

Pattern of systolic and diastolic blood pressure in healthy newborns from 0-28 days by Dinamap

Author(s): Uzma Firdaus, Syed Manazir Ali, M. Ashraf Malik, A. J. Ahmed

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Uzma Firdaus, Syed Manazir Ali, M. Ashraf Malik, A. J. Ahmed

Department of Paediatrics, Jawahar Lal Nehru Medical College, Aligarh Muslim University, Aligarh, India

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Abstract

The pattern of blood pressure (BP) in healthy newborns by Oscillometric method was studied and compared with the conventional method. The percentile ranks of blood pressure in the newborn at different ages were established. For this a longitudinal study in the Neonatal Intensive Care Unit (NICU) of a tertiary care hospital was conducted. BP measurement of the newborn was carried out at birth, at discharge/ day 3 and at day 28 by the same investigator. The BP in the newborns increased from day 1 to day 3 at a rate of 2 mmHg/ day. The BP was found to increase till 1 month though at a slower rate. BP values obtained by Dinamap correlated well with those by mercury sphygmomanometer for all the three limbs. Percentile ranks of BP according to age were worked out.

Oscillometry can be a good alternative to the conventional method for BP measurement in the newborn, however large multicentric trials should be done to establish the reference percentiles of BP for the newborn.

Introduction

Blood pressure monitoring is an important part of neonatal care both for the acutely ill and convalescing neonate. Despite the importance of routine BP monitoring this vital sign is often omitted. This may be due to lack of proper facilities for the measurement of BP or lack of extensive data regarding BP norms as per the gestational age, sex and weight of the newborn.

The requirement for the technique of BP measurement include that the method should be simple, painless, reliable and with an acceptable risk to benefit ratio. In addition, it should give information continuously or at least at frequent intervals without disturbing the newborn [2]. The methods of BP measurement can be Direct/ Invasive and Indirect/ Non-invasive. In the newborn period, the most accurate method of BP determination is by direct intra arterial BP monitoring [3], however, because of the risks attending the procedure, it has been generally reserved for infants with clinical condition sufficiently serious to justify the known hazards of catheterization [4]. In other situations other indirect methods of BP measurement are employed. Automatic oscillometry is one of them, having several advantages over other non invasive methods. It can be used accurately for neonates in whom Korotkoff sounds are usually very weak. In addition it can be used in noisy surroundings and observer related bias is eliminated. It is useful for regular monitoring of sick newborns as it can be applied safely to all newborns

In view of the above mentioned facts, the present study was conducted to study the pattern of systolic and diastolic blood pressure in the newborns by oscillometry and to test the accuracy of blood pressure measurement by Dinamap (an oscillometric device) relative to the conventional method using Mercury sphygmomanometer.

Material and Methods

This longitudinal study was conducted in the Neonatal Unit of the Department of Pediatrics JNMCH between May, 2003 and April, 2004. A total of 550 newborns delivered at JNMCH and cared for in NICU were included in the study. The permission was taken from their parents to enter them in this study. The subjects were studied from Day 1 to Day 28. BP measurement was done on Day 1, Day 3 and Day 28 of life in three limbs by the conventional method and the Dinamap monitor (Model 9301).

Exclusion Criteria

- All sick newborns
- Newborns with congenital malformation
- Newborns weighing less than 1.5 kg

Only those newborns that were healthy and without any major congenital anomaly and with a normal cardiovascular status were included in this study.

After taking consent from the newborn's parents, relevant history was taken and physical examination was done. The measurement of blood pressure by the Dinamap monitor and by conventional method (Mercury Sphygmomanometer) was done as a part of each examination and the findings were recorded on a predesigned proforma. BP measurement was done on each occasion in the three limbs i.e. right upper limb (RUL), left upper limb (LUL) and right lower limb (RLL).

The arithmetic mean and standard deviation were calculated for BP values as per the age, sex, weight and length of the newborn. Comparative analysis for various variables was done by applying unpaired t test. Correlation between the two groups was tested by Karl Pearson's method.

Percentile ranks of SBP, DBP and MAP specific for the age (24 h, 72 h and 28 days) of the newborn were worked out. The rank[®] of the percentile was calculated by the formula

$$R = \frac{P(N+1)}{100}$$

where P stands for the desired percentile and N denotes the number of observations

Results

The sex ratio in the sample studied was almost 1:1 Most of the subjects were term newborns with a mean birth weight of 2.80 ± 0.51 kg and a mean body length of 49.23 ± 2.00 cm. Mean maternal age was 25.34 ± 4.13 years. The systolic blood pressure(SBP), diastolic blood pressure (DBP) and mean arterial pressure(MAP) obtained for right upper limb(RUL), left upper limb (LUL) and right lower limb(RLL) obtained on day 1, day 3 and day 28 was as shown in the following tables

Table 1: Showing mean of SBP in various limbs at 24 hr, 72 hr, and follow up by Dinamap and conventional method

	At 24 hours		At 72 hours		On follow up at 28 days (Follow up/FU)	
	Dinamap (mmHg)	Conventional (mmHg)	Dinamap (mmHg)	Conventional (mmHg)	Dinamap (mmHg)	Conventional (mmHg)
RUL	70.54 (5.70)	67.7 (7.07)	76.39 (4.90)	73.67 (5.15)	85.78 (5.84)	82.94 (8.00)
LUL	70.32 (5.80)	68.18 (6.00)	76.65 (5.48)	73.9 (5.44)	80.64 (13.80)	78.56 (13.38)

RLL	70.38 (5.58)	68.05 (5.95)	76.49 (5.04)	73.9 (5.15)	85.30 (5.62)	83.02 (6.26)
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Figure in parenthesis shows standard deviation.

Table 2: Showing mean of DBP in various limbs at 24 hr, 72 hr and follow up by Dinamap and conventional method

	At 24 hours		At 72 hours		On follow up at 28 days (Follow up/FU)	
	Dinamap (mmHg)	Conventional (mmHg)	Dinamap (mmHg)	Conventional (mmHg)	Dinamap (mmHg)	Conventional (mmHg)
RUL	38.9 (5.65)	37.02 (5.60)	43.11 (5.48)	40.76 (5.84)	49.00 (6.28)	47.27 (6.81)
LUL	41.12 (7.49)	39.00 (7.37)	46.67 (10.44)	44.49 (10.48)	53.82 (11.21)	51.63 (10.95)
RLL	44.18 (10.90)	37.14 (5.43)	42.48 (5.63)	40.97 (5.22)	48.76 (6.52)	47.03 (6.49)

Figure in parenthesis shows standard deviation right upper limb(RUL), left upper limb(LUL) and right lower limb (RLL) obtained on day 1, day 3 and day 28 was as shown in the following tables.

Table 3: Showing mean of Mean Arterial Pressure (MAP) in various limbs at 24 hr, 72 hr and follow up by Dinamap and conventional method.

	At 24 hours		At 72 hours		On follow up at 28 days (Follow up/FU)	
	Dinamap (mmHg)	Conventional (mmHg)	Dinamap (mmHg)	Conventional (mmHg)	Dinamap (mmHg)	Conventional (mmHg)
RUL	49.25 (5.22)	47.13 (6.14)	52.43 (5.83)	50.56 (6.13)	56.51(10.95)	56.68 (7.74)
LUL	49.24 (5.34)	46.86 (5.11)	52.82 (5.92)	50.73 (5.49)	57.87 (7.06)	56.06 (6.83)
RLL	50.22 (5.53)	46.92 (5.02)	51.96 (5.58)	50.61(5.25)	57.70 (6.96)	56.34 (6.95)

Figure in parenthesis shows standard deviation

The figure (1) given below shows the graphical representation of the results:

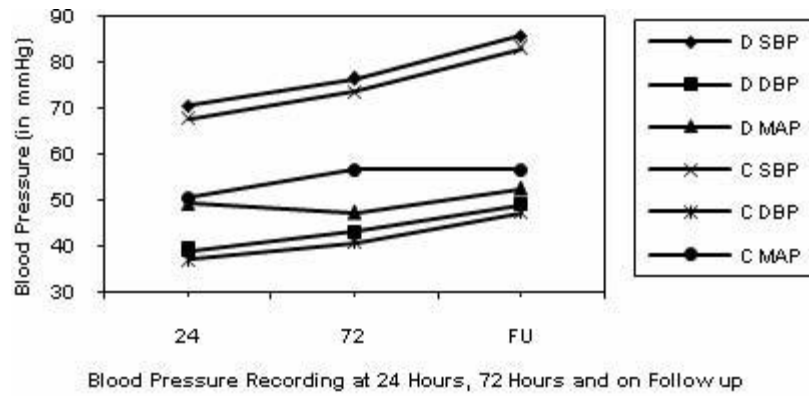


Figure 1 comparing Mean SBP, DBP and MAP values obtained by Dinamap and Conventional Methods

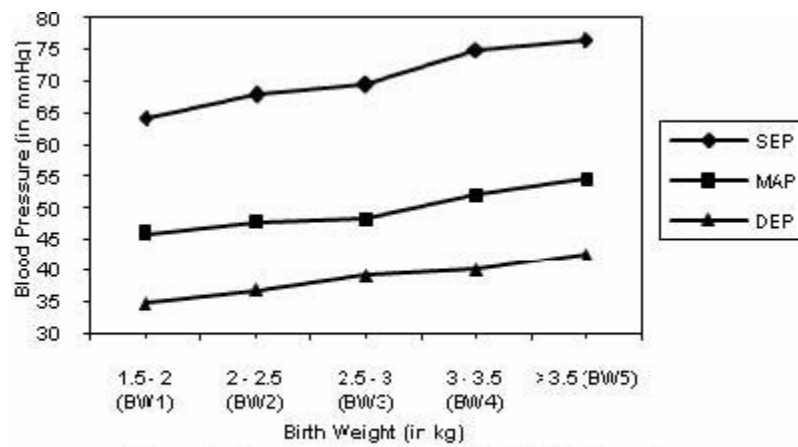


Figure 2 showing the effect of Birth Weight on the mean SBP, DBP and MAP of the newborn

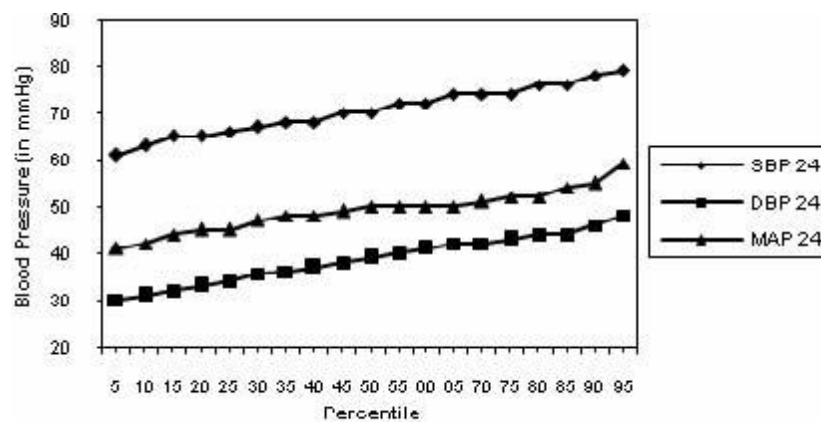


Figure 3 showing the Percentile of Mean SBP, DBP and MAP at 24 Hours

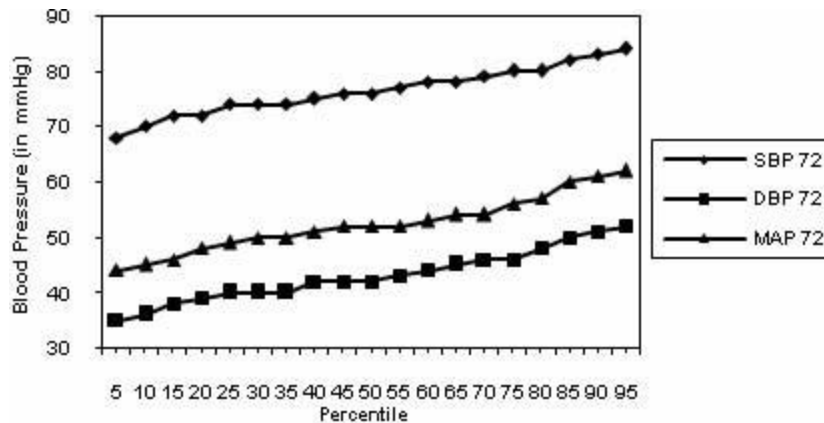


Figure 4 showing the Percentile of Mean SBP, DBP and MAP at 72 Hours

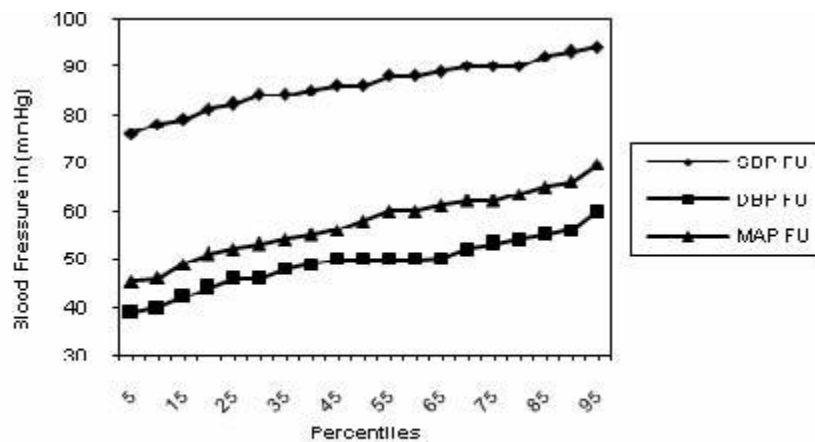


Figure 5 showing the Percentiles of Mean SBP, DBP and MAP at Follow up

Discussion

BP monitoring is an essential part of neonatal care. Although BP norms of the newborn are available in the western literature but there is paucity of data from the Indian subcontinent. So the present study is therefore a humble effort to fill this gap.

Our data results show BP values in RUL on Day 1 as $70.54 \pm 5.70 / 38.9 \pm 5.65$ (MAP 49.25 ± 5.22). Tan et al⁵ studied BP in full term healthy neonates and found similar results. Likewise, values in study by Kitterman et al [6] correlates well with our results. In contrast, Zinner et al [7] obtained the diastolic BP value as 52.7 ± 7.5 which was higher than ours. This difference may be due to the babies with different ethnic group or with higher birth weight included in their study. It is interesting to note, however, that SBP values on Day1-2 in their study was 69.7 ± 7.3 which is close to our respective result. Our data of BP values at 72 h also confirms the values of previous studies. We found BP at 72 h in RUL as $76.39 \pm 4.90 / 43.11 \pm 5.46$ (52.43 ± 5.8). The results of study by Zinner demonstrated respective values as 75.7 ± 8.1 for SBP and 55.9 ± 7.7 for DBP.

An increase of 2mm Hg / day was found for SBP in the initial three days. Similar rate was found by Zinner where BP was shown to increase from 69.7 to 75.7, the rate of increase being again 2mm Hg / day.

Our data also confirms earlier reports by Schachter [8] et al that BP does not vary with the sex, race, or socioeconomic status. The effect of abnormal forms of delivery or fetal anoxia on the baby could not be tested in our

study as we included only healthy newborn as part of our study. Also remarkable is the fact that BP obtained from RUL, LUL and RLL correlated well. Same results were also reported by Tan et al [5].

We also attempted to test the accuracy of dynamap by comparing its values with those of mercury sphygmomanometer and found strong correlation between paired BP values. Maximum correlation coefficient was found to be 0.94, 0.97 and 0.96 for SBP, DBP and MAP. Various previous studies comparing Oscillometric method with other methods of BP measurement had also found good correlation. Kafka and Oh [9] studied the measurement of BP by Oscillometric method in comparison to the direct method. They demonstrated a Correlation coefficient (r) of 0.93 and 0.82 for SBP and DBP respectively. Likewise, Frieson and Lichtor [10] did the comparison with Doppler technique and found the results of the two methods to be close to each other. r in their study was found to be 0.93 both for SBP and DBP. Other investigators like Lui et al [11], Baker et al [12] and Park et al [13] compared the oscillometric method with the direct method. They in their respective studies demonstrated oscillometric method to be highly accurate in recording the BP as is the direct method. In all the studies r for the two sets of values of BP was above 0.9. All these results show that Oscillometry can be a safe and accurate tool for BP recording in the newborn.

Finally, we arranged the data and worked out percentile ranks of SBP, DBP and MAP for different ages namely 24 h, 72 h and 28 day of life.

Conclusion

Although BP norms of the newborn are available in the western literature, there is paucity of data from the Indian subcontinent. This study has established that oscillometry can be a good alternative to the conventional method for BP measurement in the newborn. We, however, suggest that further large multicentric trials should be done to establish the reference percentiles of BP for the newborns.

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Correspondence:

S. Manazir Ali

Department of Paediatrics, J. N. Medical College, Aligarh Muslim University,
Aligarh 202 002, India

[e- mail: manazir1958\(at\)yahoo.com](mailto:manazir1958@yahoo.com)