

## Original Article

## Prevalence of Hypertension in Neonates: A study in two Tertiary Care Hospitals of Bangladesh

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### Abstract:

*Hypertension is a condition which is usually not common in neonates. If hypertension can be detected early in neonates it is possible to decrease morbidity and mortality in future by taking appropriate measures. This cross sectional study was carried out in two tertiary care hospitals to find out the prevalence of hypertension in neonates. Study period was from July, 2017 to June 2018. To determine the prevalence of neonatal hypertension, 600 neonates were included. Blood pressure was measured by using neonatal cuff; on three occasions at same visit at least 5 minutes interval while neonates were quiet and awake. Out of the 600 neonates only two had hypertension (0.33%). Both hypertensive neonates were male and detected in Neonatal Intensive Care Unit (NICU). The prevalence of hypertension in term and preterm neonates were 0.57% and 0.23% respectively. Paired samples test of blood pressure of neonates showed significant value with birth weight in kg and gestational age in weeks. Linear regression showed increase blood pressure with increasing gestational age of neonates. In this study 95% of neonates had blood pressure at or lower than reference value. It can be concluded from the present study that early diagnosis of hypertension during neonatal period will help to control childhood hypertension and prevent future morbidity and mortality.*

**Key words:** Neonates, Blood pressure, Hypertension.

### Introduction:

Neonatal hypertension defined as elevation in systolic blood pressure in a neonate which is  $\geq 95$ th percentile for age, weight and gender on 3 separate occasions<sup>1</sup>. This definition also approved by National High Blood Pressure Education Program Working Group on high blood pressure in children (2004). Blood Pressure (BP)

in neonates (preterm and term) admitted to neonatal intensive care unit (NICU) varies with gestational age, chronological age, post-conceptual age (corrected gestation), and birth weight. Hence it is difficult to define normal BP and hypertension in neonates<sup>2</sup>.

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On day 1, systolic and diastolic blood pressure correlates strongly with gestational age and birth weight. BP decreases within first 3 hours of life and then spontaneously increases by 0.2 mm Hg/hour (mean BP)

over the first 24 hours<sup>3</sup>. Blood pressure continues to rise rapidly in the first 5 days of life regardless of gestational age or weight at birth before the rate of rise slows down<sup>4</sup>. By definition, 5% of neonates will have hypertension, but the reported incidence in infants admitted to neonatal units ranges from 0.2-3.0%<sup>5</sup>.

Since the severity of hypertension influences its management, it should be staged as below<sup>6</sup>.

- Stage 1 hypertension: Systolic or diastolic blood pressure values exceeding the 95<sup>th</sup> percentile and up to 5 mm above the 99<sup>th</sup> percentile. Blood pressures in this range should be rechecked at least twice in the next 1-3 weeks, or sooner if symptomatic, before the patient is diagnosed to have sustained hypertension.
- Stage 2 hypertension: Systolic or diastolic blood pressure values 5 mm or more above the 99<sup>th</sup> percentile. The presence of stage 2 hypertension should be confirmed on a repeat measurement, at the same visit. These patients require further evaluation within one week or immediately if they are symptomatic

#### **Etiology and risk factors:**

The reported incidence of hypertension in neonates varies from 0.2% up to 2.6%<sup>1</sup>. Hypertension is much more common in neonates with Broncho Pulmonary Dysplasia (BPD), Patent Ductus Arteriosus (PDA) or those with indwelling Umbilical Artery Catheterizations (UACs)<sup>5</sup>. Other risk factors for hypertension are antenatal steroids, maternal hypertension, and postnatal acute renal failure<sup>7</sup>. One study reported a 0.81% incidence of hypertension in neonates<sup>8</sup>.

In a retrospective review of over 650 neonates seen in follow-up after discharge from a NICU, incidence of hypertension (defined as a systolic blood pressure of greater than 113 mm of Hg on three consecutive visits over 6 weeks) of 2.6%<sup>9</sup>. Neonates of this study who developed hypertension tended to have greater risk of developing hypertension in sicker babies<sup>8</sup>.

Umbilical artery catheter-associated thromboembolism affecting either the aorta or the renal arteries was first demonstrated in the early 1970s<sup>10</sup>. Various studies confirmed that there was association between umbilical arterial catheter-associated thrombi and the development of neonatal hypertension<sup>11-15</sup>. The rate of thrombus formation was typically in the range of 25%, which was same in various studies<sup>11,16</sup>. Renal venous thrombosis classically presents with the triad of gross hematuria, thrombocytopenia, and palpable renal mass in the clinical setting of high-risk prothrombotic disorders, including infant of a diabetic mother or Factor V Leiden mutation<sup>17,18</sup>.

Hypertension may be quite severe in such cases and may persist beyond the neonatal period<sup>19</sup>. Renal artery stenosis may also be accompanied by mid-aortic coarctation and cerebral vascular stenosis<sup>20,21</sup>. Other blood vessel abnormalities may also lead to hypertension in the neonate, including idiopathic arterial calcification<sup>22</sup>.

Both autosomal dominant and autosomal recessive polycystic kidney disease (PKD) may present in the newborn period with severe nephromegaly and hypertension<sup>23</sup>. With recessive PKD, infants will be discovered to be hypertensive during the first year of life<sup>24</sup>. Ureteral obstruction by other intra-abdominal masses may also be accompanied by hypertension. The mechanism of hypertension in such instances is unclear, although activation of the renin-angiotensin system has been implicated<sup>25</sup>.

Neonatal hypertension and aortic coarctation is readily detectable in the newborn period<sup>2</sup>. Hypertension may persist or reappear in these patients even after early surgical repair of the aortic coarctation<sup>26</sup>.

Low birth weight infants have low nephron mass which makes them more vulnerable to the development of hypertension, cardiovascular, and renal disease later in life<sup>27,28</sup>. This further emphasizes the need for routine screening for hypertension as well as proteinuria in the low birth weight preterm infant after discharge from the NICU<sup>29</sup>.

Hemolytic uremic syndrome (HUS), which has been described in both term and preterm infants, is usually also accompanied by hypertension<sup>30</sup>. Renal obstruction may be accompanied by hypertension<sup>31</sup>. Tumors, including neuroblastoma, wilms tumor, and mesoblastic nephroma, may all present in the neonatal period and may produce hypertension, either because of compression of the renal vessels or ureters or because of the production of vasoactive substances, such as catecholamines<sup>32</sup>.

Neurologic problems, such as seizures, intracranial hypertension, and pain, constitute fairly common causes of episodic hypertension in older children and infants and should be considered in neonates as well<sup>33</sup>. Hypertension may be seen in more than 50% of infants requiring extracorporeal membrane oxygenation (ECMO) and may result in serious complications, including intracranial hemorrhage<sup>34</sup>.

The objective of the study is to find out the prevalence of hypertension among neonates. For this reason it is necessary to measure blood pressure in healthy neonates who are well and not admitted in NICU and sick neonates who are admitted in NICU as well as to correlate neonatal hypertension with gestational age, birth weight and associated maternal risk factors.

### Methods and Materials:

This prospective cross sectional study was done from July 2017 to June 2018 at Department of Neonatology, Dhaka Medical College Hospital (DMCH), Dhaka, which is the largest government Medical College Hospital in Bangladesh and Gynae and Obstetrics Department of Ad-Din Womens Medical College Hospital (AWMCH), Dhaka. Neonates who were admitted in Neonatal Intensive Care Unit (NICU) of DMCH during the study period was 1186 and all the healthy neonates of Gynae and Obstetrics department of AWMCH was 308. So, total population was 1494. In this study, 384 cases from Neonatology Department of DMCH and 216 cases from Gynae and Obstetrics Department of Ad-Din Womens Medical College Hospital, Dhaka was taken. So, total 600 neonates were included. Purposive sampling technique was applied as per inclusion and exclusion criteria.

### Measurement of Blood Pressure:

The gold standard for BP measurement is an appropriately calibrated intra-arterial catheter. Both umbilical and radial arterial blood pressure correlates with aortic blood pressures<sup>35</sup>. However, for babies who do not have or require invasive monitoring, the most frequently used technique is via an oscillometric manometer. Blood pressure should be taken preferably in right upper arm, when babies are quietly awake and not feeding (systolic BP is 5 mmHg lower in sleeping babies and is higher after a feed) with an appropriate sized cuff. The cuff bladder should measure 2/3rd of the length of the arm and 0.44 to 0.55 of the arm circumference<sup>33</sup>. After cuff placement, infant is left undisturbed for 15 minutes, 3 successive BP readings are obtained at 5 minutes intervals.

Estimated BP values in well infants >2 weeks of age from 26-44 weeks postconceptional age<sup>5</sup>.

### Results:

Among total 600 neonates, major portions (77.7%) were within 7 days of age & 67.2% were male (Table I).

**Table I:** Distribution of neonates according to age & sex (n = 600).

Age (in days)	Number of patients (%)
1 to 7 days	466 (77.7)
8 to 14 days	99 (16.5)
15 to 21 days	24 (4.0)
22 to 28 days	11 (1.8)
Total	600 (100)

Among the mother of all 600 neonates 6.5% of neonatal mother had hypertension, 3.7% had diabetes mellitus but only 0.5% had both hypertension and diabetes mellitus together (Table II)

**Table II:** Distribution of neonates according to history of maternal disease (n=600)

Disease	Number of patients (%)
Hypertension	39 (6.5)
Diabetes mellitus	22 (3.7)
Diabetes mellitus with hypertension	3 (0.5)
Others	84 (14)
Free from disease	452 (75.3)
Total	600 (100)

In this study only 2 neonates had hypertension, which was 0.33% (Table III).

**Table III:** Distribution of neonates according to blood pressure (n= 600).

Blood pressure	Number of patients (%)
Normotensive	598 (99.67)
Hypertensive	2 (0.33)
Total	600 (100)

Among 600 neonates 2 were found hypertensive. Blood Pressure of both hypertensive was at and above 95<sup>th</sup> percentile (Table IV).

**Table IV:** Distribution of blood pressure of hypertensive neonates at percentile (n=2).

Hypertensive neonates number	BP*(mm of Hg)	BP (mm of Hg) according to gestational age at 95 <sup>th</sup> percentile	
		Gestational age	At 95th percentile
Case I	SBP*-95	37 weeks	SBP-92
	DBP*-70		DBP-65
Case II	SBP-85	34 weeks	SBP-85
	DBP-55		DBP-55

\*BP-Blood Pressure, SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure

No significant correlation of blood pressure with age, sex, gestational age and birth weight of the neonates. Here this pearson correlation with SPSS analysis found no significance (p> 0.05) (Table V)

**Table V:** Correlation between blood pressures with other variables.

BP (mm of Hg)	Pearson Correlation	Age of neonate (days)	Sex of neonate	Gestational age (weeks)	BW* of neonate (kg)
		Significance (2- tailed)	0.05	- 0.05	-0.02
N		600	600	600	600

\* BW-Birth Weight,

There was significant value ( $P<0.05$ ) in paired samples test between birth weight and blood pressure of neonates (Table VI).

**Table VI:** Paired Sample t-test of birth weight in kg and blood pressure in mm of Hg.

Paired differences	Mean	SD*	SE* of Mean	95% CI* of the difference		t	df	Significance (2-tailed)
				Lower	Upper			
				BW*(kg)- BP* (mm of Hg)	1.63			

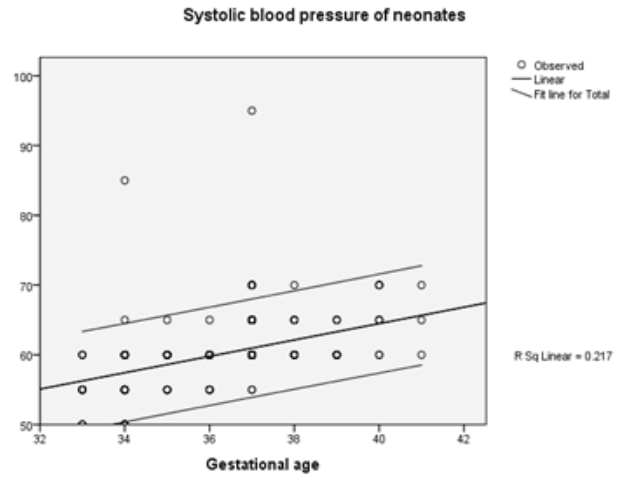
\*SD-Standard Deviation, SE-Standard Error, CI-Confidence Interval, BW-Birth Weight, BP-Blood Pressure.

There was significant value ( $P<0.05$ ) in paired samples test between gestational age and blood pressure of neonates ((Table VII).

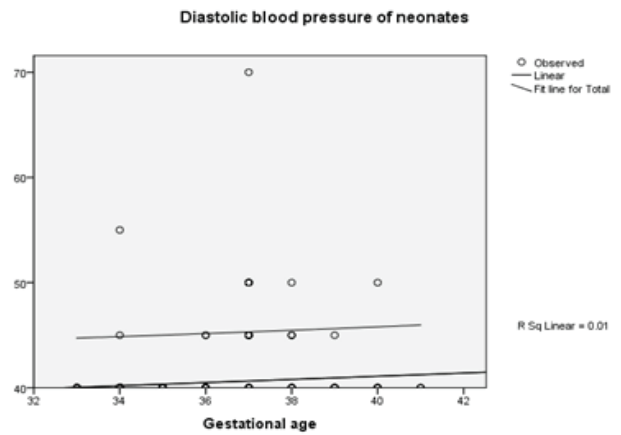
**Table VII:** Paired Sample t-test of gestational age in weeks of the neonates and blood pressure in mm of Hg.

Paired differences	Mean	SD	SE of Mean	95% CI of the difference		t	df	Significance (2-tailed)
				Lower	Upper			
				BW*(kg)- BP* (mm of Hg)	1.69			

\* SD-Standard Deviation, SE-Standard Error, CI-Confidence Interval, GA-Gestational Age, BP-Blood Pressure.



**Figure 1:** Shows linear regression of systolic blood pressure of neonates by gestational age, with 95% confidence limits (upper and lower lines).



**Figure II:** Shows linear regression of diastolic blood pressure by gestational age of neonates, with 95% confidence.

**Discussion:**

Hypertension is a rare condition in the neonate. In NICU neonates with hypertension are at a high risk of developing cardio-respiratory failure. So measurement of blood pressure for the management of neonates is required to save lives.

Two neonates (0.33%) had hypertension in this study. By definition, 5% of neonates will have hypertension, but the reported incidence in infants admitted to neonatal units ranges from 0.2-3.0%<sup>6</sup>. One study showed among 3179 neonates, who were admitted to their NICU, 0.81% (26/3179) incidence of hypertension in this population<sup>5</sup>. In a review of over 3000 infants admitted to a Chicago neonatal intensive care unit, the overall incidence of hypertension was found 0.81%<sup>36</sup>.

In this study, mother of one hypertensive neonate had hypertension. According to etiology of neonatal hypertension neonates having hypertensive mother is a risk factor for developing hypertension<sup>37</sup>. Another one hypertensive neonate had perinatal asphyxia, which was also a cause for developing neonatal hypertension<sup>38</sup>.

In a study in Australia over a period of 4 years in a single center, demonstrated that maternal hypertension was associated with development of neonatal hypertension<sup>8</sup>. Maternal hypertension has been identified as risk factors for a higher blood pressure (BP) in the preterm neonates<sup>39</sup>. Philadelphia study demonstrated a significant correlation between blood pressure and gestational age<sup>5</sup>. In this study that upper and lower 95% confidence limits for blood pressure for the neonates studied, their data clearly demonstrated increases in blood pressure with increasing gestational age.

#### Conclusion:

In this study 0.33% of neonates had high blood pressure. So, although neonatal hypertension is very rare but it should be kept in mind during neonatal examination. Previously there was no data regarding neonatal hypertension in Bangladesh. Early diagnosis of hypertension during neonatal period will help to control childhood hypertension and prevent future morbidity and mortality.

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