Original Article

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Preterm Incidence with Analytical Assessment of Causes and Risk Factors of Mortality

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ABSTRACT

BACKGROUND AND OBJECTIVE: Prematurity is a serious health problem and an important risk factor in neonatal mortality. This study aimed to determine the incidence rate of preterm newborns in the neonatal care unit and to study their different causes and risk factors in relation to their outcomes.

METHODS: We conducted a prospective cross-sectional study in Misan Hospital for Child and Maternity during the whole year of 2018. All preterm neonates with gestational age 26-37 weeks needed ventilation support and associated with risk factors were enrolled in this study. Different preterm variables were studied in relation to their outcome including gestational age, birth weight, length, head circumference, gender, type of pregnancy, mode of delivery, presence of congenital anomaly, ventilation support. While maternal variables include age, address, antenatal care, education, past maternal history, and maternal risk factor such as antepartum hemorrhage, premature rupture of membrane, hypertension, diabetes mellitus, previous cesarean section, and previous premature labor.

FINDINGS: There was a predominance of males with mean gestational age and birth weight of (32.6±3.1) weeks and (1755.25±485.8) grams, respectively. Prematurity and its complications were responsible for more than one-third of neonatal hospitalization and their mortality rate was 36.1%. We found a converse significant correlation between the gestational age, as well as, anthropometric parameters of preterm infants and their outcomes ($p<0.05$). Preterm mortality was more significant in those who delivered vaginally or needed ventilation support. High maternal educational level, urban setting and more antenatal visits were associated with less neonatal death. While antepartum hemorrhage, abortion, and premature rupture of membrane were associated with poor outcome.

CONCLUSION: A high rate of preterm admission was observed in the neonatal care unit of Misan hospital with subsequent poor outcome. Determining their risk factors can be used to improve the outcome.

KEY WORDS: *Preterm, Neonatal Care Unit, Outcome.*

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Introduction

A Preterm baby is any delivered neonate before 37 weeks of gestation. Usually, they need special care and have a greater risk of serious health problems (1). In the last decades, many changes and great development have been witnessed in neonatal care, particularly, in the management of preterm neonates in order to decrease their morbidity, as well as, mortality. Using surfactant (2), continuous positive airway pressure (CPAP), mechanical ventilator (3), total parenteral nutrition and applying high level of experienced nursing team (4) have a dramatic role in this issue which was supported by different studies (2,3,4). Moreover, the American Academy of Pediatrics released a further categorization of the levels in the neonatal care unit (NCU) consisting of basic, specialty, and subspecialty care levels reflecting the important role of applying a suitable physical space, equipment, proper personnel, and organization in achieving a better prognosis in preterm neonates (5).

To date, in Iraqi hospitals, providing a high quality of service for neonates and specifically for preterm is underdeveloped. Categorization of the neonatal care levels is not established yet. Currently, the same obstacles were found in Misan hospital. In spite of being a new hospital (established in May/2017), the facilities and practices in neonatal care and stabilization are still restricted resulting in suboptimal supportive care.

During four years (2011 to 2014) study in Misan, the neonatal mortality rate was high and increasing from approximately 12 to 16 in 2011 and 2014, respectively. The preterm rate was also high and associated with a significant increase in the morbidity and neonatal mortality rate in comparison with term neonates (6). Furthermore, the annual statistical report at 2017 revealed that respiratory distress of newborn was the third one in sequence for the top ten causes of hospitalization in our country (7). For these reasons, this study was conducted to estimate the incidence of preterm neonates and to identify the different risk factors in relation to their outcomes.

Methods

This cross-sectional and prospective study was carried out after obtaining permission from the Committee of Ethics in Scientific Researches of the College of Medicine/ Misan University and from Misan Hospital for Child and Maternity with the code 1115 and was conducted according to the Declaration of Helsinki. Informed written consent was obtained from all parents.

Description of NCU: It has twenty incubators distributed in two significant halls with three bubbles CPAP and has only one conventional mechanical ventilator. Moreover, one observation room contains five resuscitators. Usually, the NCU receives an average of 73 newborns per month.

All patients in this study did not receive any surfactant therapy or total parenteral nutrition due to the lack of these substances. In addition, no mechanical ventilation was initiated because it was not working. Therefore, we depend mainly on CPAP for ventilation support.

PEEP as a type of non-invasive ventilation was built in the resuscitator which was used initially in the first 10 minutes followed by CPAP, but sometimes a longer period is required to continue on PEEP due to limitation of CPAP number. In this hospital, no categorization levels were established.

Inclusion criteria: All neonates with gestational age less than 37 weeks (range from 26-37) who delivered in this hospital and needed ventilation support associated with risk factors were admitted to the NCU and were enrolled in this study and the New Bellard scoring system was used for determining their gestational age (8).

The required data were collected from the patient's record by using a special data sheet form (questionnaire), constructed by the researchers and through direct interview with the mother within 48 hours after delivery. Other information was obtained from the records of neonatal care and obstetrical units. The questionnaire sheet consists of the following:

The first part includes the characteristics of the preterm newborns; gestational age, birth weight (measured by electronic weighing machine), length (measured by infant-meter), head circumference (measured by tape measure), gender, type of pregnancy, type of delivery, presence of congenital anomaly, ventilation support (CPAP and positive end expiratory pressure (PEEP)), outcome, and cause of death.

The second part includes maternal information; age, address, antenatal care, education, past maternal history (gravidity, parity, and abortion), and maternal risk factors such as antepartum hemorrhage, premature rupture of membrane, hypertension, diabetes mellitus, previous cesarean section, and previous premature labor.

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During the whole period of this research, each preterm was observed and followed up during their admission.

Exclusion criteria: Any neonate with gestational age equal to or more than 37 weeks and any neonate who delivered outside the hospital.

Statistical analysis: The data analysis was carried out using the available statistical package of SPSS-24 (Statistical Packages for Social Sciences- version 24). Data were presented in simple measures of frequency, percentage, mean, and standard deviation. The significance of the difference between different percentages (qualitative data) was tested using the Pearson Chi-square test (χ2-test) using Yate's correction or Fisher Exact test whenever applicable. Moreover, t-test was used. Statistical significance (p-value) was calculated for each variable independently and considered significant whenever the value was equal to or less than 0.05.

Results

A total of 319 preterm newborns were enrolled in this study. The percent of admitted preterm from total admission (872 patients) in the NCU was 36.6% while the percent of admitted preterm from the total live birth (11343) was 2.8% (95% CI: 0.14-0.16).

The range of gestational age was 26-37 weeks and the mean was (32.6±3.1) weeks with a predominance of males. More than half of the preterm were delivered by cesarean section and a single normal infant was forming the majority (Table 1).

The death rate was 36.1% of the total admitted preterm. Respiratory distress syndrome (RDS) with or without extreme prematurity was the commonest diagnosis leading to death (Table 2).

In studying the association between the main characteristics of preterm and their outcome; mean gestational age of dead neonate was less than that of a live one. Neonates born with lower birth weight, head circumference, and lesser length were at a higher risk of death compared with those with higher figures. Regarding the type of delivery; vaginal delivery had a significant association with preterm death. Preterm mortality was more in those who needed resuscitation, PEEP, and CPAP (Table 3).

High maternal educational level, urban setting and more antenatal visits were associated with less neonatal death ($p<0.05$), while presence of antepartum hemorrhage, abortion, and premature rupture of membrane were associated with more preterm death. Other maternal characteristics were failed to be predictors for neonatal death (Table 4).

Table1. The main characteristics of the preterm infants

Characteristic	Preterm, total 319 Mean±SD or Number(%)
Range of gestational age	(26-37 week)
Gestational age (week)	32.6±3.1
Birth weight (gm)	1755.25±485.8
Length (cm)	43.6±3
Head circumference (cm)	31.1±2.6
Gender	
Male	176(55.2)
Female	143(44.8)
Type of pregnancy	
Single	245(76.8)
Twin	62(19.4)
Triplet	12(3.8)
Type of delivery	
Cesarean section	170(53.3)
Vaginal delivery	149(46.7)
Congenital anomaly	
Yes	9(2.8)
No	310(97.2)

Table 2. The outcome of the preterm and causes of death

	Number(%)
Outcome	
Discharged well	204(63.9)
Died	115(36.1)
Causes of death	
RDS	43(37.4)
Extreme prematurity complicated by RDS	40(34.8)
RDS with sepsis	13(11.3)
Birth asphyxia	9(7.8)
RDS with birth asphyxia	7(6.1)
Preterm with congenital anomalies	4(2.6)

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Table 3. The association between main preterm characteristics and their outcome

Characteristic or Management factors	Outcome		P-value
	Death	Discharged	
	Mean±SD or Number(%)	Mean±SD or Number(%)	
Gestational age (weeks)	29.9±3.1	33.8±2	<0.001*
Birth weight (gm)	1357.2±452.3	1979.6±338.3	
Head circumference (cm)	29.3±2.6	32.2±1.9	
Length (cm)	41.2±2.9	44.9±2.2	
Gender			
Male	69(39.2)	107(60.8)	0.19**
Female	46(32.2)	97(67.8)	
Type of delivery			
Cesarean section	45(26.5)	125(73.5)	<0.001**
Vaginal delivery	70(47)	79(53)	
Type of pregnancy			
Single	86(35.1)	159(64.9)	
Twin	26(41.9)	36(58.1)	0.43**
Triplet	3(25)	9(75)	
Resuscitation			
Yes	59(80.8)	14(19.2)	<0.001**
No	56(22.8)	190(77.2)	
PEEP			
Yes	83(46.9)	94(53.1)	<0.001**
No	32(22.5)	110(77.5)	
CPAP			
Yes	96(68.1)	45(31.9)	<0.001**
No	19(10.7)	159(89.3)	
PEEP time (hours)	2.5±1.2	3±1.4	0.014**
CPAP period (days)	2.4±2.5	1.3±0.53	0.003**

***T test, **Chi square test**

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Table 4. The association between main maternal characteristics and the preterm outcome

Maternal Characteristic or Maternal Risk Factors	Outcome		P-value
	Death Mean±SD or Number(%)	Discharged well Mean±SD or Number(%)	
Age	26.46±7.3	26.85±5.9	0.6*
Gravida	3.4±2.5	3.6±2.2	0.55*
Parity	3.4±2.4	3.3±1.8	0.8*
Abortion	0.28±0.7	0.45±0.9	0.09*
Address			
Urban	65(31)	145(69)	0.01**
Rural	50(45.9)	59(54.1)	
Number of antenatal care visit			
1	54(35.8)	97(64.2)	
2	38(30.4)	67(69.6)	0.023**
3	23(53.5)	20(46.5)	
Education			
Illiterate	41(44.6)	51(55.4)	
Primary school	46(39)	72(61)	0.028**
Secondary school	16(22.9)	54(77.1)	
Higher education	12(30.8)	27(69.2)	
Antepartum hemorrhage			
Present	21(52.5)	19(47.5)	0.023**
Absent	94(33.7)	185(66.3)	
Premature rupture of membrane			
Present	39(47)	44(53)	0.017**
Absent	76(32.3)	160(67.8)	
Hypertension			
Present	10(22.2)	35(77.8)	0.044**
Absent	105(38.3)	169(61.7)	
Diabetes Mellitus			
Present	6(54.5)	5(45.5)	0.213†
Absent	109(35.4)	199(64.6)	
Previous cesarean section			
Present	21(30)	49(70)	0.26**
Absent	94(37.8)	155(62.2)	
Previous premature labor			
Present	16(34.8)	30(65.2)	0.84**
Absent	99(36.3)	174(63.7)	

***T test, **Chi square test, †Fisher exact test**

Discussion

The present study illustrated that prematurity and its complications were responsible for more than one third (36.6%) of neonatal hospitalization. In comparison with other provinces in Iraq; this rate was consistent with Babylon (9) which reported a similar rate (36%), while it was higher than Najaf (10) province (31%). Different studies have been emphasized that infants born preterm are at increased risk for admission to the neonatal intensive care unit (NICU) compared to term infants (9,11). Out of 11.343 live newborns delivered, 319 (2.8%) were preterm admitted to the NCU. This rate was much less than different areas in Iran like Mashhad 6.1%, Qom 5.6% (12), Ardabil 5.8% (13), and Shiraz 12.7% (14). In addition, it was less than Jordan (15) which reported a rate of 5.1%. In fact, this rate was underestimated in our study, because we are calculating,

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specifically, the admitted preterm in the NCU while the stable preterm cases (late preterm or near term< 37 week) without the need for hospitalization were not recorded.

Furthermore, the mortality rate of preterm was apparently high exceeding one-third of the total admitted preterm neonates. Respiratory problems (more specifically RDS) were the most common causes of poor outcomes. Consistently, RDS was reported as a leading cause of death among preterm infants in Misan (6) and Najaf (10). Many investigations demonstrated that there is a converse association between the gestational age and the development of neonatal respiratory distress (6,11,16).

Consistently, a study in Saudi Arabia found that 35% of admitted preterm neonates had died, mainly due to RDS and prematurity (17) while less mortality figures (9.9%) were reported in Iran (Shiraz) (14). On the other hand, Babylon province (9) reported that about (50%) of neonatal death were due to prematurity and its complications which was attributed to the poor health services for preterm care and lack of NICU. This difference in the preterm outcome can be attributed to the difference in neonatal care, ventilation support, and presence of NICU with the leveling system.

However, it is well established that the neonatal mortality rate is higher in hospitals without NICU than for those with intermediate care (18). It is of note that Najaf province recorded a significant decline in neonatal mortality rate after the implementation of level II regional NICU (10). Thus, a further step toward improving neonatal care by the implementation of NICU with the regionalization system in our province is required and can make a great turnover in preterm prognosis. Several variables concerning the preterm and maternal side were considered as important risk factors for predicting the outcomes of preterm newborns.

Among these factors, we noticed a significant correlation between the anthropometric parameters of preterm infants and their outcomes. The head circumference, as well as, the length had a strong correlation with gestational age. They are increasing with increasing gestational age and vice versa (19). Furthermore, there was a strong association between lower birth weight and more premature neonates which were considered as undesired predictors of survival (20). Moreover, the low birth weight is considered a significant factor in neonatal mortality as reported by Iran (21) and Turkey (22). In the current study we noticed that preterm neonates delivered vaginally were at significant risk for death. In fact, vaginal delivery has the greatest impact on outcomes of preterm births (23). We found that preterm mortality was more in those who needed resuscitation, PEEP, and CPAP and this was supported by Gouyon et al. who confirmed that preterm infants were more likely to have severe respiratory diseases that necessitated mechanical ventilation or nasal CPAP and would have a poor prognosis (24). In this study, mothers with low educational level and living in rural areas were more prone to lose their preterm infants and this was compatible with Brazil (23). Similarly, increased risks of mothers having a preterm birth were associated with low or no education levels were reported in Jordan (15).

Our study revealed that a higher mortality rate in preterm was strongly associated with fewer antenatal care visits which was agreed with Australia (25) which also can be attributed to the importance of education. Actually, mothers with chronic hypertension or hypertension during pregnancy or pre-eclampsia are more prone to have a premature delivery (13,26). We found that hypertension during pregnancy was strongly associated with less mortality in preterm neonates. It was demonstrated that hypertension has a protective mechanism against major intra-ventricular hemorrhage (25).

We reported that the presence of a positive history of premature rupture of the membrane was significantly linked with more neonatal deaths. This can be attributed to the higher risk of premature delivery (13,26) and a higher risk of chorioamnionitis, hence, more risk for preterm sepsis (25). The role of understanding, screening, and managing these maternal risk factors during the antenatal care visit is the key component in decreasing a preterm delivery with its complication and this was supported by different studies (15,26). In the last decades, lots of challenges and obstacles were witnessed in Iraq and particularly in the South area-located provinces because of the economic and political issues. Consequently, the health system did not improve and need more efforts especially in the field of neonatal care.

Furthermore, the regionalization program of the neonatal care levels is considered as an essential step in improving the preterm outcome (27) but, unfortunately, it is not implemented yet in Misan. Thus, Millennium Development Goal 4 (28) cannot be met in our province without more attention and efforts toward reducing the preterm death, hence, more reduction in the neonatal and infant mortality. From the findings of this study, we concluded that a high rate of preterm admission was observed with subsequent poor outcome. Determining

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their risk factors can be used to improve the outcome. Regarding the limitation of this study; we are calculating, specifically, the admitted preterm in the NCU while the stable preterm cases without the need for hospitalization were not reported. Therefore, the inclusion of all preterm neonates should be considered in subsequent research in order to obtain a precise preterm rate from the total live birth. Additionally, the preterm's temperature, glucose level, and the role of antenatal corticosteroid were not evaluated in relation to preterm outcomes and should be considered in the future.

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