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Study of Some Predictors of Neonatal Mortality among Preterm Newborn at Zagazig University Hospital

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ABSTRACT

Background: Birth before the 37th week (259th day) of pregnancy, measured from the first day of the last menstrual cycle, is referred to as preterm.

Objective: Early prediction of neonatal outcome in preterm neonate.

Patients and Methods: This was a prospective cohort study carried out in Neonatal Intensive Care Unit in Zagazig University Children Hospitals for 6 months. The estimated sample was 58 neonates.

Results: About 65.5% died and 34.5% were discharged alive. There was statistically significant relation between outcome and maternal age. Singleton pregnancy represented 92.1% and 95% of those died and discharged respectively. There was statistically significant relation between outcome and order in family. Mortality was significantly higher among those with first order (42.1% and 15% within who died and discharged respectively). There was statistically significant relation between outcome and Apgar score at 1 minute, at 5 minutes and at 10 minutes. The best cutoff of Apgar at 1 minute in prediction of mortality was ≤6.5 with area under curve 0.961, sensitivity 92.1%, and specificity 90%. The best cutoff of Apgar at 5 minutes in prediction of mortality was ≤7.5 with area under curve 0.944, sensitivity 84.2%, and specificity 95%. The best cutoff of Apgar at 10 minutes in prediction of mortality was ≤8.5 with area under curve 0.914, with sensitivity 84.2%, and specificity 90%**.**

Conclusion: Premature infants with a low Apgar score have a higher mortality rate.

Keywords: Apgar Score, Neonatal Mortality, Predictors, Preterm Newborn.

INTRODUCTION

Birth before the 37th week (259th day) of pregnancy, measured from the first day of the last menstrual cycle, is referred to as preterm, it's a common medical word that is endorsed by organizations like the American Academy of Pediatrics, the American College of Obstetricians and Gynecologists, and the WHO. Even while preterm neonates are known for their high mortality and other morbidities, the overall prevalence of prematurity-related issues decreases considerably if the baby was delivered after 34 weeks gestational age. Infants born at lower preterm levels are generally considered functionally full-term in the obstetric and pediatric community, and as a result, they receive postnatal care in the well-baby nursery. In the recent decade, the topic of the health of near-term neonates was highlighted[(1)].

The Apgar score was first suggested in 1952 as a quick way to examine a baby's clinical state, and it is still widely used today for newborn infant assessments shortly after birth. Predicting infant death with a reduced Apgar score (one with fewer than five components) is just as accurate as using the full Apgar score[(2)].

Neonatal and newborn deaths revealed a high connection with low Apgar scores [(3)]. Low Apgar scores have been linked to increased perinatal morbidity and mortality. Infants with low Apgar scores at 5 minutes have a greater risk of neonatal respiratory distress, mechanical ventilation and hospitalization in the neonatal intensive care unit, as well as a higher chance of childhood cancer[(3)].

This aim of this study was early prediction of neonatal outcome in preterm neonate.

PATIENTS AND METHODS

This study was carried out in Neonatal Intensive Care Unit in Zagazig University Children Hospitals as prospective cohort study on 58 neonates.

Ethical considerations:

The study protocol was submitted for approval by Zagazig University Institutional Review Board (IRB). Consent was obtained from patient's parents. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion criteria: Preterm newborn <37 weeks, lives in Sharkia Governorate, and admitted to Neonatal Intensive Care Unit in Zagazig University Children Hospital.

Exclusion criteria: Full term newborn >37 weeks.

All neonates included in the study were subjected to the following:

(1) Detailed history taking:

With special focus on gestational age (full-term-preterm), full maternal history, delivery history (antenatal, natal, postnatal). Assessment of the gestational age in most of the neonatal units in sick infants or those in incubators by The New Ballard score (NBS) [(4)]. Preterm birth was stratified into extremely

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preterm (fewer than 28 weeks), very preterm (28 to 32 weeks), moderate to late preterm (32 to 37 weeks).

(2) Full clinical examination:

(3) Apgar Score: At 1,5,10 minutes.

Interpretation: Infants in low health scored 0-2, newborns in fair health scored 3-7, and infants in good health scored 8-10 [(5)].

(4) Laboratory investigations: Arterial blood gases (ABG), complete blood count (CBC), which include white blood cells count, red blood cells count, hemoglobin, and platelets count, and quantitative C-reactive protein (CRP) using Latex agglutination test, Rapitex CRP kit (England).

(5) Follow up till discharge from NICU.

Statistical analysis

In order to analyze the data acquired, Statistical Package for the Social Sciences (SPSS) version 20 was used to execute it on a computer. The quantitative data were presented in the form of the mean, median, standard deviation (SD), and range and were compared by the independent Student's t test if the data were normally distributed or by Mann-Whitney U test if were non-normally distributed. Qualitative data were presented as frequency and percentage and were compared by Chi-Square or Fisher's exact test. The significance of a P value of 0.05 or less was determined.

RESULTS

Concerning outcome of the studied patients, 65.5% died and 34.5% were discharged alive.

This table shows that all of gender, numerous pregnancies, and socioeconomic status had no statistically significant impact on the outcomes. Lower weight and length were significantly associated with mortality. Mortality was also significantly higher among those first in order of family **(Table 1).**

Table (1): Relation between outcome and baseline data of the studied patients

Parameter	Outcome		p
	Died	Discharged	
	N=38 (%)	N=20 (%)	
Gender: Female Male	 21 (55.3%) 17 (44.7%)	 11 (55.0%) 9 (45.0%)	0.985
Multiple pregnancy: No (singleton) Twins Triplet	 35 (92.1%) 2 (5.3%) 1 (2.6%)	 19 (95%) 1 (5%) 0 (0%)	0.556
Order in family: First Second Third Fourth Fifth and sixth	 16 (42.1%) 13 (34.2%) 4 (10.5%) 4 (10.5%) 1 (2.6%)	 3 (15%) 6 (30%) 5 (25%) 3 (15%) 3 (15%)	0.011*
SES: Low Mild Moderate	 25 (65.8%) 11 (28.9%) 2 (5.3%)	 13 (65%) 6 (30%) 1 (5%)	0.974
	Mean ± SD	**Mean ± SD**	**p**
Weight	1.5 ± 0.32	2.11 ± 0.43	<0.001**
Length	40.05 ± 1.87	41.7 ± 3.13	0.02*
Head circumference	30.17 ± 1.64	30.1 ± 1.29	0.434

*: Significant, **: Highly significant

The relationship between the outcome and the method of delivery or prenatal history was not statistically significant. Lower maternal age was significantly associated with mortality. Extremely and very preterm were significantly associated with mortality (**Table 2).**

Table (2): Relation between outcome and antenatal data of the studied patients

Parameter	Outcome		p
	Died	Discharged	
	N=38 (%)	N=20 (%)	
Gestational age:			
Extremely preterm	1 (2.6%)	1 (5%)	
Very preterm	19 (50%)	2 (10%)	0.024*
Moderate to late preterm	18 (47.4%)	17 (85%)	
Mode of delivery			
NVD	12 (31.6%)	3 (15%)	0.171
CS	26 (68.4%)	17 (85%)	
Antenatal history:			
No MRF	24 (63.2%)	11 (55%)	0.546
Anhydramnios	3 (7.9%)	0 (0%)	0.544
Hypertension	5 (13.2%)	5 (10%)	0.256
PE and diabetes	0 (0%)	2 (10%)	0.115
Cord abnormalities	1 (2.6%)	3 (15%)	0.114
Placenta previa	2 (5.3%)	1 (5%)	0.328
Tender scar	1 (2.6%)	1 (5%)	>0.999
Vaginal bleeding	4 (10.5%)	1 (5%)	0.65
	Mean ± SD	Mean ± SD	p
Maternal age (year)	23.95 ± 3.3	25.9 ± 4.76	0.036*

*: Significant

The presence of low birth weight or other reasons for admission had no statistically significant relationship with outcome. In terms of result, neither the requirement for oxygen nor the period of hospitalization were statistically significantly different between both groups. Nasal oxygen was associated with better outcome while MV was significantly associated with mortality (**Table 3).**

Table (3): Relation between outcome and hospital-related data of the studied patients

Parameter	Outcome		p
	Died	Discharged	
	N=38(%)	N=20(%)	
Cause of admission			
Low birth weight	29 (76.3%)	6 (30.0%)	<0.001**
RD II	10 (26.3%)	5 (25.0%)	0.913
RD III	23 (60.5%)	11 (55%)	0.685
RD IV	2 (5.3%)	1 (5%)	>0.999
Sepsis	1 (2.6%)	0 (0%)	>0.999
Down syndrome	1 (2.6%)	0 (0%)	>0.999
IUGR	3 (7.9%)	0 (0%)	0.544
Need for O2:			
Suction only	35 (92.1%)	19 (95%)	>0.999
Suction and Ambu bag	2 (5.3%)	1 (5%)	
LOS (days):			
Median	9.5 days	11 days	0.826
Range	1 – 34 days	2 hours – 40 days	
Respiratory support:			
Nasal O2	5 (13.2%)	17 (85%)	<0.001**
HFNC	8 (21.1%)	3 (15%)	0.731
NCPAP	25 (65.8%)	8 (40%)	0.059
CPAP	3 (7.9%)	0 (0%)	0.544
MV	32 (84.2%)	3 (15%)	<0.001**

**: Highly significant

Apgar score after 1, 5, and 10 minutes was significantly higher in the neonates who were discharged alive than those who died **(Table 4)**.

Table (4): Relation between outcome and Apgar at 1 minute, 5 minutes and 10 minutes of the studied patients

Parameter	Outcome		p
	Died	Discharged	
	N=38(%)	N=20(%)	
APGAR at 1 minute:			
0 – 3	12 (31.6%)	0 (0%)	
4 – 6	23 (60.5%)	2 (10.0%)	<0.001**
7 – 10	3 (7.9%)	18 (90.0%)	
Mean ± SD	4.32 ± 1.51	7.8 ± 0.77	<0.001**
APGAR at 5 minute:			
0 – 3	4 (10.5%)	0 (0%)	
4 – 6	23 (60.5%)	0 (0%)	<0.001**
7 – 10	11 (28.9%)	20 (100%)	
Mean ± SD	5.5 ± 1.74	8.75 ± 0.79	<0.001**
APGAR at 10 minute:			
0 – 3	1 (2.6%)	0 (0%)	
4 – 6	23 (60.5%)	0 (0%)	<0.001**
7 – 10	14 (36.8%)	20 (100%)	
Mean ± SD	6.11 ± 1.91	9.3 ± 0.8	<0.001**

**: Highly significant

The best cutoff of Apgar score at 1 minute in prediction of mortality was ≤6.5 so Apgar score of 6.5 or less can predict mortality. The best cutoff of Apgar at 5 minutes in prediction of mortality was ≤7.5 and the best cutoff of Apgar at 10 minutes in prediction of mortality was ≤8.5 so (**Table 5).**

Table (5): Performance of Apgar score at 1, 5 and 10 minutes in prediction of mortality among the studied patients

APGAR	Cutoff	AUC	Sensitivity	Specificity	PPV	NPV	Accuracy	p
1 minute	0.961	≤6.5	92.1%	90%	94.6%	85.7%	91.4%	<0.001**
5 minutes	0.944	≤7.5	84.2%	95%	97%	76%	87.9%	<0.001**
10 minutes	0.914	≤8.5	84.2%	90%	94.1%	75%	86.2%	<0.001**

**: Highly significant.

There was statistically significant positive correlation between Apgar score at 1, 5, and 10 minutes and both of gestational age and weight. There was statistically significant positive correlation between Apgar score at 1 and 5 minutes and order in family (**Table 6).**

Table (6): Correlation between Apgar score and anthropometric and baseline data

Parameter	APGAR					
	1 minute		5 minutes		10 minutes	
	r	p	r	p	r	p
Maternal age	0.138	0.301	0.087	0.517	0.081	0.544
GA	0.466	<0.001**	0.387	0.003*	0.414	0.001**
Weight	0.633	<0.001**	0.592	<0.001**	0.564	<0.001**
Length	0.165	0.216	0.098	0.465	0.164	0.219
HC	0.096	0.472	0.15	0.262	0.184	0.168
LOS	0.097¥	0.471	0.056¥	0.681	0.068¥	0.614
Order in family	0.275¥	0.036*	0.271¥	0.039*	0.239¥	0.07

*: Significant, **: Highly significant

DISCUSSION

Our study showed that regarding outcome of the studied patients, 65.5% died and 34.5% were discharged alive. This agreed with **Abdel Hady *et al.* [6];** a team of researchers from Benha University Hospital in Egypt that was tasked with determining the risk factors for infant death among patients hospitalised in the neonatal intensive care units (NICU). In their study, they found that 30.6 percent of the newborns investigated had died.

This study showed that gender has no statistically significant impact on the outcome. Females represented 55.3% and 55% of those died and discharged respectively. This agreed with **Riyas *et al.* [7]** in their study sex was not shown to have a statistically significant impact on the results.

An association between result and gestational age was found in our research (extremely and very preterm were significantly associated with mortality). **Carvalho *et al.* [8]** analysis of 4,629 live births and 213 fatalities found a statistically significant connection between neonatal death and gestational ages of up to 36 weeks in groups of newborns delivered alive.

According to the findings of this study, there was no correlation between the outcome and the method of delivery (68.4% and 85% of those who died and discharged respectively). **Riyas *et al.* [7]** reported that a statistically insignificant correlation was found between mode of delivery and the outcomes.

A statistically insignificant correlation was found between prenatal history and the outcome of the study. Maternal age has a statistically significant impact on a child's fate (lower maternal age was significantly associated with mortality). There was no statistically significant link between numerous pregnancies and outcomes and social status. Singleton pregnancy represented 92.1% and 95% of those died and discharged respectively. There was statistically significant relation between outcome and order in family. Mortality was significantly higher among those with first order (42.1% and 15% within who died and discharged respectively). This agrees with **Poudel and Budhathoki [9]** who found that neonatal death was substantially linked with maternal history of abortion, vaginal hemorrhage, and failure to administer steroids antenatally at least 24 hours before delivery. **Forssas *et al.* [10]** found that in-vitro fertilization, a previous stillbirth, an older mother, diabetes, a low socioeconomic position, smoking during pregnancy, and having a first child are all risk factors for perinatal mortality in mothers. They also came to the conclusion that maternal risk factors caused an increase in mortality mostly because of their likelihood to result in low birth weight (LBW). In spite of this, LBW was not the only factor that contributed to the increased mortality associated with poor socioeconomic status and diabetes.

An association between the outcome and the Apgar score at one minute was statistically significant. About 32% among those who died versus 0% in the group discharged alive had Apgar score (0 – 3). About 61% among those who died versus 10% in the group discharged alive had Apgar score (0 – 3). About 8% among those who died versus 90% in the group discharged alive had Apgar score (7 – 10). This agrees with **Razaz *et al.* [11]** who were interested in examining the correlation between Apgar ratings of 7, 8, and 9 (instead of 10) at 1, 5, and 10 minutes and neonatal death and morbidity. When Apgar scores ranged from 7 to 9, it was found to be associated with a higher risk of preeclampsia, chorioamnionitis, and preterm labour (versus 10), and that low Apgar scores in the normal range are early indicators of neonatal morbidity due to the consequences of prenatal and delivery difficulties.

Razaz *et al.* [11] revealed that in the first minute of life, just 11 percent of infants had an Apgar score of 10 and this was generally related to a reduction in skin tone. A higher risk of neonatal morbidity was shown to be associated with an Apgar score of 9 at one minute in our study. There should be no doubt about this conclusion's validity.

Results of outcome and the Apgar score at 5 minutes had a statistically significant correlation. About 11% among those who died versus 0% in the group discharged alive had Apgar score (0 – 3). About 61% among those who died versus 0% in the group discharged alive had Apgar score (0 – 3). About 29% among those who died versus 100% in the group discharged alive had Apgar score (7 – 10). **de Oliveira *et al.* [12]** reported that it is possible that a 5-minute Apgar score of less than 7 may indicate asphyxiation and consequently, the danger of death. Newborns with 5-minute Apgar scores of 7 or lower were more likely to die from suffocation and deformities, however the greater percentage of malformation fatalities occurred after seven days.

Mu *et al.* [13] investigated if the Apgar score and death rates in China were related to gestational age, or whether this relationship altered when Apgar values were combined at 1 and 5 minutes after birth. There were greater rates of newborn deaths in our study (524 per 1000 live births and 132 per 1000 live births, respectively) compared to high-income nations in both low and intermediate Apgar score groups[14]. **Getachew *et al.* [15]** reported that the proportion of low 5th minute Apgar score in their study was 11.5%.

There was statistically significant relation between outcome and Apgar score at 10 minutes. About 3% among those who died versus 0% in the group discharged alive had Apgar score (0 – 3). About 61% among those who died versus 0% in the group discharged alive had Apgar score (0 – 3). About 37% among those who died versus 100% in the group discharged alive had Apgar score (7 – 10).

Razaz *et al.* [11] revealed that infant mortality and morbidity are significantly correlated with lower

Apgar scores within the normal range of 1, 5, and 10 minutes. Normal Apgar scores (seven to nine) are strongly linked to increased risk of infant death and neonatal morbidity, as well as long-term neurological problems [(16)].

This study showed that the best cutoff of Apgar at 1 minute in prediction of mortality was ≤6.5 so Apgar score of 6.5 or less can predict mortality with area under curve 0.961, with sensitivity 92.1%, specificity 90%, positive predictive value 94.6%, negative predictive value 85.7% and accuracy 91.4%. The best cutoff of Apgar at 5 minutes in prediction of mortality is ≤7.5 so Apgar score of 7.5 or less can predict mortality with area under curve 0.944, with sensitivity 84.2%, specificity 95%, positive predictive value 97%, negative predictive value 76% and accuracy 87.9%. The best cutoff of Apgar at 10 minutes in prediction of mortality was ≤8.5 so Apgar score of 8.5 or less can predict mortality with area under curve 0.914, with sensitivity 84.2%, specificity 90%, positive predictive value 94.1%, negative predictive value 75% and accuracy 86.2%.

For the first time, both birth weight and the 5-minute Apgar score have been demonstrated to be independent predictors of neonatal mortality[(17)].

CONCLUSION

Low Apgar score was associated with increased mortality in premature neonates.

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