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Risk of Neonatal Mortality among Preterm Infants and Its Prediction Using Apgar Score

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Abstract

Background: The main period of development of a human is the foetal life which is potentially influenced by various genetic, social and environmental factors. Also many physiological adaptation processes necessary for the extra-uterine life are also developed during this period which makes the foetus vulnerable to morbidity and mortality. The most important cause of the neonatal mortality is the premature delivery of babies. Researchers have found that using Apgar score, they were able to predict the risk of neonatal death among preterm infants within 28 days of delivery up to a certain extent and are one of the most efficacious methods available for the same now

Methods: previously published articles regarding the risk of neonatal mortality among preterm infants and its prediction using Apgar score have been collected and reviewed.

Observations: More than a third of neonatal deaths globally were due to preterm related causes. The main causes of deaths were respiratory distress syndrome, sepsis, pneumonia, asphyxia, intraventricular haemorrhage, apnoea, meningitis and congenital abnormalities. The most common maternal risk factors that contributed to preterm death are pre-eclampsia and eclampsia. Apgar score provides substantial information about the risk of neonatal mortality among the preterm infants across various gestational age groups. The relative risk of neonatal death increases consistently with decreasing Apgar score in all gestational age groups. Though some limitation to this scoring system has been identified in the recent years, it continues to be the most effective tool for assessing the neonates even after half a century

Keywords: Apgar score, eclampsia, gestational age, mortality, neonatal

INTRODUCTION

Prematurity is one of the leading causes of neonatal mortality worldwide and around 1 million infants under age 5 die due to complications related to preterm birth annually. The survival rates are much lower in low income countries compared to high income countries. The survival rates can be increased by feasible and cost effective methods like proper birth care, using of latest medical technologies, prevention of infant infections etc...

Researchers have found that using Apgar score, they were able to predict the risk of neonatal death among preterm infants within 28 days of delivery up to a certain extent and are one of the most efficacious methods available for the same now.

Apgar is a quick test that is performed at 1minute, 5 minute and 10 minute on a baby after birth. The 1 minute test shows how well the baby tolerated the birthing process and the 5 minute test shows how well the baby is coping up outside the mother's womb. The test is also performed in 10 minutes in rare cases [1]

The Apgar score can be defined as a vitality index that is assigned to newborn in a scale of 7-10.This score is assigned based on the measures of heart rate, skin tone, respiratory effect, muscle tone and reflexes. Each category is given a score from 0-2 based on the newborn's condition (Table a). Higher the score the better is the baby's health.

A score of 7-10 is considered normal and any score lower than 7 indicate that the baby needs medical attention. There can be various causes of low Apgar score in infants which include perinatal asphyxia, congenital infections, malformations, maternal fever during labour as well as preterm birth [1, 2]

The current review deals with the risk of neonatal mortality among preterm infants and the prediction of risk using the Apgar score

NEONATAL MORTALITY

This is one of the main indicator of the overall health and welfare of the population. The most important cause of the neonatal mortality is the premature delivery of babies [3].The main period of development of a human is the foetal life which is potentially influenced by various genetic, social and environmental factors [4].Also many physiological adaptation processes necessary for the extra-uterine life are also developed during this period which makes the foetus vulnerable to morbidity and mortality [5].

According to a survey [6], every year more than 4 million newborns die and more than ten thousand deaths occur in the 1st day of life globally. These are more common in developing or underdeveloped countries [7].In developed countries, neonatal morbidity has been reduced to a large extent by using proper strategies and preventive measures [8].

Proper health education, prenatal care, social support, nutritional planning, identifying the risk factors and obstetric care can reduce the neonatal mortality rate [9].

Prematurity also has a major role in neonatal mortality and the infant survival rate can be increased by its proper management [10].Globally around 15 million infants are born prematurely and thus increased mortality rate [11].

Table a) Apgar scoring system

INDICATOR	0	1	2
Appearance(skin colour)	Pale/cyanotic	Only peripheral cyanosis	Pink
Pulse (heart rate)	absent	<100/min	100-140/min
Grimace (reflex)	No response	Grimace (facial movement)/weak cry when stimulated	Good vigorous cry, cough/sneeze
Activity (muscle tone)	Flaccid	Some flexion	Well flexed
Respiration	Absent	Weak, irregular breathing	Strong cry

Table b) Apgar score Interpretation

SCORE	INTERPRETATION	INTERVENTION
0-3	Infant severely depressed	✓ CPR ✓ Intubation ✓ Ventilation with 100% oxygen ✓ Intensive resuscitation ✓ Maintain body temperature ✓ IV fluids
4-6	Infant moderately depressed	✓ Suction ✓ Ventilate till the infant become stable ✓ Airway clearance ✓ Rub newborn's back ✓ Observe the infant carefully for further symptoms
7-10	Normal	✓ No intervention required

RISK OF NEONATAL DEATH AMONG PRE-TERM BABIES

Premature birth is when the baby is born before 37 weeks of pregnancy resulting in increased health problems than the normal babies born on time. In the year 2017, 2.5 million neonatal deaths occurred globally, which accounts for 47% of deaths among children under 5 years of age. More than a third of these deaths were due to preterm related causes [12].Due to this increased rate of neonatal deaths, it is essential to establish the causes of preterm mortality.

In a study conducted in Ethiopia [13], among 4919 preterm infants admitted to the study over a period of 2 years, 1117(22.7%) were dead. Among these, on reviewing 1109 deaths, the causes of death for 1104 neonates were established.

The main causes of deaths were respiratory distress syndrome, sepsis, pneumonia, asphyxia, intraventricular haemorrhage, apnoea, meningitis and congenital abnormalities(Fig 1). These contributed to 92% of all deaths. The most common maternal risk factors that contributed to preterm death are pre-eclampsia and eclampsia (20.6%)

In a similar study conducted in India [14], 2691 preterm neonates less than 33 weeks gestation of the total 8024 admitted in NICU died. Of these 50.1% of deaths were due to complications related to prematurity.

According to WHO[10],more than 60% of the global preterm births occur in Africa and South Asia.12% of babies are born preterm in low income countries while the rate is 9% in high income countries. There has been a profound increase in disability among preterm babies who survived neonatal period in middle income settings due to suboptimal use of technology.

The main causes of preterm birth among the neonates are mentioned in Fig2 .

APGAR SCORE IN ASSESSING HEALTH OF NEWBORNS

Apgar score provides a convenient method for reporting the health status of a neonate immediately after birth. It was developed in 1952 by Dr Virginia Apgar, who was a physician and anaesthesiologist, as a rapid method for assessing the clinical status of a newborn baby at various time intervals after birth and providing healthcare if needed .the newborns are assessed here based on the 5 variables which include heart rate, muscle tone, reflex irritability, respiratory effort and colour [15].

It quantifies clinical signs of newborn depression like cyanosis or pallor, bradycardia, depressed reflex response to hypotonia, apnea etc...Scores in the range of 7-10 at one

minute indicates that the baby needs only standard post partum care. Resuscitation must be initiated before assigning of 1 minute score. Thus it is not used to determine the need for initial resuscitation or the steps involved [16].But a score of 0 beyond 10 minutes can be useful to determine whether continued resuscitation is needed as most of the newborns with such condition have not survived with normal neurologic outcome [16, 17].

According to 2011 neonatal resuscitation programme guideline [16], if there is no heartbeat detectable for atleast 10 minutes, it is appropriate to discontinue resuscitative efforts. Also around 10% of neonates require assistance to commence breathing immediately after birth.

Neonates who require immediate resuscitation can be easily evaluated by assessing the term of gestation, tone and respiratory rate. If all these 3 factors are normal, then there is only need for routine postnatal care for the infant. If any of these factors are abnormal, then proper healthcare interventions should be made [16, 17].

According to a study [18], a 5 minute Apgar score of 7-10 is said to be reassuring, score of 4-6 is moderately abnormal and a score less than 3 is considerably low. Mostly the scores are recorded at 1 and 5 minutes. This is because if the score is low at 1 minute, the healthcare team can intervene and if the score improves at 5 minute, further assessing is not required. But if the score do not improve after 5 minute, the medical staff will reassess the baby after 10minutes [19].Table (b) represents the interpretations of Apgar score and the necessary interventions to be taken. Apgar scores are mainly low in [19]

- Premature babies
- Babies born by caesarean delivery
- Babies born by complicated deliveries

The Neonatal Resuscitation Program guidelines states that if the Apgar score is less than 7 even after 5 minutes, the assessment should be repeated every 5 minutes for up to 20 minutes[16]

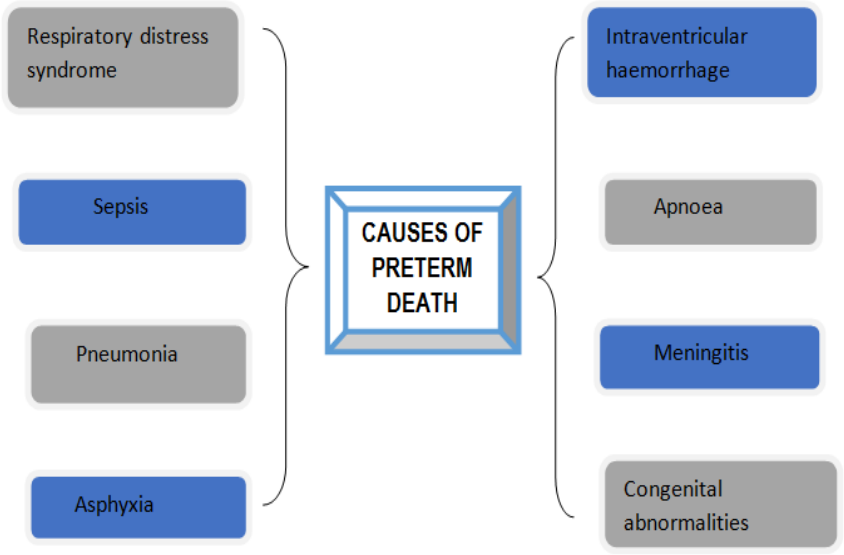

Fig 1: Causes of mortality among preterm infants

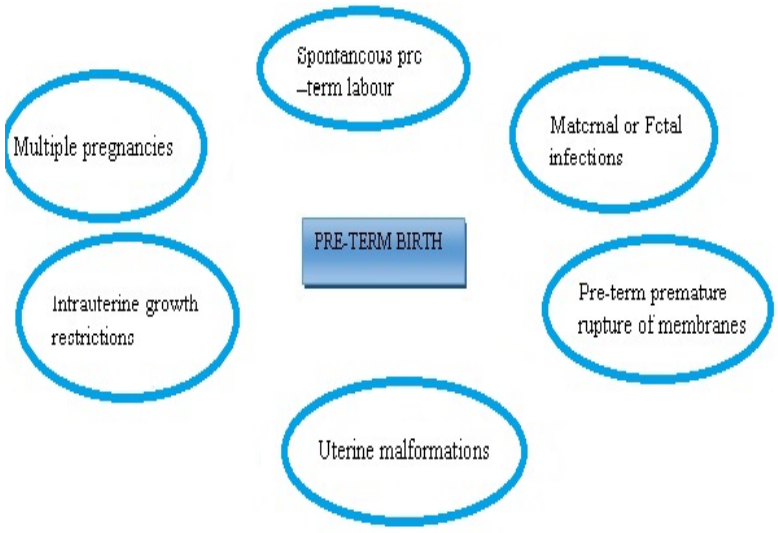

Fig 2: Causes of preterm birth

APGAR SCORE IN PREDICTING RISK OF PRETERM INFANT MORTALITY

The Apgar system for evaluating neonates was primarily developed to assess term infants during a time period when preterm infant mortality rates were considerably high. With decreasing gestational age, the frequency of low Apgar score increases and this reflects the biological immaturity in preterm infants [20]

The preterm birth is particularly categorized into 3 groups [21].

- Extremely preterm(22-27weks)
- Very preterm(28-31 weeks)
- Moderately preterm(32-36 weeks)

In a nationwide survey conducted in Sweden [21], among a total of 390 extremely preterm infants with a 5 minute score of 0-3 and 10 minute score of 0-3,347(89%) died while among those with improved 10 minute score of 4-6,only 52(33.5%) out of the total 155 died. Among 97 very preterm infants, around 73(75.3%) with a 5 minute score of 0-3 and 10 minute score of 0-3 died. Survival rate was increased in the same group with a 5 minute score of 0-3 and 10 minute score of 4-6.Only 26(26%) out of the total 100 among them died. The rate further increased in moderately preterm infants,ie,101(50.8%) of the total 199 with 5 minute score and 10 minute score of 0-3 died and among those who showed improvement in 10 minute score(4-6),only 32(17.3%) of the total 185 died.

So in this nationwide survey it was concluded that Apgar score provides substantial information about the risk of neonatal mortality among the preterm infants across various gestational age groups. The relative risk of neonatal death increases consistently with decreasing Apgar score in all gestational age groups [21].

With decreasing gestational age, the percentage of children with low Apgar score increases Components of Apgar score like respiratory effort, muscle tone, irritability and colour can be widely influenced by the Apgar score.

Low Apgar score in preterm babies may not always reflect fetal depression but can also be biological immaturity. But still it can provide useful prognostic information regarding the survival rate of preterm infants [22].

LIMITATIONS OF APGAR SCORE

The Apgar score is an effective tool currently available to report the status of a newborn and their post delivery responses to resuscitation. But there has been no consistent data that signifies the accuracy of Apgar score on preterm neonates. Thus it should not be used for any purposes other than the ongoing assessment in the delivery room in preterm neonates. The importance of this is to use the Apgar score in its proper perspective and to avoid prediction of future outcomes using this score.

The incidence of low Apgar score is related inversely to the birth weight of infants. A low score is limited to predicting morbidity or mortality [23].A low score may be received by a healthy preterm infant with no evidence of asphyxia only because of immaturity [20].

Apgar scores at 1 and 5 minutes were significantly higher in female preterm infants compared to male infants. This may be related to higher catecholamine level in female infant at birth .This results in a more pressor response and improved cardiovascular stability. Also male premature infant requires more vigorous resuscitation compared to females [21]

Also the score is an insensitive predictive index of long term neurologic or mental handicap and lacks sensitivity and specifity to accurately reflect the degree of acidocis [24].The Apgar is often influenced by subjective factors as objective assessments [25]. The score can vary depending on the knowledge of the medical staff assessing the newborn.

There are many other factors that can influence the Apgar score. Some are the congenital malformations, trauma, maternal sedation or anaesthesia or inter observer variability. There needs to be proper knowledge and awareness regarding the prompt use of this scale among the healthcare professionals to improve its accuracy.

CONCLUSION

As preterm births are the leading cause of infant mortality globally, adequate preventive measures are needed to prevent preterm birth as well as the preterm birth related mortalities. Prevention of preterm birth begins with a healthy pregnancy. To ensure a healthy pregnancy period for all women, there is a need to ensure quality care before, between and during pregnancies. Providing proper counselling on healthy diet and optimal nutrition, timely checkups and consultations with health professionals are all necessary for a healthy pregnancy experience.

Gestational age is shown to be a major determinant in neonatal mortality within the first 28 days of life. The Apgar score provides prognostic information regarding the neonatal survival among the preterm infants. If properly applied, it is a standardized tool for neonatal assessment.

Though some limitation to this scoring system has been identified in the recent years, it continues to be the most effective tool for assessing the neonates even after half a century. The most important thing to consider is to avoid making long term predictions using this score and just limit it to assessing the infant immediately after postpartum.

The American association of paediatrics has recommended the usage of a combined Apgar scoring system that includes the concurrent resuscitative interventions for a more accurate assessment score. It is also highly sensitive in predicting birth asphyxia. The combined Apgar scoring system consists of both the specified and expanded Apgar scoring systems and is a more standardized tool for assessing the newborns.

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