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# Hypotension in Preterm Newborns and its Short-Term Outcome: Experience of a Tertiary Care Hospital in Bangladesh

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## Abstract

**Background:** Blood pressure values of too low or too high can be related with serious morbidity and mortality. Neonatal hypotension has been found to be related with serious short term as well as significant long term health complications. Thus, identifying this low blood pressure in preterm neonates with its impacts on neonatal health is crucial.

**Objectives:** To evaluate blood pressure values in preterm newborn and short-term impacts of hypotension on neonatal health.

**Methods:** This prospective observational study was conducted in Neonatal Intensive Care Unit (NICU) of Bangabandhu Sheikh Mujib Medical University a tertiary care hospital of Dhaka city after approval from Institutional Review Board for a period of one years. Neonates having gestation< 37 completed weeks admitted in NICU of BSMMU were enrolled in the study after getting informed consent from the parents. Proper antenatal and postnatal history were recorded in data collection form. Blood pressure was measured by non-invasive oscillometric method in all neonates within 24 hours after birth by ideal procedure. Blood pressure was monitored at an interval of 12 hours or more frequently when required till discharge or death. Information on neonatal mortality and morbidity was recorded in data collection form.

**Results:** A total of 114 preterm neonates were studied during the study period, among them 61 (53.5%) had normal blood pressure and 53 (46.5%) had hypotension. Among the enrolled patients, 15 (13.2%) patients died, 3 (2.6%) left against medical advice, 11 (9.6%) 96 (84.2%) were discharged with advice. Short time outcomes like culture proven sepsis, use of ionotrops, need for oxygen support and assisted ventilation, feeding intolerance, Necrotizing enterocolitis, intraventricular hemorrhage, retinopathy of prematurity and duration of hospital stay were significantly higher in hypotensive group. Mortality was also higher in hypotensive group than normotensive group (26.4% vs 3.3%, p <0.001).

**Conclusion:** Hypotension in preterm neonates was associated with significant mortality and morbidity in early post-natal period.

**Keywords:** Preterm; Hypotension; Morbidity; Mortality

## Introduction

Blood pressure (BP) measurements is the most commonly used surrogate of end-organ perfusion and have been increasingly used across neonatal intensive care units to determine and monitor hemodynamic status in neonates [1]. It is considered a vital sign, as values too low or too high can be related with serious morbidity and mortality [2]. Several maternal and neonatal factors influence neonatal blood pressure. Maternal conditions, including hypertension and preeclampsia have some impact on neonatal BP and maternal drugs, in particular antenatal steroids also have a strong influence. Among the neonatal factors, gestational

age, post-conceptual age and birth weight have the strongest influence on blood pressure [1]. Hypotension is common in newborn infants. Common conditions leading to systolic hypotension include those that lead to low left ventricular preload, poor myocardial contractility or high left ventricular after load [1]. In pathological conditions such as hypoxia and sepsis, poor myocardial contractility and pulmonary hypertension, which can further be aggravated by acidosis, cause hypotension and tissue hypo-perfusion. Systemic vasodilation or vasoplegia is often found in sepsis, profound hypoxia and in postoperative period. Sick neonates often have impaired auto regulation or a redistribution of organ blood flow that alters the relationship between blood pressure, cardiac output and organ perfusion [3]. The major argument to treat low blood pressure in newborn infants is the aim to preserve or restore adequate organ perfusion, with special emphasis on cerebral blood flow. This is based on the observed association between systemic hypotension and neuro-morbidity, such as intracranial hemorrhage, white matter injury, hearing loss and impaired neurologic development. Thus, hypotension have been identified as important factors in the patho-physiology of cerebral injury [4]. On the basis of previous literature, it has been seen that hypotension pose significant short term as well as long term health complications to neonates [5,6]. Thus, identifying this low blood pressure in neonates with its impacts is crucial. As per my knowledge, there is paucity of information about relationship between low blood pressure and related morbidities and mortalities of preterm neonates in Bangladesh. So, this study aimed to identify low blood pressure related health outcomes in neonates and its impact on neonatal mortality.

## Methodology

### Study Design

This Prospective Observational study was conducted in the Department of Neonatology, Bangabandhu Sheikh Mujib Medical University, Shahbagh, Dhaka, Bangladesh over a period of one years from January 2021 to December 2021. All preterm neonates having gestational age < 37 completed weeks admitted in the NICU of BSMMU during the study period were enrolled. Out born neonates and neonates with major congenital anomalies were excluded from the study.

### Study Procedure

After enrollment detail antenatal, natal and post-natal history was recorded in data collection form. Blood pressure was measured by non-invasive oscillometric method in all neonates within 24 hours after birth. Blood pressure calf was applied to the right upper extremity. Bladder length covered 75%to 80% of arm circumference and bladder width was measured by measuring mid upper arm circumference. Blood pressure was measured 1.5 hours after feeding or a medical intervention preferably during sleep or in a quiet state, lying prone or supine. Neonate was allowed to rest undisturbed after cuff placement for 15 minutes and 3 successive BP readings was taken at 2- minute intervals. Final blood pressure was considered as the mean of three readings. Blood pressure was monitored at an interval of 12 hours or more frequently when required till discharge or death. The eligible infant who fulfilled the inclusion criteria were divided into two strata: normotensive group and hypotensive group. Those who developed hypotension, the name of drugs with dose administered were recorded. Primary outcome was death. Secondary outcomes development of short-term complications like intra ventricular hemorrhage, retinopathy of prematurity, necrotizing enter colitis, chronic lung disease, acute kidney injury etc.

Statistical Analysis: After collecting the data, it was entered in a personal computer. Statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), version 25. Continuous variables were presented as mean ± SD for normally distributed data. Categorical variables were presented as frequencies and percentages. The unpaired Student t test was-used for quantitative variables with a normal distribution and the chi square test was performed for qualitative variables. A result was considered statistically significant if values of- $P<0.05$.

**Table 1:** Baseline Characteristics of enrolled neonates.

| | Normotensive group, n= 61 | Hypotensive group, n= 53 | P value |
|---|---|---|---|
| Gestational age, mean ± SD (weeks) | 31.934 ± 2.24 | 33.208 ± 2.152 | 0.511 |
| Gestational age category<br>Moderate to late preterm, n (%)<br>Very preterm, n (%) | <br>32 (52.5)<br>29 (47.5) | <br>31 (58.5)<br>22 (41.5) | 0.518 |
| Birth weight, mean ± SD (gram) | 1562.034 ± 323.269 | 1487.528 ± 324.971 | 0.123 |
| Birth weight category<br>Low birth weight, n (%)<br>Very low birth weight, n (%)<br>Extreme low birth weight, n (%) | <br>31 (50.8)<br>28 (45.9)<br>2 (3.3) | <br>18 (34)<br>30 (56.6)<br>5 (9.4) | 0.119 |
| Male, n (%) | 35 (57.4) | 25 (47.2) | 0.276 |
| Small for gestational age, n (%)<br>Appropriate for gestational age, n (%) | 18 (29.5)<br>43 (70.5) | 21 (39.6)<br>32 (60.4) | 0.256 |


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## Results

A total of 114 preterm neonates were studied during the study period, among them 61 (53.5%) had normal blood pressure and 53 (46.5%) had hypotension. The baseline and maternal characteristics of the preterm neonates are shown in Table 1 and Table 2. Among the characteristics like gestational age, birth weight, sex, multiple births, mode of delivery, resuscitation at birth and maternal hypertension showed no significant difference in between two groups. Morbidities like feeding intolerance, culture proven sepsis, necrotizing enterocolitis, intraventricular hemorrhage, retinopathy of prematurity and duration of hospital stay were significantly higher in hypotensive group (Table 3). Need for oxygen support, use of ionotrops, need for assisted ventilation and use of antibiotics were also higher among the hypotensive group (Table 4). Mortality was higher in hypotensive group than normotensive group (26.4% vs 3.3%, p <0.001). Retinopathy of prematurity and duration of hospital stay were also higher among the hypotensive group (Table 4).

**Table 2:** Maternal Characteristics of enrolled neonates.

| | Normotensive group, n= 61 | Hypotensive group, n= 53 | P value |
|---|---|---|---|
| Multiple births, n (%) | 16 (31.4) | 25 (49) | 0.069 |
| Cesarean delivery, n (%) | 54 (88.5) | 49 (92.5) | 0.479 |
| Maternal hypertension, n (%) | 23 (37.7) | 25 (47.2) | 0.307 |
| Antenatal corticosteroid, n (%) | 47 (77) | 42 (79.2) | 0.777 |
| Resuscitation needed at birth, n (%) | 4 (6.6) | 3 (5.7) | 0.578 |

**Table 3:** Morbidities of the study population.

| Morbidities | Normotensive group, n=61, | Hypotensive group, n=53 | p value |
|---|---|---|---|
| Respiratory distress, n (%) | 48 (78.7%) | 49 (92.5%) | 0.04 |
| Shock, n (%) | 1 (1.6%) | 48 (90.6%) | <0.001 |
| Feeding intolerance, n (%) | 8 (13.1%) | 28 (52.8%) | <0.001 |
| Culture proven sepsis, n (%) | 5 (8.2 %) | 43 (81.1%) | <0.001 |
| Necrotizing enterocolitis, n (%) | 0 (0%) | 14 (26.4%) | <0.001 |
| Intraventricular hemorrhage, n (%) | 1 (1.6%) | 7 (13.2%) | <0.001 |

**Table 4:** Treatment modalities used in the study population.

| Treatment modalities | Normotensive group, n=61, | Hypotensive group, n=53 | p value |
|---|---|---|---|
| Use of oxygen, n (%) | 48 (78.7%) | 49 (92.5%) | 0.04 |
| Use of ionotrops, n (%) | 1 (1.6%) | 48 (90.6%) | <0.001 |
| Use of Assisted ventilation, n (%) | 17 (27.9%) | 33 (62.3%) | <0.001 |
| Use of antibiotics, n (%) | 5 (8.2 %) | 43 (81.1%) | <0.001 |

**Table 5:** Outcome of the study population.

| Outcome | Normotensive group, n=61, | Hypotensive group, n=53 | p value |
|---|---|---|---|
| Duration of hospital stay, mean ± SD (days) | 7.737 ± 3.439 | 17.773 ± 9.039 | <0.001 |
| Retinopathy of prematurity, n (%) | 4 (6.6%) | 10 (18.9%) | <0.001 |
| Death, n (%)<br>Yes<br>No | 2 (3.3%)<br>59 (96.7%) | 14 (26.4 %)<br>39 (73.5%) | <0.001 |
| Discharged | 59 (96.7%) | 39 (73.5%) | <0.001 |



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## Discussion

This prospective observational study was conducted to find out the short-term effect of hypotension among preterm neonates. The data suggested that hypotension was significantly associated with short term adverse morbidity and mortality among preterm neonates. Our finding that early postnatal hypotension is associated with significant mortality is similar to conclusions from some prior studies [5-7]. Zubrow and coworkers reported almost a decade ago a strong association between birth weight, gestational age, and blood pressure. In recent years there has been increasing focus on the untoward effects of low blood pressure in this population, especially on cerebral blood flow. [8] Munro and coworkers, for example, recently found that cerebral autoregulation was functional in normotensive but not hypotensive ELBW infants. Other factors which increase the risk of hypotension include lack of antenatal steroids, perinatal blood loss, large patent ductus arteriosus and higher-pressure ventilation. Hypotension occurs commonly among ventilated preterm neonates because of iatrogenic fluid restriction, impaired venous return caused by positive intrathoracic pressure (often with inadvertent PEEP), limited myocardial contractility, decreased adrenocortical responses, and comorbidities such as sepsis and pulmonary hemorrhage [9].

Infants with hypotension were more likely to have significant IVH. This may be due to the impairment of vascular autoregulation which leaves cerebral blood flow at the mercy of perfusion pressure. Furthermore, the deficits in cerebral blood flow may be profound even in the presence of mild systemic hypotension. [10] Symptomatic hypotension has been clinically tied to IVH in the past, but very few study reported an association with hearing loss. [11,12] Potential mechanisms for this finding include either ischemic injury to the cochlear nuclei or hemorrhage involving the auditory nerve. [13] Additional studies are needed to fully elucidate the relationship among the multiple factors involved in this injury. Hunt and coworkers reported in one study that low early postnatal blood flow to the upper body and brain may be one factor in the causal pathway of impaired preterm neurodevelopmental outcome [14].

The strengths of our study include the use of prospectively collected data, defined by gestational age and the use of follow-up data collected by examiners who were trained in the standardized administration of the BSID-III. A potential limitation of our study is the lack of a consistent method for obtaining Mean Arterial Pressure. Mean Arterial Pressure measurements were obtained by oscillometry which overestimates blood pressure where standard is to measure by intra-arterial method. Hypotension affects close to half (46.5%) of all preterm infants in our study, yet there is lack of consistency or agreement on its definition. Nomograms have been useful in other areas of neonatology. It is important to establish normative values for blood pressure in preterm infants and to further evaluate the short-term effects of hypotension. Moreover, just as the etiology of brain damage in preterm newborns is multifactorial, so are the clinical factors that modify cerebral perfusion. In this study, most of the hypotensive infants received some treatment (volume expansion or vasopressor therapy) for hypotension. Use of vasopressors could have adverse effects on infants' short-term outcome. Above all, we need to be better informed regarding the optimal timing and modes of intervention. Despite these limitations, our study has implications for researchers interested in preventing hypotension related adverse outcomes in preterm infants. Specifically, our findings support the concept that early postnatal hypotension is an important risk factor for mortality.

## Conclusion

Postnatal hypotension in preterm neonates was associated with significant mortality and morbidity in the early post-natal period.

## Recommendations

Further multicenter studies including larger samples should be done for more appropriate findings.

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