Original research article

A Retrospective Cross Sectional Study To Validate Tops Score In Outborn Neonates Referred To Tertiary Care Centre.

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KEYWORDS

TOPS score (Acronym for Temperature, oxygenation, perfusion, sugar) NMR- Neonatal mortality rate.

ABSTRACT

Background-
One of the Sustainable Development Goals aims to reduce neonatal mortality to at least as low as 12 per 1000 live births by 2030. In India, 63% all deaths among children under the age of 5 occurs in the neonatal period, of which 75% deaths occur in their first week of birth. Intrauterine transport to a centre with the necessary resources is considered ideal to deliver a high risk neonate. A further fall in Neonatal Mortality Rate can be achieved by improving Neonatal Transport Facilities with special emphasis on monitoring parameters like temperature, oxygen saturation, skin perfusion, and blood sugar (acronym TOPS) that can significantly affect neonatal physiology and outcome. This retrospective study aims to validate the TOPS score as a predictor of severity and mortality in outborn neonates.

Materials And Methodology - A retrospective diagnostic accuracy cross sectional study was conducted in Department of Paediatrics in a Tertiary care hospital for a duration of 12 months to validate the use of TOPS score to predict severity and outcome in out born neonates referred to Tertiary care hospital.

Results - The present study showed increase in mortality with increase in TOPS score.

A score of ≥2 has got the maximum discrimination for prediction of mortality. The sensitivity, specificity, positive and negative predictive values of derangements of two or more TOPS parameters in predicting mortality were 37.5%, 98.9% 75% and 94.7% respectively.

Conclusion-Our study showed that an increase in the TOPS score correlates with higher mortality, making it an excellent tool for predicting severity and mortality in transported outborn neonates. It is simple, inexpensive, and requires minimal expertise, making it practical for healthcare professionals.

Introduction

One of the Sustainable Development Goals aims to end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births by 2030.[1] In India, NMR has declined by 2 points from 22 per 1000 live births in 2019 to 20 per 1000 live births in 2020 with Annual Decline Rate of 9.1%. Nearly 63% all deaths among children under the age of 5 occurs in the neonatal period, of which 75% deaths occur in their first week of birth (Early neonatal period) only.[2]

Most experts agree that whenever possible, it is preferable to safely and expeditiously transfer the mother to a centre with the necessary resources prior to delivery of high-risk newborn. Unfortunately, some infants requiring expert neonatal care are not identified prior to birth, and others deliver too quickly to permit maternal transfer.[3]

A fall in Infant Mortality Rate can only be achieved by improving the Neonatal Transport Facilities. The introduction of Neonatal 108 ambulance services in India has revolutionised the transport of sick neonates to the SNCU. It is well known that the transport of newborn baby by a skilled organised team reduces neonatal mortality and morbidity.[4] Unfortunately most of neonatal transports are self-transported without any pre-treatment stabilization or care during transport.[5] Significant decrease in neonatal mortality can be anticipated with regionalization of perinatal care, where many sick newborns can be provided with better care and outcome if they are timely transported in stable condition.[6]

Acute derangements in parameters like temperature, oxygen saturation, skin perfusion and blood sugar (given the acronym of TOPS) are known to affect the neonatal physiology adversely. However, derangements in a combination of these four easily assessable parameters have not been evaluated for prediction of fatality. The present study was therefore designed to evaluate the role of derangements in temperature, oxygen saturation, capillary filling time (CFT) and blood sugar (TOPS) in predicting fatality.[4] The TOPS score is a useful, simple and a reliable method that can be used in a resource limited settings during the early course of hospitalisation. The variables which are used for the scoring purpose are less susceptible to subjective variation and each variable has an independent risk associated with mortality.[7]

Materials and methodology - After obtaining ethical clearance from the institutional ethical committee a retrospective diagnostic accuracy cross sectional study was conducted in Department of Paediatrics in a Tertiary care hospital for a duration of 12 months.

Objectives- To validate TOPS score as a valuable resource in prediction of mortality of neonates referred to tertiary health centre and to prove its efficacy.

Inclusion criteria-Neonates who were transported to a tertiary care hospital from peripheries, due to various reasons fulfilling the criteria of birth weight more than 1 kg were included in the study.

Exclusion criteria- Babies with birth weight of less than 1 kg, major congenital malformations, those needing lifesaving surgeries and parents/care givers leaving against medical advice were excluded.

Cases fulfilling the inclusion and exclusion criteria were considered in the present study. A total of 99 cases were added into the study. Demographic data like name, age, gender and date of birth were recorded. Additional data like date of admission, birth and admission weight, type of delivery, gestational age, place of referral, type of health care facility (Government or Private) was also noted. Details of mode of neonatal transport, pre referral care, availability of skilled health care personnel during transport, details of intimation to referring hospital including referral letter were also collected.

The necessary clinical and laboratory data of out born referred-in neonates was retrieved from admission notes, along with 4 following parameters at the time of admission.

1. Temperature
2. Oxygen saturation
3. Capillary filling time
4. Random blood glucose

Each parameter was awarded a score of "0" if normal and "1" if abnormal. A TOPS score was assigned to the neonate by taking the sum of score of every parameter.

TABLE 1 – Definition of parameters of TOPS score

Parameter	Normal	Abnormal
Temperature (Axillary)	36.5-37.4^{0}C	<36.5; >37.4^{0}C
Oxygenation (SpO_2)	>92%in preterm neonates >94% in term neonates	<92%in preterm neonates <94% in term neonates
Perfusion (CFT)	< 3 seconds	>3 seconds
Random blood sugar	<4 hours - >45mg/dL >4 hours - >54mg/dL	<4 hours - <45mg/dL >4 hours - <54mg/dL

Provisional diagnosis and outcome at 72 hours were carefully recorded. At discharge or at the time of death number of days of hospital stay were noted. All the data was entered in excel sheet. Data analysis was done using Microsoft excel, spss software. Statistical analysis was performed and ROC curves were plotted for the obtained data.

Study design- Retrospective diagnostic accuracy cross sectional study

Statistical analysis- Validity of the outcome predictor of the referred- in neonates have been assessed by using ROC in terms of sensitivity, specificity, NPV, PPV, accuracy, AUC etc.

Results

Out of 99 neonates, 61 were male and 38 were female. With regards to birth weight, 10 neonates fell into <1.5 kg, 32 neonates fell between 1.5-2.5kg and remaining 57 neonates had >2.5kg. 75 neonates were born by normal vaginal delivery and 24 were born by Caesarean section. 2 neonates were born at a gestational age of early preterm (28-34 weeks), 28 neonates were at late preterm (34-37 weeks) and 69 neonates were of term gestation.

TABLE 2 – Birth details of neonates

Study parameters		TOPS score 0 (75) n (%)	1 (20) n (%)	2 (4) n (%)	Total (99) n (%)	Chi square	p value
Gender	Female	29 (38.7)	8 (40)	1 (25)	38 (38.4)	0.328	0.849
	Male	46 (61.3)	12 (60)	3 (75)	61 (61.6)		
Gestation	Early Pre-term	0 (0)	1 (5)	1 (25)	2 (2.0)	15.269	**0.004***
	Late Pre-term	22 (29.3)	4 (20)	2 (50)	28 (28.3)		
	Term	53 (70.7)	15 (75)	1 (25)	69 (69.7)		
Mode of Delivery	LSCS	18 (24)	5 (25)	1 (25)	24 (24.2)	0.01	0.995
	Normal	57 (76)	15 (75)	3 (75)	75 (75.8)		
Birth weight (in Kgs)	< 1.5	3 (4)	5 (25)	2 (50)	10 (10.1)	15.211	**0.004***
	1.5 - 2.5	25 (33.3)	6 (30)	1 (25)	32 (32.3)		
	≥ 2.5	47 (62.7)	9 (45)	1 (25)	57 (57.6)		
Admission weight (in Kgs)	< 1.5	4 (5.3)	5 (25)	3 (75)	12 (12.1)	21.44	< **0.001***
	1.5 - 2.5	30 (40)	6 (30)	0 (0)	36 (36.4)		
	≥ 2.5	41 (54.7)	9 (45)	1 (25)	51 (51.5)		

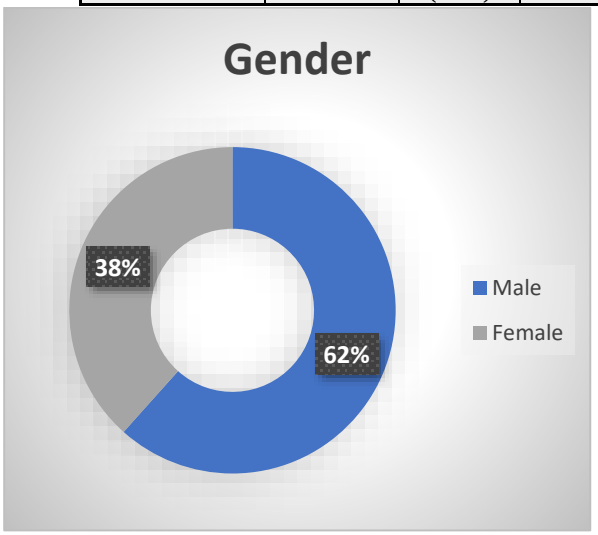


Figure 1- Depicting gender Male & Female ratio

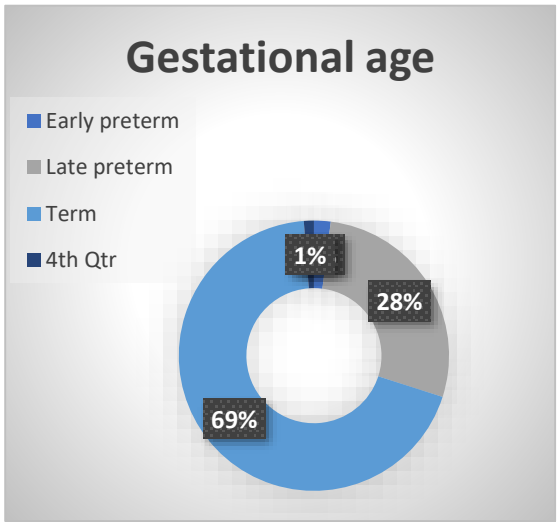


Figure 2 – Depicting distribution according to Gestational age

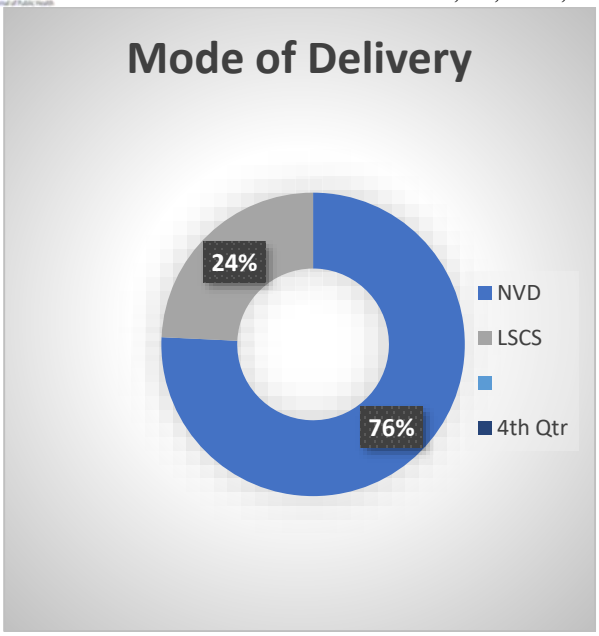


Figure 3- Depicting distribution according to mode of delivery

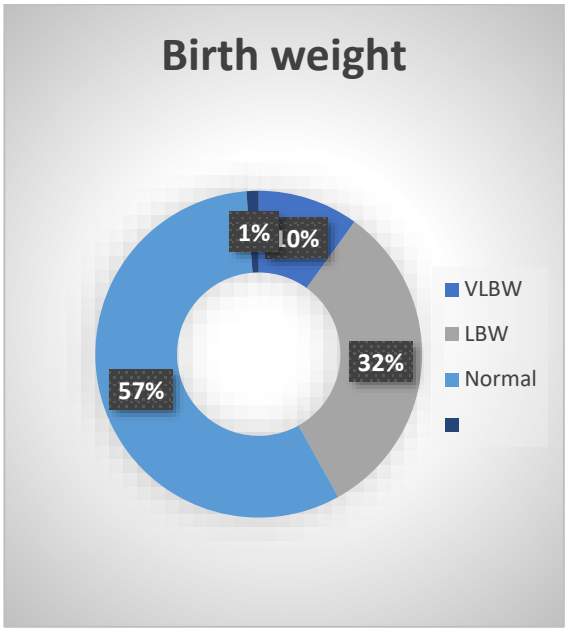


Figure 4 - Depicting distribution according to birth weight

51 neonates were referred from Peripheral government hospitals and 48 from Private hospitals. Ambulance was used to transport neonates in 47 cases and 52 cases did not use ambulance as mode of transport. 60 neonates received pre referral care in form of intravenous fluids, oxygen support, thermoregulation etc. and 49 were received without any pre referral care. None of the neonates were accompanied by skilled health care personnel.

TABLE 3 – Details of pre referral care and transport

Study parameters		**TOPS score**			
		0 (75) n (%)	**1 (20) n (%)**	**2 (4) n (%)**	**Total (99) n (%)**
Facility	Government	35 (46.7%)	12 (60%)	3 (75%)	50 (50.5%)
	Private	40 (53.3%)	8 (40%)	1 (25%)	49 (49.5%)
Travel	Ambulance	32 (42.7%)	12 (60%)	3 (75%)	47 (47.5%)
	Others	43 (57.3%)	8 (40%)	1 (25%)	52 (52.5%)
Prior Intimation given	No	53 (70.7%)	15 (75%)	3 (75%)	71 (71.7%)
	Yes	22 (29.3%)	5 (25%)	1 (25%)	28 (28.3%)
Referral Letter	No	59 (78.7%)	7 (35%)	4 (100%)	70 (70.7%)
	Yes	16 (21.3%)	13 (65%)	0 (0%)	29 (29.3%)

TABLE 4 – Pre referral care and its association with TOPS score

Study parameters		TOPS score				Chi square	p value
		0 (75) n (%)	1 (20) n (%)	2 (4) n (%)	Total (99) n (%)		
Length of stay (in Days)	≤ 7	49 (65.3)	7 (35)	2 (50)	58 (58.6)	6.114	0.047*
	> 7	26 (34.7)	13 (65)	2 (50)	41 (41.4)		
Pre-referal Care given	No	45 (60)	11 (55)	3 (75)	59 (59.6)	0.575	0.750
	Yes	30 (40)	9 (45)	1 (25)	40 (40.4)		
IV Fluids given	No	47 (62.7)	7 (35)	2 (50)	56 (56.6)	4.992	0.082
	Yes	28 (37.3)	13 (65)	2 (50)	43 (43.4)		
On O_2	No	53 (70.7)	7 (35)	2 (50)	62 (62.6)	8.866	0.012*
	Yes	22 (29.3)	13 (65)	2 (50)	37 (37.4)		

Out of the total 99 neonates received, at admission, 6 neonates were hypothermic, 9 had poor oxygenation, 6 had poor perfusion, and 10 neonates were hypoglycemic. Among them, 3 neonates had both hypothermia and poor oxygenation, 1 neonate had both poor oxygenation and poor perfusion at the time of recieving. No neonate had combination of hypoglycemia and poor oxygenation or hypoglycemia and poor perfusion.

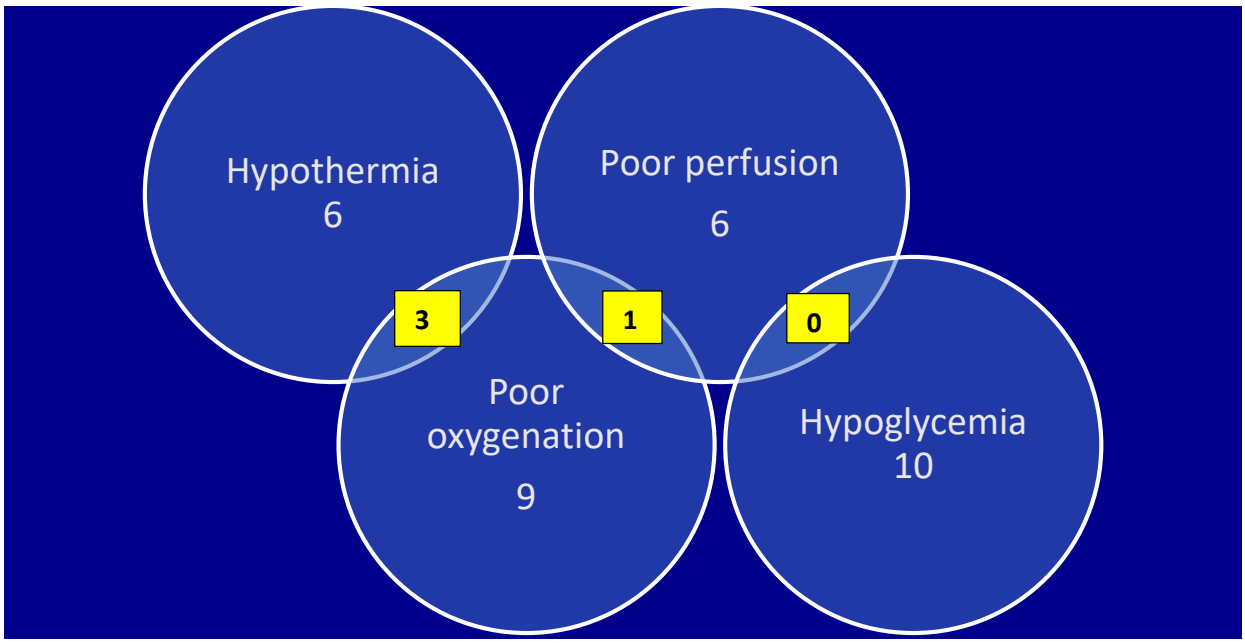


Figure 5 – Venn diagram depicting deranged parameters and their combination

Among the neonates with deranged parameters, 3 out of 6 hypothermic neonates ;4 out of 9 neonates with deranged oxygenation; 3 out of 6 with poor perfusion and 1 out of 10 hypoglycemic neonates expired. In this study hypoglycemia was the most common deranged parameter followed by poor oxygenation followed by an equal incidence of hypothermia and perfusion.

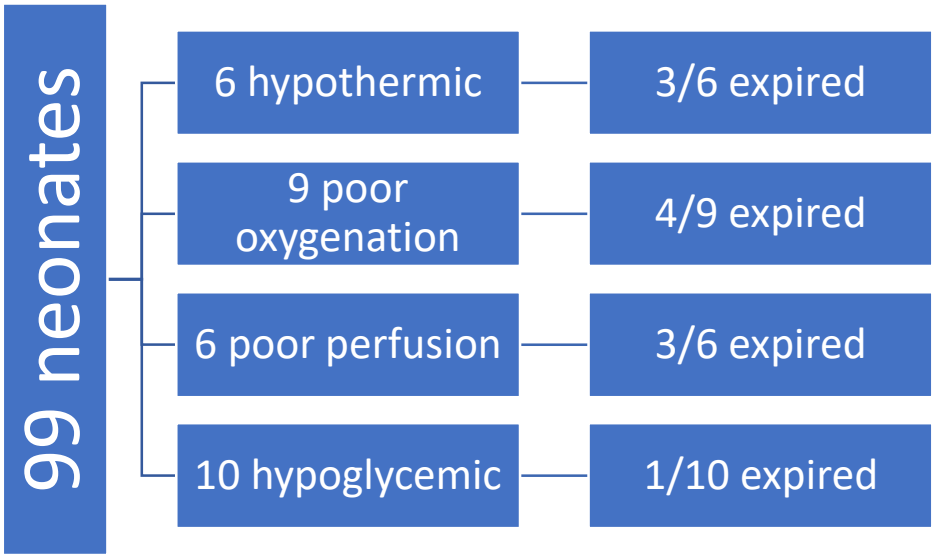


Figure 6 – Depicting mortality with respect to each deranged parameter

Out of total 99 neonates received, 75 neonates had no derrangements, that is TOPS score of "0" and 24 neonates had abnormal TOPS score. 20 neonates had score of "1" and 4 had score of "2". Of the 8 neonates that expired, 5 neonates had TOPS score of 1 and 3 neonates had TOPS score of "2". No neonate with TOPS score of "0" expired during the hospital stay.

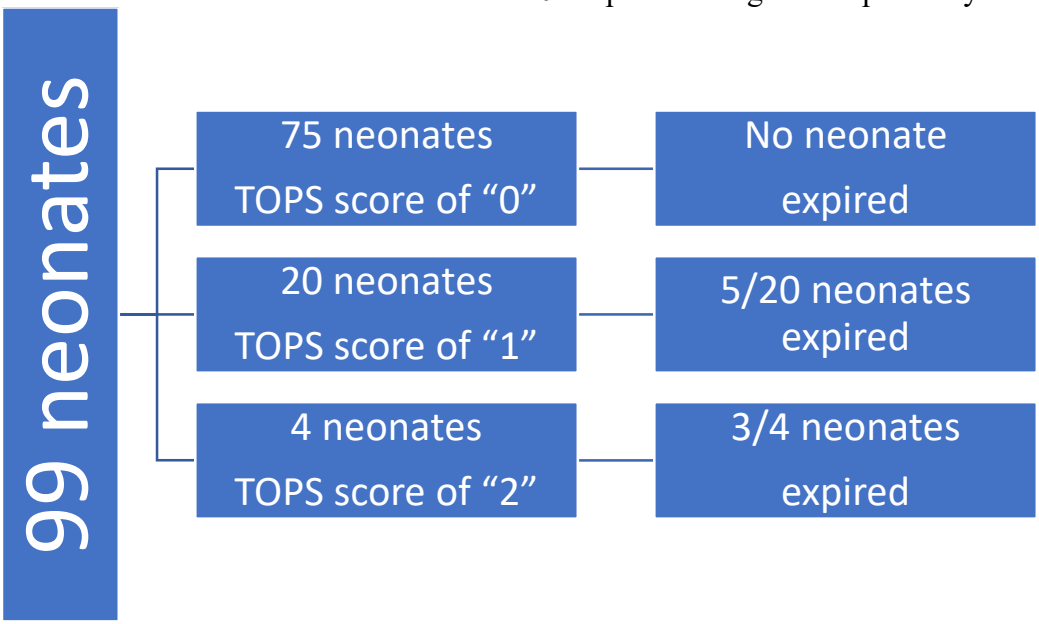


Figure 7 – Depicting mortality with respect to TOPS score

Out of the 12 neonates that were ventilated within 72 hours of arrival, 4 neonates had TOPS score of "2" and out of these 4 neonates, 3 neonates expired.

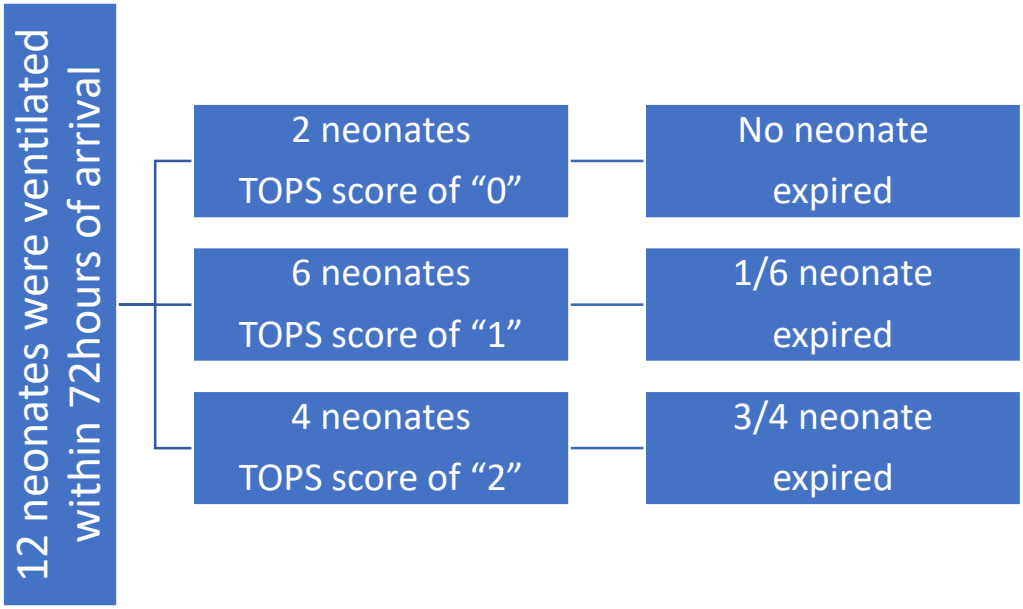


Figure 8 – Depicting outcome of ventilated neonates with respect to TOPS score.

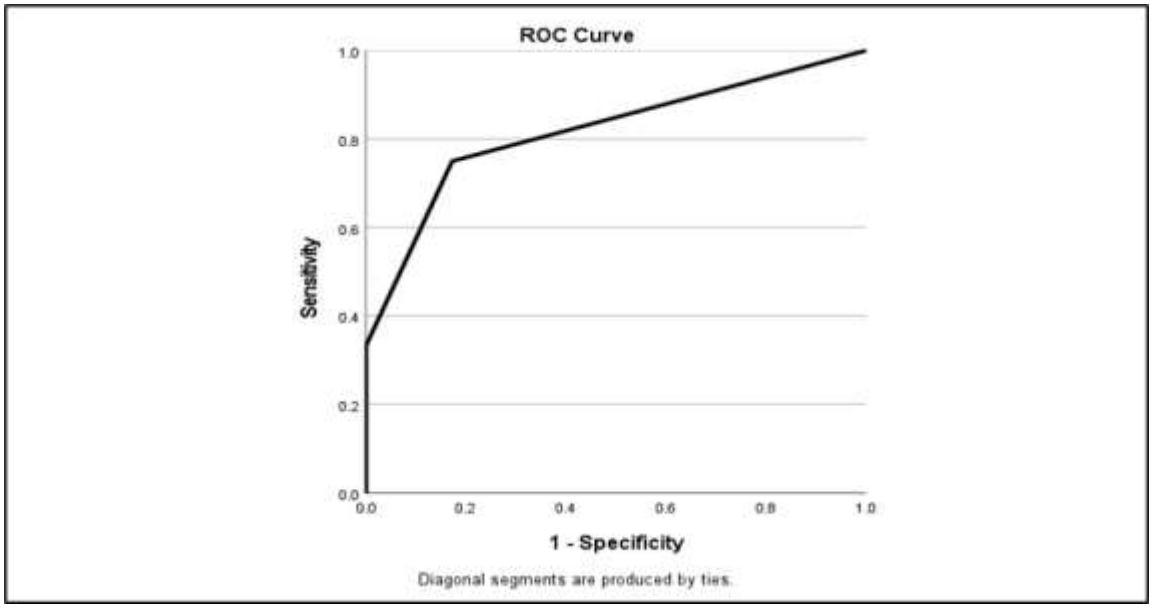


Figure 9-Receiver Operating Characteristic (ROC) curve of TOPS score for predicting "severity"

Table 5 - Study parameters and their ability to predict severity

Table 5 represents the ability of TOPS score parameters to predict severity in form of requirement of ventilator support, ionotropes and duration of hospital stay. Sensitivity was maximum with hypoxia, most specific parameter was hypothermia. Positive predictive value was maximum for hypoperfusion and hypothermia and Negative predictive value was maximum for hypoxia.

Study parameters	Area under curve (95% CI)	Significance	Sensitivity	Specificity	PPV	NPV	Accuracy
Hypo-thermia	0.655 (0.463 - 0.847)	0.082	33.3%	97.7%	66.7%	91.4%	89.9%
Hypoxia	0.733 (0.548 - 0.917)	0.009*	50.0%	96.6%	66.7%	93.3%	90.9%
Hypo-perfusion	0.56 (0.374 - 0.746)	0.499	16.7%	95.4%	33.3%	89.2%	85.9%
Hypo-glycemia	0.549 (0.365 - 0.733)	0.585	16.7%	93.1%	25.0%	89.0%	83.8%

Discussion-

Mathur *et al*[4] the sensitivity, specificity, positive and negative predictive values of derangements of two or more TOPS parameters in predicting mortality were 81.6%, 77.39%, 65.3% and 89%, respectively, where as in our study they were found to be 37.5%, 98.9% 75% and 94.7% respectively.

Table 6- Comparison of accuracy of TOPS score ≥2 in predicting mortality.

Parameter	This study	*Begum A et al* [8]	*Mathur NB et al* [4]
Sensitivity	**37.5%**	71.9%	81.6%
Specificity	**98.9%**	80.8%	77.4%
Positive Predictive Value	**75%**	64.3%	72.3%
Negative Predictive Value	**94.7%**	90.1%	89%

In the results of previous studies, TOPS parameters, odds ratio for mortality was maximum for delayed capillary filling time, followed by hypoxia, hypothermia and hypoglycaemia.[4, 8]. In contrast *Buch M et al*[9], studied two of these parameters and found odds ratio for hypothermia to be higher than delayed capillary filling time (3.65 Vs 3).

Whereas in this study we found hypoglycemia to be most common deranged parameter, followed by poor oxygenation followed by an equal incidence of hypothermia and perfusion. But, 50% of neonates with poor perfusion and 50% of neonates with hypothermia expired. Whereas 44.44% of neonates with poor oxygenation expired, and only 10% of hypoglycemic neonates expired.

TABLE 7 - Individual parameters and their ability to predict mortality

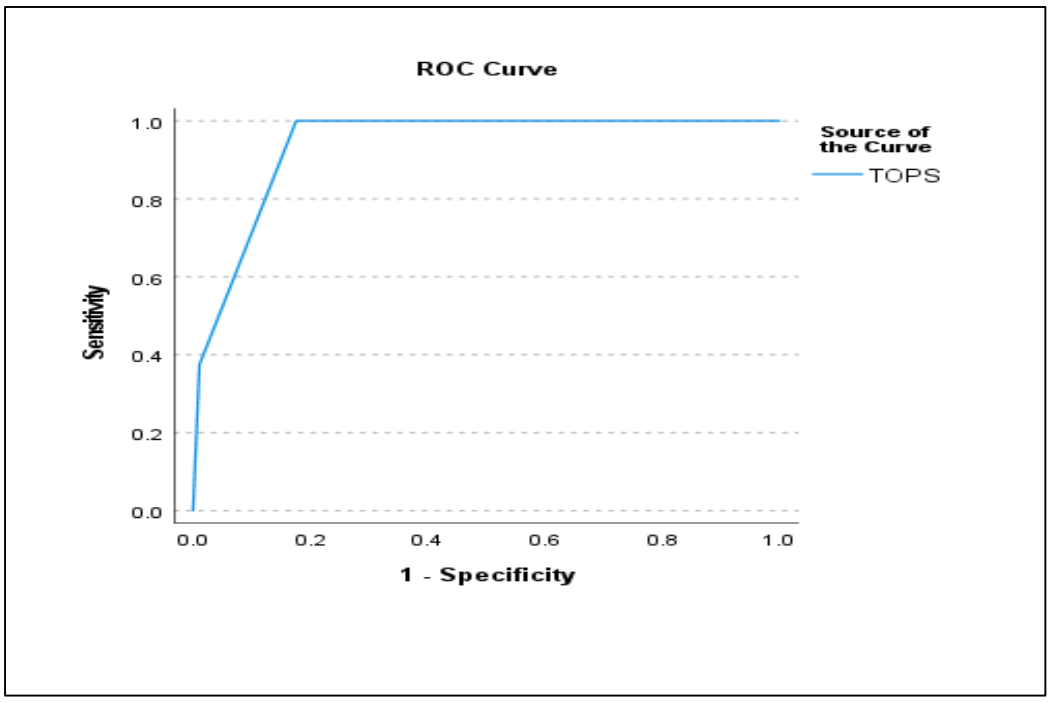
Study parameters	AUC (95% CI)	Significance	Sensitivity	Specificity	PPV	NPV	Accuracy
Hypo-thermia	0.671 (0.439 - 0.903)	0.110	37.5%	96.7%	50.0%	94.6%	91.9%

Hypoxia	0.723 (0.5 - 0.946)	0.038	50.0%	94.5%	44.0%	95.6%	90.9%
Hypo-perfusion	0.671 (0.439 - 0.903)	0.110	37.5%	96.7%	50.0%	94.6%	91.9%
Hypo-glycemia	0.524 (0.308 - 0.74)	0.822	12.5%	92.3%	12.5%	92.3%	85.9%

(AUC- Area under curve; PPV- Positive predictive value; NPV- Negative predictive value)

The present study showed increase in mortality with increase in TOPS score, these findings are in concordance with the previous studies. 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 0.95, *Mathur NB et al*[4], 0.89, *Begum A et al*[8].,0.76)

Figure 6 - Receiver Operating Characteristic (ROC) curve of TOPS score for predicting "mortality"



(AUC (95% C.I) = 0.94 (0.887 – 0.992) with S.E = 0.027 & Significance, P < 0.001*)

Conclusion

TOPS score is an excellent tool both for predicting severity and mortality of out born neonates that are transported to higher care centres. It is simple, inexpensive and needs minimal skill and easy to apply by health care professional. This study validates the use of TOPS score to predict severity and mortality, especially in a resource limited country like India.

Conflict of interest- None

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