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ORIGINAL ARTICLE

Sick Neonate Score - A Simple Clinical Score for Predicting Mortality of Sick Neonates in Resource Restricted Settings

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Abstract
Objective To evaluate an objective score to assess the condition of sick neonates at arrival and its use in predicting mortality.
Methods This descriptive study included 303 extramural neonates who were evaluated using a simple clinical score - Sick neonate score (SNS). All neonates were followed up till discharge or expiry. The score and its individual components were correlated with outcome. A receiver operating curve was plotted to determine the cutoff value for SNS in predicting mortality.
Results The common indications for neonatal transport were sepsis (30.7 %), birth asphyxia (17.5 %) and respiratory distress (15.2 %). Sixty neonates (20 %) expired and among them 76 % were hypothermic and 10 % hypoglycemic at admission. The average SNS for all neonates was 10 while it was 6 for those who expired. A cutoff value of SNS ≤ 8 predicted mortality with a sensitivity of 58.3 % and specificity of 52.7 %.
Conclusions SNS is a useful scoring system to predict outcome of sick neonates in resource restricted settings.

Keywords Neonatal transport · Newborn · Hypothermia · Score · Mortality

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Introduction

Nearly 27 million babies are born in India each year and one million die before completing the first four weeks of life. This accounts for nearly 25 % of the total 3.9 million neonatal deaths worldwide [1, 2]. Globally, infections, asphyxia and prematurity are the leading causes of neonatal deaths and 40 % of these deaths occur on the first day of life [3–5]. Hence condition of neonates after delivery especially on day 1 is of paramount importance and objective methods to ascertain their severity of illness are valuable. There are several scoring systems like Score for Neonatal Acute Physiology (SNAP), SNAP-Perinatal Extension (SNAPPE) and the Clinical Risk Index for Babies (CRIB) to evaluate the severity of illness in a neonate. However, not all of them could be applied in resource restricted settings. So this study was designed to evaluate a simple clinical score for assessing the condition of neonates at arrival and its use in predicting mortality.

Material and Methods

This descriptive study on transport of extramural neonates was conducted in the division of neonatology, JIPMER, Pondicherry after due approval from the Institute Ethics committee. Informed consent from parents was obtained before the neonates were included in the study. Extramural neonates transported to the hospital during the study period (February 2012 – January 2013) were included. Those neonates with either major congenital anomalies or surgical anomalies were excluded. Demographic parameters and transport details were recorded in a structured proforma. Maternal morbidities, mode

of delivery, liquor quality, resuscitation details and Apgar score were noted. Clinical features like poor feeding, lethargy, vomiting, abdominal distension, bleeding, jaundice and seizures, if present were also recorded. Modified Ballards scoring was used to assess the gestational age of the neonates and their condition at arrival was evaluated using a simple clinical score - Sick neonate score (SNS) as described in Table 1. SNS has been adapted from Hermansen score, a validated score for neonatal transport [6]. The authors had modified the Hermansen score by adding additional parameters - capillary filling time, SPO_2, respiratory effort and heart rate which are easy to measure and vital. Two original components of Hermansen score - pH and PO_2 were excluded in SNS for ease of practical use. All neonates were managed as per standard NICU protocol and were followed up till discharge or expiry.

Assuming the sensitivity and specificity of SNS as 0.9 with absolute precision 0.07 at 95 % confidence level, the sample size was estimated as 300. SPSS version (IBM, New York) and Graphpad insat 3 were used for statistical analysis. Frequencies and percentages were used for depicting categorical data while mean and standard deviation were used for presenting continuous variables. Chi-square and Fisher exact test were used to determine the association of clinical factors with outcome. All statistical analysis was carried out at 5 % level of significance and a 'p' value <0.05 was considered significant. Receiver operating curve (ROC) was plotted to determine the cutoff value for the clinical score (SNS) in predicting mortality.

Results

Among the 339 neonates considered for the study, 303 satisfied the inclusion criteria and 36 were excluded. Table 2 shows the baseline characteristics of the study participants. Private ambulances (36 %) were mostly used for transporting these extramural neonates. The other modes of transport included taxi (29 %), bus (15 %), 108 services (11 %), two wheeler (6 %) and auto (3 %). Neonates transported by 108 services and private ambulances had better SNS and outcome compared to neonates transported by other modes of transport. Sepsis (30.7 %), birth asphyxia (17.5 %) and respiratory distress (15.2 %) were the common indications for transport of these extramural neonates. The average SNS was more in term neonates than preterm

Table 2 Baseline characteristics of neonates included

Characteristics	n = 303	%
Maturity		
Term	228	78.5
Preterm	65	21.5
Post term	10	3.3
Mode of delivery		
Spontaneous vaginal delivery (SVD)	237	78.2
Lower segment cesarean section (LSCS)	47	15.5
Delivered by forceps/vacuum	19	6.3
APGAR score at 5 min		
0–3	7	2.3
4–6	41	13.5
7–10	211	69.6
Not available	44	14.5
Clinical features		
Lethargy	186	61.4
Seizures	87	28.7
Grunting	60	19.8
Vomiting	41	13.5
Abdominal distension	37	12.2
Bleeding	20	6.6
Outcome		
Discharged	232	76.5
Expired	60	19.8
Against medical advice (AMA)	11	3.6

Table 1 Sick neonate score (SNS)

Variable	Score		
	0	1	2
Respiratory effort	Apnea or Grunting	Tachypnea (>60/min) with or without retractions	Normal (40–60/min)
Heart rate	Bradycardia/Asystole	Tachycardia (>160/min)	Normal (100–160/min)
Mean blood pressure (mmHg)	<30	30–39	>39
Axillary temperature (°C)	<36	36–36.5	36.5–37.5
Capillary filling time (s)	>5	3–5	<3
Random blood sugar (mg/dl)	<40	40–60	>60
SpO_2 (in room air)	<85 %	85–92 %	>92 %

neonates (10 *vs*. 9). The average SNS for all neonates was 10 while it was 6 for those who expired. Among the 60 neonates who expired, 55 had SNS ≤8 and only 5 neonates had SNS > 8 and this difference was statistically significant ($p < 0.001$). Among the expired neonates, 76 % and 10 % of the neonates were hypothermic and hypoglycemic at admission respectively. Among those neonates who expired in the first 24 h, 92 % were hypothermic. The best component of SNS predicting mortality was axillary temperature and the other components of SNS were also individually significant in predicting the mortality (Table 3). An ROC showed the cutoff value of SNS for predicting the mortality as ≤8 with a sensitivity of 58.3 % and specificity of 52.7 % (Fig. 1).

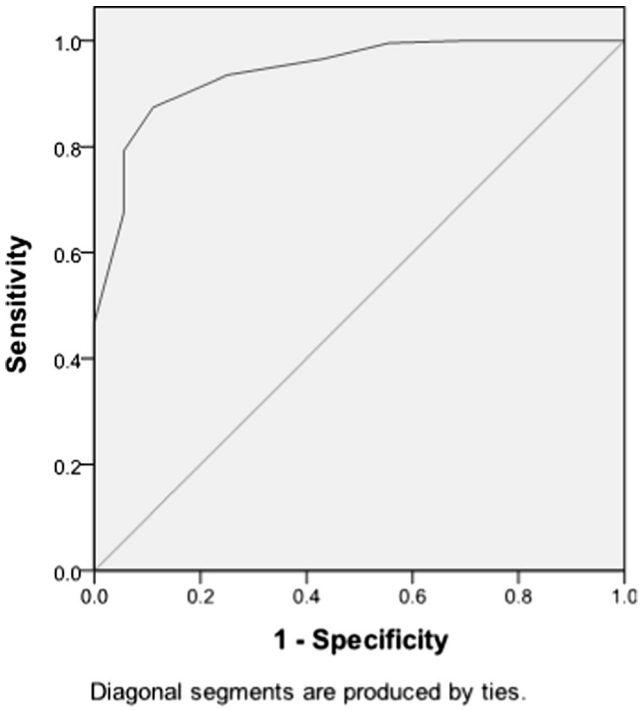

Fig. 1 ROC curve for predicting mortality in sick neonate score (SNS)

Discussion

Despite the fact that neonatal transport is very crucial in determining the clinical outcome of sick neonates, it is often not given due importance in developing countries [7, 8]. A similar study from New Delhi highlighted the infrequent use of ambulances and paucity of trained healthcare personnel for neonatal transport [9]. The authors observed that extramural neonates were often transported by private ambulances while the free 108 services contributed to just 11 % of the transports. The private ambulances utilized were found to be lacking ample facilities and trained personnel. In this study, only 3 % of the neonates were transported by dedicated neonatal 108 ambulances. GVK Emergency Management and Research Institute (GVK EMRI) is the only professional emergency service in India providing an organized, integrated, accessible 108 Emergency Response Service. On an average, their ambulances reached the destinations in urban and rural areas in 14 and 22 min respectively. GVK EMRI has so far saved over 80,000 lives but their services also require expansion [7]. Neonates transported in private ambulances and 108 services had better SNS and outcome compared to neonates transported by taxi, bus and auto. SNS can also be useful in assessing the quality of neonatal transport provided pre transport scores are available.

The Scoring system used in the index study (SNS) is an evolution of the basic Hermansen score which was a validated score designed for neonatal transport in United Kingdom in 1994 (6). The authors had modified the Hermansen score by adding additional parameters - capillary filling time, SPO_2, respiratory effort and heart rate which are easy to measure and vital. Two original components of Hermansen score - pH and PO_2 were excluded in SNS for ease of practical use. The present scoring is more simple and likely to be useful for all centers

Table 3 Components of Sick neonate score (SNS) *vs.* outcome ($n = 303$)

Variables	Score	Outcome				*p* value
		Discharged	Expired	AMA	Total	
Respiratory effort	0	18	32	5	55	<0.0001
	1	106	23	6	135	
	2	107	5	1	113	
Heart rate	0	1	9	2	12	<0.0001
	1	55	37	6	98	
	2	175	14	4	193	
Mean blood pressure (mmHg)	0	6	32	5	43	<0.0001
	1	139	26	6	171	
	2	86	2	1	89	
Axillary temperature (°C)	0	38	46	7	91	<0.0001
	1	133	14	3	150	
	2	60	0	2	62	
Capillary filling time (s)	0	0	11	1	12	<0.0001
	1	24	42	5	71	
	2	207	7	6	220	
Random blood sugar (mg/dl)	0	5	6	0	11	<0.0001
	1	31	22	5	58	
	2	195	32	7	234	
SpO_2 (in room air)	0	5	17	7	29	<0.0001
	1	60	38	3	101	
	2	166	5	2	173	

including district hospitals and Primary health centers (PHC), especially in the Indian context. Term neonates had higher SNS compared to preterm neonates. This is expected as preterm neonates are likely to have more morbidity and complications. The score predicting the mortality was ≤8, which is similar to Glasgow coma scale where a score of 8 or less is an indication for intubation. Though SNS for predicting the mortality ≤8 had only a sensitivity of 58.3 % and specificity of 52.7 %, it could still be useful in prognostication and counseling the parents. All the components of SNS were significantly correlating with outcome which means lower the score poorer the outcome..

A total of 60 neonates died. Among them, 76 % were noted to be hypothermic at admission and most of them died within the first 24 h. This reiterates the fact that hypothermia is a major factor contributing to the poor outcome among sick neonates. Several methods have been tried to keep neonates euthermic during transport. Skin-to-skin contact, radiant warmers, plastic coverings and exothermic mattresses have been used successfully during neonatal transport. However, a substantial number of neonates continue to become hypothermic soon after delivery, leading to an increased risk of co-morbidities and death [10]. A poor respiratory effort and low mean blood pressure also results in adverse outcome. This emphasizes the importance of maintaining TABC (Temperature, Airway, Breathing and Circulation) during transport. SNS is a useful scoring system to predict mortality of sick neonates especially in resource restricted settings and efforts to improve neonatal transport in India is the need of the hour. However, this score requires further validation by studies from other parts of the country.

Contributions DR: Collected and analyzed data; BA: Designed and supervised study; BVB: Edited the manuscript and will act as guarantor for this paper.

Conflict of Interest None.

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