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Original Research Article

A Study of Outborn Referred Neonates Admitted at a Tertiary Care NICU

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Abstract

Background and Aim: The survival perspective of extramural neonates significantly relies on the state of neonate at admission. This study was undertaken to analyze clinical, demographic and transport characteristics of external referred neonates. It was also designed to delineate correlation of TOPS score with outcome of referred neonates.

Material and Methods: Present Prospective Observational Study conducted at NICU of a Nootan General Hospital affiliated with Nootan Medical College & Research Centre, Visnagar, Gujarat during October 2022 to September 2023. Clinico- demographic characteristics including details of pregnancy, birth history, sex, weight on admission, transport details, clinical status on admission, and indication of admission, course during hospital stay, final diagnosis and final outcome were recorded in a pre-designed proforma. TOPS score was documented as observed on arrival of neonates to NICU.

Results: Out of 120 neonates 70 (58.3%) were males and 50 (41.6%) were females. Male: female ratio came to be 1.40:1. 67 out of 120 (55.83%) neonates were in early neonatal period (7 days old) including 15 neonates who were <24 hours old. 53 (44.16%) neonates were >7 days old. The main indications for admission were neonatal jaundice, probable sepsis and respiratory distress syndrome. Hypothermia was present in 37.5% (45/120) of neonates on admission. 12.5% (15/120) had poor perfusion, 11.6% (14/120) were hypoxic and hypoglycemia was detected in 2.5% (3/120) neonates.

Conclusion: In order to reduce neonatal mortality rate in the country, strengthening of neonatal services is an essential step. Establishment and strengthening of SNCUs and Janani shishu suraksha karyakram (JSSK) are important steps taken by the government in this direction.

Introduction

The first 28 days of life – the neonatal period is the most vulnerable time for child's survival. The neonatal mortality rate in India is 21.66/1000 live birth. [1] Newborns require special attention and care to achieve the "Sustainable Development Goal 3" which aims to reduce the NMR to as low as 12 per thousand live births. [2]

Common causes for neonatal death are prematurity, birth asphyxia and septicemia. Effective management of sick neonates requires specialized neonatal intensive care units with well-trained human resources. As all medical centers are not capable of providing appropriate level of care to the neonates, these neonates have to be transported to the dedicated SNCU (Sick newborn care unit). Though in-utero transport is safest but many perinatal illnesses cannot always be anticipated resulting in continued need of transport of sick neonate. Prematurity, respiratory distress syndrome, severe birth asphyxia, hypoxic respiratory failure requiring mechanical ventilation, convulsion and congenital anomalies are common conditions requiring transfer. These critically ill neonates have to undergo various hazards like noise, vibration, temperature instability and non-aseptic environment, all of these can further destabilize the sick neonate who is already struggling hard to maintain normal homeostasis. A reasonable delay in arranging required facilities may compromise the condition of the neonate .Neonatal transport without pre referral communication may create chaos at receiving unit due to vacancy issues. Hence preparedness at the receiving unit is also equally important.

For strengthening of neonatal services in the country, funds were provided to the states for SNCU (Sick newborn care unit), Newborn stabilization unit (NBSU) and NBCC (Newborn baby care corners). Navjaat Shishu Suraksha Karyakram (NSSK) and Janani Shishu Suraksha Karyakram (JSSK)

launched by government at India also highlight the role of safe neonatal transport. 108 neonatal ambulance services are already established in Tamil Nadu and Goa. [3] Such pilot projects are also initiated in Gujarat.

The survival perspective of extramural neonates significantly relies on the state of neonate at admission. Various survival scores like CRIB (Clinical risk Index for babies), SNAP (Score for neonatal Acute physiology), MINT (Mortality index for neonatal transport), TRIPS (Transport risk index of physiological stability), TOPS (Temperature, oxygen, saturation, skin perfusion and blood sugar level) etc. are designed to prognosticate the outcome of neonate at admission. Many of them are time consuming and require sophisticated instruments and trained personnel. TOPS score devised by Mathur'et al is quick, easy to use and without subjective variation. [4]

This study was undertaken to analyze clinical, demographic and transport characteristics of external referred neonates. It was also designed to delineate correlation of TOPS score with outcome of referred neonates.

Material and Methods

Present Prospective Observational Study conducted at NICU of a Nootan General Hospital affiliated with Nootan Medical College & Research Centre, Visnagar, Gujarat during October 2022 to September 2023.

Inclusion Criteria:

All extramural neonates admitted NICU during study period.

Exclusion Criteria:

Neonates who left against medical advice (LAMA) or transferred to another health care facility for specific management (e.g. Cardiology, paediatric surgery) were excluded as their survival analysis is not possible.

All extramural neonates satisfying inclusion criteria were enrolled in the study. Informed written consent was obtained from parents or guardian of neonates. Clinico- demographic characteristics including details of pregnancy, birth history, sex, weight on admission, transport details, clinical status on admission, and indication of admission, course during hospital stay, final diagnosis and final outcome were recorded in a pre-designed proforma. Neonates were classified as facility referred if they were referred from another health care facility, rest were classified as community referred.

Following transport details were included: Transport vehicle, accompanying person, referring center and pre-transport intervention or stabilization.
The referred documents were categorized as 'No document', 'inadequate document' and 'adequate document'.
TOPS score was documented as observed on arrival of neonates to NICU. It includes:
1. Temperature assessed by digital thermometer in axilla.
2. Oxygenation by measuring SPO2 with help of Pulse-oximeter. (silver line)
3. Perfusion by capillary refilling time (CRT on mid-sternum)
4. Sugars by one touch glucometer.
Hypothermia, Hypoxia, prolonged CRT and Hypoglycemia were defined as <36.5C, <90%, ≥3 secs and <40mg/dl respectively. Each parameter was assigned a score of '1' if abnormal and '0' if normal. Total TOPS score (an aggregate score of all 4 parameter) for each neonate was calculated on admission. Individual and aggregate TOPS score were related with short term outcome; expired or survive.

Results and Discussion

Total 450 NICU admissions were recorded during the study period; out of them 310 (68.8%) were intramural and 140 (31.11%) were extramural. Out of 140 extramural neonates, 18 took LAMA and 2 neonates with complex congenital heart disease were transferred to cardiac institute, so were excluded from the study, hence total 120 extramural neonates were considered.

Table 1: Demographic profile of extramural neonates (n=120)

Gender	Males – 70	Females – 50	1.40:1*
Age at Admission	≤ 7 days – 67	> 7 days – 53	8.86±7.68**
Weight at admission	< 2.5 kg – 131	≥ 2.5 kg – 108	2.37±0.58**
Gestational Age	< 37 weeks – 54	≥ 37 weeks – 66	1.20:1*
Place of delivery	Institutional – 115	Home – 5	28.80:1*
Referred from	Community – 100	Health facility – 20	4.60:1*

*indicates ratio

**indicates mean +/- Standard deviation

Out of 120 neonates 70 (58.3%) were males and 50 (41.6%) were females. Male: female ratio came to be 1.40:1. According to Niti Aayog's 2013-15 report, the birth ratio of Gujarat was 1.17:1. [5] Similar studies done by suresh kumar et al and venkateswaran et al have observed male to female ratio of 1.47:1 and 1.43:1 respectively. [6,7]

67 out of 120 (55.83%) neonates were in early neonatal period (7 days old) including 15 neonates who were <24 hours old. 53 (44.16%) neonates were >7 days old. The mean age at admission was 8.86 days. 45% (54/120) neonates were weighing > 2.5kg on admission. 55% (66/120) were weighing between 1.5-2.5kg. Mean weight on admission was 2.37±0.58kg. Out of 120 babies, 62(51.66%) were born at full term of gestation, 54(45%) were preterm babies and 4 3.33%) neonates were post term.

Table 2: Pattern of referral extramural neonates (n=120)

Place of referral	No. of referred neonates
Referred from community	99 (82.5%)
Referred from health care facility	21(17.5%)
Mode of transport	
108 ambulance	10(8.3%)
Two wheeler	41(34.16%)
Auto rickshaw	68 (56.6%)

Out of 120 extramural neonates, 68 (56.6%) were transported by auto rickshaw, 41(34.16%) by two wheeler and 10(8.3%) were transported by ambulance. Buch Punkaj et al and Manish Narang et al had reported transport by ambulance 26.8% & 29.6% respectively. [8,9] As majority of patients are referred from community, transport was arranged by relatives. Out of 21 facility referred neonates, 9 were transferred by ambulance, 6 were transferred by auto rickshaw and 6 by two wheeler. 12 neonates referred from other health care facility, were transported by self arranged transport despite of availability of 108 free ambulance transfer service. So awareness regarding use of 108 ambulance service should be promoted in the community and private hospitals should also be sensitized to transfer sick neonates in a well-equipped ambulance even if they took LAMA (leave against medical advice) from their hospital. Community referred neonates outnumber the facility referred neonates, as our institute is located in urban area; awareness regarding seeking health care is likely to be more. Our institute caters majority of patients from urban slums and under JSSK program even level 3 NICU care is provided free of cost, so care givers might have preferred it.

Out of 21 neonates referred from other hospitals, pre-transfer communication was not done in any of the neonates. Only 42.80 %(9/21) babies were accompanied by paramedical staff and none of them were accompanied by doctor. Zankhana et al had observed appropriate required documents in 63% of neonates. [10]

Table 3: Indication of admission tops score and outcome (n=120)

*Indication of admission	TOPS Score					RECOVERED	EXPIRED	TOTAL
	0	1	2	3	4			
Neonatal jaundice	33	12	0	0	0	45 (100%)	0(0%)	47 (37.5%)
RDS	8	3	1	7	0	13 (72.2%)	5 (26.31%)	18 (15%)
probable sepsis	11	7	3	0	0	20(90.9%)	2(9.09%)	22(18.33%)
Feeding difficulty	6	2	1	1	0	10(100%)	0(0%)	10(8.33%)
wt. loss	3	1	0	0	0	4 (100%)	0(0%)	4 (3.33%)
Fever	4	0	0	0	0	4 (100%)	0(0%)	4(3.33%)
Shock	0	0	1	2	1	1(25%)	3(75%)	4(3.33%)
Perinatal asphyxia	0	1	0	2	0	1(33.3%)	2(66.6%)	3(2.5%)
Preterm/ LBW	1	2	0	0	0	2(66.6%)	1(33.3%)	3(2.5%)
MAS	1	0	0	1	0	1(50%)	1(50%)	2(1.66%)
Neonatal convulsion	1	1	0	0	0	2(100%)	0(0%)	2(1.66%)
Others	2	1	0	0	0	3 (100%)	0(0%)	3(2.5%)
Total	70	30	6	13	1	106 (88.33%)	14(11.6%)	120

The main indications for admission were neonatal jaundice, probable sepsis and respiratory distress syndrome. In study done by Manish Narang et al, RDS (45%) followed by prematurity (22%) were the common indications for referral. [9] The common indications for referral were RDS, perinatal asphyxia and prematurity in a study done by Suresh Kumar Verma et al. [6]

Neonatal jaundice was the commonest indication of admission of extramural neonates in this study. Majority of cases of jaundice can be managed at maternity units also, if facility of phototherapy and consultation by pediatrician is arranged. So SNCU beds of tertiary care hospitals can be utilized for the care of critical neonates.

Hypothermia was present in 37.5% (45/120) of neonates on admission. 12.5% (15/120) had poor perfusion, 11.6% (14/120) were hypoxic and hypoglycemia was detected in 2.5% (3/120) neonates. All of the above are modifiable risk factors which need to be addressed by appropriate stabilization before transport. Study by Ekta et al had depicted hypothermia as the highest altered parameter (55.3%) followed by hypoxia (27.4%), poor perfusion (23.4%) and hypoglycemia (20.6%). [11]

There was a significant difference between the survived and expired groups in terms of distribution of Temperature. In studies done by Suresh Kumar et al and Dalal Ekta et al, 46.67% and 55.3% of neonates were hypothermic. [6,11] There was a significant difference between the survived and expired groups in terms of distribution of Oxygenation ($\chi2$ = 122.636, p = <0.001). Suresh Kumar et al and Ekta Dalal et al had observed occurrence of hypoxia in 39.23% and 27.4% neonates respectively. [6,11] In our study, 11.2% of neonates were hypoxic which is lower than other studies. There was a significant difference between the survived and expired groups in terms of distribution of Perfusion ($\chi2$ = 103.563, p = <0.001). Poor perfusion is predictor of poor prognosis and it depict that derangement has started long back. Study done by Suresh Kumar et al has observed 14.61% of neonates had poor perfusion on admission. [6]

97.5% (117/120) neonates had score 0 (RBS≥ 40mg/dl) for sugar parameter and 2.5% (3/120) of neonates had score 1 (RBS<40mg/dl) on admission. Out of 3 hypoglycemic neonates, 1 expired while 12 neonates expired who were not hypoglycemic. There was no significant difference between the survived and expired in terms of distribution of Sugar ($\chi2$ = 0.561, p = 0.414). Hypoglycemia on admission is not significantly associated with mortality.

Table 4: Comparison of the 2 subgroups of the variable outcome in terms of tops total (n = 120)

TOPS Total	Outcome		Wilcoxon-Mann- Whitney U Test	
	Survived	Expired	W	p value
Mean (SD)	0.42 (0.72)	2.58 (0.93)	349.500	<0.001
Median (IQR)	0 (0-1)	3 (2.75-3)		
Range	0 – 3	0 - 4		

The variable TOPS Total was not normally distributed in the 2 subgroups of the variable Outcome. Thus, non-parametric tests (Wilcoxon-Mann-Whitney U Test) were used to make group comparisons. The mean (SD) of TOPS Total in the Outcome: Survived group was 0.42 (0.72). The mean (SD) of TOPS Total in the Outcome: Expired group was 2.58 (0.93). The median (IQR) of TOPS Total in the Outcome: Survived group was 0 (0-1). The median (IQR) of TOPS Total in the Outcome: Expired group was 3 (2.75-3). The TOPS Total in the Outcome: Survived ranged from 0 - 3. The TOPS Total in the Outcome: Expired ranged from 0 - 4. There was a significant difference between the 2 groups in terms of TOPS Total (W = 349.500, p = <0.001), with the median TOPS Total being highest in the Outcome: Expired group.

Table 5: Diagnostic parameter of tops score

Parameter	Value (95% CI)
Cutoff (p value)	≥ 2 (<0.001)
AUROC	0.932 (0.874 - 0.99)
Sensitivity	83.3% (63-95)
Specificity	93.0% (89-96)
Positive Predictive Value	57.1% (39-74)
Negative Predictive Value	98.0% (95-99)
Diagnostic Accuracy	92.1% (88-95)
Positive Likelihood Ratio	11.94 (7.1-20.09)
Negative Likelihood Ratio	0.18 (0.07-0.44)
Diagnostic Odds Ratio	66.67 (20.18-220.21)

AUC near to 1 in ROC means the test has good measure of separability. Higher the curve above the diagonal and more towards the left the test is considered significant. The area under the ROC curve (AUROC) for TOPS Total predicting Outcome: Expired vs Outcome: Survived was 0.932 (95% CI: 0.874 - 0.99), thus demonstrating excellent diagnostic performance. It was statistically

significant (p = <0.001). At a cutoff of TOPS Total ≥2, it predicts Outcome: Expired with a sensitivity of 83%, and a specificity of 93%. The odds ratio (95% CI) for Outcome: Expired when TOPS Total is ≥2 was 66.67 (20.18-220.21).

For prediction of mortality, hypothermia was found to be the most sensitive parameter followed by total TOPS score cut off (≥2), while hypoglycemia was found to be the most specific parameter followed by hypoxia. Hypoxia had highest diagnostic accuracy (94.6%) followed by hypo perfusion (92.9%) while total TOPS ≥2 had diagnostic accuracy of 92.1%.

Presence of hypothermia, hypoxia, poor perfusion and raised TOPS score on admission were significantly associated with mortality. Out of 120 neonates 14 (11.66%) neonates expired and 106 (88.33%) survived, the most common cause of death was sepsis, followed by RDS, birth asphyxia and MAS.

The survival perspective of extramural neonate does not rely only on the quality of neonatal intensive care, but also on the state of neonate at admission. Once irreversible cellular injury sets in, any extent of efforts to revive the baby may become unsuccessful.

Conclusion

T Total 450 NICU admissions were recorded during the study period; out of them 310 (68.8%) were intramural and 140 (31.11%) were extramural. Out of 140 extramural neonates, 18 took LAMA and 2 neonates with complex congenital heart disease were transferred to cardiac institute, so were excluded from the study, hence total 120 extramural neonates were considered. Common indications for admission were neonatal jaundice, probable sepsis, RDS, feeding difficulties, weight loss, perinatal asphyxia, meconium aspiration syndrome and neonatal convulsion. In order to reduce neonatal mortality rate in the country, strengthening of neonatal services is an essential step. Establishment and strengthening of SNCUs and Janani shishu suraksha karyakram (JSSK) are important steps taken by the government in this direction. Strengthening of in utero transfers, promotion of institutional deliveries and establishment of small health setups for neonatal care will minimize the need and complications of neonatal transfer. Pre-transport stabilization and appropriate communication is a very vital step in the process of transport. Facility of well-equipped and dedicated 108 neonatal ambulances with skilled personnel must be augmented.

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