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Diagnostic accuracy of extended sick neonate score in sick neonates received at tertiary care neonatal intensive care unit and its impact on the outcome of the neonate

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Abstract

Background: Neonatal Mortality is a vital concern across the globe and about four million neonates die annually predominantly in developing countries with limited resources. It is possible to enhance survival and health of newborns, prevent stillbirths by outreaching high coverage of skilled care at birth, standard antenatal care, post-natal care for mother and baby and care of small and sick infants.

Materials & Methods: This was a hospital based prospective observational study conducted in Neonatal Intensive Care Unit (NICU) of a tertiary care hospital from January 2020 to June 2021. All sick neonates admitted to NICU of a tertiary care teaching hospital over one year time frame were included in the study. The score that we have proposed is a modified version of the SNS system with two extra parameters, first is Moro reflex and second is Downes score and blood pressure interpretation in percentile which was published by Samantha et al.

Results: In our study 6.6% cases were out born and rest 93.4% cases were inborn babies. 86.79% babies were preterm. Commonest indication of admission was RDS (76.42%) followed by MSL (12.26%). 72.64% babies survived. No significant association was observed between mortality and age, sex, mode of delivery. Significant association was seen between mortality and maturity (p= 0.017). An ROC showed that for predicted mortality the sensitivity and specificity of ESNS was 93.1% and 97.4% respectively with cut off value 10.5.

Conclusion: According to our study, ESNS is a useful clinical scoring system that can be applied quickly because of its simplicity, ease of use, perfection, robust across populations and reliable for newborns. It can be worked out even in the primary level of care and efforts should be made to upgrade neonatal transport which is the need of the hour.

Keywords: ESNS, newborn, RDS, MSL

Introduction

Neonatal Mortality is a vital concern across the globe and about four million neonates die annually predominantly in developing countries with limited resources (1). India contributes to one-fifth of universal live births and more than a quarter of neonatal deaths (2).

The larger part of all neonatal deaths (up to 75%) happen during the first week of life and about one million neonates die within the first 24 hours. The “Committing to Child Survival: A Promise Renewed aims to decrease under 5 mortalities to 20 or less per 1000 live births by 2035 and this cannot be achieved without

specific efforts to decrease newborn mortality (2). Active interventions can prevent more than two-thirds of such deaths if they arrive on need basis. These conditions can be easily served and beneficially managed with suitable level of care. Unfortunately, not all medical centres grant specialized care for the newborns, therefore these neonates have to be transferred to the tertiary care centres where such facilities are available. The huge majority of newborn mortality takes place in low- and middle-income countries. It is possible to enhance survival and health of new borns, prevent stillbirths by outreaching high coverage of skilled care at birth, standard antenatal care, post natal care for mother and baby and care of small and sick infants. One in ten babies born need immediate intensive care and require a well framed and productive transport team to transfer these babies to the centres specialized for such care. These serious ill neonates have to undertake multiple physical hazards in the form of vibration, noise, deceleration or acceleration forces and temperature uncertainty has the ability to destabilize the sick neonate who is already fighting hard to sustain normal homeostasis. (3)

Delivery of sick neonates under controlled circumstances has a straight effect on morbidity and mortality (4).

Stable microenvironment is the key for such transportation. Preferably, neonates should be stabilized before transport and balance should be continued during transport (3). Uncertainty or complications during the transfer lead to enhanced morbidity and mortality in these vulnerable babies (5). The victory of neonatal transfer depends mostly on the early recognition of sick neonates, early referral, pre transportation stabilization, care during transfer and establishment of appropriate care.

There is a requirement for reliable but easy scoring mechanism to assess outcome of newborn at arrival to tertiary care centre NICU. There are many neonatal disease severities scoring systems available. Desirable characteristics of such systems have been reported as ease of use, early applicability during hospitalization, potential to reliably forecast mortality, specific morbidities and potential to distinguish between infants with multiple outcomes (6). Not all scoring systems attain such criteria, therefore we suggest an altered version of SNS (Sick Neonate Scoring) system with an inclusion of two more parameters (Moro Reflex and Modified Downes score) and Blood Pressure Interpretation in percentile published by Samantha et al (7). The complete ESNS (Extended sick neonate scoring) system is highlighted in the Figure 1

Figure 1: ESNS.

Sr. No.	**Parameter**	**Score**		
		0	**1**	**2**
1	Lowest MAP	Apnoea/ Grunting	Tachypnoeawith or without Retraction	Normal (40 to 60)
2	Heart Rate	Bradycardia	Tachycardia (>160)	Normal (100-160)
3	Mean PressureBlood	<50 percentile	5 to 50 th	>50th
4	Axillary Temperature(^{o}c)	<36	36 to 36.5	36.5 -37.5
5	Capillary refilling time(sec)	>5	3 to 5	<3
6	Random Blood Sugar(mg/dl)	<45	45 to 60	>60
7	Spo2 (in room air)	<85%	85 to 92%	>92%
8	Moro Reflex	Absent	Depressed/Exaggerated	Corresponding gestational age
9	Modified Downes' score*	>6	2-6	<2

Our scoring system is easy to use, cost effective and can be used as soon as babies are brought with no invasive parameters. ESNS can predict "in hospital mortality" results with adequate sensitivity and specificity. Therefore, the study was planned with the aim to compare Extended sick neonate score (ESNS) with score for Neonatal

Acute Physiology- perinatal Extension II (SNAPPE II) and sick neonate score (SNS) to predict 'in hospital mortality.'

Figure 2 – SNAPPE II and Sick Neonate Score (SNS)

Score for Neonatal Acute Physiology-Perinatal Extension II score

VARIABLES	MEASURE	SCORE
LOWEST MAP	>29mm hg 20-29 mm hg <20 mm hg	0 9 19
LOWEST TEMPERATURE	>35.6*C 35-35.6*C <35*C	0 8 15
PaO2/FiO2	>2.49 1-2.49 0.3-0.99	0 5 16
LOWEST pH	>7.19 7.10-7.19 <7.10	0 7 16
SEIZURES	NO YES	0 5
URINE OUTPUT	>0.9ml/kg/hr 0.1-0.9 ml/kg/hr <0.1 ml/kg/hr	0 5 18
BIRTH WEIGHT	>999 grams 750-999 grams <750 grams	0 10 17
Small for Gestational Age	>3 rd percentile <3 rd percentile	0 12
APGAR	>7 <7	0 18

Materials and Methods

This was a hospital based prospective observational study conducted in Neonatal Intensive Care Unit (NICU) of a tertiary care hospital from January 2020 to June 2021. All sick neonates admitted to NICU of a tertiary care teaching hospital over one year time frame were included in the study. Neonates with congenital anomalies or those requiring surgical interventions were excluded. Institutional Ethics Committee approval was taken. Consent was taken from the parents. Within 15 minutes of arrival at the NICU the baby was evaluated by measuring heart rate, blood pressure (BP), oxygen saturation, axillary temperature, random blood sugar, weight and arterial blood gas analysis for pH and PaO2. The data collected from the neonates included Mean BP, PO2, FiO2, Serum pH (lowest serum pH in first 24 hours of admission), gestational age for calculating SNAPPE score, lowest temperature, urine output, multiple seizures (more than or equal to 1 seizure in first 12 hours of admission), Birth weight and APGAR score.

The score that we have proposed is a modified version of the SNS system with two extra parameters, first is Moro reflex and second is Downes score and blood pressure interpretation in percentile which was published by Samantha et al (4).

Statistical analysis

Correlation among ESNS and the referral scoring systems have been analyzed by constructing scatter plots and finding correlation coefficient. The success of each of the scoring systems in forecasting pre-discharge mortality was set by building receiver operating characteristics (ROC) curves and finding the sensitivity and specificity of the cut off informed by the ROC analysis. A probability of 5% was examined statistically significant. SPSS statistical software was utilized for statistical analysis.

Results:

Table 1 shows that 6.6% cases were out born and rest 93.4% cases were inborn babies. Out of the 106 babies, 62.26% were males and 37.74% were females. Mode of delivery was vaginal in 33.02% cases and LSCS in 66.98%. 86.79% babies were preterm. Commonest indication of admission was RDS (76.42%) followed by MSL (12.26%).72.64% babies survived.

Table 2 shows that no significant association was observed between mortality and age, sex, mode of delivery. Significant association was seen between mortality and maturity (p= 0.017). Mean ESNS was significantly higher in preterm as compared to term babies (p=0.021).

In our study of the 29 mortalities, 89.66% were hypothermic at the time of admission and low mean BP was 82.76%.

An ROC showed that for predicted mortality the sensitivity and specificity of ESNS was 93.1% and 97.4% respectively with cut off value 10.5. ESNS can predict in hospital mortality outcome with satisfactory sensitivity and specificity.

Discussion

Our study included 106 neonates who were assessed using easy clinical score-Extended Sick Neonate score (ESNS). All neonates were followed till discharge or death. The score and all components were correlated with results.

Of the 106 neonates included in our study, 6.6% were outborn and 93.4% were inborn. Dulal Kahta et al (8) in his study included 2042 neonates and of these 65.8% were inborn.

The male: female ratio of our study was 1.65:1 which was similar to another study by Somosri Rayet et al (9). Less female babies were admitted in NICU because families do not want to save the girl child, may be due to gender bias, financial issues or many female siblings.

In our study, 86.79% were preterm neonates. In a study by K P Mansoor et al (10), 41% were preterm neonates. In our study the most common indication of transfer for admission was Respiratory Distress Syndrome (RDS) in 76.42% followed by 12.26% with Meconium-Stained Liquor (MSL). Deepak Rathod et al (11) found that RDS with 52.8% cases was the commonest reason for transport followed by sepsis in 30.7%. Enhancing the referral system in our surroundings is needed for decreasing neonatal morbidity and mortality.

Prematurity in 42%, perinatal asphyxia in 15.3% malformations in 15.3% and neonatal infections in 9% were the causes for neonatal mortality across the world (12, 13). In our study 72.64% cases survived which is similar to a study by Agrawal J et al (13).

The current study showed a significant difference in mortality profile and maturity (p=0.017) which was like a study by Deepak Rathod et al (11). This is probably because preterm neonates have a higher probability of additional morbidity and complications.

We noticed a considerable risk of death in newborns that were born ahead of time which was also established by Diakite et al (14). In the current study, there was no significant association noticed of the indication for acceptance with mortality profile. Also, during our study, univariate investigation among 9 variables seems to be significant in determining the result that is forecast mortality which is in accordance with the study managed by Agrawal J et al (13) where similar notable exceptions were noticed. Also, in our study, a remarkable high

ESNS score in demise was noticed in all 3 types of system as compared to survived cases. This is consistent with the study by Deepak Rathod et al (15).

As per our study, out of total 29 deaths 89.66% were noted to be hypothermic at the time of admission, low mean BP in 82.76% and tachypnea with or without retractions in 65.52% which was found in agreement with the study done by Deepak Rathod et al (15) which said that out of the 60 neonatal deaths, 76% were noticed to be hypothermic at acceptance. This reiterates the reality that hypothermia is a key component contributing to the poor results among sick neonates.

Our study presents a summary of the three scoring systems. In our study, for predicted mortality an ROC showed the sensitivity and specificity of ESNS was 93.1% and 97.4% respectively with cut off value 10.5, SNAPPE-II score was 79.3% and 98.7% with cut off value 55 and SNS score was 89.7% and 98.7% with cut off value 7.5 respectively. This implies that all have good specificity while ESNS was observed to have highest sensitivity so it is a good screening score system.

Limitations- The study was conducted during Covid 19 epidemic so enrolled patients were much less than expected and referrals during pandemic were reduced. We recommend further studies with larger cohorts to establish the superiority of this scoring system.

Conclusions

According to our study, ESNS is a useful clinical scoring system that can be applied quickly because of its simplicity, ease of use, perfection, robust across populations and reliable for newborns. It can be worked out even in the primary level of care and efforts should be made to upgrade neonatal transport which is the need of the hour. No mathematical formula is completely perfect to capture the complex clinical processes in a neonate. The use of scores for predicting individual outcomes is troubled with difficulty most particularly because of variation in the approach to clinical care processes in a newborn. The ESNS can predict 'in hospital mortality' outcome with greater sensitivity and specificity than other scores. However, further studies are required to validate our scoring system at multiple centres.

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TABLE No. 1: Demographic Statistics of cases according to Study Population characteristics, sex, mode of delivery, maturity, indication for admission and mortality Profile

VARIABLE	**TOTAL**	**(N= 106)**
Study Population	**NUMBER**	**PERCENTAGE**
Inborn	99	93.40
Out born	7	6.60
Sex		
Female	40	37.74
Male	66	62.26
Mode of Delivery		
LSCS	71	66.98
NVD	35	33.02
Maturity		
Extreme preterm	1	0.94
Pre term	92	86.79
Term	13	12.26
Indication for admission		
MSL	13	12.26
NNJ	1	0.94
RDS	81	76.42
TTNB	11	10.38
mortality Profile		
Death	29	27.36
Survived	77	72.64

Table No 2: Association of mode of delivery, maturity, and indication for admission with mortality Profile

	Death		**Survived**		**Total**
MODE OF DELIVERY	**NO**	**%**	**NO**	**%**	**NO**
LSCS	19	65.52	52	67.53	71
NVD	10	34.48	25	32.47	35
Total	29	100.00	77	100.00	106
	Death		**Survived**		**Total**
MATURITY	**NO**	**%**	**NO**	**%**	**NO**
Extreme preterm	1	3.45		0.00	1
Pre term	21	72.41	71	92.21	92
Term	7	24.14	6	7.79	13
	Death		**Survived**		**Total**
Indication for admission	**NO**	**%**	**NO**	**%**	**NO**

MSL	5	17.24	8	10.39	13
NNJ	0	0.00	1	1.30	1
RDS	19	65.52	62	80.52	81
TTNB	5	17.24	6	7.79	11

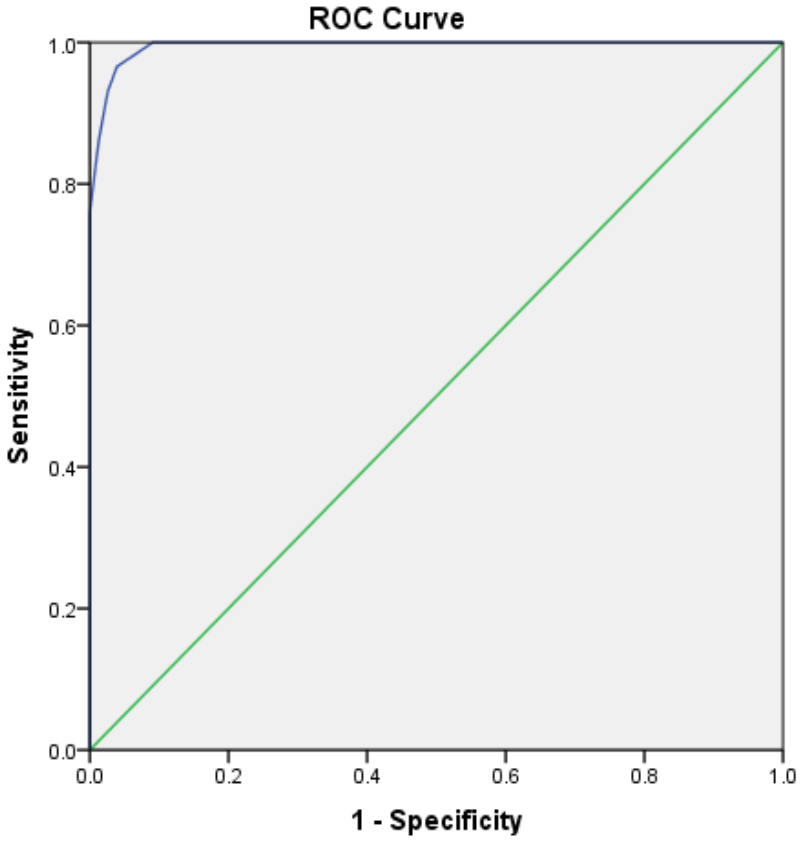
Table No 3: Univariate analysis

		Death (N=29)		**Survived(N=77)**		**Total (N=106)**
1.RESPIRATORY RATE(/min)		**No**	**%**	**No**	**%**	
	Apnoea/ Grunting	6	20.69	0	0.00	6
	Tacypnoea with or without Retraction	19	65.52	10	12.99	29
	Normal (40 to 60)	4	13.79	67	87.01	71
2. HEART RATE(/min)	Bradycardia	13	44.83	1	1.30	14
	Tachycardia (>160)	8	27.59	10	12.99	18
	Normal (100-160)	9	31.03	66	85.71	75
3.MEAN BLOOD PRESSURE	<50 percentile	24	82.76	2	2.60	26
	5 to 50th	5	17.24	75	97.40	80
4.AXILLARY TEMPERATURE	<36	26	89.66	9	11.69	35
	36 to 36.5	3	10.34	37	48.05	40
	36.5 -37.5	0	0.00	31	40.26	31
5. CAPILLARY FILLING TIME(s)	>5	4	13.79	0	0.00	4
	3 to 5	22	75.86	4	5.19	26
	<3	3	10.34	73	94.81	76
6. RANDON BLOOD SUGAR(mg/dl)	<45	7	24.14	2	2.60	9
	45 to 60	14	48.28	6	7.79	20
	>60	8	27.59	69	89.61	77
7. SPO2(%)	<85%	16	55.17	0	0.00	16
	85 to 92%	12	41.38	37	48.05	49
	>92%	1	3.45	40	51.95	41
8. MORO REFLEX	Absent	13	44.83	2	2.60	15

	Corresponding to gestational age	16	55.17	75	97.40	91
9 MODIFIED DOWNES SCORE	<6	19	65.52	0	0.00	19
	2 to 6	10	34.48	59	76.62	69
	<2	0	0.00	18	23.38	18

Table No 4: **Different score and outcome**

		SNPPE II	**SNS**	**ESNS**
Survived	N	77	77	77
	Mean	20.16	11.31	14.49
	Median	20.00	11.00	15.00
	SD	11.33	1.21	1.45
Died	N	29	29	29
	Mean	65.97	4.59	6.03
	Median	71.00	5.00	6.00
	SD	18.03	2.18	3.08
Total	N	106	106	106
	Mean	32.69	9.47	12.18
	Median	20.00	11.00	14.00
	SD	24.51	3.38	4.29
P value LS		<0.001s	<0.001s	<0.001s



Diagonal segments are produced by ties.