Original Article

DOI: 10.7860/IJNMR/2021/46275.2286

Paediatrics Section

Outcomes of Sick Neonates Transported to a Tertiary Care Hospital by a Trained Team, in Northern India

BIJAYLAXMI BEHERA[1], BABU LAL MEENA[2]

ABSTRACT

Introduction: In developing countries, like ours, the major causes of neonatal mortality are Prematurity, Birth asphyxia and Sepsis. Although institutional delivery and in utero transport of newborn is the safest way to transport but it is difficult to anticipate preterm deliveries and perinatal illnesses. Moreover, transport with a well equipped and manned team improves neonatal outcomes than self transport. Hence, with the above hypothesis this study was conducted to analyse the profile of newborn babies transported to our unit by our team.

Aim: To study the outcome of the sick neonates transported by a well equipped and manned neonatal transport to a Tertiary Care Hospital, indications of transport and also evaluate their condition at arrival.

Materials and Methods: This was a retrospective longitudinal descriptive study, including 101 extramural neonates who were transported by a well equipped and manned team, to a Tertiary Care Hospital in Northern India. Transport details along with demographic parameters and clinical features prior to transport and at arrival were recorded. Follow-up was done for all neonates till discharge or death. Transport, clinical variables and Score for Neonatal Acute Physiology-Perinatal Extension II (SNAPPE-II) were correlated with outcome using logistic regression analysis.

Results: Total 101 newborn infants were transported. Fifty-eight babies were term and 43 were preterm. Birth asphyxia, Meconium Aspiration Syndrome, Hyaline Membrane Disease, Transient Tachypnea of Newborn, Congenital Cyanotic Heart Disease, Neonatal Jaundice, Pneumonia, Hypoglycaemia, Preterm, Fever, Feed intolerance were the major indications for transport. Total 16 neonates died. Out of all babies at admission, 14.8% of babies were still hypothermic, 10.8% were still hypoxic, 4.9% were still hypoglycemic and 14.8% were still in shock. SNAPPE score >40, hypoglycaemia, hypothermia, hypoxia and shock correlated with poor outcome. Distance did not correlate with the outcome.

Conclusion: Stabilising newborns prior to transport is crucial and neonatal transport is not dependent on distance. Hypothermia, hypoglycaemia, hypoxia and shock should be managed in neonates before and during transport as they affect their outcomes.

Keywords: Ambulance, Hypothermia, Mortality, Neonatal, Score for neonatal acute physiology-perinatal extension score-II, Transport

INTRODUCTION

Neonatal transport is an evolving concept in the Indian scenario. Although the safest method of transport is in utero transfer but unfortunately, it is difficult to anticipate preterm delivery, perinatal illness and congenital malformations, thus resulting in transfer of babies postnatally [1-3]. Although treatment of sick neonates in Tertiary Care Units has been associated with decrease in mortality and morbidity, having an organised and developed emergency neonatal transport system is an important component in the regionalisation of perinatal care [1-3]. According to the target of World Health Organisation (WHO), as per Millennium Development Goal (MDG), timely treatment of complications for newborns is one of the key strategies is to reduce under-five mortality rate by two-thirds [4,5]. Increased number of deliveries and poorly organised system of neonatal transport in developing countries are definite hurdles for achievement of the same. Most neonatal transport in India is done by self in private vehicles or the source hospital by utilising private ambulances and semi-trained or ill-trained personnel. The risk can increase in case of less experienced staff, than with well-equipped and trained staff [6-8]. Navjat Shishu Suraksha Karyakram (NSSK) launched by Government of India also emphasises the role of safe neonatal transport [9]. Few studies done earlier have shown that mortality almost doubles as the transport time increases and most of the children arriving after a prolonged transport were cold, hypoglycaemic or hypoxic [10]. Short-term outcomes such as the clinical condition of the newborns at admission to the NICU and within 24 hour of admission are important indicators of the effectiveness of specialised transport teams [10,11]. To the best of our knowledge there is only one published data about the efficacy of a well equipped neonatal transport of a Tertiary Care Centre in India, by the index hospital itself and all other studies have depicted the outcomes of newborns who are self transported [12]. The aim of the present study was to identify the various indications of referral, look at the effectiveness of a well equipped and manned neonatal transport on the neonatal outcomes and complications present at the time of admission in our unit.

MATERIALS AND METHODS

Study Design

A retrospective descriptive cohort study was conducted, from July 2017 till December 2018, enrolling 101 consecutive extramural neonates who were transported by our own team to Neonatal Intensive Care Unit (NICU) of our hospital. Babies with major congenital anomalies were excluded. Ethical committee approval was taken for the study {IIH-IEC Approval for the Protocol No.EC/IIH-IEC/SPI (RETRO)}. The objective was to study the outcome of the neonates transported by our well-equipped and manned neonatal transport team, indications of transport and also to evaluate their condition at arrival.

Sample Size Calculation

If the resulting estimate fall within 10% points of the true proportion with 95% confidence was 81, based on the formula for descriptive studies, sample size=$z^2_{1-\alpha/2}$ p(1-p)/d^2, where p=70%, d=10%.

Total 101 consecutive patients were enrolled and all the babies were transported by our well-equipped hospital ambulance, with the facility of transport incubator, transport ventilator, infusion pumps, pulse oximeter, defibrillator, well trained staff and doctors. Patient's relatives and parents were properly counselled and informed consent was taken prior to transport. Data were collected regarding the maternal morbidities, natal and postnatal details including mode of delivery, liquor quality, APGAR score, indication of referral, gestational age, sex, birth weight, age at admission, distance travelled, in a structured proforma. SNAPPE-II scoring was done to assess the clinical severity and relation with outcome; the parameters of the same are given on [Table/Fig-1] [13]. Less than 20 kilometer (km) transport was considered as short distance and ≥20 km was long distance. Data was taken from the transport sheets, the case sheets and ambulance records. All neonates were uniformly managed as per National Neonatology Forum (NNF) guidelines [14] and were followed-up till discharge or death.

Parameter	Value (Score)	Value (Score)	Value (Score)	Value (Score)
MAP (mm of Hg)	<20 (19)	20-29 (9)	>30 (0)	
PaO_2/FiO_2	<0.33 (28)	0.33-0.999 (16)	1-2.4 (5)	>2.5 (0)
Lowest temp (F)	<95 (15)	95-96 (8)	>96 (0)	
Lowest pH	<7.1 (16)	7.1-7.19 (7)	>7.2 (0)	
Multiple seizures	None/ single (0)	Multiple (19)		
Urine output (mL/kg/hr)	0.1 (18)	0.1-0.9 (5)	>1 (0)	
Birth weight (grams)	<750 (17)	750-999 (10)	>1000 (0)	
SGA	Yes (12)	No (0)		
APGARS at 5 minute of birth	<7 (18)	≥7 (0)		

[Table/Fig-1]: Score for Neonatal Acute Physiology-Perinatal Extension score (SNAPPE-II).
Each column value represents the parameter range and the scores assigned to each is given in bracket; MAP: Mean arterial pressure

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for the Social Sciences (SPSS) statistics. Baseline characteristics were given in number (N) and percentages. Descriptive statistics are expressed as mean and SD for variables that show normal distribution in continuous data and as percentages {% (n)} for categorical variables. Binary logistic regression analysis was used to analyse the effect of independent variables on two outcome dependent variables. The differences between groups were analysed using Independent t-test for parametric data. Statistical analysis was carried out at 5% level of significance and the p-value <0.05 was considered significant.

RESULTS

A total of 101 newborn infants were transported to NICU during the study period in which 58 babies were term and 43 were preterm. Mean gestational age was 35 (±SD 3.7) weeks and mean birth weight was 2246.60 (±SD 913.9) grams. Sixty five babies were male and 36 were female. The mortality rate for all patients was 15.8% (n=16).

Most common causes of transport are mentioned in [Table/Fig-2] and amongst the miscellaneous causes of transport, Neonatal Jaundice (NNJ) 5 (4.9%) was the commonest one. The baseline characteristics of the babies are given in [Table/Fig-2]. SNAPPE II scores of admitted babies are given in [Table/Fig-3]. SNAPPE II was calculated in 91 babies as in 10 babies APGAR was not known.

Physiological instability at receiving the baby from other hospital and at admission in NICU and outcome are given in [Table/Fig-4]. Total 16 babies died. Five out of 10 babies were received with moderate hypothermia (50%), 10 out of 11 babies were still having saturation <90%, 10 out of 15 babies with deranged

Variables	No. (%)#
Gestational age (Weeks)	
<28	6 (5.9)
28-32	24 (23.7)
33-36	13 (12.9)
≥37	58 (57.5)
Mean gestational age (SD)	**35 (±3.7) weeks***
Birth weight (Grams)	
≤1000	11 (10.9)
1001-1500	15 (14.9)
1501-1600	14 (13.9)
1601-2000	18 (17.8)
2001-2500	43 (42.5)
>2500	0 (0)
Mean birth weight (SD)	**2246.60 (±913.9) grams***
Sex	
Male	65 (64.4)
Female	36 (35.6)
Sex ratio	**1.8:1**
AGA/SGA/LGA	
AGA	73 (72.3)
SGA	26 (25.8)
LGA	2 (1.9)
Mode of delivery	
VD	38 (37.6)
Forcep	1 (1)
LSCS	62 (61.4)
Age at admission	
0-24 h	69 (68.4)
25-72 h	17 (16.9)
4-7 d	6 (5.9)
8-15 d	7 (6.9)
16-30 d	2 (1.9)
Significant obstetric problems	
A) Medical disorders of pregnancy	
DM	11 (10.8)
Cholestasis	3 (2.9)
Fever	5 (4.9)
UTI	3 (2.9)
Anaemia	2 (1.9)
RHD	1 (0.9)
Hypothyroidism	16 (14.8)
Seizure disorder	1 (0.9)
Herpes labialis	1 (0.9)
B) Obstretic complications	
Pregnancy Induced Hypertension (PIH)	14 (12.9)
Premature Rupture of Membranes (PROM)	16 (15.8)
Foul-smelling liquor	2 (1.9)
APH	3 (2.9)
C) Normal	50 (49.5)
APGAR score at 5 min	
0-3	6 (5.9)
4-6	7 (6.9)
7-10	78 (77.3)
Not available	10 (9.9)
Indication for transport	
Birth asphyxia	14 (13.9)
MAS	13 (13)
HMD	34 (33.8)
Sepsis/Pneumonia	12 (11.9)
TTNB	8 (8)
Preterm	6 (5.9)
Miscellaneous	14 (13.8%)
Hypoglycaemia	2 (1.9%)
CCHD	3 (2.9%)
Fever	2 (1.9%)
Feed intolerance	2 (1.9%)
NNJ	5 (4.9%)
Outcome	
Discharged	85 (84.2)
Expired	16 (15.8)
Distance travelled	
Short distance	67 (66.33)
Long distance	34 (33.67)

[Table/Fig-2]: Baseline characteristics of neonates included.
AGA: Appropriate for gestational age; APH: Antepartum hemorrhage; LGA: Large for gestational age; SGA: Small for gestational age; VD: Vaginal delivery; LSCS: Lower segment caesarian section; MAS: Meconium Aspiration Syndrome; HMD: Hyaline membrane disease, TTNB: Transient tachypnea of newborn; CCHD: Congenital cyanotic heart disease; NNJ: Neonatal jaundice; DM: Diabetes mellitus; UTI: Urinary tact infection; RHD: Rheumatic heart disease; *mean (SD) for continuous data; #n (%) for categorical variables

perfusion and all the 5 babies with hypoglycaemic records at the time of receiving at our centre died. Twenty-two babies stayed for nearly one day, 28 babies stayed for one week, 29 babies for one to three weeks and 22 babies for more than 3 weeks. Eleven babies expired within first 48 hours of admission. Amongst causes of mortality, four babies were with Hypoxic Ischemic Encephalopathy (HIE), four with sepsis with pneumonia, four due to prematurity and three Meconium Aspiration Syndrome (MAS) with Persistent Pulmonary Hypertension (PPHN), 1 Congenital Diaphragmatic Hernia (CDH) [Table/Fig-5].

Scores	Discharge (N)	Death (N)
0-10	22	0
11-20	14	0
21-30	9	0
31-40	10	0
41-50	9	4
51-60	6	3
61-70	2	1
71-80	3	2
>80	2	4
Total	77	14

[Table/Fig-3]: SNAPPE II scores at admission and outcome.

	TOPS at starting of transport No.	TOPS at receiving in our NICU No.	Outcome mortality N (%)#
Temperature	**Temp 1**	**Temp 2**	
36.5-37.5°C	50	>37.5=1	5 (50%)
		36.5-37.5=48	
		36-36.4=1	
36-36.4°C	18	36.5-37.5=17	
		36-36.4=1	
32-35.9°C	33	36.5-37.5=20	
		36-36.4=3	
		32-35.9=10	
Oxygenation	**SpO_2 1**	**SpO_2 2**	
<90%	36	<90%=11	10 (90.9%)
		≥90%=25	
≥90%	65	<90%=0	
		≥90%=65	
Perfusion	**Perfusion 1**	**Perfusion 2**	
<3 sec	60	<3 sec=60	10 (66.7%)
≥3 sec	41	<3 sec=26 ≥3 sec=15	
Blood sugar	**Blood sugar 1**	**Blood sugar 2**	
≤40	19	≤40=5(5)	5 (100%)
		>40=14	
>40	80	≤40=0	
		>40=80	
Hyperglycaemia	2	2 (1)	1 (8.3%)

[Table/Fig-4]: Physiological instability at admission/at receiving the baby and outcome.
#N (%) for categorical variables; TOPS: Temperature, Oxygenation, Perfusion, Sugar

On univariate analysis, hypoxic, hypoglycaemic, hypothermic, babies with poor perfusion, low APGARs and babies having SNAPPE score more than 40 were significant risk factors for mortality. On multiple logistic regression analysis, hypothermia, hypoperfusion, hypoglycaemia and SNAPPE II score have effects on outcome with sensitivity of 70% and specificity of 93%. [Table/Fig-6] represents the results of regression analysis. Less than 20 kilometer (km) transport was considered as short distance and ≥20 km as long distance, which didn't have any effect on outcomes of babies. There was no CPR during transport or at arrival to our hospital.

Cause	No.
Hypoxic Ischemic Encephalopathy (HIE)	4
Sepsis with pneumonia	4
Prematurity	4
MAS with PPHN	3
CDH	1
Total	16

[Table/Fig-5]: Causes of mortality.
MAS: Meconium aspiration syndrome; PPHN: Persistent pulmonary hypertension; CDH: Congenital diaphragmatic hernia

	Outcome	N	Mean	Standard deviation	p-value*
Gestational age	Death	16	34.2707	4.56967	0.240
	Discharge	85	35.3845	3.47444	
Birth weight	Death	16	2152.89	819.653	0.622
	Discharge	85	2268.58	938.033	
APGARS	Death	14	5.41	2.671	0.003
	Discharge	77	7.10	1.865	
Temp 1	Death	16	35.197	1.4399	0.003
	Discharge	85	36.046	0.8993	
Temp 2	Death	16	35.146	0.8266	0.010
	Discharge	85	36.487	0.6136	
$SpO_2$1	Death	16	83.00	7.899	<0.001
	Discharge	85	93.03	4.720	
$SpO_2$2	Death	16	82.82	10.033	<0.001
	Discharge	85	93.30	6.474	
Blood sugar 1	Death	16	32.87	15.332	0.0001
	Discharge	85	66.38	18.585	
Blood sugar 2	Death	16	43.79	19.994	0.00001
	Discharge	85	80.90	21.604	
SNAPPEII	Death	14	67.11	19.980	<0.001
	Discharge	77	26.27	22.592	
Short distance	Death	12			0.697
	Discharge	57			
Long distance	Death	4			0.532
	Discharge	28			

[Table/Fig-6]: Logistic regression analysis of parameters which predict mortality amongst survivors and non-survivors of transported neonates.
*t-test

DISCUSSION

Neonatal transport from level I and II to level III units are common for improving neonatal outcomes and for this a well equipped ambulance with well trained staff and doctors are the need of the hour. In the current study, babies who had deranged Temperature, Oxygenation, Perfusion and Sugar levels (TOPS) and higher SNAPPE-II score had poor outcomes.

Studies have shown that babies who were self-transported had poor outcome compared to babies transported by equipped and trained team [12,15]. In present study 42.6% babies were premature, which was nearly similar to studies by Sehgal A et al., and Singh H et al., and Mir NA et al., [15-17]. Male to female ratio was 1.2:1 and indications of transport were almost similar to previous studies [18]. Hypothermia was observed in 14.8% babies in present study however, it ranged from 23.18% to 54% in previously published studies[18-20]. Hypoxia and hypoglycaemia were10.8% and 4.9% respectively in present study however, in previously published studies it was 18.6% and 7.27% respectively [18]. This suggests that with a well trained and equipped transport system the physiological instability of babies can be decreased to a large extent. A 66.3% babies received ventilation compared to 44.3% as reported in literature [12]. Studies by Sehgal A et al., and Kumar PP et al., have shown that stabilisation of neonates temperature, oxygenation, perfusion, sugar, prior to and during transport improves neonatal outcome [15,21]. There was no CPR recorded during or receiving baby in our NICU compared to 28% as reported by Henry S and Trotman H [19]. Nearly 15.8% of babies expired compared to 19.8 to 32% as published by Rathod D et al., and Buch Pankaj M et al., [22,23]. Eleven (68.7%) babies expired within first 48 hours of admission compared to 33.3% to 55.2% reported in other studies [12,15] which was justified by the severity of clinical condition of the transported patients with high SNAPPE II scores [13]. Mortality was high in babies with SNAPPE II score more than 40. In present study there was no effect of duration of transport on the outcome, as seen in Buch Pankaj M et al., might be explained by the fact that babies physiological parameters were stabilised by our well trained team prior and during transport, but those babies with severe deranged parameters succumbed [23]. But other studies have shown significant effect of the same [20,22]. Usually the transportation team should devote time in stabilisation of the baby prior to starting transport, without which, clinical deterioration of baby's condition during transport is expected.

Limitation(s)

It was a retrospective study. A prospective study needs to be planned for more definitive recommendations.

CONCLUSION(S)

A well equipped and manned neonatal transport service can improve the outcomes and decrease the temperature and hypoxic abnormalities in transported babies. A significant number of these deaths can be avoided by early identification and referral, appropriate stabilisation prior to transport and provision of adequately skilled and equipped team and monitoring facilities during transport of neonates.

REFERENCES

[1] Segal S. Transfer of a premature or other high-risk newborn infant to a referral hospital. Pediatr Clin North Am. 1996;13(4):1195-205.
[2] Segal S (Ed). Manual for the transport of high risk newborn infants. Canadian Pediatric Society. 1972;167-74.
[3] Standards For Improving Quality Of Maternal and Newborn Care in Health Facilities. World Health Organisation. 2016; http://www.who.int.
[4] Health and the Millennium Development Goals. World Health Organisation. 2018.
[5] Millennium Development Goals - Final Country Report of India. Ministry of Statistics and Programme Implementation Government of India [www.mospi.gov.in].
[6] Cornette L. Contemporary neonatal transport: Problems and solutions. Arch Dis Child Fetal Neonatal Ed. 2004;89:F212.
[7] Cornette L. Transporting the sick neonate. Current Pediatr. 2004;14:20-25.
[8] Parmanum J, Field D, Rennie J, Steer P. National census of availability of neonatal intensive care. BMJ. 2000;321:727-29.
[9] Ministry of Health and family Welfare. Participant Module Navjat Shishu Suraksha Karyakram. New Delhi, Government of India, Oct 24, 2018.
[10] Ramji S. Transport in community. J Neonatol. 2005;4:328-31.
[11] Chang ASM, Berry A, Sivasangari S. Specialty teams for neonatal transport to neonatal intensive care units for prevention of morbidity and mortality. Cochrane Database of Systematic Reviews. 2008, Issue 4.
[12] Mohan KR, Kumar R. Study of indications, complications and outcomes of neonatal transport by a skilled team. Int J Contemp Pediatr. 2019;6(6):2402-05.
[13] Harsha SS, Archana BR .SNAPPE-II (Score for Neonatal Acute Physiology with Perinatal Extension-II) in predicting mortality and morbidity in NICU. J Clin Diagn Res. 2015;9(10):SC10-12.
[14] Evidence Based Clinical Practice Guidelines, National Neonatology Forum India, 2010; www.nnfpublication.org.
[15] Sehgal A, Roy MS, Dubey NK, Jyothi MC. Factors contributing to outcome in newborns delivered out of hospital and referred to a teaching institution. Indian Pediatr. 2001;38:1289-94.
[16] Singh H, Singh D, Jain BK. Transport of referred sick neonates: How far from ideal? Indian Pediatr. 1996;33:851-53.
[17] Mir NA, Javied S. Transport of sick neonates: Practical considerations. Indian Pediatr. 1989;26(8):755-64.
[18] Jajoo M, Kumar D, Dabas V, Mohta A. Neonatal transport: The long drive has not even begun. Indian J Community Med. 2017;42(4):244-45.
[19] Henry S, Trotman H. Challenges in neonatal transport in Jamaica: A resource-limited setting. J Tropical Pediatr. 2017;63(4):307-13.
[20] Narang M, Kaushik JS, Sharma AK, Faridi MMA. Predictors of mortality among the neonates transported to referral centre in Delhi, India. Indian J Public Health. 2013;57(2):100-04.
[21] Kumar PP, Kumar CD, Venkatlakshmi A. Long distance neonatal transport–the need of the hour. Indian Pediatr. 2008;45:920-22.

[22] Rathod D, Adhisivam B, Bhat BV. Transport of sick neonates to a tertiary care hospital, south India: Condition at arrival and outcome. Trop Doct. 2015;45(2):96-99.

[23] Buch Pankaj M, Makwana Aarti M, Chudasama Rajesh K, Doshi Smita K. Status of newborn transport in periphery and risk factors of neonatal mortality among referred newborns. JPBMS. 2012;16(16):01-06.

PARTICULARS OF CONTRIBUTORS:
1. Consultant, Department of Paediatrics and Neonatology, Chaitanya Hospital, Chandigarh, India.
2. DM Student, Department of Hepatology, PGIMER, Chandigarh, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Bijaylaxmi Behera,
Chaitanya Hospital, Sector 44, Chandigarh, India.
E-mail: jollybubu2008@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Aug 18, 2020
- Manual Googling: Dec 03, 2020
- iThenticate Software: Dec 26, 2021 (11%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Aug 14, 2020**
Date of Peer Review: **Sep 29, 2020**
Date of Acceptance: **Dec 07, 2020**
Date of Publishing: **Mar 31, 2021**