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ORIGINAL ARTICLE / RESEARCH

Morbidity Index: An Objective Scoring System for Predicting Neonatal Outcome

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ABSTRACT

Objective: The goal of the study was to evaluate the efficacy of a scoring system called **'morbidity index'(MI)** consisting of a combination of grades of electronic foetal heart rate patterns, five-minute Apgar scores and cord arterial base deficit to predict death before discharge in neonatal period.

Design: This was a prospective, analytic cohort study.

Subject & Methods: 985 live born infants irrespective of gestational age and birth weight were enrolled. A relevant obstetric history was recorded for each case. FHR, umbilical cord (arterial) blood base deficit (BD)values and 5 minute Apgar scores of all babies were collected and graded as per Portman(1990) criteria (Grades (GR)of Foetal Heart Rate patterns: GR 0 - Normal tracings, GR I-Variable decelerations, GR II -Severe Variable / Late decelerations, GR III Prolonged bradycardia; 5 minute Apgar score grades: GR 0 - > 6, GR I - 5 - 6, GR II 3 - 4, GR III 0 - 2; Cord blood BD grades: GR 0 BD - <10mEq/L, GR I BD 10 -14 mEq/L, GR II BD 15 -19 mEq/L, GR III BD ≥ 20 mEq/L.) All the grades were added up to form the MI for each baby (MI = FHR GR + Apgar Score GR + Cord BD GR). The *MI* was then analyzed statistically for its efficacy in predicting neonatal mortality.

Results: Larger MI values were found to predict neonatal mortality with better specificity than the three predictors taken individually. However sensitivity of MI was relatively low.

Conclusion: Morbidity index, as compared to the three individual predictors under study, is a better predictor of neonatal mortality. This is easy to do and the score provides more information than the traditional Apgar score.

Key words: Morbidity index, neonatal mortality, newborns

Introduction

An accurate prediction of newborn status after perinatal asphyxia would be immensely beneficial as it would identify newborns at risk for short-term complications, facilitate monitoring, diagnostic tests, specific therapies and supportive interventions and considerations for new and developing therapies to minimize asphyxial injury[1]. It would also help in identifying those infants on whom support can be withdrawn due to high likelihood of neonatal death and long-term morbidity. The present study is an attempt to evaluate the prognostic value of a scoring system published by Portman *et al* in 1990 [2] and later validated by Carter *et al* in 1998[3], with respect to

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prediction of mortality of perinatal asphyxia. The clinical scoring system as described by Portman *et al*, comprised of graded abnormalities of intrapartum FHR monitoring, umbilical arterial base deficit and the five-minute Apgar score for identifying **term** newborns at risk of multiple organ system involvement of **acute perinatal asphyxia** [1]. As against the original study by Portman *et al*, the score termed morbidity index in the present study has been applied to (1) all inborn babies, irrespective of gestational age and weight. The study population therefore also includes preterm and low birth weight babies; (2) The study did not limit itself to babies that experienced acute perinatal asphyxia (3) considering the fact that asphyxia can manifest in myriad ways and other conditions may mimic asphyxia in a newborn[4], all morbidities in the early neonatal period were taken into account; (4) in addition, the score has been used to evaluate its predictive potential for long-term neurodevelopment at 9 months of age of the study subjects.

The present study is a part of a much larger study. Here we limit ourselves in presenting finding related to neonatal mortality only.

Subjects and Methods

The study was carried out in the neonatal unit of the department of Paediatrics, Moolchand Khairati Ram Hospital, New Delhi. This is a 350 bedded private, tertiary level multi-speciality hospital in Delhi. Approximately 900 deliveries occur every year in this hospital.

This was a prospective, analytic cohort study. In the study, 985 inborn live babies irrespective of gestational age and birth weight were enrolled. The time period of enrolment extended from December 2001 to July 2003. Infants on whom data was missing in any of the three constituent parameters (FHR,APGAR, Cord BD) were not enrolled in the study This study was done as a part of Diplomate of National Board thesis.

The Most recent Foetal Heart Rate (FHR) tracing strips prior to birth, (after admission to labour ward); arterial vessel sample, taken from a doubly clamped section of the cord; and Apgar Score was noted for each baby. These were then graded per the criteria of the Portman study [Table 1]. Morbidity Index (MI) was assigned to every baby. The Primary Outcome studied was death before discharge from hospital

Assignment of Morbidity Index (MI)

It is a sum of the grades of the three parameters under study —

MI = FHR Grade + Apgar Score Grade + Cord BD Grade

Statistical Analysis

Bi-variate logistic regression was performed using statistical package for the social sciences (SPSS version 11.5.0, SPSS.inc, Chicago I ll,USA 2002).

Results

Baseline characteristics

Out of 985 babies enrolled – 53 %(517) babies were males and 47 %(468) were females (M:F=1.1:1). 86% of the babies were of term (n=847), 12 % were preterm (n=118) and 2% were postterm (n=20). Mean gestational age was 38 weeks (range 22 to 42 weeks).

Table 1. Grading of the FHR, APGAR and Cord BD according to Portman study [2].

	0	1	2	3
5minute Apgar Score grades	7-10	5 - 6	3 - 4	0 - 2
Cord Base Deficit grades	< 10	10 - 14	15 - 19	≥ 20
FHR Tracing grades*	Normal	Variable Decelerations	Severe variable/ Late decelerations	Prolonged Bradycardia

*Loss of beat to beat variability when associated with variable decelerations was considered grade 3.

The mean birth weight was 3000 (range 680 to 4900 gm). Low birth babies (birth weight < 2500 grams) formed 15.8 % (n=156).

No correlation was found between maternal parity or mode of delivery and neonatal mortality.

51 babies died. The mean wt of babies who died was 2.3 kg (median 2.3 kg) and 41% of these were male babies. ***Babies who left against medical advice (13) or were transferred to other hospitals (9) were excluded from all calculations involving mortality. Data on outcome of these babies was lacking.***

Table 2 NEONATAL OUTCOME (n=985)

Outcome	No of babies
Discharged alive & healthy	912
Died	51
Left Against Medical Advice	13
Shifted to other hospitals	9

Primary outcomes

Morbidity index and its constituents

The following distribution of FHR pattern grades, five-minute Apgar score grades, cord base deficit grades and morbidity index was seen in the study population: [Table3-6]

All the three predictors i.e. FHR pattern grades, 5 minute Apgar score grades and Cord Base Deficit grades were found to be positively associated with neonatal mortality.(p values <0.001).

TABLE 3 DISTRIBUTIONS OF FHR (n=985)

FHR Grade	Frequency	Percent
0	489	49.6
1	370	37.6
2	97	9.8
3	29	2.9
Total	985	100.0

TABLE 4 DISTRIBUTIONS OF 5min APGAR (n=985)

Apgar Grade	Frequency	Percent
0	692	70.3
1	172	17.5
2	101	10.3
3	20	2.0
Total	985	100.0

TABLE 5 DISTRIBUTIONS OF Cord BD(n=985)

Cord BD	Frequency	Percent
0	887	90.1
1	91	9.2
2	7	0.7
3	0	0.0
Total	985	100.0

TABLE6 DISTRIBUTION OF MORBIDITY INDEX (MI) (n=985)

Morbidity Index (MI)	No. of babies (n=985)	Percentage
0	409	41.5%
1	331	33.6%
2	96	9.8%
3	27	2.8%
4	73	7.4%
5	25	2.5%
6	17	1.7%
7	6	0.6%
8	1	0.1%
9	0	0%

Fig1: Morbidity index and percent of babies who died. (n= 912)

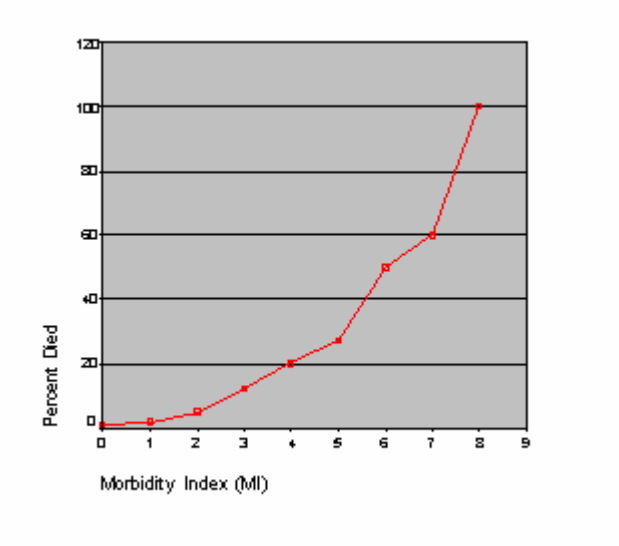

Fig1: ROC for probability of Death using MI as predictor. (n=912)
Area Under the Curve**:** 0.845; Pvalue= <0.001; 95% CI 0.782 - 0.908.

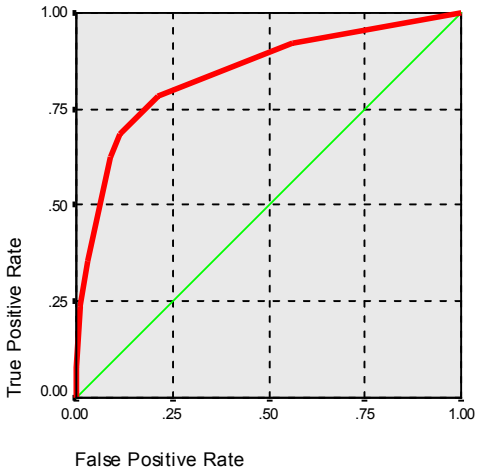

Table 7 MI score utility Based on ROC curve.(n=912)

MI value	**Sensitivity** to predict Neonatal Death	**Specificity** to predict Neonatal Death
4 or Greater	63 %	93%
5 or Greater	35%	97%
6 or Greater	26%	99 %

Table 8. R square value after controlling for gestational age for MI and its constituent predictors. (n=912)

	Cox & Snell R Square	**Nagelkerke R Square**
MI	.137	.405
APGAR	.121	.358
Cord Base Deficit	.111	.327
FHR	.122	.359

However the r square change was maximum for the MI than for any individual predictor, after controlling for gestational age. Therefore a combination of the three predictors (i.e. MI or Morbidity index) was found to be more accurate in predicting neonatal outcome than the three predictors taken individually. The three individual predictors were also significantly correlated with each other. (P-value <0.001).

Discussion

In the present study, foetal heart rate patterns, 5 minute Apgar scores and cord blood base deficit of 985 inborn babies were graded as per Portman grading system[2]. Thereby, gestational age, low birth weight babies or the presence of disease process experienced by the baby did not limit the study population. Portman *et al* had included **only asphyxiated** babies in their study. In the present study, the criterion for inclusion was not targeted at a specific disease population.

With respect to **neonatal survival**, both specificity (99%) and negative predictive values (96%) were found to be very high. The positive predictive value was however low at 50%.

Overall, the presence of a high MI, owing to its high specificity and negative predictive value can warn the treating physician and prompt him to heighten surveillance, plan adequate treatment and if required, transfer the baby to centres with more specialized care.

On taking the three individual predictors into consideration, a positive correlation was found between all the three of them taken separately and neonatal mortality. Foetal heart patterns were found

to be associated significantly with neonatal mortality. 11 out of the 27 babies with FHR grade of 3 died. The results of the present study are in agreement with previous literature [5][6]. However the study findings did not match that of Caravale *et al*[7] and Leuthner *et al* [8] who have reported a lack of correlation between the FHR patterns and neonatal mortality.

Five-minute Apgar scores were found to be similarly significantly associated with neonatal mortality. 9 out of 18 babies with Apgar score grade of 3 (5 min Apgar 0-2) died. The results of the present study are in agreement with those of Casey *et al* [9] and Heller *et* al[10] to name a few.

There was a significant association noted between cord base deficit values and neonatal mortality in the present study. 3 out of 7 babies with base deficit grade 2(15-19meq/l) died. We did not have any baby with cord deficit more than 20 meq/l.

The presence of antenatal complications was seen to be associated with an adverse neonatal outcome. In this study, no significant correlation of the outcome with respect to sex of the baby could be ascertained. A significant correlation between gestational age and neonatal mortality was seen. Prematurity was therefore a confounding factor in the study.

Conclusion

Value of this scoring system lies in its immediate availability and simplicity; specificity; its potential for affecting early clinical management of the newborn, including transfer to tertiary centres and closer follow up and early rehabilitation for developmental delays. *Therefore, it can be concluded that morbidity index, as compared to the three individual predictors under study, is a better predictor of neonatal outcome. It can serve as a good prognostic indicator and should be assigned to all babies at birth.*

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Editorial comment

This study was done as part of a mandatory post graduate thesis by a DNB student in a private hospital. Due to the private nature of care, there is a tendency towards early withdrawal of care in such setups. Therefore, the mortality may have been skewed upwards. Moreover, the authors did not present the data on the babies who left the hospital against medical advice. This number was significant when compared to the number of babies who died. As it is, more information on such cases would have been useful, where a moribund baby whom the parents elect to take home for final hours, rather than recording them as missing data. Similarly, with regard to those cases which were transferred to other hospitals, no data was presented. The data did not segregate the cases with congenital abnormalities. Hence, though prospective, with a large number of cases and an interesting topic, we caution the readers about the interpretation of the study results.

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