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The Effectiveness of the 'Extended Sick Neonatal Score in Predicting Mortality in a Resource-Constrained Neonatal Care Unit

Romisa Rehman, Asma Razzaq, Asad Maqbool Ahmad, Zarlish Rehman*, Roshaan Rehman, Saad Ateeq**

Combined Military Hospital, Peshawar/ National University of Medical Sciences (NUMS) Pakistan, *Khyber Teaching Hospital, Peshawar Pakistan, **Kabir Medical College, Peshawar Pakistan

ABSTRACT

***Objective*:** To determine the diagnostic accuracy of the extended sick neonatal score (ESNS) in neonates admitted in a resource-limited neonatal intensive care unit (NICU) at Peshawar.

***Study Design*:** Cross-sectional analytical study

***Place and Duration of Study*:** Neonatal Intensive Care Unit, CMH Peshawar Pakistan, from Mar to May 2020.

***Methodology*:** Primary data was collected from 60 neonates admitted to NICU after taking consent from the parents. The receiver operating characteristic curve (ROC) was plotted to determine the clinical score (ESNS) cut-off value in predicting mortality.

***Result*:** The sensitivity and specificity of the Extended sick neonatal score to predict mortality among neonates was 93.3% and 97%, respectively, for a cut-off of 12.5. The area under the ROC curve was 0.990 (95% CI: 0.971–1.000). This was statistically significant with a *p*-value of <0.001

***Conclusion*:** Extended Sick Neonatal score is an important tool that helps predict the risk of mortality of a neonate without the help of any invasive diagnostic procedure, thus enhancing the prioritization of health care to the most deserving neonates.

Keywords: Neonatal mortality, Neonatal intensive care, Neonatal score.

How to Cite This Article: *Rehman R, Razzaq A, Ahmed AM, Rehman Z, Rehman R, Ateeq S. The Effectiveness of the 'Extended Sick Neonatal Score in Predicting Mortality in a Resource-Constrained Neonatal Care Unit. Pak Armed Forces Med J 2023; 73(1): 176-179. DOI: https://doi.org/10.51253/pafmj.v73i1.6880*

INTRODUCTION

The neonatal period is crucial and has the highest risk of mortality, with an average global rate of 18 deaths per 1,000 live births in 2018; in contrast to the post-neonatal period till five years, the prevalence decreases to around 11 and 10 per 1,000/births, respectively.[1,2] In 2018, the neonatal mortality rate(NMR) in Pakistan was 42/1,000 live–the highest NMR globally. Neonatal deaths accounted for 46 percent of all under-five deaths, increasing from 41% in 2000, which was preceded by a steady decline of about 2% annually (from 75to 42 per 1,000 live births) from 1969 to 2018 respectively.[3,4] In 2019, NMR was 41.2/1000 live births, indicating a need for programs at the national level to improve maternal, child and neonatal care comparable to the more developed nations.[5] Most of the effort is needed in rural areas where the rate is 62/1,000 live births versus 47/1,000 live births in urban areas for an urban-to-rural ratio of 0.8.[6,7] Most of the main causes of neonatal death in Pakistan are preventable, such as preterm birth complications (36%), intrapartum related events (22%), sepsis or tetanus (18%) congenital abnormalities (6%), pneumonia (6%), diarrhoea (1%) & the remaining 10% other miscellaneous conditions.[8,9]

Early detection of neonatal conditions at risk of mortality in the neonatal care unit is critical in neonatal survival and would help improve the quality of care.[10] Many neonatal severity scoring systems have been developed for NICUs to prioritize care, largely based on patient demographics and clinical and laboratory data. Most scoring systems, such as clinical risk index for babies (CRIB, CRIB 2), acute neonatal physiology (SNAP score), and neonatal acute physiology-Perinatal extension score (SNAPPE), use invasive procedures like blood gases to predict the outcome of the neonate. However, in most resource-limited setups, such facilities need to be improved and carrying out a score is challenging. A scoring system needs to be devised to guide clinicians in such settings regarding the mortality risk so that resources may be adequately channelled to babies needing them most.

METHODOLOGY

The cross-sectional analytic study was carried out at CMH, Peshawar from April to June 2020 on neonates admitted to NICU after approval from the Institutional Ethics Committee. The sample size was calculated using the software G-Power. A pilot study used 22 patients to get input values for the sample size calculator. By keeping the mean score of patients who died

Correspondence: Dr Romisa Rehman, Department of Pediatrics, Combined Military Hospital, Peshawar Pakistan

Received: 11 Jun 2021; revision received: 25 Jul 2021; accepted: 02 Aug 2021

at 10.82±1.67 & those who were discharged at 15.27± 1.61, a sample size of 10 was calculated. However, we used a sample size of 60 for the current study, with 30 in each group. Informed consent was taken from parents.

Inclusion Criteria: Neonates admitted in a resource-limited Neonatal ICU were included in the study.

Exclusion Criteria: Neonates were detained temporarily for observation, or those who could not be analyzed within 12 hours of admission, who died at birth & those with gross deformity were excluded from the study.

Primary data was collected by filling a structured proforma, and babies were followed up till discharge or death. The baby was evaluated on an ESNS, a modified version of a pre-existing SNS,[8] which has been adapted from Hermansen score nine, a validated score for neonatal transport. ESNS consists of nine variables which have been mentioned in Table-I. Each is given a score of 0, 1, or 2, with a total score of 18. Higher scores were expected to correlate with decreased mortality risk and vice versa.[11]

Table-I: Extended Sick Neonatal Score

Parameters	Score 0	Score 1	Score 2
Respiratory effort	Apnea/Grunt	Tachypnea >60/min with or without retraction	Normal respiratory rate (40-60)
Heart rate	Bradycardia/Asystole	Tachypnea >160/min	Normal (100-160/min)
Mean blood Pressure	<5 centile	5-50 centile	>50 centile
Axillary temperature	<36	36-36.5	36.5-37.5
Capillary refill time	>5	3-5	<3
Random blood sugar	<40mg/dl	40-60mg/dl	>60mg/dl
SpO2 (room air)	<85	85-92	37
Moro reflex	Absent	Depressed/exaggerated	Appropriate for GA
Modified Downes' score	>6	2-6	0-2

SPSS-26.0 was used for the data analysis. This study was performed to determine the diagnostic accuracy of the ESNS by using ROC to calculate the sensitivity and specificity of this score.

RESULTS

During this study, 60 neonates were assessed according to the score; out of these, 35(58.3%) were males, 25(41.7%) were females, 32(53.3%) of these were preterm by definition, and the rest 28(46.7%) were term. The mean ESNS scores of babies in both groups were shown in Table-II.

Table-II: Extended Sick Neonatal Score of Neonates who Died versus Discharged (n=60)

	Outcome	Number	Mean± SD	*p*-value
Total Score (ESNS)	Discharged	30	15.43±1.75	<0.001
	Death	30	10.36±2.57	

The mean ESNS score of the discharged group was 15.43±1.75, and in the expired group was 10.36± 2.57, respectively. The difference was statistically significant at *p*-value <0.001. Table-III compared the two parameters (gestational age and weight) of those discharged and those who died. The deaths increase at the extremes of gestational age, and the discharges increase with gestational age (GA). The difference between the GA was not statistically significant (*p*-value=0.569). The table reflects the weight of both groups.

Table-III: Comparison of Gestational Age and Weight of Neonates who were Discharged versus Expired (n=60)

Parameter		Outcome		*p*-value
		Discharged (n=30)	Death (n=30)	
GA (weeks)	29-32	6(20.0%)	9(30.0%)	0.569
	33-37	10(33.3%)	7(23.3%)	
	>37	14(46.7%)	14(46.7%)	
Weight (grams)	<1000	0(0%)	3(10.0%)	0.119
	>1000 <1500	3(10.0%)	6(20.0%)	
	>1500 <2500	9(30.0%)	10(33.3%)	
	>2500 <3500	18(60.0%)	10(33.3%)	
	>3500	0(0%)	1 (3.4%)	

The receiver operating characteristic(ROC) curve generated with ESNS to test variables to anticipate mortality was shown in the Figure, which demonstrated that the area under the ROC curve is 0.990 (95% CI: 0.971–1.000). The best possible cut-off value obtained for mortality prediction was 12.5, with sensitivity and specificity of 93.3% and 97%, respectively, in predicting mortality.

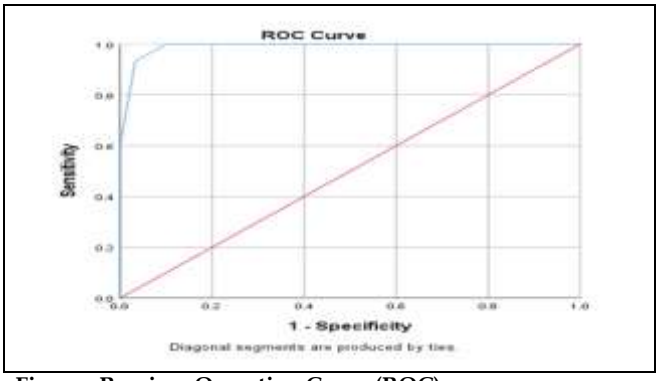

Figure: Receiver Operating Curve (ROC)

DISCUSSION

In this study, we judge the effectiveness of the ESNS system for resource-limited settings, all the parameters included in this are based on clinical examination of the patient, and none require an invasive procedure. Therefore, a score of 12.5 was used as a cut-off to predict mortality. The sensitivity and specificity are 93.3% and 97%, respectively, which is equivalent to the same study conducted in India, which shows sensitivity and specificity of 94% and 89%, respectively.[13] In predicting mortality, the MSNS 12 was conducted on 585 neonates with sensitivity and specificity of 80% and 88.8%, respectively. The parameters included were Respiratory effort, Heart rate, Axillary temperature, CRT, BSR, SPO^2, GA, and Birth weight.

In a study by Deepak Rathod *et al*.[8] extramural neonates who had been transported were assessed using the same clinical parameters and followed up until discharge or death. The cut-off value of Sick neonatal scoring (SNS) for predicting mortality was ≤8 with a sensitivity of 58.3% and specificity of 52.7%. The mortality was less if they were transported via private ambulance versus any other mode of delivery. The sensitivity and specificity of our study are more than that of MSNS and SNS. The sample size of MSNS is more, and the parameters also include GA and birth weight, which are directly related to survival. The latter only included neonates who were referred to tertiary care hospitals. One of the more invasive scores which predict mortality and includes the following parameters mean blood pressure, Temperature, PO^2/FiO^2 ratio, seizures, urine output, APGAR score, birth weight, intrauterine growth restriction and Ph, named Score for Neonatal Acute Physiology with Perinatal Extension-II (SNAPPE II) has sensitivity and specificity of 84.4% and 91% in Nepal,[14] 76.9 and 87.1 in India,[15] to predict mortality. The sensitivity and specificity of the SNAP score are 63% and 95%, respectively.[16] A study in India compared the sensitivity and specificity of ESNS vs SNAPPE II, which was 85.90 and 89.80 vs 92.40 and 88.10, respectively.[17]

The ROC of our study is 0.990 (95% CI: 0.971–1.000). It is 0.913 (95% CI: 0.879–0.946) in a similar study,[12] done in India. It included other variables, including GA and birth weight. It is comparable to the ROC curve obtained using more invasive scoring systems like SNAPPE -II was 0.9114.[18] ROC curve for birth weight, gestational age and clinical risk index for babies (CRIB) score-a scoring system primarily for preterm or low birth weight neonates is 0.829, 0.819 and 0.823, respectively, for a study done in India.[19]

STUDY LIMITATIONS

The score was taken on arrival or within 12 hours of admission. Therefore, there was a potential that the score can be affected by complications of the disease or the treatment, which resulted in the death of the patient despite an initially higher score or discharge of the patient after appropriate treatment despite a lower score on admission.

CONCLUSION

ESNS score has the potential as an effective and comprehensive prognostic tool to predict the mortality of neonates admitted to NICU and facilitate prioritization of care.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

RR & AR: Conception, drafting the manuscript, approval of the final version to be published.

AMA & ZR: Study design, drafting the manuscript, data interpretation, critical review, approval of the final version to be published.

RR & SA: Data acquisition, data analysis, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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