

# Pain Response of Neonates to Venipuncture

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**Abstract. Objective:** To study the physiological and behavioral response to pain. **Methods:** 80 healthy neonates requiring bilirubin estimation, blood sugar etc. were randomly assigned to receive a venous puncture. All parameters were recorded 10 minutes prior, during and 10 minutes after the procedure. Evaluated NIPS score and RR., HR, NIBP and O<sub>2</sub> saturation observed on Datex-Ohmeda multimonitor. **Results:** After the venepuncture, heart rate ( $p < 0.001$ ) and blood pressure ( $p < 0.001$ ) were significantly increased in both the groups but more significant increase was present in Group I (>2.5kg) as compared to Group II (>2.5kg). Respiratory rate was also increased but more significant in Group II ( $p < 0.001$ ) whereas Oxygen saturation was decreased in both the groups but more significant in Group I ( $p < 0.001$ ). Median Neonatal Infant Pain Scale (NIPS) score was higher in both the Groups ( $p < 0.001$ ). **Conclusion:** The outcome measures appear to be reliable indices of term neonates responses to painful stimulation. NIPS are suitable instruments for neonatal pain evaluation.

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**Key words:** Newborn; Pain; Pain assessment

The subjectivity of pain causes enormous difficulties in evaluating neonatal pain with a single, practical and easy to apply tool.<sup>1</sup> The evaluation of pain in the human fetus and neonate is difficult because pain is generally defined as a subjective phenomenon.<sup>2</sup> Pain evaluation in the neonatal period should be performed by valid, safe, useful and feasible methods.<sup>1</sup> Previously, it was thought that neonates do not feel pain because of inadequate myelination of the sensory nerves, immaturity of pain receptors and cortex and reduced localization of pain.<sup>2</sup>

Newborn babies experience pain similarly and probably more intensely than older children and adults. They are also at risk of adverse long term effects on behaviour and development.<sup>3</sup> Pain in the neonatal period is frequently experienced by 6-10% of newly born infants, who require neonatal intensive care.<sup>4</sup>

Behavior is the main source of information in nonverbal infants.<sup>5</sup> Female neonates of all gestational ages expressed more facial features of pain than male infants, during the capillary puncture.<sup>6</sup> NIPS are suitable instruments for neonatal pain evaluation.<sup>1</sup> Physiological responses to painful or stressful stimuli include increase in circulating catecholamines, increased heart rate and blood pressure and elevated intracranial pressure. The stress response of the immature fetus or preterm infant is less competent than that of the more mature infant or child. Therefore, in immature infant the classical vital signs of stress (eg. Tachycardia, hypertension, agitation) are not reliable indicators of painful stimuli.<sup>7</sup> The focus of this prospective study was to evaluate the use of physiologic and behavioral parameters as valid

assessment tools for acute pain in healthy term newborn infants.

## MATERIALS AND METHODS

Eighty term infants less than 7 days of age who required blood sampling for bilirubin estimation, blood sugar and workup were assessed for their responses to venipuncture performed in a standard manner. Healthy neonates between 37 weeks to 42 weeks gestational age were eligible. Babies with significant morbidity like septicemia, birth asphyxia, major congenital malformations and neurological involvement were excluded. The selected cases were divided into 2 groups: Group I : < 2.5kg and Group II : >2.5kg. The resident doctor rated infant's pain using NIPS at baseline (before the procedure) and during the period when maximal response was observed. The NIPS includes five behavioral groupings (facial expression, crying, movement of arms and legs, and state of arousal) and one physiological indicator (breathing pattern). The total score ranges from 0 to 7.<sup>7</sup> Heart rate, respiratory rate, blood pressure and oxygen saturation were monitored continuously from 10 minutes before to 10 minutes after the procedure. Non-invasive blood pressure and oxygen saturation was measured by Datex-Ohmeda multimonitor. The maximal change in the above parameters were noted. The data was statistically analyzed by using EPI-6.

## RESULT

In the study group, there were total 80 neonates out of which 47 were males and 33 were females. The mean postnatal age in group I was  $3.7 \pm 1.4$  days and group II

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3.6 ± 1.61 days respectively. The time of last feed was 36 minutes in group I and 34.5 minutes in group II. The mean birth weight was 2.240 kg in group I and 2.852 kg group II.

The mean heart rate (Table 1) increased during the procedure in both the groups and showed a significant differences (p < 0.001) when compared to that recorded prior to venepuncture. The non-invasive systolic blood pressure (Table 4) also increased during the procedure in both the groups and showed a significant differences (p < 0.001) when compared to that recorded prior to venepuncture. There was significant increase in the respiratory rate (Table 2) during the procedure in both the groups as compared to the baseline (p < 0.001). A significant decrease in oxygen saturation during the procedure (p < 0.001) found in both group as compared to the baseline (Table 3).

The mean Neonatal Infant Pain Scale (NIPS) (Table 5) score during venipuncture was higher in both the groups as compared to baseline values (p < 0.001) but more significantly increased in group II as compared to group I.

**DISCUSSION**

Every year, millions of neonates require diagnostic blood sampling. Neonates undergoing these procedures cry and

TABLE 1. Changes in Heart Rate in Response to Venepuncture.

Group	No.	Heart Rate		“p”
		Before	During	
I	40	134±4.4	151±10.4	P<0.001*
II	40	132±14	146±13	P<0.001*

Values depict means ± SD; If P < 0.001\* = very significant.

TABLE 2. Changes in Respiratory Rate in Response to Venepuncture.

Group	No.	Respiratory Rate		“p”
		Before	During	
I	40	50.9±6	53.8±7.62	P<0.06
II	40	50.5±6.43	56±7.5	P<0.001*

TABLE 3. Changes in SPO<sub>2</sub> in Response to Venepuncture.

Group	No.	SPO <sub>2</sub>		“p”
		Before	During	
I	40	94.4±2.94	89.4±3.08	P<0.001*
II	40	93.73±3.17	89.4±3.23	P<0.001*

TABLE 4. Changes in Blood Pressure in Response to Venepuncture.

Group	No.	Blood pressure		“p”
		Before	During	
I	40	69.29 ± 8.71 / 36.83 ± 7.20	77.42 ± 12.98 / 39.67 ± 8.66	P<0.001* / P<0.081
II	40	72 ± 7.1 / 36 ± 7.6	78.02 ± 8.35 / 37.55 ± 10.20	P<0.001* / P<0.451

TABLE 5. NIPS Score in Response to Venepuncture.

Group	No.	NIPS Score (0-7)		“p”
		Before	During	
I	40	1.84±0.73	5.74±0.91	p<0.001
II	40	1.56±0.70	6.41±0.50	p<0.001

exhibit facial expression and body movements which are indicative of pain. Until recently, it was believed that infants and young children could not appreciate pain due to the immaturity of the central nervous system. However, now it is a well established fact that the anatomical, physiological and neurochemical structures which convey pain are well developed in neonates.<sup>8</sup>

Physiological changes in response to painful stimuli had been uniformly reported by previous studies.<sup>8</sup> The present study clearly indicates that all neonates responded to painful stimuli in one or the other way. A significant increases in heart rate was reported by Owen ME in the context of a tissue damaging stimulus.<sup>10</sup> The magnitude of changes in the heart rate was related to the intensity and duration of the stimulus and to the individual temperaments of the babies.<sup>2</sup> The study done by KJS Anand found that heart rate increased after circumcision or heel lancing in term neonates.<sup>2</sup>

McIntosh N *et al*<sup>6</sup>, Van Cleve L *et al*<sup>10</sup>, Harmesh Singh *et al*<sup>11</sup> and Gessler P *et al*<sup>12</sup> also reported that heart rate was significantly increased after venepuncture. These changes are comparable to that observed in the present study. Heart rate was significantly increased in both groups but more in group I (p < 0.001).

Brown L<sup>13</sup> and Gessler P *et al*<sup>12</sup> showed that blood pressure increased after painful stimulation which was also recorded in these studies (p < 0.001).

The statistically significant (p < 0.001) rise in respiratory rate was recorded in the present study during the procedure which was also reported by Brown L,<sup>13</sup> McIntosh N *et al*<sup>6</sup>, Harmesh Singh *et al*<sup>11</sup> and Gessler P *et al*<sup>12</sup>

A significant decrease in oxygen saturation in response to painful stimuli was reported by KJS Anand<sup>2</sup>, Van Cleve L *et al*<sup>10</sup>, Harmesh Singh *et al*<sup>11</sup> and Gessler P *et al*<sup>12</sup>. Similar finding were recorded in the present study (p < 0.001). Potentially injurious hypoxia occur even during essential routine care procedure.<sup>11</sup>

Johnston CC *et al* showed that full-term newborn is better equipped to interact with his caretakers and expresses his distress through specific facial actions.<sup>14</sup> Crying is the primary method of communication in newborn infants and is also elicited by stimuli other than

pain. The pain cry has specific behavioral characteristics and spectrographic properties in healthy full-term neonates.<sup>2</sup> Rushforth JA *et al* found that thirty 5 (97%) term infants showed an increase in the number of behaviours in response to heel lance. Brow bulge and nasolabial furrow were seen most often, and occurred more often than crying.<sup>15</sup> Van Cleve L *et al* found that infants moved abruptly into a hyperalert or crying state in response to venipuncture, skipping several states without transition and showing disorganized behavior.<sup>10</sup> The motor responses of healthy full-term neonates to a pinprick in the leg were reported to be flexion and adduction of the upper and lower limbs associated with grimacing, crying, or both, and these responses were subsequently quantified.<sup>2</sup> The mean Neonatal Infant Pain Scale(NIPS) score was significantly higher in both the groups.

### CONCLUSION

This study helps to validate the Neonatal Infant Pain Scale(NIPS) as suitable instruments for neonatal pain evaluation. Moreover Heart rate, Blood pressure, Respiratory rate and O<sub>2</sub> saturation were good indicators for evaluating the neonatal pain. As behavioral pain score response during venipuncture and changes in physiologic parameters were uniformly present in both groups, it can be concluded that the weight of the term baby does not influence the pain response in newborn babies.

### Key messages

- The full-term newborn is better equipped to interact with his caretakers and express his distress through specific facial actions; a combination of physiological and behavioural changes provides a better estimate of infant pain.
- The message of distress sent by the neonates through the cry sensitizes the adult, either the child's mother or another adult, who is taking care of it.

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