IS THERE A CORRELATION BETWEEN THE OUTCOME OF REFERRED SICK NEONATES AND PERIPHERAL UTILIZATION OF RESOURCES DURING TRANSPORT? EVIDENCE FROM THE NICU OF A TERTIARY CARE HOSPITAL OF EASTERN INDIA USING TOPS SCORE

Neonatology

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ABSTRACT

BACKGROUND: This study was conducted at the NICU of Dr B C Roy Post Graduate Institute of Paediatric Sciences, a tertiary care children's hospital in Kolkata, West Bengal, India, to study the immediate outcome of the referred sick neonates and peripheral utilization of resources before and during transport.

METHODOLOGY: A prospective observational study on 250 new born babies referred to Dr. B. C. Roy Post-Graduation Institute of Paediatric Sciences, Kolkata, India during the period of June 2016 to May 2017. At the admission detailed clinical assessment of the baby has been done and clinical physiological parameters (TOPS- Temperature, Oxygenation (Airway & Breathing), Perfusion, Sugar) were recorded. Pre transport TOPS and transport TOPS were noted. The babies were followed up for the next seventy two hours to study the correlation between the utilization of the resources and immediate outcome of the babies in terms of death, cardiorespiratory support (mechanical ventilation, CPAP, inotrope therapy), supportive care and discharge within next 72 hours.

RESULTS: Out of 250 babies, 62% were boys, 58.4% were pre term, 65% were low birth weight. 60% were transported in government ambulance. 100% mortality was present in babies taking > 2 hrs to reach the hospital. 44 babies had no alteration of TOPS parameters while one parameter was affected in 115 babies (46%), two parameters were affected in 51 babies (20.4%), three parameters were affected in 30 babies (12%) and all four parameters were affected in 10 babies (10%). Hypothermia was present in 65%, hypoxia in 34.8%, hypoperfusion in 23% and hypoglycemia in 16%. 44.8% were discharged within 72 hours, 23.6% received supportive care, 17.2% required cardio-respiratory support and 14.4% died.

CONCLUSION: Emphasis on stabilization of sick new born before and during transfer should be done. Training modules to all the personnel involved in the care of a sick new born and regular practise of the same should be encouraged. In-utero transport by identifying the high-risk pregnancies is better way to decrease the requirement of transport should be supplied. Longer duration of transportation has a high mortality

KEYWORDS

Neonatal transport, TOPS scoring, Sick neonate, Mortality.

INTRODUCTION

Dr B C Roy Post Graduate Institute of Paediatric Sciences is a tertiary care children's hospital in Kolkata, West Bengal. This institute has more than 170 neonatal beds including 20 NICU beds and 70 NHDU beds and caters to a large number of extramural babies referred from different Government and Non-Government facilities of this state and also from the surrounding states. The referred babies very often come from remote areas with minimal health care facilities and travel large distances to reach this institute. The success of neonatal survival in terms of both mortality as well as morbidity largely depends upon the efficacy and adequacy of the transport process of the newborn.

High-risk infants should ideally be born in tertiary care facilities which are adequately equipped and staffed to care for them. Unfortunately, not all high-risk infants are identified prior to birth, and infants are delivered in facilities that are not matched to their needs (1,2). In cases of at-risk pregnancy, it is safer to transport the mother prior to delivery than to transfer the sick baby after birth (in-utero transport).

The success of transportation of a sick neonate depends on early identification, pre-referral stabilization, appropriate referral and care during transport. Poor transportation is one of the factors significantly associated with greater neonatal mortality. Transportation of sick neonates under controlled conditions has a direct relationship with morbidity and mortality (3).

In developing countries like India the problem of transporting small and sick neonates is compounded by several practical constraints like:

- Most neonates are transported without any pre-transport stabilization or care during transport.
- Families have poor resources.
- Organized transport services are not always available. At times the

baby may have to be transported on foot or on a bullock cart.

- No health care provider is available to accompany the baby.
- Even when support stuff is available, there is lack of knowledge regarding the resuscitation of the acute deterioration of the babies during transport.
- Communication systems are non-existent or inefficient.

Principles of transport remain same for any type of transport. Available models for pre-transport stabilization and care during transport are:

- STABLE:** Sugar, Temperature, Artificial breathing, Blood pressure, Laboratory work, Emotional support.
- SAFER:** Sugar, Arterial circulatory support, Family support, Environment, Respiratory support
- TOPS:** Temperature, Oxygenation (Airway & Breathing), Perfusion, Sugar

TOPS, a simplified assessment of neonatal acute physiology gives a good prediction of mortality in these neonates. There are various other newer scores available to assess the acute physiology of transported sick neonates

- MINT (2004) – Mortality index of neonatal transportation.
- TRIPS (2001) – Transport risk index of physiologic stability.
- SNAP (2001) – Score for neonatal acute physiology.
- CRIB II (2003) – Critical risk index for babies.
- PRISM – Pediatric risk of mortality.
- PIM – Pediatric index of mortality.

This study uses TOPS scoring to assess the immediate outcome (morbidity and mortality) of referred sick neonates and peripheral utilization of resources before and during transport. TOPS scoring is more easy and practical method for a developing country like India.

MATERIAL AND METHODOLOGY

This is a prospective observational study of systematic randomly

selected 250 out born neonates referred to Dr. B. C. Roy Post-Graduate Institute of Paediatric Sciences, Kolkata, India, during the period of June 2016 to May 2017.

Sample size is calculated with the following formula -

$$N = \frac{Z_{\alpha}^2 \times P \times (100 - P)}{L^2}$$

Where,

Z_{α} (Z_{α}) = standard normal deviate (1.96 assuming 95% confidence interval)

P = prevalence of characteristic (taking the prevalence of expired children among the pre referral stabilization group as 14.16) (4)

L = allowable error, 5 (assuming 5% absolute precision)

So the value of $n = (1.96)^2 \times 14.16 \times (100 - 14.16) / 5^2 = 186.7$

Assuming a Loss to Follow-up of 25%, final sample size will be $(186.7 \times 125/100) \approx 233$

So 250 neonates were taken as final sample size.

At the time of admission detailed clinical assessment of the baby was done and the clinical physiological parameters (TOPS) were recorded on arrival of the baby on a data capturing sheet. Pre transport TOPS and transport TOPS score were noted if available. The babies were followed up for the next seventy two hours to study the correlation between the quality of the utilization of the resources and immediate outcome of the babies in terms of death, cardiorespiratory support (mechanical ventilation, CPAP, inotrope therapy), supportive care and discharge (includes immediate discharge from triage and discharge within next 72 hours after receiving supportive care).

Hypothermia, hypoxia, prolonged CRT and hypoglycemia were defined as $<36.5^{\circ}\text{C}$, (5) $<90\%$ (6), ≥ 3 seconds (7) and $< 45\text{mg/dl}$ (8), respectively.

The study included neonates aged 0-28 days. All babies with lethal congenital malformation, surgical emergencies and brought dead newborns were excluded from the study.

Statistical analysis

Data was entered into a Microsoft excel spreadsheet and analysed using SPSS 20 software. Data have been summarized as count and percentages for categorical variables. Proportions were compared by Chi-square test or Fischer's exact test. Z-test was used to test the significance between two proportions.

RESULTS

Out of 250 neonates studied, 155 (62%) were boys and 95 (38%) were girls, which included pre term and term babies. 41.6% of the neonates were term and 58.4% were pre term. 166 (66.4%) babies who were referred to the higher center were early neonates (post-natal age 0-7 days).

Table 1: Age distribution of all patients.

	Frequency	Percent
Early Neonate (0-7 days)	166	66.4
Late Neonate (7-28 days)	84	33.6
Total	250	100.0

43.6% were low birth weight (1500g-2490g), 34.4% have birth weight $\geq 2500\text{g}$, 18.8% were very low birth weight (1000g-1490g) and 3.2% were extremely low birth weight ($<1000\text{g}$). 10.4% babies were born at home, 62.8% babies were born at government hospital and 26.8% were born at private hospitals.

Table 2: Weight distribution of all patients

Weight of Newborns	Frequency	Percent
$< 1000\text{ gm}$	8	3.2
1000-1499 gm	47	18.8
1500-2499 gm	109	43.6
$\geq 2500\text{ gm}$	86	34.4
Total	250	100.0

Though most of the babies had institutional delivery but still 26 of 250 (10.4%) babies were born at home. Of the rest maximum no. of babies - 157 of 250 (62.8%) babies were born at govt. hospital while 67 babies (26.8%) were born at private hospitals and nursing homes.

Most of the babies were referred from govt. hospital (152 of 250 - 60.8%) while almost equal no. of babies came from home including

those discharged (46 of 250 - 18.4%) and from private institutions (52 of 250 - 20.8%).

55% ($n=138$) of babies received pre referral stabilization. Out of those who received stabilization before and during transport 130 survived and 8 babies expired. 45% ($n=112$) did not receive any form of stabilization before referral. 28 died and 84 babies survived out of the babies who did not receive stabilization. Out of 130 babies survived in pre referral stabilization group 71 (51%) were discharged within 72 hours of admission, 42 (30%) received supportive care and 17 (13%) received cardiorespiratory support. Whereas, out of 84 surviving babies who did not receive any stabilization, 41 (37%) babies were discharged, 17 (15%) received supportive care and 26 (24%) received cardiorespiratory support which was again statistically significant.

On further analysis it was found that most of the babies (69.4%) were receiving pre referral stabilization when born in govt hospitals while relatively less no. babies (41.8%) received stabilization when born in private hospitals and as expected almost none of the babies (0.7%) born at home received any stabilization.

Referral notes were found for 197 babies (79%). None of the referral notes were complete and also there was no monitoring of the babies during transport. The outcome between the babies whether referral reason specified or not were not found to be significant. ($p\text{-value} = 0.068$).

Road was the mode of transport for all the babies, 60% brought in by government ambulance, 35% by private ambulance and 5% by their own means like paid taxi/auto/motorcycle. 100% of the babies referred from a government hospital were able to utilise the facility of government ambulance free of cost.

58.4% babies took less than 1 hour to reach our hospital, 23.2% took 1-2 hours and 18.4% took more than 2 hours to reach our hospital. In our study we found that babies taking time between 1-2 hrs required more life support and those who took more time ($>2\text{ hrs}$) had more incidence of mortality.

At the time of admission 65% of babies had hypothermia, 35% had hypoxia, 23% of babies were in shock and 16% of them were hypoglycemic. It was found that 44 babies (18%) had no alteration of any TOPS parameter, one parameter was affected in 115 babies (46%), two parameters were affected in 51 babies (20.4%), three parameters were affected in 30 babies (12%) and all four parameters were affected in 10 babies (10%).

Regarding the outcome of the study population, 44.8% were discharged within 72 hours, 23.6% received supportive care, 17.2% required cardio-respiratory support and 14.4% died.

Table 3: Outcome of study ($n=250$)

Outcome	Frequency	Percent
Discharge	112	44.8
Supportive Care	59	23.6
Cardio-Respiratory Support	43	17.2
Death	36	14.4
Total	250	100.0

Outcome significantly depended on the alteration of TOPS parameters. When no TOPS parameters were altered all babies survived and got discharged. When 1 parameter was altered (in 115 babies) none expired but 68 babies were discharged while 47 received supportive care. When 2 parameters were altered (in 51 babies) 4 babies died, 35 received cardio-respiratory support, 12 received supportive care and none was discharged. When 3 parameters were altered (in 30 babies) 22 babies died and 8 babies received cardio respiratory support. When 4 parameters were altered all of the 10 babies expired.

DISCUSSION

With advancements of the care of sick newborns, the outcome has drastically improved. Studies suggest that transportation of a sick newborn has an important role in the outcome of the referred neonate. Majority of the sick newborns who were transported to a higher centre were boys, the same trend is seen in other studies (3-6). Verma *et al* (9) showed that 78% of their study population were early neonates, while in this study 66.4% are early neonates. Sachan *et al* (10) and Narang *et*

al (3) showed that 28% and 16% of their studies were of normal birth weight respectively, but our study showed 34% are of normal birth weight.

Pre referral stabilization in *Sachan et al* (10) study was 48%, *Dalal et al* (4) study was 38%, *Hapani P Tet al* (11) was 35%, in the current study it is highest 55.2%. This suggests that the importance of pre referral stabilization is gaining emphasis. Stabilization is given in the form of taking care of hypothermia, hypoglycemia, hypoxia and shock. This stabilization should be continued during the transport as well, but this is lacking in India. Our study shows that only 35% of the referred babies had stabilization during transport, which is far less than the pre referral stabilization, this is same in other studies as well.

Referral slip with appropriate information of the child's condition was present with 79% in this study, *Narang et al* (3) had 66.6%, *Dalal et al* (4) had 55%. With the improvement of the facility of the ambulance services in the government hospital, 60% were transferred in ambulance, which is low in other studies. *Sachan et al* (10) and *Narang et al* (3) showed it as 33% and 41% respectively.

The more is the time of travel, the greater is the mortality, *Sachan et al* (10) found 11.2% babies took >2 hrs to reach the hospital, *Mori et al* (12) showed that the neonates who were transported for >90 minutes had a risk more than twice normal of death. In our study 18% took >2 hours to travel. Subsequently, mortality was found to be 100% in these babies.

Dalal et al., *Narang et al.*, and *Sachan et al.*, found the incidence of hypothermia -55.3%, 47%, 21.2%; hypoxia -27.4%, 32.6%, 30.6%; hypo perfusion -23.4%, 69.3%, 11.1% and hypoglycemia as 20.6%, 29.6%, 3.7% respectively. In this study it was 65%, 35%, 23% and 17% in the same order.

Table 4: TOPS score comparison with other studies

	Present study	Verma et al.	Mathur et al.	Dalal et al.
TOPS score	Expired 36/250 (14.4%)	Expired 81/390 (20.76%)	Expired 60/175 (34.28%)	Expired 71/300 (23.66%)
0	0/44(0%)	1/128(0.78%)	4/49(8.16%)	--
1	0/115(0%)	14/105(13.33%)	7/51(13.72%)	12/121(9.91%)
2	14/51(27.8%)	35/112(31.25%)	14/34(41.17%)	17/48(35.41%)
3	22/30(73.3%)	23/35(65.72%)	23/29(79.31%)	29/37(78.37%)
4	10/10(100%)	8/10(80%)	12/12(100%)	13/13(100%)

Table 5: Pre referral stabilization and Outcome

Pre Referral Stabilization		Outcome				Total
		Discharge	Routine Care	Cardio-Respiratory Support	Death	
Done	Count	71	42	17	8	138
	% within Pre Referral Stabilization	51.4%	30.4%	12.3%	5.8%	100.0%
Not done	Count	41	17	26	28	112
	% within Pre Referral Stabilization	36.6%	15.2%	23.2%	25.0%	100.0%
Total	Count	112	59	43	36	250
	% within The study	44.8%	23.6%	17.2%	14.4%	100.0%

CONCLUSION

Proper stabilization before and during transport of sick neonates in case of a referral to a higher center is very important. Emphasis on stabilization of sick new born before and during transfer should be given. Training should be given to all the personnel involved in the care of a sick newborn and every caregiver of any newborn has to regularly practise the same. Stabilization during transport has equal importance as stabilization given prior to transport. In India stabilization prior to transport has seen some improvement but stabilization during the transport is still underway. Longer duration of transportation has a high mortality, so the sick newborn should be transported to the nearest higher centre. In-utero transport by identifying the high risk pregnancies is clearly the better way to decrease the requirement of transport. The person who is referring the babies should provide a full detail of the condition of the baby, along with diagnosis and management done. Parents should be well informed regarding the condition of their baby, why and to where their baby is being transferred.

Limitations:

Funding: none

Conflict of interest: none declared

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

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