

Predictors of neonatal mortality in the intensive care unit in Abha, Saudi Arabia

Mostafa A. Arafa, MBCHB, DrPH, Mohammed A. Alshehri, MBBS, FRCPC.

ABSTRACT

Objectives: Based on 11 months of prospective surveillance in the neonatal intensive care unit (NICU) of Abha General Hospital, Abha, Kingdom of Saudi Arabia, The association of neonatal morbidity and mortality with different risk factors were studied for prediction of different factors of mortality.

Methods: All neonates admitted to the ICU during the period of study; April 2002 through to February 2003 were included. They were followed until discharge or death.

Results: Of the 277 infants admitted, 62 died (22.4%). The 3 common illnesses were prematurity with respiratory problems (31%), respiratory distress syndrome (27%) and perinatal asphyxia (7.6%). Sixty one percent of deaths occurred within the first 3 days, while only 3.2% died after

the first month. Fifty-five percent of admission were premature; the percent of mortality among them was 35%. Those who were delivered before 30 week constituted 13% with a very high case fatality rate, 86%. Multivariate analysis revealed that gestational age, severity of illness, Apgar score <7 at 5 minutes (asphyxia) and mechanical ventilation were the most important predictors of mortality.

Conclusion: Mortality in the NICU is high, these results suggest more effort is needed to identify and reduce risk factors associated with neonatal mortality with special emphasis on prematurity, and to evaluate medical care provided in NICU.

Saudi Med J 2003; Vol. 24 (12): 1374-1376

Advances in perinatal and neonatal care have significantly reduced neonatal mortality rates and have benefited preterm infants admitted to neonatal intensive care units (NICU).¹⁻³ There was a large reduction in mortality rate in the recent years, despite the clinically small but statistically significant reductions in birthweight and gestational age which, by themselves, would be associated with a higher mortality rate. The rapid decline in neonatal mortality during the past 4 decades has been attributed to improvements in neonatal intensive care. This decline was attributable to improved condition of the infants on NICU admission (improved birthweight, higher Apgar scores, and better physiologic ability) that reflected improving obstetric and delivery room care.

It was also due to more effective newborn intensive care and aggressive respiratory and cardiovascular treatment.⁴

Our purpose was to identify the incidence and determinants of mortality for neonates admitted to NICU in Abha General Hospital (AGH), Kingdom of Saudi Arabia (KSA), and to develop a predictive model for neonatal mortality.

Methods. A prospective study was carried out at the NICU of AGH, KSA. This hospital is the only governmental hospital that provides maternity services in the city, in addition to high percentage of referral of high risk pregnancies from other peripheral hospitals.

From the Department of Family and Community Medicine (Arafa), Department of Pediatrics (Alshehri), Faculty of Medicine, King Khalid University, Abha, Kingdom of Saudi Arabia.

Received 9th June 2003. Accepted for publication in final form 10th September 2003.

Address correspondence and reprint request to: Dr. Mostafa A. Arafa, Associate Professor of Family and Community Medicine, Faculty of Medicine, King Khalid University, PO Box 641, Abha, Kingdom of Saudi Arabia. Tel. +966 58336697. E-mail: mostafaarafa@hotmail.com

All neonates admitted to the unit during the period from April 2002 through to February 2003 were included in the study. They amounted to 277 infants. They were followed until discharge or death. Readmission and transfers were tracked as data from the same infant. Patient information included demographic information, mode of delivery, status of the infant and problems at birth, anthropometric measurements, severity of illness on admission, occurrence of infection and time of appearance of signs of that infection and antenatal history. Blood sample was drawn on the early admission and when appearance of the first signs of infection. Gestational age was recorded based on obstetric examination and obstetric history, unless the postnatal pediatric estimate of gestation differed from the obstetric estimate; Ballard score⁵ was used instead for accurate estimation of gestation. Univariate and bivariate analyses were performed to describe the characteristic of the study population and to study the association between different attributed and death. Multiple logistic regression was used to adjust for different variables and to develop a predictive model for death for neonates.

Results. The total number of infants admitted to NICU was 277. More males were admitted to the NICU than females (60% versus 40%), and 14% of all infants were small for date. Fifteen percent of the mothers delivered by cesarean section and 8% had hypertension. The overall mortality rate was 22.4% (62 deaths), 46.8% of deaths (n=29) occurred within the first day of NICU admission, 14.5% (n=9) within 3 days, and 32.3% (n=20) within 14 day. Only 2 deaths (3.2%) occurred after one months of NICU admission. The most common causes of admission were prematurity with respiratory problems (31%), respiratory distress syndrome (27%) and perinatal asphyxia (7.6%). Other causes like suspected sepsis; congenital malformation and intra uterine-growth retardation constituted 14% of the whole reasons of admission. Nearly 30% needed mechanical ventilation. Premature infants formed 55% of admissions; the percent of mortality among them was 35%. Those who were delivered before 30th week constituted 13% with a very high case fatality rate, 86%. Crude association of mortality with different factors showed that the most common cause of death were respiratory distress, neonatal infection, severity of illness, presence of congenital anomalies and receiving mechanical ventilation; the odds of dying were 5.98, 3.68, 68.42, 1.03 and 82.86, **Table 1**. Infant birthweight and gestational age were significantly lower for those who died in comparison to those who survived (t=9.02, 9.38, p=0.000).

It is worth mentioning that birthweight and gestational age were highly significantly correlated to each other (r=0.83), only one of them was added to the

Table 1 - Crude odds ratios and 95% confidence interval (CI) for causes of neonatal deaths.

Causes of death	Crude odds ratio	95% CI
Respiratory distress	5.98	2.29 - 15.57
Mechanical ventilation	82.86	30.42 - 225.68
Asphyxia	1.82	0.71 - 4.74
Neonatal infection	3.68	1.84 - 7.36
Severity of illness	68.42	20.53 - 227
Congenital anomalies	1.03	0.49 - 2.17

Table 2 - Adjusted risk factors significantly predictive of mortality.

Risk factor	Adjusted odds ratio	95% CI
Severity of illness	10.59	2.02 - 45.37
Gestational age	0.75	0.66 - 0.85
Apgar score at 5 minutes	2.94	1.05 - 8.21
Receiving ventilation	8.97	2.36 - 34.08
The variables added to this model were gestational age, severity of illness, apgar score <7 at 5 minutes, receiving mechanical ventilation, sex, neonatal infection, respiratory distress and congenital anomalies -2logLL = 114.95, model χ^2 = 12.82, p=0.000		

multivariate model as it could predict the other one and to avoid the collinearity. The results of the final model of logistic regression are presented in **Table 2**. Severity of illness, gestational age, Apgar score <7 at 5 minutes and receiving mechanical ventilation were the most significant independent predictors of neonatal mortality in order. Ninety-one point three percent of cases were correctly classified, which indicated how well our model fitted the data. The probability of dying increased from 92-98% with decreasing gestational age from 29-23 weeks which indicates the significant weight of gestational age for determining the neonatal survival.

Discussion. There is a great variation in neonatal mortality between ICUs. This variation probably reflects the difference in admission severity, and level of care. In the present study the overall neonatal mortality rate in the unit was 22.4%, with 61% of deaths within the first 3 days. It was as low as 4%, 9% and 6% in the studies in, Canada⁶ Pakistan,⁷ and Brazil.⁸ The figures reported from other studies in Kenya⁹ and Togo¹⁰ was much higher (24.6%, 27%). A

moderate percent (14%) was reported from the study carried out in Taipei metropolitan area, Taiwan.¹¹ Mortality decreased nearly 50% for infants <1500 g in the past 4 decades. One third of this decline is attributable to improved condition on admission that reflects improving obstetric and delivery room care. Two thirds of the decline is attributable to more effective newborn intensive care, which was associated with greater aggressiveness of respiratory and cardiovascular treatments.^{4,12} The present study revealed that gestational age was the most important predictor of neonatal mortality specially when accompanied with respiratory problems that needed ventilatory support. More than half of the admitted infants were premature, with a very high case fatality rate (85%) among those who were delivered before 30th week. Prematurity encompassed many problems specially the respiratory ones, which was found to be highly prevalent among prematures and without adequate ventilatory support would carry high mortality.^{13,14} Problems of immaturity may be on the increase, many researches^{8,10,15-17} have indicated that the major causes of death in the NICU were prematurity or low birthweight, and complication of asphyxia as survival was improving as gestational age and birthweight rose. Yau¹¹ mentioned that logistic regression revealed that among the factors significantly related to mortality was gestational age <28 weeks. Kambarami et al¹⁷ found that the odds of dying were 12.29 times greater for those who were ventilated. All the factors which were found to be significant predictors of mortality in the present study, indicating collectively to the severity of illness of the admitted cases. The strong association between NICU mortality on one hand and preterm delivery on the other indicates the importance of antenatal care, prevention of preterm deliveries and transfer of mothers with high risk pregnancies to tertiary level perinatal centers before deliveries. These results suggest a need for great efforts to identify and reduce risk factors associated with neonatal mortality, and to adequately evaluate the medical care provided in NICUs. Declining mortality is associated with improving birth weight, Apgar scores, and physiologic stability on admission to the NICU, which should be attributed to improving high-risk obstetric treatment ("better babies"). However, even for infants of equivalent birth weight and severity risk, the likelihood of survival is significantly improved ("better NICU care"). Thus increased survival has resulted from both improved obstetrics and improved NICU technology.

Acknowledgment. Great thanks and much appreciation should be due to Dr. Henda Ahmed, Head of the neonatal Intensive Care Unit, Abha General Hospital, for her utmost and great help during the collection of data.

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