DOI: 10.7860/IJNMR/2017/26048.2201

Original Article

Paediatrics Section

Status of Transported Neonates and Evaluation of TOPS as a Survival Score

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ABSTRACT

Introduction: 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 clinical and demographic characteristics of referred neonates and to evaluate TOPS as a survival score in these babies.

Aim: To study the morbidity and mortality pattern in out born neonates admitted in Umaid Hospital. To evaluate TOPS score to predict their outcome.

Materials and Methods: This prospective observational study was carried out in a tertiary care teaching hospital. All neonates ≥ 1 kg, born outside of this hospital, and referred here for further management were included. All the data pertaining to clinical and demographic characteristics were recorded. TOPS score was applied at admission and was related with the final outcome; expired or survived. Outcomes were analyzed using chi square test, and ROC curve analysis was done to find out optimum TOPS score to predict mortality.

Results: Seventy percent of neonates were referred via ambulance, but condition of these babies at admission was dismal; hypothermic (46.67%), hypoxic (39.23%), hypoglycaemic (21.28%), and poor perfusion (14.61%), the last group being the most fatal (63.16% mortality). TOPS score of ≥2 with AUC of 0.83 proved to be accurate in predicting mortality among these neonates.

Conclusion: Though, condition of neonatal transport is gradually improving in the country, it needs further acceleration for desirable reductions in neonatal mortality. TOPS is a valid survival score.

Keywords: Mortality predictor, Outcome, Referred newborns

INTRODUCTION

In India since 1991 infant mortality rate has been steadily declining at a rate of 2-3 points per year but this pace of decline has failed to achieve the millennium development goal 4, which had aimed to reduce the under five mortality rate by 2/3rd between 1990 and 2015 [1,2]. From 1991 to 2013 post-neonatal mortality rate was reduced by approximately 60% (29 to 12 per thousand live births) but reduction in neonatal mortality was only 40% (51 to 28 per thousand live births). Decline in early neonatal mortality rate was even slower with only 37% reduction during this period. Now early neonatal deaths have become the main component of infant mortality, contributing to more than 50% of total infant deaths [3]. Most of the neonatal transport also takes place during this early neonatal period and in a recent study from India mortality rate among out-born neonates was found to be much higher than inborn neonates (25.39% vs 14.92%) [4], reflecting the higher deaths among referred early neonates. These newborns require special attention and care to accomplish 'Mission Twenty-Twenty' that is reduction of infant mortality rate to twenty per thousand live births by 2020 in India and to achieve the 'Sustainable Development Goal 3' (SDG-3) which aims to reduce the neonatal mortality rate to at least as low as 12 per thousand live births by 2030 worldwide [1, 2].

Prognostication is the most important part of counselling of parents/care givers of any sick baby. For this purpose various survival scores have been devised and are in use in developed countries, but most of them are time consuming and require sophisticated equipments also, so restricting their use at large hospital settings only [5,6]. There is a need of simple, rapid score which does not require sophisticated equipments and can be applied by paramedical staff also, for use in resource limited settings. One of the score was devised by Mathur et al., and was given the acronym TOPS [7].

This study was planned to delineate the clinical and demographic characteristics of out born neonates, keeping in mind that the data obtained will help in formulating the policy for intact survival of these tiny babies. We also want to validate the TOPS score in our population. If this simple score proves to be accurate in different populations and at different settings, it can be widely applied for prognostication.

MATERIALS AND METHODS

This prospective observational study was carried out over a period of 12 months from January 2014 to December 2014 in Department of Pediatrics Umaid Hospital attached to Dr S.N Medical College Jodhpur, India, after approval by Institute's ethical committee. All out born neonates admitted on Monday or Thursday, with birth/admission weight ≥1kg were included and extremely low birth weight babies and those with life-threatening malformations were excluded. Written and informed consent was obtained from the parents/guardians of the enrolled neonates. Clinico-demographic characteristics including details of pregnancy, birth history, transportation details, clinical status at admission, course during hospital stay and final outcome were recorded in a pre-designed performa.

TOPS – It included 4 parameters–temperature, oxygenation, perfusion and sugar. Temperature was assessed by digital thermometer at axilla, oxygenation by SpO2 (pulse oximeter), perfusion by Capillary Filling Time (CFT) at sternum, and blood glucose by glucometer. Hypothermia, hypoxia, prolonged CFT and hypoglycemia were defined as <36.5°C, <90%, ≥3 second and <40 mg/dL respectively [7]. Each parameter was assigned a score of one, if abnormal and zero if normal. Total TOPS score (an aggregate score of all four parameters) for each baby was calculated at admission. Individual and aggregate TOPS score were related with the short-term outcome; expired or survived.

Qualitative data were presented as proportion or percentage and were analyzed using Chi-square test or Fisher's exact test. To find out the best cut off score to predict mortality, ROC curve analysis was done. For all statistical analysis SPSS version 20 was used and p-value less than 0.05 was taken as significant.

RESULTS

Total 462 newborns were admitted during this period, out of which finally 390 qualified to be included in the study. Males (232) outnumbered females (158) (59.49% & 40.51% respectively) with a male to female ratio of 1.47:1. Out of 390 babies, 306 (78.46%) were in early neonatal period and 162 (41.54%) babies were less than 24 hours old. Low birth weight (169) and very low birth weight babies (57) constituted 43.33% and 14.62% of study population respectively. Mean birth/admission weight and gestational age were 2.29±0.65 in kg and 37.49±3.16 weeks respectively. Hundred (25.64%) babies were preterm (<37wks) and eight (2.05%) were post-term (>42 wks) [Table/Fig-1].

Mothers who had complete tetanus toxoid vaccination were 368 (94.36%), and 372 (95.38%) had undergone at least one ante natal check up while only 85 (21.79%) had completed the course of iron folic acid tablets. Three hundred and sixty four (84.35%) babies were institutionally delivered and only 36 (9.24%) of referred babies were born through LSCS [Table/Fig-1].

Characteristics			
Age at Admission (days)	≤ 7 days- 208 (53.33%)	> 7 days- 84 (21.53%)	5.19± 6.64*
Weight at Admission (Kg)	< 2.5 kg – 226 (57.94%)	≥2.5 Kg -164 (42.05%)	2.29± 0.65*
Gestational Age (weeks)	<37 wks – 100 (25.64%)	≥37 weeks -290 (74.36%)	37.49± 3.16*
Gender	Males -232 (59.49%)	Females -158 (40.51%)	1.46:1**
Dwelling	Rural -292 (74.87%)	Urban – 98 (25.13%)	2.97:1**
Mode of Delivery	NVD -354 (90.77%)	LSCS -36 (9.23%)	9.83:1**
Place of Delivery	Institutional – 364 (93.33%)	Home -26 (6.67%)	14:1**

[Table/Fig-1]: Clinical and demographic profile of admitted babies.
*Mean ±Standard Deviation
**Ratio

Around 3/4th (292/390, 74.87%) were from rural areas. A major chunk (65.89%) 257 babies were referred by government health care setups {primary health centre- 8 (2.05%), community health centre- 142 (36.41%), district hospital -107 (27.43%) and 38 (9.74%) private hospitals/clinics}. Ninety five (24.35%) did not receive any medical consultation/care prior to admission, and were directly brought to our hospital from home.

Two seventy five (70.51%) babies came in ambulance either government or private which was equipped with oxygen line while 115 (29.49%) in self vehicle (unequipped) without any support and 169 (43.33%) babies travelled >100 km to reach our hospital. Though, most of the babies 280 (71.79%) reached in 1-4 hours, 25 (6.41%) even took longer (>4 hrs). Most common causes for referrals were respiratory distress 166 (42.56%), perinatal asphyxia 106 (27.18%), prematurity 100 (25.64%) and meconium stained liquor 62 (15.90%). Out of total 81 babies expired, 31(38.2%) had sepsis, 26 (32.10%) perinatal asphyxia, 19 (23.46%) each RDS and MAS and 32 (39.51%) were low birth weight. Few babies had two or more risk factors.

At admission hypothermia was present in 182 (46.67%) neonates, 153 (39.23%) were hypoxic, 83 (21.28%)

hypoglycemic and 57 (14.61%) had poor perfusion. Highest mortality 36/57 (63.16%) was found in poor perfusion group, whereas hypoglycemic babies had the least expiries 27/83 (32.53%) (p<0.05) [Table/Fig-2]. For prediction of mortality, hypothermia and hypoxia were found to be most sensitive (77.78% and 74.07% respectively) with the best negative predictive value (91.3% and 91.1% respectively). Hypoperfusion had the highest specificity (93.20%) and maximum positive predictive value (63.2%) [Table/Fig-3].

Parameter	Score 0		Score 1		p*-value
	Survived	Expired	Survived	Expired	
Temperature	190 (91.34%)	18 (8.65%)	119 (65.38%)	63 (34.62%)	<0.05
Oxygenation	216 (91.13%)	21 (8.86%)	93 (60.78%)	60 (39.22%)	<0.05
Perfusion	288 (86.49%)	45 (13.51%)	21 (36.84%)	36 (63.16%)	<0.05
Sugar	253 (82.4%)	54 (17.59%)	56 (67.47)	27 (32.53%)	.0029

[Table/Fig-2]: Relation between individual TOPS parameter and outcome.
*Chi square test

	Individual Abnormal Parameter			
	Hypo-thermia	Hypoxia	Hypo-perfusion	Hypo-glycemia
Sensitivity (%)	77.78	74.07	44.44	33.33
Specificity (%)	61.49	69.90	93.20	81.88
Positive Predictive Value (%)	34.6	39.2	63.2	32.5
Negative Predictive Value (%)	91.3	91.1	86.5	82.4
Positive likelihood Ratio	2.02	2.46	6.54	1.84
Negative likelihood Ratio	0.36	0.37	0.60	0.81
Odds Ratio	5.58	6.63	10.97	2.25

[Table/Fig-3]: Test characteristics of individual abnormal parameter.

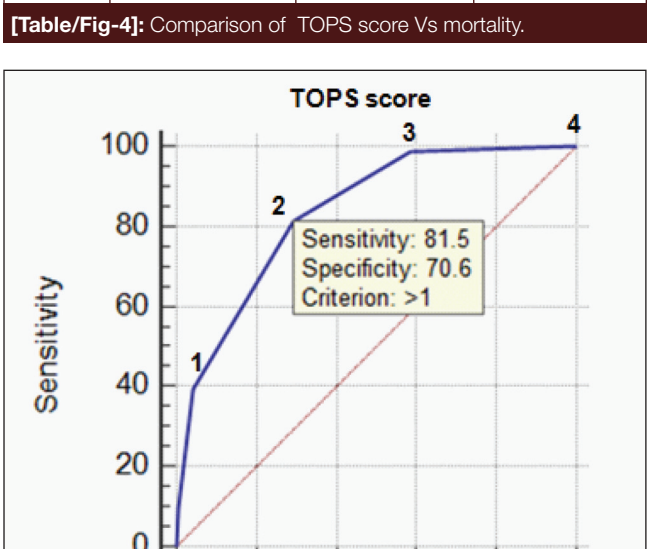
Out of total 390 babies, 262 (67.17%) had abnormal TOPS score (≥1). Total 81 (20.76%) babies expired, out of which 80 (98.76%) had abnormal TOPS score. Only one baby with normal TOPS score expired. There were incremental changes in mortality with advancement of TOPS score [Table/Fig-4]. A score of ≥2 had the best discrimination (AUC-0.835) on ROC curve plotted between TOPS score and mortality (p<0.0001) [Table/Fig-5].

DISCUSSION

The percentage of institutional delivery in our study (84.35%) is comparable to a recent study from Gujarat (Buch et al., 85.2%) [8], but is higher than a previous study from the same state

	Present Study	Mathur et al[7]	Dalal et al[14]
TOPS Score	Expired 81/390 (20.76%)	Expired 60/175 (34.28%)	Expired 71/300 (23.66%)
0	1/128(0.78%)	4/49(8.16%)	--
1	14/105(13.33%)	7/51(13.72%)	12/121(9.91%)
2	35/112(31.25%)	14/34(41.17%)	17/48(35.41%)
3	23/35(65.72%)	23/29(79.31%)	29/37(78.37%)
4	8/10(80%)	12/12(100%)	13/13(100%)

[Table/Fig-4]: Comparison of TOPS score Vs mortality.



[Table/Fig-5]: ROC curve plotted between TOPS score and mortality.

(55.8% in Gujarat) [9], probably an effect of Janani Shishu Suraksha Karyakaram; an incentive based scheme launched by Government of India on first June 2011. Similarly, in the present study a large percentage (70.51%) of referred neonates were transported by ambulance, which is again quiet higher than reported by Buch et al., [8] (26.8%) and Narang M et al., (29.6%), again probably an effect of 108 ambulance service launched in September 2008 in the State of Rajasthan [10].

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) [4, 8,10,11].

Neonatal mortality rate among our neonates was 20.76% which is in line with the findings of a recent study done by Begum et al., in Telangana (22.8%) but is lower than older studies done

by Buch et al., and Mathur et al., and Narang et al., (32.2% in Gujarat and 34.25% in New-Delhi, 46.3% in New-Delhi respectively) [7,8,10,11], reflecting trends of deaths among out-born neonates with time. Mortality rate among out-born neonates always remained higher than contemporary inborn neonatal mortality rate in our institute. In a previous study also proportion of deaths due to respiratory distress syndrome, meconium aspiration syndrome, perinatal asphyxia and sepsis have been found to be more among outborn neonates in comparison to inborn [4]. Most of the referred neonates are already very sick at the time of referral, carrying the high mortality and some of them deteriorate during transport also. Though, intrauterine transfer is considered the safest mode of transport, but every time it is not possible to predict the high risk during antenatal period [12].

India has got a wide network of peripheral health centres in rural areas where most of our population resides [13]. As a sizeable proportion of neonates were referred at less than 24 hours of age, perinatal care facilities at these set ups need upgradation. Reduction in referrals will decrease the loads on tertiary care centres located in urban areas and will improve their functioning also. A neonate should be referred only when it is absolutely necessary, and here safe neonatal transport would act as a bridge between referring and receiving centres. Distance travelled by the neonates and condition at arrival emphasize the need of further improvement of transport services.

Hypothermia is a common event among transported neonates. In our study also almost half (46.67%) of the referred neonates were hypothermic, which is commensurate with the findings of Dalal E et al., [14] (55.3% hypothermic). In both the studies again hypoxia was the next most common event (39.23% Vs 27.4% respectively). In contrast Narang M et al., [10] reported delayed CFT to be the most common event followed by hypothermia (69.3% and 47% respectively). These parameters can be managed easily during transport without requiring any sophisticated equipments. Even if no facility is available then at least kangaroo parental care can be practiced during transport to prevent hypothermia.

In the present study among TOPS parameters, odds ratio for mortality was maximum for delayed capillary filling time, followed by hypoxia, hypothermia and hypoglycaemia, these findings are again in agreement with the results of previous studies [7,11]. In contrast Buch M et al., studied two of these parameters and found odds ratio for hypothermia to be higher than delayed capillary filling time (3.65 Vs 3) [8].

The present study showed increase in mortality with increase in TOPS score, these findings are in concordance with the previous studies [Table/Fig-4]. ROC curve analysis showed that the score of ≥2 has got the maximum discrimination for prediction of mortality as noted in previous studies also (AUC: present study 0.83, Mathur NB et al., 0.89, Begum A et al., 0.76) [Table/Fig-6].

Parameters	Present study: Mean (95% CI)	Begum A et al [11]	Mathur NB et al [7]
Sensitivity	81.48 (71.3-89.2)	71.9%	81.6%
Specificity	70.55 (65.1-75.6)	80.8%	77.4%
Positive Predictive Value	42 (34.2-50.2)	64.3%	72.3%
Negative Predictive Value	93.6 (89.6-96.4)	90.1%	89%
Area Under Curve	0.835 (0.794-0.870)	0.764	0.89

[Table/Fig-6]: Comparison of accuracy of TOPS score ≥2 in predicting mortality.

LIMITATIONS

Limitations of our study include; no head to head comparison between out-born and in-born data and lack of long term follow-up.

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 TOPS parameter among referred neonates at receiving hospital, every neonatal transport should be supervised by a team of transport experts. TOPS score again proves to be accurate in predicting the mortality among out-born neonates.

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FINANCIAL OR OTHER COMPETING INTERESTS:
None.

Date of Publishing: **Apr 01, 2017**