Original Article

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The Causes of Neonatal Death in the NICU

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ABSTRACT

BACKGROUND AND OBJECTIVE: To reduce neonatal death, it should be studied the causes of it in any region or medical centers and with appropriate measures we can improve quality of health care and treatment. To achive this goal, this study was conducted in one of the 3rd referral mother-infant care level centers.

METHODS: This cross-sectional study was done in intensive care unit (NICU) of Ayatollah Rohani Hospital, affiliated by Babol University of medical science, from 2009 to 2017. The causes of neonatal death were identified based on ICD10 (International Classification of Diseases, Tenth Revision) by laboratory, clinical and Para clinical evidence recorded in patients sheets.

FINDINGS: Of the total number of 4029 admitted infants in NICU, 276 cases (6.7%) died that 99 (35.9%)of them died within the first 24 hours. The average annual death was 6.7±1.85 and the gestational age was 29.9±4.77 weeks. These infants were born with an average birth weight (g) of 1300.5±810.04 and lived at average 7.99±10.14 days. The most common causes of death in neonates were sepsis and DIC fallowing it 33.4%, extreme premature less than 26 weeks 18.4%, congenital anomalies 14.8% and respiratory distress syndrome 14.1%.

CONCLUSION: According to the results of this study, although severe sepsis and prematurity were the most common causes of death after the first 24 hours, RDS management was more favorable than sepsis, and measures should be taken to reduce sepsis.

KEY WORDS: *Neonate, Mortality, NICU, Cause, Death, Sepsis, Sever Prematurity.*

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Introduction

According to the World Health Organization (WHO) report in 2018, 2.5 million new born died worldwide, of which one million were died on the first day of birth, and nearly one million occurred in the next six days. Major causes of neonatal death (death from birth to 28 days of age) included premature birth, asphyxia, infection, and fatal birth defects (1). About 65% of infant deaths occur in infants under 5 years of age, with approximately 50% occurring on the first day (2). 99% of infant deaths have been reported in developing countries (3).

In a report from Ghana in 2018, 51.8% of infants failed to reach 28 days of age (4). Infant deaths in the Asian continent account for two-thirds of infant deaths worldwide. Infant mortality rate is one of the key indicators in assessing community health and is often used as a standard indicator for the development of a country's health, education and social care systems and it includes the deaths of all babies who die from birth to the first 28 days of life and is expressed as the number of deaths per 1000 live births during a year (5).

The high infant mortality rate is accounted for by unmet health needs and adverse environmental factors, economic conditions, nutrition, education, environmental health and medical care (6,7). The pattern of death in Iran is neither like developed countries nor developing countries, but we are in an epidemiological transition. Precision in infant mortality rate in the country and having a direct impact on infant and child mortality rates of children under 5 years old, on the other hand, the causes of neonatal deaths vary according to the availability and quality of health services in different countries, identifying these causes is essential (8).

Since 1395, the National Iranian Maternal and Neonatal System have been launched in the Department of Population and Family Health of the Ministry of Health and Medical Education in the country and since 1396; more serious infant hospitalization information has been recorded. This study aimed to determine the causes of death in the neonatal intensive care unit (NICU) of Ayatollah Rouhani Hospital in Babol, a referral center for high-risk mothers and neonatal care in the northern part of the country during 1389-1396 (prior to the comprehensive implementation of data registration on the National Iranian Maternal and Neonatal System) to provide more accurate planning for future perinatal care, by knowing the causes of neonatal death.

Methods

This cross-sectional study was performed on all neonates who died in the Neonatal Intensive Care Unit of Ayatollah Rouhani Hospital in Babol, Iran during the years 1389-1396. After obtaining permission from the Medical Ethics Committee and coordinating with hospital officials,the files were studied by referring to the registry of deceased. Required information was recorded based on neonatal demographic characteristics including sex, birth weight, age at death and gestational age and the need for resuscitation and the cause of death was determined by two neonatal specialists based on laboratory and clinical evidence and paraclinical evidence written in the case file. It was extracted based on ICD10 coding, and since autopsy was not performed to determine the cause of death, patients were assigned to an unknown cause group in cases where the cause of death was unknown. Six major causes of neonatal death are identified in the belief system as: birth defects, respiratory distress syndrome (RDS), hypoxic ischemic encephalopathy (asphyxia), severe prematurity (gestational age less than 26 weeks), infections (sepsis), the extracted causes were categorized in the same way to better compare with the situation in the country. The data were analyzed by SPSS (version 18) using chi-square test and $p < 0.05$ was considered significant.

Results

In this study, 4029 neonates admitted to neonatal intensive care unit (NICU) during the period of 1389 to 1396 were studied 54.4% of infants were male and 45.6% were female. These infants were born with a mean gestational age of 29.9±4.77 weeks, birth weight of 1300.56±810.04 and a mean life expectancy of 7.99±10.14 days. In terms of birth weight of dead neonates, 54% (149 cases) of neonates were severely low (ELBW: <1000) and 19.2% (53 cases) were in the very low birth weight range (VLBW: 1000-1499), 14.1% (39 cases were in the low range (LBW: 1500-2400) and 12.3% (34 cases) were in the normal range (BW: 2000-2500) and 0.4% were above 4000 g. Infant mortality was significantly higher at lower weights ($p<0.001$). 264 neonates died from 276 cases whose recovery was recorded in the delivery room, 15.5% (41 cases) without need of resuscitation, 65.5% (173 cases), requiring positive pressure ventilation, 14.8% (39 cases), requiring chest compression and 4.2% (11 cases) required medication. 138 (50%) cases of the deceased infants were less than 28 weeks

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of gestation, 51 cases of which were under 26 weeks of age. 54 (19.6%) cases were born at 28 to 32 weeks gestation, 46 (16.7%) cases were at 32 to 36 weeks gestation and 38 (13.8%) cases were born at 37 weeks gestation. Out of the total 276 deaths, 99 cases (35.9%) occurred within the first 24 hours of birth, 23 cases (23.2%) due to severe prematurity under 26 weeks and 15 cases (15.2%) due to respiratory distress syndrome. The most common cause of RDS deaths at pre-gestational age less than 28 weeks and also at 28 to 32 weeks was immaturity, sepsis, and Disseminated Intravenous Coagulation (DIC); Congenital Heart Disease (CHD) in infants aged 32 to 36 weeks and then, sepsis and DIC, and in infants older than 37 weeks CHD, sepsis was the most common cause of death. The main causes of neonatal death in this study were compared with national outcomes in year 96 (Table 1).

Table1. Frequency of major causes of neonatal deaths in Ayatollah Rouhani Hospital of Babol during 1389-1396 compared with country statistics in 1396

Reported item / The main causes of death	All items in this study Number (%)	The number of cases in the first 24 hours Number (%)	Total cases in country in year 96 Number (%)
Birth Defects	41(14.8%)	15(15.1%)	1094(13.62%)
Respiratory Distress Syndrome (RDS)	39(14.1%)	15(15.1%)	3614(44.98%)
Hypoxic Ischemic Encephalopathy (Asphyxia)	10(3.7%)	5(5.1%)	542(6.75%)
Infections (sepsis)	92(33.4%)	27(27.3%)	429(5.34%)
Severe prematurity (gestational age less than 26 weeks)	51(18.4%)	23(23.2%)	1312(16.33%)
Other cases	43(15.6%)	14(14.2%)	1044(12.98%)
Total	276(100%)	99(100%)	8035(100%)

Discussion

The study found that 276 infants (6.7%) died within 7 years, with an average annual death ratewas of 6.7±1.85. A study in Tabriz by Zeinalzadeh et al found a similar result of 7.5% (3). In the study of Aramesh et al. in the intensive care unit of Imam Khomeini Hospital in Ahwaz, mortality rate of neonates admitted to NICU in 1390 was 284 out of 1620 admitted (17.5%) (9). In a study carried out by Basiri et al., in 1394, 1080 neonates admitted to the neonatal intensive care unit of Fatemieh hospital in Hamadan had died (18.5%) (10). The incidence of neonatal deaths in the NICU was approximately three times higher in the two reports, which were similar in time to the present study. Perhaps one reason for this discrepancy is the presence of the NICU unit at the referral center at the level of three (high risk) labors in this study. In Juneja et al., report in 2018 in India, 218 (10.81%) hospitalized infants died in the NICU 2017 study (11), which was still higher than our study. The mean lifespan of deceased infants was approximately 8 days, with 35.9% dying within the first 24 hours indicating their clinical deterioration. A study by Monsef et al showed that 63% of neonatal deaths were in the age group of 1 to 10 days (12). A June 2018 report in India also revealed 218 (10.81%) deaths in the NICU 2017 study of infants hospitalized in India (11), which is still higher than our study. The mean lifespan of deceased infants was approximately 8 days, with 35.9% dying within the first 24 hours indicating their clinical deterioration. A study by Monsef et al showed that 63% of neonatal deaths were in the age group of 1 to 10 days (12). In this study, 50% of deceased infants

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were less than 28 weeks gestation and more than one third were less than 26 weeks. While in the study of Basiri et al in Hamadan, the highest incidence of neonatal death (63%) occurred at 32-32 weeks gestation (10), But in the present study, the age group of 28-32 weeks accounted for 16.7% of deaths.

In the Juneja et al. study, 40.06% of neonates died less than 37 weeks gestation (13), in other words, more than half of all neonatal deaths occurred in term neonates. In the present study, 54.4% of infants were male and 45.6% were female. In the Basiri et al. study, of the 200 neonates who died in the neonatal intensive care unit of Fatemieh Hospital in Hamadan, 48% (96) were female and 52% (104) were male, indicating in both studies, male mortality was slightly higher (10). A systematic review study examining the prevalence of gender in premature and deceased infants also found that mortality was higher in males and only six of 32 studies reported no difference (14).

The same finding was also found in the study of Monsef et al. in 195 NICU deaths, 53% of deaths were in boys and 47% in girls (12). The prevalence of male death was higher in the study by Aramesh et al., Juneja et al., with 59.9% and 56.67% reported respectively (9 and 11). In the study based on neonatal birth weight status in our study, more than half of the patients (54%) had a very low birth weight (EBL: 1000) and 12.3% were in the normal weight range (BW 2500- 4000).

In the Juneja et al study, however, only 2.33% of deceased infants weighed less than 1000 grams. Also, in the study mentioned, approximately 60% of infants were in the weight range of 1500 to 2500 (11) but in our study 14% were in this weight group. The most common causes of death in infants examined at this center vary across the country. RDS is the fourth most common cause of neonatal death in the whole country.

Appropriate remedies such as non-invasive respiratory protection and timely use of surfactants appear to have significantly reduced the rate of RDS-induced death. In a study conducted by Michel MC et al in the United States from 2008 to 2013, congenital anomalies and brain injuries and infections were the most common causes of neonatal deaths with frequency of 50%, 13%, and 8%, respectively (NICU) (15). Lawn et al. showed that the most common causes of death in infants worldwide were infections (35%), preterm birth (28%), and asphyxia (23%) (16). In the study of Baqui et al., In 2006 in India, the most common cause of death in first day was asphyxiation and birth injury (31%) and preterm birth (26%). Among the first to sixth days, the most common cause of neonatal death was preterm birth (30%) and sepsis (25%) (17). But a study from Iraq in 2018 showed different results, with RDS having a frequency of 41.6%, malformations 18.9%, prematurity and low birth weight 13.9%, septicemia 13.5% and asphyxia with frequency of 8.6% were the most common causes of neonatal death (18).

One reason for the higher prevalence of sepsis in the present study may be that all suspected infections (including clinical symptoms with increased inflammatory markers) in this center, despite negative blood cultures, have also been considered as causes of death. Given that it is not possible to obtain positive neonatal blood cultures in many centers due to inadequate laboratory diagnostic facilities, neonatal specialists should also consider the cause of death in cases that are clinically suggestive of sepsis or have elevated CRP (C Reactive Protein) and other inflammatory markers. In the present study, 85% of deceased infants needed resuscitation and PPV in the delivery room, indicating that the majority of infants were in poor clinical condition from birth and died due to immaturity and other risk factors.

One of the important limitations of this study is that it used the data recorded in the patients' records, which could reduce the value of the analyzed information, given its retrospective nature and the deficiencies in the writing especially in previous years. Therefore, it is recommended to conduct prospective studies to investigate more closely the frequency and risk factors of neonatal death. Particularly since statistics are already being processed in the National Iranian Maternal and Neonatal System for some time now, this can provide more accurate information and be used for future planning.

The results of this study showed that the frequency and causes of neonatal death in neonates hospitalized in Ayatollah Rouhani hospital are in a good condition compared to the whole country. RDS treatment is more favorable than nationwide; however, precautions should be taken to reduce deaths due to sepsis.

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