Original Article

Analysis of the adverse events related to transfer of neonates to a tertiary centre of central India

Amit Kumar Baghel[1], Kewal Kishore Arora[2], Swati Mulye[3], Anuj Malhotra[4]

From [1]Ex Resident, [4]Resident, [2]Assistant Professor, [3]Professor, Department of Pediatrics, Sri Aurobindo Medical College and Postgraduate Institute, Indore, Madhya Pradesh, India

Correspondence to: Dr. Kewal Kishore Arora, 301 A Gulmarg Valley, 1 Gulmarg Colony Near Telephone Nagar, Indore - 452 016, Madhya Pradesh, India. E-mail: kewalkishore@gmail.com

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ABSTRACT

Background: Institutional delivery and *in utero* transport of the newborn is the safest method of neonatal transport. However, neonatal illnesses cannot always be predicted, resulting in the continued need of transfer of these babies after delivery. **Objective:** The objective of the study was to analyze the adverse events related to transfer of neonates to a tertiary center of Central India, the impact of the epidemiological factors, and the role of temperature, oxygenation, perfusion, and blood sugar (TOPS) scoring in predicting mortality in transferred neonates. **Materials and Methods:** This observational study was conducted at the special care newborn unit of a tertiary teaching hospital of Indore. A total of 217 transported neonates were included in the study. The TOPS scoring for each neonate was done at admission and the parameters of the TOPS score were correlated with the outcome. **Results:** The common indications for referral were respiratory distress in 103 (47.4%), prematurity/low birth weight care in 31 (14.2%), sepsis in 27 (12.4%), seizures in 21 (9.6%), and neonatal hyperbilirubinemia in 16 (7.3%) cases. At the time of admission, 25.4% of neonates had normal temperature, while 31.8% had temperature between 96.8 and 97.6°F, and 42.9% had hypothermia (89.6–96.6°F). Almost 5.1% of admitted neonates were hypoglycemic (<45 mg/dl) and rest 94.9% were normoglycemic (>45 mg/dl). Hypoxemia (oxygen saturation <90%) was seen in 51.6% of neonates and 16.1% of neonates had prolonged capillary refill time at admission. A higher TOPS score of 3 and 4 was correlated with higher incidence of mortality. **Conclusion:** TOPS score is a useful and easy to use method to assess the physiological status and helps in prediction of mortality in neonatal transport.

Key words: *Low birth weight, Neonatal intensive care unit, Neonatal transport, Prematurity, Sepsis*

Neonatal transport has been found to be associated with increased infant mortality in the developing countries [1,2]. In India, the neonatal mortality rate is 29/1000 live births. This high mortality could be attributed to delay in recognition of the severity of illness or delay in transport of sick neonates or in delivery of appropriate health care [3].

Although institutional delivery and *in utero* transport of the newborn is the safest method, neonatal illnesses cannot always be predicted, resulting in the continued need of transfer of these babies after delivery [4]. Respiratory distress, prematurity, asphyxia, sepsis, and neonatal jaundice are the common causes of neonatal transport [4]. Facilities for neonatal transport in India are dismal. Most of the neonates are transported without any pre-transport stabilization or care during transport, which can have serious clinical implications on the ultimate outcome of babies [5]. Navjat Shishu Suraksha Karyakram launched by the Government of India also highlights the role of safe neonatal transport [6].

Various score systems have been developed to predict mortality in neonates in different settings, for example, the clinical risk index for babies score [7], score for neonatal acute physiology (SNAP) score [8], SNAP II and its perinatal extension (PE) SNAPPE II score [9], and mortality index for neonatal transportation score [10]. Neonatal physiology is adversely affected by decrease in temperature, oxygen saturation (SpO_2), skin perfusion, and blood sugar (temperature, oxygenation, perfusion, and blood sugar [TOPS]) which have shown to predict the mortality in transported neonates by Mathur and Arora [5]. It is a good predictor for mortality as SNAP II and can be used for the assessment of fatality immediately at admission. The aim of this study was to analyze the adverse events related to transfer of neonates, impact of epidemiological factors, and role of TOPS scoring in predicting mortality.

MATERIALS AND METHODS

This observational study was conducted among newborns transferred to the neonatal intensive care unit (NICU) of the tertiary teaching hospital in Central India from January 2017 to June 2018. Approval for conducting the study was obtained from the Institutional Ethics Committee. A written consent was obtained from the parents/caregivers of the newborns included in the study.

Population catered by the hospital is generally lower-middle and middle class of surrounding tehsils and districts, both rural and urban population. The current transport network such as taxi cars, auto-rickshaws, ambulances with or without oxygen, and ambulances with ventilator setup exists in the area; however, due to the lack of knowledge and higher cost of these services, often, these are underutilized, resulting in self-transport on own vehicle.

The inclusion criteria included all extramural babies referred/brought to our NICU during the study period. Babies with lethal congenital malformations and acute surgical emergencies were excluded from the study. In a structured pro forma, details were recorded about more of transport, level of education of accompanying person, indication of transport, the time taken to reach referral center, and TOPS at arrival. Detailed clinical examination was by the resident doctor on duty and findings were recorded.

The temperature was assessed using a digital thermometer kept in the axilla of the baby for 3 min. Oxygenation was assessed by measuring SpO_2 using a pulse oximeter (IntelliVue MPS) or a multipara monitor (Philips, India). Capillary refill time (CRT) was measured at the sternum of the baby to assess perfusion. Blood glucose level was obtained by glucostrips read by glucometer. The temperature <36.5°C or <97.7°F was taken as hypothermia. SpO_2 <90% was taken as hypoxia, CRT ≥3 s was taken as prolonged, and blood sugar <45 mg/dl was defined as hypoglycemia. Each parameter was assigned a score of "1" if abnormal and "0" if normal. Total TOPS score (an aggregate score of all four parameters) for each baby was calculated at the time of admission and after 1 h of admission.

Data were analyzed using the SPSS software trial version 21.0 (Statistical Package for the Social Sciences, IBM Inc., New York). Continuous variables were analyzed using t-test. Categorical variables were analyzed using Chi-square test and multiple logistic regression tests. Sensitivity, specificity, positive and negative predicted values, area under the receiver operating characteristic (ROC) curve, and total classification rate were calculated for validation of TOPS score. For predictors of mortality, $p<0.01$ was considered statistically significant.

RESULTS

A total of 217 neonates were enrolled in the study, of which 137 (62.8%) were male and 80 (36.7%) were female. Around 53 (24.4%) cases belonged to rural area and 164 (75.6%) were from urban area. Almost 50% of babies were premature babies and 10 (4.6%) of babies had weight <1 kg, 31 (14.3%) had 1–1.5 kg, 93 (42.9%) had 1.5–2.5 kg, and 83 (38.2%) had weight of >2.5 kg. Almost all neonates were delivered in the institute except one who was delivered at home.

The majority of neonates were transported by ambulance (173, 79.7%) followed by other four-wheelers (30, 13.8%) and two-wheelers (14, 6.5%). A total of 97 (44.7%) babies were brought from the government delivery points such as hospitals or primary health center or community health centers, 13 (6%) from home, and 96 (44.3%) were transported from private hospitals and nursing homes. Common indications for referral were respiratory distress (103, 47.4%) and prematurity or low birth weight (LBW) in 31 (14.2%), followed by sepsis in 27 (12.4%), seizures in 21 (9.6%), neonatal hyperbilirubinemia in 16 (7.3%), ventilator support in 9 (4.1%), dehydration in 5 (2.3%), necrotizing enterocolitis in 2 (0.9%), post-resuscitative care in 2 (0.9%), and hypoglycemia in 1 (0.4%) neonate.

On assessing the TOPS score parameters at admission, 55 (25.4%) neonates had normal temperature, 69 (31.8%) had axillary temperature between 96.8 and 97.6°F, and 93 (42.9%) had temperature between 89.6 and 96.6°F, and none of the neonates was severely hypothermic (<89.6°F). On blood sugar, 11 (5.1%) babies were hypoglycemic and remaining 206 babies (94.9%) were normoglycemic. Hypoxemia (SpO_2 <90%) was observed in 112 (51.6%) neonates, while remaining 105 (48.4%) had normal SpO_2. At admission, 35 (16.1%) neonates had prolonged CRT, while 182 newborns had normal CRT.

Of 217 babies, 187 (86%) had abnormal TOPS score (≥1). An association of TOPS score was observed with the outcome of newborn after treatment, i.e., death. An increase in the TOPS score was associated with increased mortality. We did not associate skilled worker in our study to any degree of sickness as only 10% of newborns transported by ambulance were accompanied by trained health staff (Table 1).

TOPS score was higher in smaller babies as compared to normal weight babies, which is reflected as increased mortality and left against medical advice, as shown in Table 2.

It has been emphasized that skilled health worker (Neonatal Resuscitation Program trained) should accompany during neonatal transport which will help in reducing neonatal mortality (Table 3).

Table 1: Correlation of grades of TOPS score with outcome

TOPS score	Outcome number (%)		
	Discharge	Death	Total
0	31 (96.9)	1 (3.1)	32
1	51 (94.4)	3 (5.6)	54
2	34 (72.3)	13 (27.7)	47
3	17 (58.6)	12 (41.4)	29
4	0 (0)	1 (100)	1
Total	128 (78.5)	35 (21.5)	163

TOPS: Temperature, oxygenation, perfusion, and blood sugar

Table 2: Correlation of birth weight of newborns with outcome

Birth weight	Outcome number (%)			
	Discharge	Left against medical advice	Death	Total
Extremely LBW	1 (10)	3 (30)	6 (60)	10
Very LBW	15 (48.4)	10 (32.3)	6 (19.4)	31
LBW	60 (64.5)	21 (22.6)	12 (12.9)	93
Normal birth weight	52 (62.6)	20 (24.1)	11 (13.3)	83
Total	128 (59)	54 (25)	35 (16)	217

LBW: Low birth weight

Table 3: Association with health worker accompanying transported newborn

Accompanying staff	Temperature, oxygenation, perfusion, and blood sugar score, number (%)					
	0	1	2	3	4	Total
Trained staff	2 (9.1)	4 (18.2)	8 (36.4)	6 (27.3)	2 (9.1)	22
Untrained staff	34 (17.5)	66 (33.8)	63 (32.3)	32 (16.4)	0 (0)	195
Total	36 (16.5)	70 (32)	71 (32.7)	38 (17.5)	2 (0.9)	217

DISCUSSION

This study attempts to identify common issues related to neonatal health and transport system for newborn. There were 62.8% of males in this study and the results were in accordance with the studies done by Begum *et al*., Rao *et al.,* and Verma *et al*., who showed that the majority of the admitted neonates were male [11-13]. It is perceived that male babies are given more priority and higher percentage of males in our study also emphasizes this fact as our NICU services are paid. Around 53 (24.4%) cases belonged to rural area and 164 (75.6%) belonged to urban area which may be due to the location of study center which is a tertiary center with good infrastructure.

In this study, almost all deliveries were conducted at health-care facility, while only one baby was delivered at home. Studies from other developing countries also demonstrated that >95% of deliveries are being conducted at health-care facility [14]. Hence, there is a significant increase in institutional deliveries over the years as studied by Gogia *et al.* [15], probably an effect of Janani Shishu Suraksha Karyakaram, an incentive-based scheme launched by Government of India.

In this study, 65.8% of babies were transported within 30 min as majority of the babies were referred from urban area. There was no effect of duration on the mortality of the babies admitted. In a study by Sehgal *et al*., longer duration of transport was considered as an independent risk factor for mortality in transported neonates [16]. In a similar study by Mori *et al*., neonates who were transported for more than 90 min had twice more risk of death [17].

In this study, the major mode of transport was ambulance (79.7%) and this in accordance with a study done by Verma *et al*., where 70.51% of babies were transferred by ambulance [13]. However, this is in contrast to that found by Dalal *et al*., in which only 47.3% of babies were transported in ambulance [4]. Narang *et al.* found that most of the neonates were transported by either a private vehicle (41%) or by public transport (29.3%), while ambulance was used for transporting only 29.6% of neonates [3].

In this study, neonates who were transferred by ambulance had significantly increased hypoxemia and hypothermia at arrival, which could increase the mortality rate. This might be due to the fact that neonates, being sent to our NICU, were very sick. In contrast, Narang *et al.* and Modanlou *et al.* [3,18] concluded that babies who were transported by ambulance had good survival rate with lesser incidence of hypoglycemia and hypothermia as compared with babies who came by themselves.

In this study, common indications for referral were respiratory distress (47.4%), prematurity/LBW (14.2%), and sepsis (12.4%). These results were in accordance with the studies done by Narang *et al*., Verma *et al*., and Buch *et al*., where respiratory distress was the most common indication of referral [3,9,19]. In our study, hypothermia was found in 74.6% of neonates, of which 31.8% were mild and 42.9% were moderate hypothermic. In a study by Begum *et al*., hypothermia was found in 39% and severe hypothermia in 3.4% of babies on admission [11].

We found that higher the TOPS score on admission more is the proportion of mortality. In our study, 3.1%, 5.6%, 27.7%, 58.6%, and 100% of outborn babies died with 0, 1, 2, 3, and 4 TOPS score, respectively. A similar association was found in studies conducted by Dalal *et al.* and Mathur and Arora [4,5]. It shows that once there is an irreversible cellular injury, efforts taken to revive the baby become ineffective. These findings are in concordance with the previous studies.

The value under the ROC curve or area under the curve (AUC) was 0.820 (95% confidence interval: 0.743–0.897) with a standard error of 0.039 with a sensitivity of 97.1% and specificity of 75.8%. However, the previous studies by Mathur and Arora, Richardson *et al.,* and Begum *et al*. showed AUC as 0.89, 0.835, and 0.76 [5,9,11]. Neonatal mortality rate among the transported neonates in this study was 16.12% which is in accordance with the findings of the study done by Begum *et al.* and Verma *et al.* [11,13]; however, lower than the previous studies done by Narang *et al*., Mathur and Arora, and Buch *et al.* [3,5,19]. This could be due to the short travel time of most of our babies.

There were few limitations of this study. As most of the patients were transported within 30 min from the nearby places; they were not classified based on the time taken to reach our institution and its impact on TOPS on arrival. However, transportation time is one of the key factors that influence TOPS score. Another shortcoming was that the initial TOPS score at referring center was not recorded. Studying TOPS in pre- and post-transport would be useful in predicting mortality in transported newborns.

CONCLUSION

TOPS score is a reliable test to predict the mortality of transported neonates. Thus, it can be used effectively to triage the babies who require prompt treatment and strive for intact survival of neonates. It is recommended that ideally, it should be done at referral center, during transport in transporting vehicle and on arrival at institution for the best results.

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