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Neonates of a Tertiary NICU with their Disease Pattern and Predictors of Mortality: A Retrospective Study

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Abstract **Original Research Article**

***Background*:** Neonatal mortality rate is one of the key outcome indicators in the health status of a nation, and directly reflects prenatal, intra-partum, and neonatal care. ***Aim of this study*:** To document the disease pattern and to find out the predictors of neonatal mortality admitted at NICU. **Methods:** This retrospective study was conducted in the Department of Neonatology, Bangladesh Shishu Hospital & Institute (BSH&I), Sher-E-Bangla Nagar, Dhaka, from January 2022 to June 2022. Data were retrieved from file records of the patients regarding age, gender, working diagnosis, type of treatment, length of stay and outcome in the NICU. ***Results*:** 263 study population were analyzed and divided into two groups according to hospital outcome. 116(44.11%) neonates were in survival group and 147(55.89%) neonates were in non-survival group. Male predominance (78%) and median age of admitted patients was 5 days. The most common reason for admissions were perinatal asphyxia with neurologic problems (20.5%) and Low birth weight (LBW-20.5%) followed by post-resuscitation (20%), respiratory failure (16%) and neonatal sepsis (16%), cardiovascular disorder (5%), gastroenteritis (1.2%) and renal failure (0.8%). Overall, median length of NICU stay 12 days. Length of stay (LOS) of survivors were more than non-survivors [Mean ± SD= 18±8 vs. 5±3, respectively]. A total of 121(46%) required mechanical ventilation support. Non-survivors tended more to require mechanical ventilation 110(90.9%). Over-all, in hospital mortality was 56% (147/263). In this study, univariate logistic regression showed Respiratory failure, PNA with neurologic problems, sepsis, post-resuscitation were higher in non-survivors than survivors as independent predictor of mortality. Multivariate logistic regression showed respiratory failure was the overall predictor of neonatal mortality admitted at NICU. ***Conclusion*:** The most common reason for NICU admission were perinatal asphyxia with neurologic problems and low birth weight. Non-survivors tended more to require mechanical ventilation support. Respiratory failure was the predictor of neonatal mortality admitted at NICU.

Keywords: Neonatal Intensive Care Unit (NICU), disease pattern, mortality.

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INTRODUCTION

Neonatal mortality is one of the key indicator in the health status of a nation, directly reflects prenatal, intra-partum, and neonatal care. Neonates can acutely decompensate from a variety of causes and the presenting signs may be nonspecific. Disease pattern in NICU is a sensitive indicator of the availability, utilization and effectiveness of mother and child health services in the community. Neonates having acute life threatening conditions e.g., respiratory distress, PNA with acute neurological deterioration, cardiovascular compromise, severe infections and prematurity constitute major admission to a NICU [1, 2]. Survival predictors are considered the most reliable endpoint of clinical management as well as quality care in NICU setting [3]. Rapid evaluation, initial stabilization with proper management of major diagnosed pathological diseases of ill neonates present a special challenge for pediatrician to encounter the compromised condition. These patients may need mechanical ventilation, invasive intravascular procedures and frequent attention by both the nursing and medical staffs. Disease pattern changes between different places and time to time even at the same palace [4]. Therefore, regular review of the disease pattern in any particular setting is important for providing better services to the neonates. However, estimation of mortality is difficult in critically ill neonates whose condition may deteriorate. There are some invasive methods to assess the status of the patients as measurement for survival predictors, but these take time to institute and have side effects, such as infection.

Therefore, it is necessary to identify noninvasive, easy tools for survival prediction in NICU. The first need of a critically ill neonate is for monitoring of ventilator efficiency in respiratory disorder. The other is cardiovascular system undergoes changes after birth, respiratory gas exchange begins instead of formerly placental function, must be established by the lungs within minutes. Therefore, frequent and serious difficulties in cardio-respiratory adaptation in perinatal and neonatal periods are not surprising [5] but challenging to stabilize with skill handed. Prompt identification and treatment to prevent worse outcome. Early renal failure in critically sick neonates is prerenal due to hypo perfusion or ischemia as in perinatal asphyxia. If not treated promptly prerenal failure may result in intrinsic kidney failure [6]. Patients may be discharged or ambulated from NICU once the disease process has reversed itself and care can be provided in less intense environment. In the developed countries, the main cause or mortality in the neonatal period are non-preventable causes such as congenital abnormalities, but in the developing countries the preventable causes such as infections, jaundice, birth asphyxia and pneumonia predominant [1, 2]. It is challenge for Bangladesh to maintain momentum and achieve the target of reducing the neonatal mortality rate (NMR) per 1000 live births by 2030 [7]. To achieve this target, it is important to know the neonatal disease pattern. Timely recognition of disease pattern, a high index of suspicion of survival predictor and a thorough understanding are necessary to ensure their total correction as well as reduce mortality of critically ill neonates in NICU. This study was carried out in neonates with various diseases and to find out the predictors of mortality admitted at NICU of a tertiary care hospital, Bangladesh Shishu Hospital & Institute, Dhaka.

MATERIALS & METHODS

This retrospective study was conducted at NICU, Bangladesh Shishu Hospital & Institute, the largest tertiary care pediatric hospital in Bangladesh. Trained consultant pediatricians, pediatric surgeons and residents are responsible for medical care of the NICU patients. In this retrospective study, neonates admitted at NICU over a period of six months (January 2022 to June 2022) was undertaken. Information regarding admission and outcome were obtained from NICU hospital record forms about the patient's name, hospital registration number, age, gender, patient management and from where the patient was discharged. Data obtained included the patient's age and sex, the date of admission, diagnosis, date of discharge, and length of stay, interventions if any, final diagnosis and outcome. Outcome was measured in terms of mortality, length of stay, need of ventilator. The data were subjected to statistical analysis according to standard procedure. SPSS version 2025 was used for data recording and analysis. Basic descriptive statistics were produced to test the significance difference of neonates and also among survivors and non-survivors.

RESULTS

263 study population (neonate) were analyzed and divided into two groups according to hospital outcome. 116(44.11%) neonates were in survival group and 147(55.89%) neonates were in non-survival group.

Table I showed clinical baseline of patients in NICU. Male predominance (78.3%) and median age of admitted patients was 5 days. Median length of NICU stay 12 days. Over-all, in hospital mortality was 56% (147/263). The most common reason for admissions were perinatal asphyxia with neurologic problems (20.5%) and Low birth weight (LBW-20.5%) followed by post-resuscitation (20%), respiratory failure (16%) and neonatal sepsis (16%), cardiovascular disorder (5%). A total of 121 (46%) neonate required mechanical ventilation support.

Table II showed comparison of clinical characteristics between survivors and non-survivors. Mean ± SD of Length of stay among survivors and non-survivors were 18±8 and 5±3, respectively which was statistical significant ($p<0.05$). Non-survivors tended to require more mechanical ventilation (90.9%) support which was also statistical significant ($p<0.05$).

Table III showed comparison of disease status between survivors and non-survivors. Respiratory failure, neurologic problems, sepsis, post-resuscitation was higher in non-survivors than survivors which were statistical significant ($p<0.05$), whereas no statistical significant ($p>0.05$) was observed between survivors and non-survivors regarding male neonates, renal failure, gastroenteritis and LBW.

Fig.1 & Table III showed comparison of disease status between survivors and non-survivors. Respiratory failure, perinatal asphyxia with neurologic problems, sepsis, post-resuscitation was higher in non-survivors than in survivors which were statistical significant ($p<0.05$), whereas no statistical significant ($p>0.05$) was observed between survivors and non-survivors regarding male neonates, renal failure, gastroenteritis and LBW.

Table IV showed logistic regression for independent factor in mortality prediction. Logistic regression was performed to identify predictor of mortality. Univariate Logistic regression showed Respiratory failure (OR 2.65), perinatal asphyxia with neurological involvement (OR 2.76), neonatal sepsis (OR 2.65), post-resuscitation (OR 2.35) were statically significant ($p<0.05$), independent predictors of neonatal mortality. Multivariate logistic regression showed respiratory failure (OR 10.61) was the overall predictor ($p<0.05$) of neonatal mortality admitted at NICU.

Table I:

Baseline study population of patients in NICU (n=263)	
Age (days)	**Avg. 5 (4-6)**
Male, n (%)	**206 (78.3%)**
Length of stay in NICU, days	**12 (11–14)**
In Hospital mortality, n (%)	**147(56%)**
Requirement for mechanical ventilation, n (%)	**121(46%)**
Reasons for NICU admission, n (%)	
Respiratory failure	**42 (16%)**
Perinatal asphyxia with neurologic problems	**54 (20.5%)**
Sepsis	**42 (16%)**
Cardiovascular disorder	**14(5%)**
Post-resuscitation	**52 (20%)**
LBW	**54(20.5%)**
Renal failure	**2(0.8%)**
Gastroenteritis	**3(1.2%)**

Data expressed as number (percentage) or median value.

Table II: Comparison of clinical characteristics between survivors and non-survivors

Character	Survivors (n=116)	Non-survivors (n=147)	p-value
Age, days	6±4	4±2	0.153 ^{NS}
Length of stay, days	18±8	5±3	0.001*
Mechanical ventilator (%)	11(9.1%)	110(90.9%)	0.001*
LBW	26 (48.1%)	28 (51.9%)	0.091^{NS}

Data expressed as number (percentage) or Mean±SD.

For statistical analysis, Chi-square test or fisher exact test or Independent t test was done which was appropriate. $p<0.05$ considered as significant.

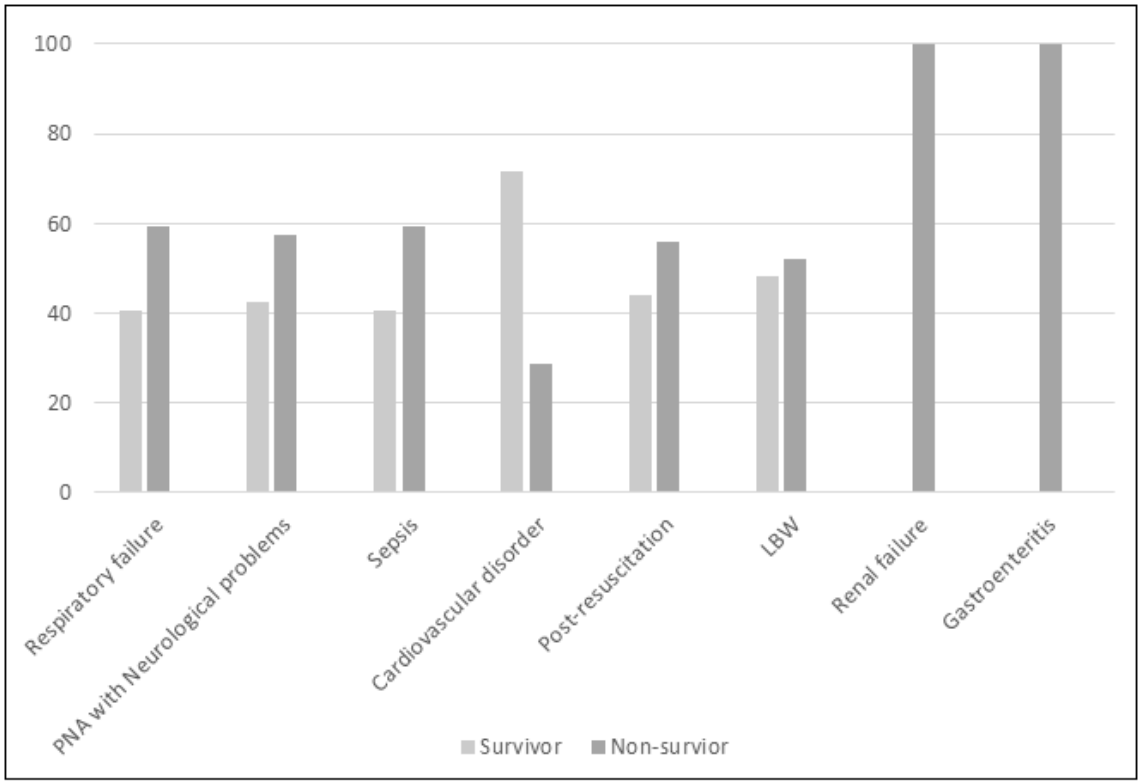

Fig 1: Disease status between survivors and non-survivors

Table III: Comparison of disease status between survivors and non-survivors

Character	Survivors (n=116)	Non-survivors (n=147)	p-value
Reason for NICU admission:			
▪ **Respiratory failure**	17 (40.5%)	25 (59.5%)	0.019*
▪ **Perinatal asphyxia with neurological problems (%)**	23 (42.6%)	31 (57.4%)	0.009*
▪ **Sepsis (%)**	17 (40.5%)	25 (59.5%)	0.019*
▪ **Cardiovascular disorder (%)**	10 (71.4%)	4 (28.6%)	0.164*
▪ **Post-resuscitation**	23 (44.2%)	29 (55.8%)	0.038*
▪ **LBW**	26 (48.1%)	28 (51.9%)	0.091^{NS}
▪ **Renal failure**	0 (0%)	2 (100%)	0.195^{NS}
▪ **Gastroenteritis**	0 (0%)	3 (100%)	0.082^{NS}

Data expressed as number (percentage) or mean ± SD.
For statistical analysis, Chi-square test or fisher exact test or Independent t test was done which was appropriate. p<0.05 considered as significant.

Table IV: Logistic regression for independent factor in mortality prediction

Univariate regression			Multivariate regression	
Factor	**OR (95%CI)**	**P**	**OR (95%CI)**	**P**
Reason for Admission in NICU:				
Respiratory failure	2.658(1.218-5.802)	0.014*	10.617(2.190-51.479)	0.003*
Perinatal asphyxia with neurological problems	2.763(1.293-5.905)	0.009*	8.024(0.841-76.589)	0.70^{NS}
Post-resuscitation	2.350(1.106-4.992)	0.026*	0.403(0.044-3.668)	0.420^{NS}
Sepsis	2.658(1.218-5.802)	0.014*	3.076(0.672-14.087)	0.148^{NS}
LBW	0.562(0.2267-1.182)	0.129^{NS}		
Cardiovascular disorder	0.460(0.135-1.562)	0.213^{NS}		
Renal failure	2.110(0.001-3.110)	0.999^{NS}		
Gastroenteritis	2.200(0.001-3.210)	0.999^{NS}		

OR= Odds Ratio; CI= Confidence Interval; p=<0.05 considered as significant.
NS= Not significant, *= Significant.

DISCUSSION

This six months' retrospective study was carried out to document the pattern of disease with which the sick neonates were admitted in NICU of Bangladesh Shishu Hospital & Institute (BSH&I) and to find out the predictor of their mortality. This study revealed that more male neonates 78.3% were admitted compared to female neonates 21.7%, representing male to female ratio of 3.6:1. Some studies have reported similar observation conducted in China [8] where predominantly male neonate 61.3%. The preponderance of male neonates to suffer various conditions which usually result in admission cannot be explained by this study. However, this has been partly attributed to relatively well developed lungs in female neonates at the time of birth compared to males, as surfactant markers such as lecithin, phosphatidylglycerol, and phosphatidylinositol appear much early in females than males [9]. In addition, a study has established the genetic in influence in neonatal infection, revealing that x chromosome linked diseases are predominant in males than females [10]. Additionally, cultural and social factors could contribute to male babies getting more attention by parents than females. The present study revealed about 21% were LBW, an observation by similar studies conducted elsewhere [11, 12] and Veena Parasad *et al*., (20%) [13]. In developing countries, like Pakistan this can be compared to 55.4% in Karachi [14] and 41.2% in Peshawar [15]. Some other studies the contribution of preterm admission is comparatively less like MS Hoque (28%) [16], Raghvendra Narayan (13%) [17]. Next to prematurity neonatal infections and perinatal asphyxia were the common causes of admission to the neonatal unit at 20% and 12.02% respectively among the term neonates similar to Raikwar P *et al*., [18] and Sridhar PV *et al*., [19].

In this study, Length of stay (LOS) of survivors were more than non-survivors [Mean±SD= 18±8 vs. 5±3, respectively], which was similar to previous study [20]. Many factors may influence the length of stay including disease severity, medical treatment effect, admission and discharge criteria and hospital resources [21]. Mechanical ventilation is a proper to increase the survival rate of the neonates and one of the essential components of NICU. However, mechanically ventilated neonates have a high fatality. Variation in the mortality among mechanically ventilated neonates has been attributed to more biomedical technological advancements in the developed countries. Various studies in developing countries have shown a mortality rate in the range of 40% to 60% [22]. There was a significant increase in length of stay on a ventilator [23]. Mortality among sick neonates in NICU is high, but mortality among mechanically ventilated neonates referred for ventilation is even higher [22]. This study showed the mortality of ventilated neonates was 90.6% which was high. Comparing survivors and non-survivors, respiratory failure, perinatal asphyxia with

neurological problem, post-resuscitation and sepsis at NICU were strongly associated with in-hospital mortality in this study. This results were consistent with previous study [24] conducted in South Ethiopia, who reported that respiratory failure, sepsis and perinatal asphyxia with neurological problem were significantly higher in non-survivors than survivors.

CONCLUSION

The most common reason for NICU admissions were perinatal asphyxia with neurologic problems and low birth weight. Non-survivors tended more to require mechanical ventilation support. Respiratory failure was the predictor of neonatal mortality admitted at NICU.

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