International Journal of Contemporary Pediatrics
Shah DM et al. Int J Contemp Pediatr. 2020 May;7(5):1081-1087
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: http://dx.doi.org/10.18203/2349-3291.ijcp20201643

Original Research Article

Utility of transport risk index of physiological stability score for predicting likely outcome of extramural neonates transferred to NICU

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Received: 25 February 2020
Accepted: 30 March 2020

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ABSTRACT

Background: To accomplish 'Mission Twenty - Twenty' and to achieve 'Sustainable Development Goal 3', now we need to focus our attention more towards neonates being transported to higher centre in this very fragile period. We planned this study to assess demographic, transport and clinical characteristics of referred neonates and to determine whether TRIPS score serves as predictor of early neonatal mortality i.e. mortality within the first seven days after admission in these babies.
Methods: This cross sectional descriptive study with analytic components was carried out in a tertiary care teaching hospital. All neonates ≥1 kg, born outside of this hospital, and referred here during study period for further management were included. All the data pertaining to clinical, demographic and transport characteristics were recorded. TRIPS score was applied at admission and was related with the final outcome within first seven days of admission; expired or survived. The association between the outcome and TRIPS score was tested using chi square test or fisher's exact test. ROC curve analysis was done to find out optimum TRIPS score to predict mortality.
Results: Neonatal mortality within first 7 days after admission is related to the TRIPS rating. The score of the survivors and neonatal deaths show a significant difference which is also even reflected by its individual components ($p< 0.001$). For a score of >18.5, a sensitivity of 89.47% and a specificity of 91.47%; area under the curve of 0.954 was determined.
Conclusions: TRIPS score is a valid predictor of early neonatal mortality. The components of TRIPS score also correlate with early neonatal death. It is important to establish measures to improve physiological stability of the newborn before, during and after the transfer in order to reduce neonatal mortality.

Keywords: Neonatal mortality, Transport risk index of physiological stability, Transfer

INTRODUCTION

According to the United Nations International Children's Emergency Fund (UNICEF) first-ever report on the newborn mortality rate, published in 2018, every year 26 lakh babies die worldwide within 28 days of birth, which is an average of 7,000 deaths every day. Of these, 6.4 lakh neonatal deaths occur in India. The neonatal mortality rate is 25.4 deaths per 1,000 live births in India makes it 12th worst among the 52 lower-middle-income countries.[1,2]

In India since 1991 IMR has been declining at a rate of 2-3 points per year but this pace of decline has fail to achieve the millennium development goal 4 which had aimed to reduce the under 5 mortality rate by two third between 1990 and 2015.[3,4] From 1991 to 2013 post-neonatal mortality rate was reduced by approximately 60% but reduction in NMR was only 40%. Decline in early neonatal mortality rate was even slower with only 37% reduction. Now early neonatal death have become the main component of infant mortality rate, contributing to more than 50% of total infant death.[5] Most of the

neonatal transport also take place during this early neonatal period and in a recent study from India mortality rate among transported (out born) neonates was found to be much higher than inbornneonates (25.39% v/s 14.92%), reflecting higher death among transported early neonates.[6] These new born require special attention and care to accomplish 'Mission Twenty -Twenty' that is reduction of IMR to 20/1000 live births by 2020 in India and to achieve the 'sustainable Development Goal 3' (SDG-3) which aims to reduce NMR to at least as low as 12/1000 live births by 2030 worldwide.[3,4,7]

A significant number of neonates require emergent transfer to tertiary care center, often because of medical, surgical or rapidly emerging postpartum problems. These are termed out born neonates. Transportation of neonates still remain one of the greatest challenges in developing countries like us. It is sad reality that most transport in India are accomplished either by parents in their own vehicle or by utilising private ambulances without any dedicated equipment or trained staff. So, most babies are cold, blue or hypoglycaemic when they reach the referral NICU. All high risk new born babies should be delivered in a centres having NICU facility to avoid hazard of transport after delivery. Timely and proper transport facility for inter and intra hospital transport of neonates should be available which is an integral component of the neonatal care process, as it improves the outcome of these neonates. During transportation a stable microenvironment is preferred that will ensure an ideal mix of oxygen, temperature and humidity to prevent cold stress.

The principle of safe transport of sick babies are expressed by a number of mnemonics like STABLE (Sugar, Temperature, Airway, Blood pressure, Laboratory work up, Emotional support), SAFER (Sugar, Arterial circulatory support, Family support, Environment, Respiratory support), TOPS (Temperature, Oxygenation, Perfusion, Sugar).[8] All these parameters should be assessed and remedial action should be taken immediately if found any compromised. This neonatal and infant critical care transport system form a major part of providing intensive care to many patients who are often referred from hospital that are invariably a long distance away from tertiary centres.[9]

Assessment of severity of illness of these transported neonates at admission is important as it helps in predicting outcome and thus in counselling the parents of these sick babies. Various illness severity scoring system available for predicting neonatal outcome like Score for Neonatal Acute Physiology (SNAP), Clinical Risk Index for Babies (CRIB) but most of them take into account an exhaustive number of parameters including laboratory investigations and are expensive and time consuming.[10,11] There is a need of simple, rapid, practical, validated score which does not require sophisticated equipment. One such score is Transport Risk Index of Physiological Stability (TRIPS) score which was devised by Lee SK and co-workers in Canada.[12] It has been used to measure the physiological consequences that can potentially be caused by neonatal transportation. It is based on four components of physiological stability that are easily recorded.

- Temperature
- Blood pressure
- Response to Noxious stimuli
- Respiratory status

METHODS

This is a cross-sectional descriptive study with analytic components. A total of 127 neonates transported to NICU of GVR Children hospital, Kurnool, AP during the period of November 2018 to May 2019 were enrolled to study TRIPS score as a predictor of early neonatal mortality (i.e. mortality within the first seven days of admission). Outborn neonates with birth weight ≥1 kg and age ≤7 days were included. Neonates with lethal congenital malformation, acute surgical emergencies (TEF, CDH) and expiry within 1 hour of admission excluded. Written and informed consent was obtained from the parents/guardian of the enrolled neonates. On admission demographic characteristics (including age and gender), cause of referral, chief complains, transport characteristics (distance, mode of transport, person accompanying), maternal history, birth history were noted. General examination and systemic examination were performed to assess vital parameters.

Table 1: TRIPS score parameters.

Parameter	Value	TRIP score
Temperature	<36.1°C- >37.6°C	8
	36.1-36.4 or 37.2-37.6°C	1
	36.5-37.1°C	0
Respiratory status	Severe (apnea, gasping, intubated)	14
	Moderate (Respiratory rate (RR) >60/min and/or saturation <85%)	5
	Mild (RR,60/min and/or sat >85%)	0
Systolic blood pressure	<20 mm Hg	26
	20-40 mm Hg	16
	>40 mm Hg	0
Responds to painful stimulus	No response, seizure, muscle relaxant	17
	Lethargic, no crying	6
	Crying and withdrawal	0

Parameters of TRIPS scoring were checked: temperature recorded by digital thermometer in axillary area; respiratory status by counting respiratory rate in one minute; checking oxygenation (spo2) with pulse oximeter and observing type of oxygen administered; systolic BP by monitoring non invasive blood pressure (NIBP) in

multipara using neonatal cuff and degree of response to physical stimulus measured.

Then sum of all four parameters of table 1 was done to calculate TRIPS score. Admitted neonates were monitored for the outcome for 7 days after admission. Outcome noted as mortality or survival during this post transport 7 days period. All these findings were recorded on a predesigned and pretested proforma.

The categorical data was expressed in terms of rates, ratios, percentages and the continuous data was expressed in terms of mean±SD. The association between outcome and TRIPS score and its components was tested using chi square test or fisher's exact test. To find out the best cut off TRIPS score to predict mortality, ROC curve analysis was done. For all stastical analysis SPSS version 20 was used and P value less than 0.05 was taken as significant.

RESULTS

This cross sectional, descriptive study was conducted on total of 127 neonates transported to NICU, GVR Children Hospital, Kurnool, Andhra Pradesh during the study period from November 2018 to May 2019. The data was analysed, and the final results were tabulated and interpreted as below.

Table 2: Demographic and transport characteristics of study population.

Characteristics		
Gender	Male (78) (61.42%)	Female (49) (38.58 %)
Day of life at admission	1st day (65) (51.18%)	2nd - 7th day (62) (48.82 %)
Mode of transport	Private Ambulance (73) (57.48%)	Private/Self vehicle (50) (39.37%) Public transport (4)(3.15 %)
Person accompanied during transport	Trained (38) (29.92%)	Untrained (89) (70.08%)
Antenatal care	Booked case (111)(87.40%)	Unbooked (16) (12.60%)
Place of delivery	Private hospital (109) (85.83%)	Gov. hospital (18) (14.17%)
Mode of delivery	LSCS (75) (59.05%)	NVD (52) (40.95%)
Weight at admission	<2.5 kg (57) (44.89%)	≥2.5 kg (70) (55.12%)
Gestational age	< 37 wk (31) (24.40 %)	≥ 37 wk (96) (75.59 %)

Most of the neonates were males (61.42%). The boy to girl ratio was 1.59:1. Most of the neonates were referred on first day of life (51.18%). Congenital anomalies were noted in 15.75% of the neonates. Although, the common modality of transport was private ambulance (57.48%), more than one third of the neonates were transferred through private vehicle (39.37%) and few were transferred through public transport (3.15%). Maximum neonates were accompanied by parents (70.08%) and only 29.92% of the neonates were transferred with trained Doctor/Nurse/paramedical during the transport. Although, most of the neonates received routine medical care and oxygen (40.16%) prior to the referral, majority of the neonates were not stabilized (77.17%) prior to the transfers. Most of the women were aged between 21 to 25 years (45.67%).

Table 3. Distribution of the neonates according to the causes of referral.

Cause of referral	Distribution (n=127)	
	Number	Percent-age
Respiratory distress syndrome	22	17.32
Birth asphyxia	21	16.54
Neonatal sepsis	19	14.96
Transient tachypnoea of newborn	13	10.24
Non emergency surgical situation	9	7.08
Meconium aspiration syndrome	7	5.51
Neonatal jaundice	7	5.51
Hypoglycaemia	6	4.72
Very low birth weight	5	3.94
Congenital heart disease	5	3.94
Neonatal seizure	4	3.14
Aspiration pneumonia	3	2.36
Congenital pneumonia	2	1.57
Necrotising enterocolitis	1	0.79
Haemorrhagic disease of newborn	1	0.79
Intracranial haemorrhage/Intraventricular harmorrhage	1	0.79
Acute bilirubin encephalopathy	1	0.79
Total	127	100.00

Most of the women reported primi parity (49.61%). History of antenatal steroid treatment was noted in 8.66% of women. Majority of the women received antenatal care (87.4%).Majority of the women (85.83%) delivered in private hospital by gynecologists (70.87%). Majority of the women had vertex presentation (92.13%). Complications of PROM were noted in 22.83% of the women, 14.17% of the women had meconium stained amniotic fluid and 19.69% of the women had prolonged labour.Most of the women underwent LSCS (59.05%). Breathing difficulty/respiratory distress was common complaint for referral in 51%. On general examination acrocyanosis was noted in 15.75% and acrocyanosis with edema in 11.02%. Most of the babies (55.12%) had birth

weight ≥2.50 kg. Most babies (75.59%) having gestational age ≥37 wks. Majority of neonates (50%) had tachypnoea on respiratory examination. Tachycardia was present in 11.81% of the neonates on cardiovascular examination while 39.37% of the neonates were lethargic on CNS examination and distension was noted in 4.72% of the neonates during alimentary system examination. In this study most of the neonates were referred for respiratory distress syndrome (17.32%) followed by birth asphyxia (16.54%). The other causes are as shown in table 3.

Table 4: Clinical characteristics of study population.

Variables	Distribution (n=127)		Median	Range	
	Mean	SD		Min	Max
Distance (Km)	43.13	38.87	42.00	0.20	193.00
Maternal age (Years)	25.43	3.57	25.00	18.00	39.00
Birth weight (Kg)	2.44	0.60	2.50	1.10	3.55
Length (cm)	47.02	3.51	48.00	36.00	52.00
Head circumference (cm)	32.88	1.61	33.00	28.00	35.00
Modified Ballard Score	36.79	2.23	37.00	31.00	41.00

Table 5: Distribution of the neonates according to the outcome seven days post transport.

Outcome seven days post transport	Distribution (n=127)	
	Number	Percentage
Improved and discharged within 7 days	74	58.27
Referred to higher centre within 7 days	8	6.30
Continued treatment for 7 days and beyond in hospital	26	20.47
In hospital mortality within 7 days	19	14.96
Total	127	100.00

The clinical characteristics of the neonates is as shown in table 4. The mean distance travelled was 43.13±38.87 kms and median distance was 42 Kms with range 0.2 Kms being minimum and 193 Kms being maximum.

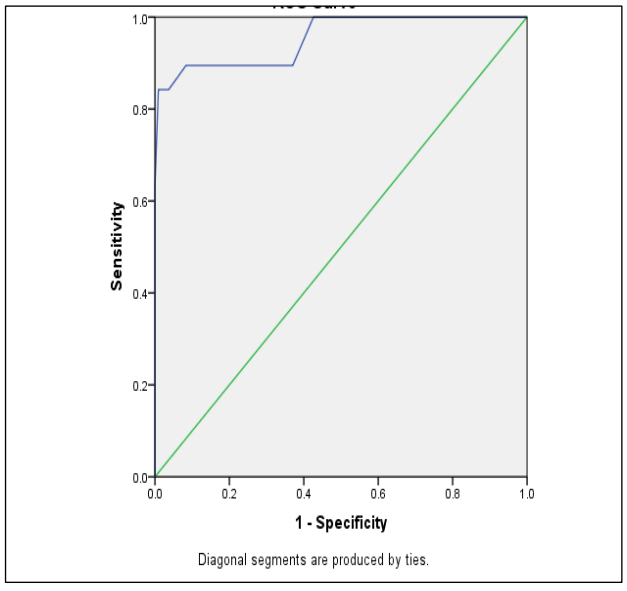

Figure 1: Receiver operating characteristic curve.

Within seven days post transport period of time in hospital mortality was noted in 19 (14.96%) neonates.

The receiver operating characteristics curve to discriminate mortality using TRIP score within seven days of transport is as shown in graph 1 which yielded a cut-off value of 18.5 in predicting mortality with AUC=0.954; SE=0.029; p=<0.001; 95% CI .898 to 1.000.

Table 6: Accuracy of TRIP score in predicting post transport seven days in hospital mortality.

Trip score	Post transport seven days in hospital mortality				Total (n=127)	
	Yes		No			
	No.	%	No.	%	No.	%
>18.5	17	89.47	9	8.33	26	20.47
≤18.5	2	10.53	99	91.67	101	79.53
Total	19	14.96	108	85.04	127	100.00

p <0.001

In hospital mortality within seven days post transport was noted in 19 (14.96%) neonates. Of them, majority of the neonates (89.47%) had TRIP score of >18.5. The TRIP score of >18.5 was 89.47% sensitive, 91.67% and specific with PPV of 65.38% and NPV of 98.02.

The positive likelihood ratio was 89.47 and Negative likelihood ratio was 0.11 in discriminating the survivors. Authors excluded death after 7 days of admission/transportation for calculation of predictive accuracy of TRIPS score because they are more likely to be related to NICU interventions than to the transport process.

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DISCUSSION

Demographic characteristics of the transferred neonates

In the present study most of the neonates were males (61.42%). The boy to girl ratio was 1.59:1 suggesting male preponderance. The male preponderance observed in the present study was consistent with a recent prospective observational study by Mehta N and Sharma MK from Indore Madhya Pradesh, India where among 513 transported babies, 329 males (64.13%) and 184 females (35.86%).[13] Another study by Verma SK et al from Jodhpur, India also reported that, males outnumbered females (59.49% and 40.51% respectively) with a male to female ratio of 1.47:1.[14]

Table 7: Association of TRIP score components with mortality.

TRIP score components	Findings	Outcome				p value
		Survivors (n=108)		Non survivors (n=19)		
		No	%	No	%	
Temperature score	0 (36.5 to 37.1)	45	100.00	0	0.00	<0.001
	1 (36.1 to 36.4/37.2 to 37.6)	38	86.36	6	13.33	
	8 (<36.1/>37.6)	25	65.79	13	34.21	
Respiratory status score	0 (RR 60 /minute and/or SPO_2>85%)	50	100.00	0	0.00	<0.001
	5(RR >60 /minute and/or SPO_2<85%)	55	84.62	10	15.38	
	14(Apnoea, gasping and intubated)	3	25.00	9	75.00	
Response to painful stimulus score	0 (Crying and withdrawal)	61	100.00	0	0.00	<0.001
	6 (Lethargic, no crying)	29	82.86	6	17.14	
	17 (No response, Seizure, muscle relaxant)	18	58.06	13	41.94	
SBP score	0 (>40 mm Hg)	108	86.40	17	13.60	<0.001
	16 (20 to 40 mm Hg)	0	0.00	2	100.00	

Common cause of referral of the transferred neonates

Most of the neonates were referred for respiratory distress syndrome (17.32%) followed by birth asphyxia (16.54%), neonatal sepsis (14.96%), Transient tachypnoea of newborn (10.24%) while meconium aspiration syndrome was noted in 5.51% of the children. Respiratory distress, prematurity, sepsis, perinatal asphyxia, meconium stained liquor and jaundice continue to be the most common causes for neonatal referrals across the country though frequency may vary from study to study, the most common being respiratory distress in Rajasthan, Uttrakhand and in New-Delhi (Northern-India), low birth weight in Gujarat (Western India) and birth asphyxia in Telangana (Southern India).[6,15-17] These observations from the literature are consistent with the present study. The main reasons for inter-hospital transfer in the present study were similar to those reported in the literature, a study by Romanzeira JC, Sarinho SW reported that, respiratory failure as the main cause of transport request in 42.4%.[18]

In another study by Verma SK. et al from Jodhpur, India most common causes for referrals were respiratory distress (42.56%) followed by perinatal asphyxia 106 (27.18%) which was similar to the present study.[14]

Transport characteristics

In the present study, the mean distance travelled for referral hospital ranged between 0.2 to as high as 193 Kms. In contrast to these observations, the study by Romanzeira JC, Sarinho SW reported that, the transport occurred within distances of less than 50 km, which was very low compared to the present study. In the present study although, the common modality of transport was

private ambulance (57.48%), more than one third of the neonates were transferred through private vehicle (39.37%) and few were transferred through auto rickshaw (3.15%) also.[18] In contrast to the findings of the present study, a study by Verma SK et al from Jodhpur, India reported that, 70.51% of the babies came in ambulance either government or private which was equipped with oxygen line while 29.49% in self vehicle without any support.[14] However, the percentage of referred neonates transported by ambulance in the present study was high compared to the study reported by Buch et al (26.8%) and Narang M et al (29.6%).[15,16]

Maternal characteristics

The frequency of antenatal care noted in 87.40% in the present study was comparable to a study by Verma SK. et al from Jodhpur, India who reported that, 95.38% had undergone at least one ante natal checkup.[14] The percentage of institutional delivery in our study that is, 100% was sharply in agreement with a study by Verma SK. et al from Jodhpur, India who reported frequency of institutional delivery 93.33%.[14] Similar rate of institutional delivery was reported in another study from Gujarat by Buch et al, where the rate of institutional delivery was 85.2%. However, the rate of LSCS noted in the present study was very high compared to a study by Verma SK. et al from Jodhpur, India which reported that, only 9.24% of referred babies were born through LSCS which can be explained by difference in referring pool between two studies.[14,15]

Birth history of neonates

The mean birth weight 2.44±0.60 Kg and mean gestational age at admission was 36.79±2.23 in present study whichwas similar to the study by Verma SK et al from Jodhpur, India who reported Mean birth weight of 2.29±0.65 in kg and mean gestational age of 37.49±3.16.[14]

Early neonatal death

In the present study within 7 days post transport in hospital mortality was noted in 19 (14.96%) neonates. The rate of in hospital END noted in the present study was slightly low compared to a study by Verma SK et al from Jodhpur, India where neonatal mortality rate was 20.76% and a study by Begum et al in Telangana reported higher neonatal mortality rate (22.8%).[14,17]

TRIP Score

In present study, the receiver operating characteristic curve to discriminate mortality using TRIP score yielded a cut-off value of 18.5 in predicting mortality within seven days of transport with AUC=0.954; SE=0.029; p=<0.001; 95% CI .898 to 1.000. The TRIP score of > 18.5 was 89.47% sensitive, 91.67% specific with PPV of 65.38% and NPV of 98.02. The positive likelihood ratio of in hospital mortality within 7 days of transport was 10.74 and negative likelihood ratio was 0.11 in discriminating the survival. These findings are strongly in agreement with the study by Luna-Hernández G et al, a study which reported that, the score of the survivors and neonatal deaths show a significant difference (p=0.009).[19] For a score of 16, a sensitivity of 62% and a specificity of 84%; area under the curve of 0.757 was determined based on the data from 56 patients. Although the cut-off for the TRIP score noted in the our study was high compared to the study by Luna-Hernández G, et al it was highly reliable since the cut-off score derived in the present study is from larger sample (n=127) compared to the study by Luna-Hernández G, et al (n=56) and due to several other limitations which included the information recorded, both the records with complete data as well as those with incomplete data, was similar.[19] Despite methodological differences the present study is also in agreement with a study by Lee SK et al in which TRIPS score has discriminated 7-day NICU mortality from survival with receiver operating characteristic areas of 0.83.[20]

Hypothermia is a common event among transported neonates. In our study also more than half (64%) of the referred neonates were hypothermic and next common event was hypoxia which was present in 60% of the referred neonates which is similar with the findings of Verma SK. et al study from Jodhpur, India which reported that hypothermia was most common in 46.67% followed by next common was hypoxia in 39.23% of the referred neonates.[14]

CONCLUSION

Though, institutional delivery and transport facilities are gradually improving in the country, but faster reduction of out-born deaths require further strengthening of small health setups to minimize the neonatal transport. Considering the percentage of abnormal TRIPS parameter among referred neonates at receiving hospital, every neonatal transport should be supervised by a team of transport experts.

The TRIPS score can be applied rapidly and reliably at the time of admission to measure acute physiological parameters in newborns referred from periphery to tertiary care even in resource constrained settings and it can predict in hospital mortality outcome within 7 days of transport at the time of admission with satisfactory sensitivity and specificity.

It is a valid predictor of early neonatal mortality. The components of TRIP score also correlate with early neonatal death (END). However, multi-centric studies involving large sample size, recruiting infants with diverse clinical problems, further categorization of ‘severe respiratory status’ (parameter of TRIPS score), measuring of pre transport TRIPS score and longer follow up period are warranted to extend and improve the

validity and reliability of TRIP score as well as epidemiology of end.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Shah DM, Bhuvaneswari M, Ramaprasad GS. Utility of transport risk index of physiological stability score for predicting likely outcome of extramural neonates transferred to NICU. Int J Contemp Pediatr 2020;7:1081-7.