIA
- Babies delivered at hospitals other than MGM, Aurangabad and getting admission in our NICU.
- Babies getting admitted after the mother being discharged from the hospital.

NICU admissions were according to the NICU admission criteria of our hospital.

Predesigned questionnaires were filled after eliciting detailed history and noting the findings. The data was compiled in master chart i.e., in MS-EXCEL Sheet and for analysis of this data SPSS (Statistical Package for Social Sciences) Version 20th was used. Frequencies and percentages were calculated to show the distribution. Chi-square test was applied to check significant association between different attributes. Also, the significance level of this test was checked at 0.05.

D. DEMOGRAPHIC DISTRIBUTION

Age	NICU	NON-NICU	Chi-square	p-value
<19 years	5(5.68%)	83(94.3%)		
19-34 years	526(13.6%)	3338(86.3%)	6.341	*0.041**
>34 years	13(7.3%)	165(92.6%)		

Table 1: Comparison Between Nicu And Non-Nicu Admissions Based On Maternal Age

*Chi-square test; p<0.05; statistically significant
From the above table, it can be concluded that maternal age as a factor by itself did not significantly influence NICU admissions.

Inspite of teenage pregnancy being a high risk factor, only 0.9% of mothers in our study were below 19 years of age, probably secondary to better awareness among the public and increased age for girls at marriage.

Address	NICU(n=544)	NON-NICU (n=3586)	Chi-square	p-value
Rural	281(51.7%)	811(22.6%)	204.78	*0.000**
Urban	263(48.3%)	2775(77.3%)		

Table 2: Regional Influence On Nicu Admissions

*Chi-square test; p<0.05; statistically significant

In our study, babies of mothers from rural population (51.7%) had a significant association with NICU admissions when compared to those babies who did not go to NICU, suggesting poor attendance of antenatal check-ups.Another contributing factor could be majority of the population residing in rural areas, owing to country's economic background.

Booking status	Frequency (n = 544)	Percentage %
BOOKED	539	99.08
UNBOOKED	5	0.9

Table 3: Booking Status Of Mother Affecting Nicu Admissions

In our study, though nearly 99.08% of mothers were booked to receive antenatal care, higher incidence of NICU admissions is noted among them because of poor compliance to antenatal visits. This signifies the importance of antenatal visits in bringing down the high risk factors contributing to NICU admissions.

Gravida status	NICU	NON-NICU	Chi-square	p-value
Primigravida	236(43.4%)	1752(48.9%)	367.79	0.000*
Multigravida with pregnancy loss	163(30%)	196(5.47%)		
Multigravida without pregnancy loss	145(26.7%)	1633(45.6%)		

Table 4: Parity Of Mother Influencing Nicu Admissions

*Chi-square test; p<0.05; statistically significant

In our study, Gravida status of the mother had significant effect on NICU admissions with 30% of multigravida with pregnancy loss having the strongest association followed by primigravida. Multigravida with pregnancy loss had higher incidence of preterm delivery (26.1%) compared to multigravida without pregnancy loss (11.4%) and subsequent NICU admissions.

E. RISK FACTOR ASSESSMENT

Antenatal factors	Frequency (n = 544)	Percentage %
Preterm labour	154	28.30
BOH	125	22.97
Anaemia	100	18.38
Oligohydramnios	88	16.17
Previous LSCS	87	15.99
None	71	13.05
PIH / chronic Hypertension	67	12.31
FGR	58	10.66
Post-dated pregnancy	44	8.08
Thyroid disorders	36	6.61
Malpresentation	29	5.33
RH isoimmunization	24	4.41
APH (placenta previa/ abruption)	16	2.94
Multiple pregnancy	16	2.94
Diabetes mellitus	15	2.75
Viral infections	11	2.02
Gestational thrombocytopenia	11	2.02
Polyhydramnios	10	1.83
Liver diseases	6	1.10
Heart disease	3	0.55
Uterine anomaly	3	0.55
Others	3	0.55
Renal diseases	1	0.18

Table 5: Antenatal Factors Contributing To Nicu Admissions

In our study, most common antenatal factor contributing to NICU admission was preterm labor with an incidence of 28.3%, followed by Bad Obstetric History (22.9%) among the mothers. Of these BOH mothers, nearly 28.8% were associated with preterm labour, 14.4% had oligohydramnios, 11.2% had pre-eclampsia and 3.2% of these mothers were postdated.

Inspite of widespread Government Programmes and awareness campaigns to reduce the incidence, especially in a developing country like ours, Anemia (18.38%) was the next most common factor, probably owing to irregular follow-ups and poor compliance to the therapy.

The next common factor found was oligohydramnios with an incidence of 16.17%, probably secondary to respiratory distress among these neonates.

Subsequent common factor in my study was previous LSCS (15.99%) mostly secondary to transient tachypnea, followed by PIH/chronic hypertension (12.31%).

Intranatal factors	Frequency (n = 194)	Percentage %
PROM	57	29.38
Induction of labour	99	51.03
Fetal distress	38	19.58

Table 6: Intranatal Factors Contributing To Nicu Admissions:

In our study, Induction of labour was the most common intranatal factor (51.03%) leading to NICU admission followed byPremature Rupture Of Membranes(29.38%).

F. NEONATAL ASSESSMENT

Neonatal factors	Frequency	Percentage %
Hyperbilirubinemia	181	33.27
Observation	100	18.38
Respiratory Distress	99	18.19
Low birth weight	98	18.01
Prematurity	91	16.72
Sepsis	52	9.55
FGR	33	6.06
Birth asphyxia	28	5.14
Meconium Aspiration Syndrome	12	2.20
Congenital malformations	12	2.20
Convulsions	2	0.36

Table 7: Neonatal Factors Contributing To Nicu Admissions

In our study, most common neonatal factor noted to have led to the NICU admission was neonatal hyperbilirubinemia contributing 33.27% of the cases, in contrary to findings of many studies in the past; which was followed by Low Birth Weight (18.01%) , Respiratory Distress Syndrome (18.19%) and prematurity (16.72%).

Baby's sex	Frequency (n = 544)	Percentage %
Female	230	42.3
Male	314	57.7

Table 8: Gender Based Admission Pattern

Babies requiring NICU admission in my study, had a slight male preponderance with an incidence of 57.7%, partly because of relatively well developed lungs among the female neonates.

Neonatal Outcome	Frequency (n = 544)	Percentage%
Improved	500	91.9
DAMA	12	2.2
Death	31	5.7
Lost to follow up	1	0.2

Table 9: Outcome Amongst Nicu Inmates:

In our study, 91.9% of them recovered and were sent home with their mothers, implying one of the best intensive cares offered in the region. Nearly 5.7% of babies died secondary to multiorgan failure.

Neonatal factors in babies with death as outcome	Frequency (n = 65)	Percentage%
Prematurity	21	32.30
Low birth weight	20	30.76
Respiratory distress	11	16.92
Birth asphyxia	5	7.69
Congenital malformations	3	4.61
FGR	2	3.07
Meconium aspiration syndrome	2	3.07
Sepsis	1	1.53

Table 10: Causes Of Death Amongst Nicu Admissions

In my study, prematurity (32.30%), especially with gestational age less than 34 weeks and Low Birth Weight (30.76%), were found to be the leading factor for neonatal deaths.

5 out of 28 babies (17.8%) admitted for birth asphyxia succumbed and rest had a favorable outcome, suggesting better neonatal care offered.

III. DISCUSSION

In our study, a total of 544 babies required Neonatal Intensive Care Unit admissions out of 4125 deliveries. They were evaluated to study the various maternal and neonatal factors and how these factors affected the NICU stay, duration and outcome. The incidence of NICU admissions in our study was 13.18%, a similar incidence of 11.1% was found by Shafagh Fallah et al in their study.[5]

In our study, only 0.9% of mothers were less than 19 years of age, inspite of teenage pregnancy being a high risk factor, a finding similar to study by Abayneh Girma Demisse et al[6].The low incidence of teenage pregnancy in our area probably signifies better awareness among the public. This incidence can be further reduced by providing sex education to the teenage girls in their schools and colleges and arranging lectures in health camps.

In our study, 51.7% of mothers whose babies went to NICU were from rural population compared to 22.6% of mothers from rural area whose babies did not go to NICU. The data regarding rural or urban population predominating as a factor for NICU admission in the country is limited. However, Preeti Raikwar et al observed neonatal morbidity rate of 36.6% among NICU inmates who were mostly from rural area.[7] This high incidence signifies poor awareness regarding the need for antenatal care among rural population, less attendance of antenatal check-ups, probably secondary to poor transportation facilities, illiteracy and ignorance contributing to the burden of NICU admissions.

As per findings of our study, 99.08%% of mothers had booking for antenatal visits. However, such large number of babies of booked mothers getting admitted to NICU stresses on the importance of adequacy of number of antenatal visits, vigilance needed to pick up high risk factors and institution of early interventions, and not just mere booking. Most of these mothers were from rural areas.

0.9% of the patients were unbooked, not having any antenatal visits and directly attending the delivery room in labour and inevitably their babies going to NICU.

In our study, 43.4% of the mothers were primigravida, compared to 48.9% of babies of primigravida not requiring NICU admissions. Primigravida is an independent risk factor as proven by many other studies like Abdifatah Elmi Farah et al where in babies of primigravida contributed to 71.2% of NICU admissions.[8] However , primigravida status by itself did not determine NICU admissions in our study.

In our study, significant number of mothers i.e.,30% were multigravida with a previous pregnancy loss either in the form of previous abortions or deaths, which is a high risk factor in this pregnancy, as concluded by many studies. This finding was statistically significant compared to 5.47% of babies of multigravida with previous pregnancy loss who did not need NICU care, similar to a study by Fengxiu Ouyang et al[9].

Among multigravida with previous pregnancy losses, preterm birth was seen in nearly 26.1% of mothers, which strongly favored NICU admission.

As per the findings of our study, Preterm labour was found to be the most common antenatal factor contributing to NICU admissions with an incidence of 28%, similar to Syed R Ali et al (27.9%)[10].

In our study, subsequently higher NICU admission rates of 22.9% were found among neonates of mothers with a Bad Obstetric History. Of these BOH mothers, 28.8% had preterm labour, 14.4% had oligohydramnios, 11.2% had pre eclampsia and 3.2% of these mothers were post dated. We also found that, 82.4% of mothers had previous abortions and 40% of mothers had previous deaths.

This concludes that among previous pregnancy losses affecting present pregnancy, previous abortions and previous deaths had significant effect on neonatal morbidity, similar to Fengxiu Ouyang et al[9].

In our study, anemia was found to be the third most common antenatal risk factor for NICU admission with an incidence rate of 18.38%. Out of these, 23% of mothers had severe anemia, which resulted in Foetal Growth Restriction, as concluded by Tara Manandhar et al with 12% incidence of FGR.[11]

Higher incidence could probably be secondary to poor number of antenatal visits and non-compliance to oral iron

therapy. Most common causes of anemia include nutritional deficiency, inadequate spacing between the births, poor compliance to oral iron therapy and physiological anemia.

In our study, only 5.2% of mothers, among those who had induction of labour with Prostaglandin E2 gel, landed up in foetal distress, However Angela P.H. B urges et al found induction of labour with prostaglandin E2 gel to be a significant predictor of NICU admissions (24.7%).[12] Hence, if well monitored , induction of labour might not significantly contribute to foetal distress.

In our study,33.27% of NICU admissions were due to neonatal hyperbilirubinemia and hence the most common neonatal factor. However this finding is contradictory to many studies including to the study conducted by Jyotsna Verma et al who found Low Birth Weight (54%) to be the most common cause[13].

According to our study, the next most common reason for babies being shifted to NICU was for observation with an incidence of 18.38%, which is followed in our hospital for the safety purpose and better outcomes of neonates.

Among those babies shifted to NICU within first 48 hours, all babies had respiratory distress, with an incidence of 21.56%, followed by low birth weight (20.26%) and prematurity (19.38), which were the next leading causes for NICU admissions.

In our study, male neonates contributed to 57.7% of NICU admission, showing a preponderance similar to study conducted by Abayneh Girma Demisse et al (58.3%)[6]. This male preponderance is probably due to relatively lesser incidence of respiratory distress among female neonates owing to well developed lungs.

91.9% of the babies admitted to our NICU recovered and were sent home with their mothers, probably signifying one of the best neonatal intensive cares offered in the region. 5.7% of the babies succumbed secondary to multiorgan failure.

Most common cause of neonatal mortality was prematurity (32.3%), a finding similar to study by Narayan R et al, however they found much higher rates of mortality among premature infants of upto 62%.[14]

Low birth weight was the next common cause for neonatal death contributing upto 30.76% of neonatal deaths in our study.

5 out of 28 babies (17.8%) admitted for birth asphyxia succumbed in our study, a finding similar to study by Narayan R et al (20.69%)[14].

IV. CONCLUSION

Incidence of NICU admission at our institute was found to be 13.18%, though seems to be a smaller figure, still points out the inadequacy of antenatal surveillance and the need for revision of protocols at the institute. Lesser incidence of teenage pregnancy(3.22% ; n= 4125) was noted in our study indicating better awareness and raised legal age of girls at marriage.

Incidence of NICU admission was higher among mothers from rural population (51.7%), reflecting inadequacy of antenatal care and higher rates of illiteracy. Hence, each antenatal visit should be considered as a golden opportunity to educate these mothers and screen for possible factors as well, since these might be their only possible contacts with healthcare system.

Though 99.08% of mothers were booked, higher rates of NICU admissions of 70.2% were found among mothers who were irregularly booked during their antenatal period, especially booked at hospitals other than our institute.

Parity of the mother influenced NICU admissions with Multigravida with previous pregnancy loss (30%), specially previous abortions, having the strongest association.

Preterm labour was the most common antenatal factor leading to NICU admissions with an incidence of 28.30%, a higher incidence noted among multigravida with previous pregnancy losses. Bad obstetric history among the mothers (22.97%) not only affected the neonatal outcome but also determined the intranatal course and monitoring in this pregnancy. Anemia (18.38%) in the mother, oligohydramnios (16.17%) and Foetal Growth Restriction (10.66%) were other significant contributory factors for NICU admission in our study. Strict monitoring of labour, when induced with Prostaglandin E2 gel, did not significantly lead to foetal distress.

Neonatal Hyperbilirubinemia (33.27%) was the most common cause for NICU admission, secondary to poor breastfeeding techniques and resultant dehydration in the neonates. Hence this factor can be eliminated as the cause by teaching the art of breastfeeding to expectant mothers and stressing on the importance of early initiation and exclusive breastfeeding, during their visit to antenatal clinics.

Respiratory distress was most commonly associated with prematurity and low birth weight babies, and almost all of these babies were shifted to NICU within first 48 hours of birth. Improving maternal malnutrition, correcting pre-existing anemia and ruling out causes for prematurity during antenatal period significantly improves the neonatal outcome and cuts down the cost and stress of NICU admissions.

Mortality was noted to be significantly higher among preterm neonates (32.3%).Favourable outcome was noted in 91.9% of the babies, reflecting the quality of care being offered at our institute.

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