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To prognosticate survival applying scoring system based on clinical parameters and study the morbidity pattern of very low birth weight inborn preterm neonates: a prospective observational study from india

Abstract

Objective: To prognosticate survival applying scoring system and study morbidity pattern of very low birth weight (VLBW) preterm neonates admitted in NICU.

Methods: Hundred and ten VLBW preterm neonates were included.10 morbid conditions were assessed and graded as per morbidity score given by Minde et al.[1] Neonates were categorized into 5 groups based on cumulative scores (Group A 0-20, B 21-40, C 41-60, D 61-80, E 81-100). All 5 groups were further divided based on total number of serious conditions (None/ 1 / 2 / 3). Final outcome (Discharged/Expired) was compared in each group.

Result: There was statistical increase in hospital duration stay with increase in the severity score. Maximum neonates were in group A (41.8%) followed by group B and C. Mortality increased from group A to E. Most common causes of morbidity was neonatal sepsis.

Conclusion: Not only an increasing total cumulative score is associated with poor outcome, rather cumulative score plus the total number of serious conditions predict the outcome more accurately.

Keywords: neonatal morbidity scoring system, very low birth weight, hospital stay duration, neonatal mortality

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Abbreviations: ELBW: Extremely Low Birth Weight Babies; EEG: Electroencephalography; VLBW: Very Low Birth Weight; CHBH: Chris Hani Baragnanath Hospital

Introduction

Survival of the newborn is an issue of great concern especially for the developing world. Almost two-third of infant deaths occur in the first month of life, among those, more than two-third die in their first week and among those, two-thirds die in their first 24 hours after birth.[2,3] Newborn care remains a neglected problem and this impacts negatively on MDG4 of child health, which pledges to reduce under five years mortality by the year 2015.[3] In a recent study published in Lancet preterm birth is a major cause of death and a significant cause of long-term loss of human potential amongst survivors all around the world. Complications of preterm birth are the single largest direct cause of neonatal deaths, responsible for 35% of the world's 4 million deaths a year, and the second most common cause of under-5 deaths after pneumonia.[4-6]

Studies from developed countries have focused on identifying factors affecting morbidity and mortality in preterm population. However, there is paucity of similar data from developing countries.[7] Also in a country like India, where rural health services are not sufficient to deal with a critically ill child, the utility of a neonatal morbidity scoring system is very high for the immediate assessment and to determine need for referral to higher center if needed.[8] No such study has been done till now in Western Rajasthan, India to determine morbidity and mortality of preterm neonates using scoring system. Hence, this study was conducted to determine morbidity and mortality pattern in preterm neonates (≤1.5 kg appropriate for gestational age) and also to prognosticate their survival using neonatal morbidity scoring system.

Material and Methods

This observational prospective study was conducted in Department of Pediatrics, RIMCH, Umaid hospital, Dr. S.N Medical College, Jodhpur, over a period of one year from January 2013 to December 2013. This hospital has level two and three nursery care for neonates and caters to the need of Western Rajasthan. It was approved by Institute's ethical committee. Sample size was calculated using Cochran's formula and the sample size was 110. All Preterm neonates delivered in Umaid Hospital with a birth weight of ≤ 1500 grams and admitted in nursery were included. For all admitted newborns standard management guidelines (as stated/given by AAP/NNF) were followed.[9] A predesigned proforma was used to collect all relevant information after obtaining written consent from the parents. Ten common morbid conditions assessed and graded in preterm babies as per morbidity score given by Minde et al.[1]

Convulsion

Seizure was defined as any paroxysmal event with at least one of the following clinical characteristics: changes in behavior, stereotyped or periodic motor activities or autonomic dysfunction.[10] and was graded.[1] as shown in Table 1. The neonates were evaluated

for neonatal seizure with necessary investigation that included serum electrolytes, serum calcium, random blood sugar, head ultrasound for Intraventricular hemorrhage and electroencephalography (EEG). The management included treatment of any metabolic abnormalities. Phenobarbitone was first line of anticonvulsant and phenytoin was kept as second line drug.

Table 1 Grading of convulsion

None	0
On anticonvulsive therapy but no seizures	1
1-5 convulsion per day	2
Frequent convulsion (>6 per day)	3

Perinatal asphyxia

Neonates were labeled as having Perinatal Asphyxia when all of the following criteria (as laid down by the American Academy of Pediatrics).[11] were fulfilled:

i. Acidosis in cord pH<7

ii. Apgar 0-3 for >5 min

iii. Neonatal neurological sequelae(seizures, coma, hypotonia)

iv. Multiorgan involvement

Perinatal asphyxia was rated.[1] as shown in Table 2. The neonates with hypoxic ischemic encephalopathy were managed with anticonvulsant drugs (phenobarbitone and phenytoin), respiratory system support in form of ventilation and cardiac dysfunction was managed with inotropes. All neonates underwent head ultrasound and MRI brain at age of two weeks. At the time of discharge detailed neurological examination was done and anticonvulsants were stopped if examination was normal, other the drug was continued.

Table 2 Grading of Perinatal asphyxia

None	0
Mild irritability or hypotonia, intubated at birth but 5 min Apgar>5	1
Neurological abnormalities	2
Cardiac arrest or prolonged attempt at resuscitation at birth or severe neurological signs (frequent convulsion, Apgar score at 5 min <5)	3

Necrotizing enterocolitis

All suspected neonates (As per modified Bell's Clinical Staging).[12] were included and rated.[1] as shown in Table 3. The neonates who were suspected to have NEC on the basis of classical triad including abdominal distension, pre-feed aspirate and occult blood positive in stool were evaluated with abdominal X ray, serum electrolytes, blood gas analysis and platelet count. The management was done as per Bell's staging and included Nil per oral, antibiotics and supportive care for the neonate.

Table 3 Grading of Necrotizing Enterocolitis

None	0
Diag. on initial x-ray or blood in stools and patient put on total parenteral regimen, colostomy, or ileostomy without problems.	1
Necrosis with marked distention, x-ray changes confirming necrosis, concern about perforation, ostomy with problems in functioning.	2
Perforation on surgery	3
Very poor condition	3

Meningitis

Lumbar puncture for CSF was performed in all symptomatic neonates being initiated on antibiotics with the exception of premature neonates with respiratory distress at birth with no risk factors for sepsis. Following criteria.[6] were used to label as suspected meningitis- In case of preterm babies, if CSF WBC≥10 or glucose <24 or protein >170 and for term babies if CSF WBC>8 or glucose <20 or protein >120. The neonates with meningitis were managed with intravenous antibiotic for 21 days and at the end of antibiotic course repeat lumbar puncture was done to see normalization of CSF. These neonates were evaluated with weekly head circumference and head ultrasound for early detection of ventriculitis and hydrocephalus. Meningitis was graded.[1] as shown in Table 4.

Table 4 Grading of Meningitis

None	0
Suspected meningitis well controlled by antibiotics with sterile CSF	1
Proven meningitis with positive culture, condition stable	2
Very poor condition, shock or convulsion	3

Sepsis

All suspected neonates.[13,14] (based on presence of risk factors and clinical examination) were subjected to sepsis screen and bactec/ bact-alert culture sent before starting antibiotics. Sepsis was rated as.[1] shown in Table 5. The neonates were given intravenous antibiotics for 48 hours if the blood culture was sterile in case of suspect sepsis. In case of probable sepsis or clinical sepsis, antibiotics were given for 5-7 days and in case of culture positive sepsis, antibiotics was given for two weeks and these neonates were also evaluated for meningitis.

Table 5 Grading of Sepsis

None or antibiotics given only for suspected infection	0
Mild infection with positive culture and controlled by antibiotics	1
Moderate infection with positive blood culture with increased WBC and if condition does not improve after 48 hours	2
Very poor condition with shock and / or DIC	3

Apnea

Apnea was defined as cessation of respiration for >20 seconds or shorter duration in presence of cyanosis or bradycardia.[15] and was rated.[1] as shown in Table 6. The neonates were evaluated for apnea with necessary investigation that included serum electrolytes, serum calcium, random blood sugar, head ultrasound for Intraventricular hemorrhage and echocardiography for patent ductus arteriosus. For apnea of prematurity caffeine was used and if baby had recurrent apneas than respiratory support was given with CPAP or invasive ventilation.

Table 6 Grading of Apnea

None	0
Requires extra o_2 or aminophylline	1
Requires CPAP or bag/mask 3 times a day	2
Requires ventilation.	3

Respiratory distress: Baby was considered to have respiratory distress if two or more of the following were present:

i. Respiratory Rate > 60/min

ii. Retractions

iii. Grunting

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iv. Nasal flaring

v. Cyanosis

The neonates of respiratory distress were managed with support with oxygen. If any preterm neonate had SAS score (Silverman Anderson score) of ≥ 3, neonate was supported with CPAP and in term SAS score ≥ 5 was taken as indication of CPAP support. If the chest x-ray was suggestive of Respiratory distress syndrome, than surfactant was given by INSURE method. Distress was rated as.[1] shown in Table 7.

Table 7 Grading of Respiratory Distress

None	0
Extra O_2 required	1
Requires CPAP	2
Requires ventilation	3

Hyperbilirubinemia

Total and direct bilirubin was/were tested in all newborns having clinical jaundice and guidelines.[16] were used to treat hyperbilirubinemia as shown in Table 8. Hyperbilirubinemia was rated.[1] as shown in Table 9.

Table 8 Guidelines used to treat hyperbilirubinemia

Birth weight(gms)	Guidelines for phototherapy		Exchange Transfusion
	Healthy	Sick (mg/dl)	
<1000	5-7	4-6	10-12
1000-1500	7-10	6-8	12-15

Table 9 Grading of Hyperbilirubinemia

None	0
Requires phototherapy	1
Exchange transfusion	2

Hyperbilirubinemia was managed with intensive phototherapy and exchange transfusion. If there was ABO or Rh incompatibility the neonate was evaluated for hemolytic jaundice that included Direct Coomb's test, peripheral smear for any evidence of hemolysis and reticulocyte count.

Hypoglycemia

Any blood glucose level<40 mg/dl (or plasma level<45 mg/dl) was defined as hypoglycemia.[17,18]. Hypoglycemia was rated.[1] as shown in Table 10. Hypoglycemia was managed with feeds and fluids depending upon the condition of the neonates. In case of symptomatic hypoglycemia or blood glucose less than 25 mg/dl, intravenous fluids were started and Glucose infusion rate was titrated. In asymptomatic neonate one feed was given followed by repeat sugar after 30 minutes and if still there was hypoglycemia than intravenous fluids were started. If the neonate had persistent or refractory hypoglycemia than neonate was evaluated for it.

Table 10 Grading of Hypoglycemia

None	0
Transient and easily corrected	1
Requiring high glucose infusion over 10%D	2
Severe producing apnea / convulsion	3

Anaemia

Standard guidelines (as given by NNF).[9] were used for management of anaemia in newborns and it was rated as.[1] shown in Table 11. Neonates that required blood transfusion were given leuco-depleted and irradiated packed cell red blood cells were given.

Table 11 Grading of Anaemia

None	0
Mild anaemia	1
Severe anaemia requiring transfusion	3

Interpretation: The medical chart of each infant was reviewed and each of the 10 medical conditions was rated for each day the infant was in hospital. Ratings vary according to how life-threatening or physically damaging the condition was to a premature infant. Thus, each condition was given a score of 0 if absent, 1 (mild) if well compensated or controlled by medical treatment, 2 (moderately severe) if still causing problems and requiring specific treatment and consistent monitoring, or 3 (severe) if acutely life-threatening and required immediate and intensive treatment.

After scoring the individual's medical conditions daily, each infant received a 'daily total score', made up of the sum total of the day's complications. In addition, each infant was given a 'total global score', which represented the sum total of each day's score for the entire period in hospital and hence was a summary of both the severity and duration of an infant's neonatal course in hospital.

Thereafter, on the basis of total global score neonates were categorized into 5 groups (Group A-score 0-20, group B-score 21-40, Group C score 41-60, Group D score 61-80, Group E score 81-100). All the five groups were further divided based on presence of total number of serious conditions, defined as any morbid condition with a score of 3. Final outcome (Discharged/Expired) was compared in each group. All the data was entered in Microsoft excel sheet and SPSS version 16 for windows was used for analysis. Appropriate statistical tests were applied to find out statistically significant difference in each group.

Results

In our present study, out of total 110 patients, males outnumbered females (M:F = 71:39). The majority of the neonates were from rural background. Majority of neonates were normal delivered (80.9%) and 80% mothers were booked. In our study, 74.55% preterm neonates (≤1.5 kg appropriate for gestational age babies) survived until discharge. The number of neonates were 6, 24 and 80 in the gestational age group of <26 wks, 26 to < 30 wks and 30-32 wks respectively and survival rates were 16.67%, 58.34%, and 83.75% respectively. The number of neonates<1 kg in our study were 6(5.45%) and their survival rate was 16.6% and that of 1000-1499 gms was 75.36%.

In our present study, the main risk factors held responsible for preterm birth were multiparity (29%), pregnancy induced hypertension(16.36%), anaemia necessitating blood transfusion(16.36%) and other were oligohydramnios, eclampsia, fever and antepartum hemorrhages. In our present study, the number of neonates were 41.8%, 21.8%, 18.18%, 12.7%, and 5.45%, in groups A, B, C, D, and E respectively. Group A included cases having cumulative score from 0-20, similarly group B from 21-40, group C from 41-60, group D 61-80 and group E from 81-100. The expiry was 8.69%, 29.16%, 25%, 57.14%and 66.66% in groups A, B, C, D, and E respectively.

In our study, when mortality pattern in all five different groups was compared with each other and within a group itself (based on number

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of serious conditions present 0, 1, 2 and 3) separately, following conclusions were drawn:

i. Group A (0-20): Mean score of 42 live patients was 11.83 ± 5.61and that of expired patients was 12.5 ± 1.73. No statistically significant difference was seen in mean scores of live and expired cases. However, 100% patients in group A having 2 serious conditions expired and no expiry was documented in other groups.

ii. Group B (21-40): Mean score of 17 live patients was 29.94 ± 4.9 and that of expired patients was 34.28 ± 6.57. Although, no statistical significance was seen in mean scores of live and expired cases but as the number of serious conditions increased, percentage of expired patients also increased.

iii. Group C (41-60): Similarly, no statistically significant difference was seen in the mean scores of 15 live cases (50.53 ± 5.81) and 5 expired cases (54 ± 8.57).

iv. Group D (61-80): Mean score of 6 live patients was 70.42 ± 5.09 and that of 8 expired patients 70.00 ± 5.41.

v. Group E (81-100): Mean score of 2 live cases was 84 ± 2.82 and that of 4 expired cases was 84 ± 2.30. In group E, no significant difference between the mean scores of live and expired cases was seen and a total of 66.66% (4/6) cases expired in group E, all having 3 serious conditions.

In our present study, when comparison between the mean scores of total discharged and expired neonates was made, it was concluded that mean cumulative score of total 82 discharged patients was 28.92 ± 21.99 as compared to mean cumulative score of 28 expired patients which was 51.42±24.07. In all five groups (A to E) there was no statistically significant difference in mean score between discharged and expired group (Table 12). Overall, expired patients had a mean score greater than live patients and it was statistically significant ($p<0.001$).

Table 12 Comparison of Mean scores of Discharged and Expired neonates in all 5 groups

Groups	Discharged Pts.	Expired Pts.	P value
	Mean Score (n=82)	Mean Score (n=28)	
A (0-20)	42 (11.83 ±5.75)	4 (12.5 ± 1.73)	>0.6
B (21-40)	17 (29.94 ±4.99)	7 (34.28 ± 6.57)	>0.2
C (41-60)	15 (50.35 ±5.81)	5 (54.0 ±8.57)	>0.4
D (61-80)	6 (70.42 ±5.09)	8 (70.0 ±5.41)	>0.9
E (81-100)	2 (84 ±2.82)	4 (84.0 ±2.30)	>0.9

Mean duration of stay in group A was 7.5435 ± 2.6974 days which was significantly decreased when compared individually with Group C (15.15 ± 7.83 days) and group D (15.57 ± 8.5 days) ($p< 0.05$). The mean duration of hospital stay in group B was 10.5 ± 4.46 days and in group E was 14.66 ± 4.84 days. The Kaplan meir survival curve when comparing the duration of hospital stay and Group with increases score demonstrates lower duration stay in group A (Figure 1).

On comparing all 5 groups, it was seen that the mean duration of stay of both discharged and expired neonates increased from group A to E but in each group duration of stay of expired neonate was less as compared to discharged neonate. Overall, mean duration of stay of 82 live patients was 12.19±6.41 days while that of 28 expired patients was 7.42±4.16 days and this finding was statistically significant. In our present study, neonates were graded (grade 0 to grade 3 with increasing severity) in each of the 10 parameters of the scoring system and when individual condition was analysed we observed that:

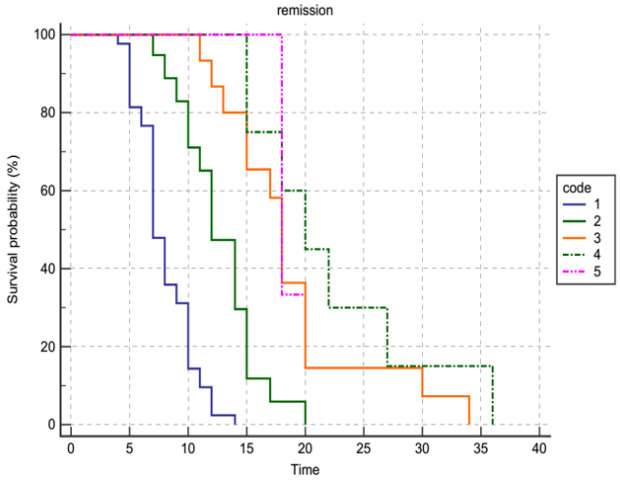

Figure 1 Kaplan Meier survival curves in VLBW neonates based on the severity score group and hospital duration stay (code 1= group A, code 2= group B, code 3 = group C, code 4 = group D, code 5 = group E).

Convulsion

Total cases were 38 (38/110, 34.5%) out of which 8 expired (28.5% of total expired). Both grade 1 and 2 accounted for 17.24% mortality while in grade 3, 33.33% cases expired.

Perinatal asphyxia

Total cases were 21 (21/110, 19.09%) out of which 6 (6/28, 21.4%) expired. Mortality of grade 3 Perinatal asphyxia was more as compared to grade 1 and 2 and this finding was statistically significant ($p<0.02$).

Necrotizing enterocolitis

A total of 16 cases (16/110, 14.5%) of NEC were documented out of which 7 expired. 6/15 (40%) patients expired in grade 1 and 2 NEC while 1/1 (100%) patients expired in grade 3.

Meningitis

Total patients were 8 (8/110, 7.2%) out of which 3 expired and all expiries were documented in grade 3 patients.

Sepsis

This was the most common morbidity seen in preterm neonates. Total patients were 42 (42/110, 38.18%) out of which 11 expired (11/28, 39.28%). In grade1, 1/16 (6.25%) expired, in grade2, 5/20 (25%) expired, whereas in grade3, 5/6 (83.33%) expired & it was statistically significant.

Apnea

Apnea as a cause of morbidity was seen in 36 patients (32.7%) out of which 8 expired. In grade 1 and 2, 11.53% cases (3/26) expired while in grade3, 50% cases (5/10) expired and this finding was statistically significant.

Respiratory distress syndrome

Total cases were 39 (35.45%) out of which 9 expired. Grade 3 patients had a higher % of mortality (7/11) as compared to others.

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Hyperbilirubinemia

Hyperbilirubinemia as a cause of morbidity was seen in 30 patients (27.27%) out of which 7 expired.

Hypoglycemia

Total cases were 18 (18/110, 16.3%) and number of expired patients having hypoglycemia, as one of the cause were 5. Both Grade 1 and 2 accounted for 25% mortality and grade3- 33.33%.

Anaemia

Total cases were 22 (20%) and numbers of expired patients having anaemia, as one of the cause were 4. All 4 expired patients were of grade 3.

Most common morbidity seen in this study was sepsis (38.18%) followed by RDS (35.45%), Convulsion (34.54%) and Apnea (32.72%) (Table 13). None of the parameters individually showed a statistically significant contribution towards neonatal morbidity score (Table 14).

Table 13 Morbidity pattern seen in preterm neonates <1.5kg (n= 110)

Morbidity	No. of Pts.	Percentage (%)
Sepsis	42	38.18
RDS	39	35.45
Convulsion	38	34.54
Apnea	36	32.72
Hyperbilirubinemia	30	27.27
Anaemia	22	20
Perinatal Asphyxia	21	19.09
Hypoglycemia	18	16.36
NEC	16	14.54
Meningitis	8	7.27

Table 14 Comparison of parameters of Neonatal Morbidity Score.

Parameters	No. of Expired Pts.	No. of Discharged Pts.		P value
Convulsion (n=38)	8	30	X^2=0.59	p>0.5
Perinatal Asphyxia (n=21)	6	15	X^2=0.13	p>0.8
NEC (n=16)	7	9	X^2=3.30	p>0.1
Meningitis (n=8)	3	5	X^2=0.66	p>0.5
Sepsis (n=42)	11	31	X^2=0.01	p>0.9
Apnea (n=36)	8	28	X^2=0.29	p>0.7
Respiratory Distress Syndrome (n=39)	9	30	X^2=0.18	P>0.7
Hyperbilirubinemia (n=30)	7	23	X^2=0.09	p>0.8
Hypoglycemia (n=18)	5	13	X^2=0.06	p>0.8
Anaemia (n=22)	4	18	X^2=0.76	p>0.5

Discussion

The measurement of severity of illness using scoring systems is gaining importance in intensive care.[19] These scoring systems help in predicting mortality and morbidity.[20] and thereby can guide us in optimizing the limited health-care resources available in our country. There are various scores devised for neonates in medical literature.[21] which includes CRIB.[22] CRIB II.[23] APACHE, SNAP.[22] SNAP II.[24] SNAP-PE, SNAPPE-II.[25] NTISS.[26] Berlin score, NICHHD.[27] score; NMPI,NEO-MOD.[28] The choice of which variables to be included in the score and their relative weights is obviously vital. A balance needs to be drawn between a complex score including many variables, and therefore difficult to complete, and a simpler model that may be easier to use but not as accurate. It also needs to be remembered that no score can completely quantify the complex factors that make up an individual infant's morbidity.[29]

In our study, 74.55% preterm neonates (≤1.5 kg appropriate for gestational age babies) survived until discharge. The number of neonates were 6, 24 and 80 in the gestational age group of <26 wks, 26-30 wks and 30-32 wks respectively and survival rates were 16.67%, 58.34%, and 83.75% respectively. The number of neonates<1 kg in our study were 6(5.45%) and their survival rate was 16.6%and that of 1000-1499gms was 75.36%. Study conducted in Chris Hani Baragnanath (CHBH) hospital, Department of Pediatrics, Johannesburg to determine survival of VLBW babies (<1.5 kg) concluded that 72% of neonates survived until discharge. The survival rate being 32% for infants <1000gms and 84 % for those weighing 1000-1499 gms. The overall survival rate was in accordance with our study but the survival rate of < 1 kg neonates in our study was much less as compared with this study.[30] This difference could be attributed to various reasons related to maternal health like maternal malnutrition, anaemia, lack of proper antenatal compliance to medications, lack of antenatal administration of steroids and lack of resources.

Survival rates at 26, 27 and 28 weeks gestation were 38%, 50%, and 65% respectively in this study. Other factors associated with better survival were antenatal clinic attendance and delivery by LSCS. Male gender, Apgar score< 6 at 1 and / or 5 min was associated with poor survival. In our study, despite 80% mothers being booked the survival rate were not satisfactory at lower gestational ages. This implies that being booked simply does not prevent preterm delivery nor does it improve discharge rate of neonates. Similarly, study conducted in NICU of Kumudini Hospital, Mirzapur, Bangladesh concluded that out of total 60 newborns(<1.5 kg) there were 37 males and 23 females. The overall survival rate was 56.7% and most of the expired cases were <1250 gms and <30 weeks gestation. No infant with birth weight <850 gms or gestational age <28 weeks survived. This was in contrast to our study where net survival rate of preterm babies was 74.55% and survival rate in <26 weeks gestation was 16.67%.[31] The reason for the difference in overall survival rate could be attributed to the fact that, in previous study, only very low birth weight babies <1.5 kg were included, but in our study both very low birth weight and babies weighing < 1.5 kg were enrolled so, this could also be the reason for better survival rate in our study.

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In our present study, the main risk factors responsible for preterm birth in mothers were multiparity (29%), pregnancy induced hypertension(16.36%), anaemia necessitating BT(16.36%) and other were oligohydramnios, eclampsia, fever and antepartum haemorrhage. Another study carried out at Kousar et al.[32] concluded the main risk factors were maternal anaemia in 65%, maternal malnutrition in 62%, poor antenatal care in 38.38%, grand multipara in 24%, PROM IN 17.6%, fever in 8.4%, PIH in 8.09% and UTI in 6.6%.

In our present study, the no. of neonates were 41.8%, 21.8%, 18.18%, 12.7%, and 5.45%, in groups A, B, C, D, and E respectively. In Group A, no statistical significance was seen in mean scores of live and expired cases. However, 100% patients in group A having 2 serious conditions expired and no expiry was documented in other groups. Although, no statistical significance seen in mean scores of live and expired cases but in Group B, as the number of serious conditions increased, number of expired patients also increased. In group C, % mortality in patients having 2 serious conditions was 33.33% and it increased to 50% in patients having 3 serious conditions. In group D, % mortality increased from 25% to 50% to 71% as the number of serious conditions increased from 1 to 3 except in 0 serious conditions where 100% mortality was seen. In group E, total 66.66% cases expired having 3 serious conditions in comparison to no mortality in other groups having less than 3 serious conditions.

The utility of CRIB score has been proved in many studies and it has been shown that increase in CRIB score increases the chances of neonatal mortality.[33,34] This is in accordance with our study where percentage of mortality was more in higher cumulative score groups. In our study, when mortality pattern in all five different groups was compared with each other and within a group itself (based on number of serious conditions present 0, 1, 2 and 3) separately, following conclusion was drawn that an isolated high mean cumulative score does not predict mortality as accurately as when combined with the total number of serious conditions present.

In our study most common cause of morbidity and mortality seen in preterm neonates was sepsis followed by RDS, convulsion and apnea. Perinatal asphyxia was documented in 19% cases in our study. These results were in contrast to the study conducted in NICU of Kumudini Hospital, Mirzapur, Bangladesh wherein the most common cause of death was birth asphyxia (38.5%), followed by extreme prematurity (26.9%) and septicemia (19.2%).[31] Similar findings were noted in study done on preterm newborns in Department of Pediatrics, Aga Khan University Hospital, Karachi wherein RDS was seen in 35.5% cases and sepsis in 43.6% cases.[35] Study carried out at Dept. of Pediatrics, Liaquat University Hospital, Hyderabad concluded that the common causes of death were sepsis (45.4%), birth asphyxia (23.9%) and RDS (13.3%).[32]

When all the 10 parameters were compared, none of the parameters individually showed a statistically significant contribution towards neonatal morbidity score. Rather, multiple conditions operate in a preterm neonate determining the final outcome**.** Study was carried out for which data was obtained from the North Carolina linked birth/infant death files (1999 to 2003) and it included 4908 records. The findings of this study indicated that newborns born <30 weeks gestation were more likely to have multiple causes of mortality recorded in comparison to infants whose gestational age was at least 37 weeks.[36]

In our present study, the no. of neonates of <1 kg were 5.45% and their survival rate was 16.6% and that of 1000-1499gms was 75.36%. Another prospective observational study done in level III neonatal unit in Northern India on extremely low birth weight babies (ELBW) concluded that the predominant causes of mortality were sepsis in 46% cases, perinatal asphyxia in 20% and pulmonary haemorrhage in 19% cases. Out of 149 ELBW babies admitted - 78(52%) survived, 68 cases expired and 3 neonates discontinued therapy. The survival rate of extremely low birth weight babies was much high in contrast to our study (16.6%).[37] The reasons attributed for this difference could be lack of resources, maternal ill health and risk factors and lack of antenatal steroids. Few other study from our country has tried to show the importance of neonatal scoring system to assess the level of sickness and mortality.[38,39]

Lim et al.[40] evaluated the postnatal SNAP-II scores in neonatal intensive care unit patients and its relationship to sepsis, necrotizing enterocolitis, and death in 141 neonates. They concluded the finding similar to ours that higher admission SNAPPE-II scores correlated with length of stay ($r = 0.44$, $p < 0.01$). Limitation of the study includes small sample size especially for neonates those who were less than 26 weeks of gestation. In future, further adequately sized studies, perhaps testing new factors, are warranted both to confirm that our current risk adjustment tools are optimal and also to check that the scores are adequately recalibrated after changes in care. Further work is needed in relation to the use of risk correction scoring systems for comparisons of later health status**.**

Conclusion

From this present study it was concluded that, not only an increasing total cumulative score is associated with poor outcome (as is evident from a rising mortality trend from group A to E), rather cumulative score plus the total number of serious conditions present predict the outcome more accurately. The most common morbidities documented in preterm babies were sepsis, respiratory distress syndrome, convulsion and apnea in our study. Also, the mortality rate of extremely low birth weight babies was very high highlighting the need to implement improved antenatal, obstetric and newborn care to increase survival amongst these neonates. Innovative solutions to prevent preterm birth (by identifying risk factors in mothers) are urgently needed so as to bring about a change in the final outcome.

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