Status of Neonatal Transport and Impact of Facilitated Referral on the Outcome of Transported Sick Newborns: At Tertiary Care Hospital.

Dr. D. Manikyamba[1], Dr. N. Madhavi[2], Dr. M. Srinivasa Reddy[3], Dr. A. Satyavani[4]
[1]Professor and Head, Department of Pediatrics, Government General Hospital, Rangaraya Medical College , Kakinada, Andhra Pradesh, India.
[2]Professor, Department of Pediatrics, Government General Hospital , Rangaraya Medical college, Kakinada.
[3]Senior Resident in Neonatology, Department of Pediatrics, Government General Hospital, Rangaraya Medical College, Kakinada
[4]Assistant Professor, Department of Pediatrics, Government General Hospital, Rangaraya Medical College, Kakinada.

Abstract: Transport of sick newborns in India is still at a premature stage. Ineffective transport results in complications like hypoglycemia, hypothermia and hypoxia which adversely affect the outcome of transported neonates. Facilitated referral in the form of pre referral stabilization, providing written referral slip and proper care during transport can improve the survival rate of referred babies. Hence this study was undertaken to evaluate the status of neonatal transport in this area. This prospective observational study was conducted on all extramural cases less than or equal to 7 days of age admitted at the NICU of department of pediatrics, Government General Hospital, Kakinada from May 2015 to October 2016. Referral and Transport details such as place of referral, type of referral (verbal or written), details of pre referral treatment , mode of transport, duration of transport , personnel accompanying during transport and treatment given, if any during transport were noted. TOPS score was recorded at admission and all cases were followed till discharge or death. Out of 1522 transported babies, 39.2% of newborns were admitted within 24 hours of life. Preterms accounted for 46.9% and 59.2% were low birth weight. 37.8% referrals were from SNCU/district hospitals and doctor was the referring person in 76.3%. Pre referral stabilization was done in 89% of SNCU referrals and 36% of non-SNCU referrals. Warmth care during transport was provided in 68.2% cases transported in ambulance whereas it was only 33.6% in non-ambulance transport. Hypothermia was noted in 48.5% newborns. Incidence of hypothermia was higher in non-SNCU referral babies (52.9%) and in those with transport time > 3hours (87%) and in babies with non-ambulance transport (87.8%). Mortality was higher in babies with 3 or more abnormal parameters of TOPS at admission. Organized neonatal transport aids for better survival of sick transported newborns.
Keywords: Transport, Referral, 108 ambulances, TOPS, Hypothermia.

INTRODUCTION

The safest place for a baby is mother's womb. Neonatal period is the most vulnerable time for the child's survival. Transport of sick newborns in India is still at a premature stage. Current Neonatal Mortality Rate of India in 2015 was 28 per 1000 live births [1] and to achieve the INAP goal of single digit NMR (<10/1,000 live births) [2] by 2030 a lot of challenges need to be confronted in coming future. Transport and referral of sick newborns is one such challenge with huge impact on NMR as it is the weakest part of newborn healthcare delivery system. In most parts of India, neonates are still transported in 108 ambulances designed for the need of adult patients which lack equipment and personnel trained in neonatal resuscitation.

Ineffective transport results in complications like hypoglycemia, hypothermia and hypoxia which adversely affect the outcome of transported neonates. Facilitated referral in the form of pre referral stabilization, providing written referral slip with details of the case and transport of sick newborn babies in specialized neonatal ambulance with trained personnel to provide proper care during transport can improve the survival rate of referred babies.

Neonatal Intensive Care Unit at Government General Hospital, Kakinada is a tertiary care unit serving as referral centre for East and West Godavari districts. Majority of newborns referred to this place from the peripheries were found to be critically sick at the time of arrival due to delayed referral, lack of pre referral stabilization and care during transport. There are very few studies in this part of the country which reflect the transport system existing in this area and the impact of referral characteristics on outcome of babies. Hence this study was undertaken.

MATERIALS AND METHODS
This prospective observational study was conducted at the NICU of department of pediatrics, Government General Hospital, Kakinada over 18 months from May 2015 to October 2016.

Inclusion Criteria:
- Extramural cases with less than or equal to 7 days of age.

Exclusion criteria
- Cases with lethal congenital malformations.
- Cases expired within 1 hour of admission.
- Cases Left Against Medical Advice.
- Cases referred to other specialties or higher centres.

Informed consent was taken from the parents or caregivers present at the time of admission. Study was conducted after approval by institutional ethical committee of medical college. All extramural newborns who met the inclusion criteria were enrolled in the study. A predesigned proforma was used to record the information at the time of admission. The subjects were assessed in terms of maternal characteristics like antenatal complications, place of birth (home or institution) and if institutional PHC, CHC, District level hospital or Private hospital were recorded.

Referral and Transport details such as place of referral (if differed from place of birth), type of referral (verbal or written), details of pre referral treatment (as per referral note), mode of transport, duration of transport, personnel accompanying during transport and treatment given ,if any during transport were noted. A case is considered as 'verbal referral' if the details of referred case are provided either by doctor/paramedic from site of referral over telephone or by the health personnel accompanying (excluding ambulance staff). Cases with written referral slip were considered as 'written referral' and all written referral slips were assessed for the information provided. Referred newborns were also assessed for advice regarding

warmth care, airway management and feeding during transport. Condition at the time of arrival was assessed using TOPS score and need for resuscitation. TOPS score was measured by:
- **T**emperature was recorded by digital thermometer in axilla and graded as per standard guidelines of WHO[3]
- **O**xygenation by Spo2 monitoring (Radical 7 pulse oxymeter).
- **P**erfusion by capillary refilling time (CRT) on mid-sternum.
- **S**ugar by reagent strip and low reading < 45 mg/dl was confirmed by serum samples at laboratory [4].

Hypothermia, hypoxia, prolonged CRT and hypoglycemia were defined as $<36.5°C$ [5], $<90\%$ [6], ≥ 3 seconds [7] and $< 45mg/dl$[8] respectively. After initial stabilization newborns were assessed for gestational age and clinical condition. All complications during hospital stay were recorded. Relevant investigations were done and babies were treated as per unit policy. Standard case definitions were used for gestational age, birth weight and diagnosis [9]. Final outcome was assessed in terms of discharge and death.

STATISTICAL ANALYSIS
All categorical variables were presented as frequencies and percentages. Chi square test was applied and p values were calculated for the risk factors and outcome. The statistical analysis was carried out at 5% level of significance and p value <0.05 was considered significant. Variables that were found significant on chi-square test were further analyzed using logistic regression analysis for their possible independent association with mortality. Data analysis was done by Microsoft Excel and SPSS (version 21) software.

RESULTS
A total of 5126 neonates were admitted during study period, of which inborns accounted for 2795 (54.4%) and outborns for 2341 (45.6%). Among total 2341 outborns, 1522 (65%) met inclusion criteria and constituted final study population. Although cases left against medical advice (LAMA) were initially in the study population, they were excluded from study as outcome is not known. Out of 1522 transported babies, 881 (57.9 %) were males and rest 641 (42.1%) were females. 39.2% of newborns were admitted within 24 hours of life. Preterms accounted for 46.9% and 59.2% babies among study population were low birth weight. Referral characteristics of study population are depicted in table 1.

Table-1: Referral characteristics of study population

S.No	Referral Characteristics	N (%)
1.	**Source of referral**	
	SNCU/District hospitals	575 (37.8)
	PHC/CHC/Area hospital	714 (46.9)
	Others	3 (15.3)
2.	**Person referring**	
	Doctor	1162 (76.3)
	Paramedical person	278 (18.3)
	Community/Relatives	82 (5.4)
3.	**Mode of transport**	
	108 ambulance	963 (63.3)
	Private ambulance	83 (5.5)
	Auto	268 (17.6)
	Others	208 (13.6)
4.	**Duration of transport (h)**	
	< 1	521 (34.2)
	1 - 3	878 (57.7)
	>3	123 (8.1)
5.	**Type of referral**	
	Written (Referral slip)	1361 (89.4)
	Verbal	48 (3.1)
	No verbal/written information	113 (7.4)
6.	**Pre referral stabilization done**	854 (56.1)
	SNCU referral	511 (88.9)
	Non – SNCU referral	343 (36.2)
7.	**Care during transport**	
	a. Ambulance	1046
	Warmth care	713 (68.2)
	Airway position	542 (51.8)
	b. Non -Ambulance	476
	Warmth care	160 (33.6)
	Airway position	43 (8.1)

37.8% referrals were from SNCU/district hospitals and 46.9% from PHC/CHC/Area hospitals. Doctor was the referring person in 76.3% cases. Major mode of transport was 108 ambulance (63.3%) followed by auto (17.6%). In 89.4% cases a written referral slip was available. Pre referral stabilization was done in 56.1% cases. Pre referral stabilization was done in 89% of SNCU referrals and 36% of non-SNCU referrals. Among babies transported in ambulance, warmth care was provided to 68.2% newborns and airway position was maintained in 51.8% cases. Among non-ambulance transport, warmth care was provided to 33.6% newborns and airway was maintained in 8.1% cases. Among the 4 parameters of TOPS score, hypothermia was most commonly noted in 48.5% cases while deranged CRT and low SPO2 were noted in 26.7% and 22.3% cases respectively. Hypoglycemia was seen in only 8.9% cases at admission. Correlation of referral charectistics with hypothermia was depicted in table 2.

Hypothermia was highest in babies transported for > 3 hours (87%) and least among neonates transported in < 1 hour (19.5%). Hypothermia was lowest among cases referred from SNCUs (41.2%) and highest among non-SNCU referrals. Neonates transported in 108 ambulances had lower incidence of hypothermia (27.8%) than others. The mortality rate among extramural babies was 24.8%.

Table 3 depicts correlation of TOPS score with outcome. Survival rate was highest 82.3% among babies who had normal parameters of TOPS. All (100%) cases expired with 4 abnormal parameters at admission. Mortality rates among babies with cold stress, moderate hypothermia and severe hypothermia were 22.5%, 43.2% and 81.4% respectively. The significant factors contributing to mortality were prematurity <34 weeks, admission weight < 1500 grams, hypothermia, duration of transport > 1hour and TOPS with 3 or more deranged parameters at admission as shown in table 4.

Table-2: Correlation of referral characteristics and hypothermia at admission

S. No	Referral characteristic	Hypothermia	
		Present	**Absent**
1.	**Duration of transport (h)**		
	< 1	102 (19.5)	419 (80.5)
	1 - 3	539 (61.4)	339 (38.6)
	>3	107 (87)	16 (13)
2.	**Source of referral**		
	SNCU	237 (41.2)	338 (58.8)
	Non – SNCU	501 (52.9)	447 (47.1)
3.	**Mode of transport**		
	108 ambulance	268 (27.8)	695 (72.2)
	Private ambulance	52 (62.6)	31 (37.3)
	Auto	238 (88)	32 (12)
	Others	182 (87.5)	26 (12.5)

Table-3: Correlation of TOPS score with outcome

Outcome	TOPS Score				
	Normal n = 616	Abnormal n =906			
		1 parameter n = 471	2 parameters n = 246	3 parameters n = 151	4 parameters n = 38
Survived N = 1145	507 (82.3%)	395 (83.9%)	185 (75.2 %)	58 (38.4%)	0
Expired N = 377	109 (17.7%)	76 (16.1%)	61 (24.8%)	93 (61.6%)	38 (100%)

Table-4: Factors independently associated with mortality of referred newborns

Variable	Expired n = 377	Survived n =1145	Odds ratio	95% CI	P value
Maturity < 34 weeks	103	225	1.5371	1.1741 - 2.0123	0.0018
Weight < 1500 grams	92	206	1.4714	1.1129 - 1.9454	0.0067
Duration of travel >1 hour	291	710	2.0731	1.5849 - 2.7118	<0.0001
Hypothermia	308	430	7.4223	5.5697 - 9.8911	<0.0001
TOPS with 3 or more abnormal parameters	131	58	9.9802	7.1129 -14.0032	<0.0001

DISCUSSION

Survival perspective of extramural neonates does not rely only on the quality and intensity of the available neonatal care, but also on the state of the neonate at admission. Present study attempts to identify common issues related to neonatal transport system existing in community and the impact of transport on outcome of referred newborns.

In the present study 39.2% of newborns were admitted within 24 hours of life. Admission in first 24 hours of life may reflect problem at birth due to high risk pregnancy. Inutero transport is always better than transport of sick newborns and all such high risk pregnancies should be referred to tertiary care hospital so that at risk neonates get access to higher level of healthcare immediately. 59.2% of babies in present study were low birth weight similar to A.k Rawat *et al.* [10] study. Prematurity and low birth weight continue to be major health problems and reasons for referral in the present study and same has been observed in many studies from other developing countries also[11,12].

In the present study 84.7% babies referred to NICU, GGH, Kakinada were from SNCUs and Government hospitals at periphery. It was observed that many sick babies from PHCs or CHCs were referred to SNCU at periphery or district hospitals especially in situation where GGH, Kakinada was far away. Majority of cases from SNCUs at periphery were again transported to GGH, Kakinada due to lack of pediatricians, trained staff and equipment to manage

sick babies at these centres. This increases the transport time, thus increasing the vulnerability of already sick newborns. Although it is desirable to send the case to immediate next referral centre for stabilization, treatment and assessment for further referral, present study emphasizes the need to improve the knowledge of PHC and CHC staff about risk stratification of babies for referral (which babies to be referred to SNCU at periphery for level II care and which babies to be referred to SNCU attached to teaching hospital for level III care) so that undue delay is avoided.

In the present study 76.4% babies were referred by doctors. Inspite of the fact that doctors are the key persons referring the sick newborns from periphery, the quality of referral slips, pre referral stabilization and care adviced before and during transport is not satisfactory. Basic aspects of neonatal care should be stressed during the undergraduate curriculum.

In the present study, 68.8 % cases used ambulance as mode of transport, which was higher than many of the reported studies in India. This could be due to the fact that health care personnel at periphery were trained to utilize 108 ambulance and also awareness of people about Government 108 ambulances which were introduced long back (in mid-2005). In the present study it is observed that 108 services are preferentially utilized for transport of sick adults rather than newborns and also there is denial of 108 services for babies referred from private hospitals. These aspects are to be taken care of.

In the present study referral slips were written in 89.4% of cases. This percentage is higher compared to other studies [13, 14,15]. This is because most of the referrals were from SNCUs and area hospitals where transport of sick newborns to higher centre with referral slip is mandatory. But most referral slips lack important details of case like pre transport condition, vitals, primary diagnosis, pre referral stabilization and treatment given etc, which make them incomplete.

88.9% among SNCU referrals and 36.2% cases among non-SNCU referrals had pre referral stabilization. This difference is statistically significant with p value < 0.05. The reason for better pre transport stabilization and care during transport of referred newborns from SNCUs was presence of well designed referral form with check list of care and advice to be provided before transport. Advice on warmth care (54.7%) and position of airway (38.8%) in present study was higher than Buch Pankaj et al [13] study. Referring person from SNCUs was either a doctor or nurse with FBNC training which imparts adequate knowledge in sick newborn care.PHC and CHC health care personnel lack any special training in newborn care. It was

observed that 31.8% cases referred from SNCU did not receive advice on warmth care and none of them were adviced to provide KMC, even though all these aspects of warmth care are included in their FBNC training. This emphasizes the need for periodic reinforcement of their knowledge.

Neonatal physiology is adversely affected by abnormalities in temperature, oxygen saturation, perfusion and blood sugar (TOPS) at admission. TOPS, a simplified assessment of neonatal acute physiology gives a good prediction of outcome of transported neonates [6]. Among the parameters included in TOPS score, oxygen saturation and capillary refill time are mostly affected by the underlying morbidity whereas temperature is main parameter which is affected by transport characteristics. Severe hypothermia adversely effects the outcome of referred babies which can be overcome by better transport conditions.

The present study showed that longer the duration of transport, higher was the incidence of hypothermia at admission. In the present study 87% of babies who were transported for > 3 hours had hypothermia and the incidence of hypothermia was lower in babies transported in ambulance. There exists difference in incidence of hypothermia among babies transported in 108 ambulance (27.8%) compared to private ambulance (62.6%). This could be due to the fact that all babies transported in 108 ambulances were accompanied by 108 staff but in majority of private ambulances driver is the only person available. This indicates that care given before and during the transport is the crucial aspect to be targeted to lower the incidence and severity of hypothermia at admission.

Mortality among referred cases was 24.8% where as mortality among intramural admissions during the study period was 17.2%. This is comparable to mortality in other studies [4, 14, 16].In the present study mortality was higher (31.8%) incases with abnormal TOPS score at admission compared to 14.4% in cases with normal TOPS score. Mortality was 100% in cases with alteration of all 4 parameters. Similar association was found in other studies [6, 14, 17]. TOPS score at admission was a good predictor of mortality, especially 3 or more abnormal parameters at admission correlates with adverse outcome.

In the present study, even though the incidence of hypoxia and hypothermia was low in newborns transported by ambulance, it is much higher when compared to the studies done by Kumar P *et al.* [18] (4.8% and 3.2%) and Punitha P *et al.* [19] (3.4% and 3.1%) who reported very low incidence of hypothermia and hypoxia in babies transported in ambulance. This is because the above studies utilized ambulances specially designed for neonatal care with

equipment and trained personnel. In the present study when interviewed with ambulance staff, it was found that none of the ambulances were designed to meet the primary needs of sick newborn. During the training of 108 staff before joining the service, only half day session was allotted for training in sick newborn care.

Upgrading the 108 ambulances with equipment required for sick neonatal care and proper training of 108 staff in sick newborn care with periodic reinforcement will improve the care of newborns during transport. Organized transport is always better than self transport. But in resource limited country like India where transport incubator is not available in most parts, kangaroo mother care used by attendant or mother is a useful way to maintain temperature along with other local alternative methods like thermocol boxes, plastic wrap etc.

CONCLUSION

Organized neonatal transportation (i.e. – upgrading 108 facilities with equipment required for maintenance of temperature , oxygenation, perfusion and euglycemia and training of 108 personnel on sick newborn care during transport) of all referred neonates to tertiary care centre definitely goes a long way in achieving the INAP goal of reducing the NMR to single digit by 2030.

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