

Factors affecting the severity of procedural pain in new-borns.

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Abstract

In recent years, the objectification and control of neonatal pain has caused many discussions. Given its early and late effects, researchers' efforts are aimed at minimizing the impact of maternal and child-related factors, with a possible effect on pain sensitivity in new-borns. Our aim is to study the influence of maternal factors (daily intake of one or more cups of coffee and bacterial vaginosis during pregnancy, birth mechanism, blood group and Rhesus factor) and child-related factors (gestational age, gender, blood group and Rhesus factor) on the severity of procedural pain, caused by puncture of the heel. The present study includes 67 infants carried to term and aged 72-84 h, born by varying birth mechanisms and with an optimal Apgar score. By video surveillance before, during and after the procedure, the pain was assessed using the Neonatal Infant Pain Scale (NIPS). The results were measured 30 s and 5 min after the heel puncture. The following statistical methods were used: Kruskal-Wallis test, X² assay (Chi-squared test), Student's t-test and Mann-Whitney's u-test, with a factor of significance of $p < 0.05$. At the 30-s mark, there was no statistically significant difference in the severity of pain among the new-borns in the groups: pregnant women, which have consumed coffee and had bacterial vaginosis during the pregnancy. The mechanism of birth, gender and Rhesus factor of the new-born and mother did not change the severity of pain. New-borns with a larger gestational age and those from mothers with the blood group AB showed a significantly increased response to procedural pain. At the 5-min mark, none of the studied factors associated with the mother and new-born had a significant effect on the degree of pain. The influence of maternal and child related factors on the severity of procedural pain in new-borns is limited.

Keywords: New-born, Procedural pain, Pain sensitivity factors.

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Introduction

The objectification and control of neonatal pain has been the subject of numerous studies. Its control is a moral and ethical act, and its treatment decreases the physiological, behavioural and hormonal deviations it causes [1]. Considering the early and late effects of neonatal pain, studies are directed to factors, which possibly affect pain sensitivity in new-borns. The effects of factors associated with the mother-alcohol, hypertension and smoking, have been proven to modify the pain and increase its duration. The data on the influence of gender and the mechanism of birth on its severity gives varying results. The relationship between blood groups and the perception of pain has also been investigated.

Purpose

The purpose of the present study is to track the impact of maternal and child-related factors on the severity of procedural

pain, caused by heel puncture of the new-born during neonatal screening.

Material and Methods

A prospective study was conducted of 67 carried to term new-borns with an average age after birth of 72-84 h, birth weight of 3243.28 ± 393.18 g and gestational age of 38.9 ± 1.21 gestational weeks, born with varying birth mechanisms and an optimal Apgar score.

The new-borns were divided into groups depending on the presence of maternal and child-related factors. Using video surveillance before, during and after the procedure on the 30-s and 5-min marks, the pain response was measured. The severity of pain was assessed using the Neonatal Infant Pain Scale (NIPS).

The results were processed using the statistical methods of Kruskal-Wallis Test; X² assay (Chi-squared test); Student's t-

test and Man-Whitney's u-test, with a significance value of $p < 0.05$ and were presented in tables.

Results

Factors related to the mother

New-borns from mothers with a daily consumption of one or more cups of coffee during pregnancy at both measurements have higher levels of pain than those from mothers, which did not consume coffee. Differences between the two groups do not have statistical significance (Table 1). A comparison of new-borns from mothers with and without bacterial vaginosis during pregnancy had similar results.

Table 1. Mean levels of procedural pain depending on coffee intake during pregnancy and presence of bacterial vaginosis.

| Coffee consumption during pregnancy | Quantity | Mean | Standard deviation | U | P |
|-------------------------------------|----------|------|--------------------|-------|-------|
| NIPS-30-s mark | Yes 23 | 7 | 0 | 1.642 | 0.111 |
| | No 44 | 6.89 | 0.333 | | |
| NIPS-5-min mark | Yes 23 | 5.13 | 1.792 | 1.363 | 0.183 |
| | No 44 | 4.22 | 1.394 | | |

| Bacterial vaginosis | Quantity | Mean | Standard deviation | U | P |
|---------------------|----------|------|--------------------|-------|-------|
| NIPS-30-s mark | Yes 11 | 6.91 | 0.302 | 0.716 | 0.477 |
| | No 56 | 6.7 | 0.971 | | |
| NIPS-5-min mark | Yes 11 | 5.45 | 1.508 | 1.906 | 0.061 |
| | No 57 | 4.12 | 2.208 | | |

Vaginal infections in pregnant woman were associated with higher levels of procedural pain in the new-borns, both at the 30-s and 5-min marks, with no significant differences in the obtained scores (Table 1).

According to the birth mechanism, at the 30s mark, the highest levels of pain was registered in new-borns born by the normal mechanism (6.79 ± 0.65), followed by those born by Caesarean section (6.7 ± 1.04) and vacuum extractor (6.67 ± 0.57). At the 5-min mark, the lowest mean pain was registered in the surgically born (4.28 ± 1.94). The second lowest registered pain was in new-borns born by the mechanism of normal labor (4.33 ± 2.58). Application of a vacuum extractor caused the highest level of procedural pain (6.0 ± 1.73). In both measurements, no significant differences were observed (30-s mark $p=0.920$ and 5-min mark $p=0.423$).

The follow-up of new-borns, according to the blood group and Rhesus factor of their mothers, found the lowest intensity of pain in both periods of study in new-borns of mothers with blood group O. Conversely, the highest levels of pain were recorded in new-borns of mothers with blood group AB, again

both at the 30-s and 5-min evaluations. Statistical differences were found at the 30-s response to pain, whereas comparisons between the groups at the 5-min mark did not show any credible differences (Table 2). At both measurements (at the 30-s and 5-min marks), a lower level of pain was registered in new-borns whose mothers had a negative Rhesus factor, without statistical significance.

Table 2. Mean levels of pain intensity depending on the mother's blood group.

| Blood group | Quantity | Mean | Standard deviation | P |
|-------------|----------|------|--------------------|-------|
| NIPS-30 s | O 22 | 6.23 | 1.445 | 0.013 |
| | A 32 | 6.97 | 0.177 | |
| | AB 7 | 7 | 0 | |
| | B 6 | 7 | 0 | |
| | Total 67 | 6.73 | 0.898 | |
| NIPS-5 min | O 22 | 3.59 | 2.153 | 0.172 |
| | A 32 | 4.66 | 1.994 | |
| | AB 7 | 5.43 | 2.149 | |
| | B 6 | 4.5 | 2.95 | |
| | Total 67 | 4.37 | 2.187 | |

Factors related to the new-born

The study of new-borns with different gestational ages found higher levels of procedural pain in those born during the 41st gestational week (30-s mark 7.0 ± 0 ; 5-min mark 4.20 ± 2.86), when compared to those born during the 37th gestational week (30-s mark 6.83 ± 0.38 ; 5-min mark 4.0 ± 2), with a statistical difference for the 30 s mark ($p=0.09$), i.e. significance of 90% result confidence. This dependence was not proven for the 5-min mark.

According to the results of the study, the gender of the new-born did not affect the severity of procedural pain, although it was higher in males (30-s mark 6.76 ± 0.75 , 5-min mark 5.11 ± 2.15 , $p=0.743$), in comparison to females (30-s mark 6.69 ± 1.07 , 5-min mark 4.72 ± 2.21 , $p=0.254$). The dependencies found between the intensity of pain and the mother's blood group could not be confirmed in the search for similar correlations between the new-born's blood group and the level of registered pain, as the number of new-borns with blood type AB and B was insufficient. At both measurements (at the 30-s and 5-min marks), a lower but not statistically significant level of procedural pain was found in new-borns with a negative Rhesus factor.

Discussion

The discussion of neonatal pain and its effects on new-borns first began 30 y ago [2]. A multidisciplinary approach has contributed to significant progress in the study and exploration of its main mechanisms, as well as its impact on the brain and

its subsequent development [2-4]. This has helped develop tools for the clinical assessment and management of neonatal pain [5]. Despite this progress, its identification in the neonatal period remains a major challenge [2]. In this respect, the role of some additional factors, which influence stress and pain sensitivity in new-borns, has been studied.

In recent years, the emphasis on neonatal pain research has focused on the health status and harmful habits of the mother. Smoking during pregnancy has been shown to increase the perception of pain, while alcohol consumption has been shown to reduce the reactivity of affected new-borns [6,7]. In the available literature, we did not find evidence of an association between maternal coffee intake and new-born pain perception according to which to discuss our results. The basis for our study is frequent intake of coffee and its possible effects on the foetus and new-born. Adults are exposed to caffeine mainly by coffee consumption. The half-life of caffeine is 2.5 to 4.5 h longer during pregnancy, especially in the last trimester. Caffeine passes freely through the placenta and the foetus does not metabolize it well. It can lead to uterine placental vasoconstriction and foetal hypoxia; also, it can affect cell growth by increasing cell cyclic adenosine monophosphate. Currently, there is inconclusive data from studies showing that pregnant women with a high caffeine intake (>300 mg per d) give birth to new-borns weighing 100-200 g less than those of women with a low caffeine intake [8]. Bech et al. established a relationship between coffee intake and spontaneous abortions [9]. Our study showed increased levels of pain in new-borns whose mothers consumed coffee during pregnancy. The lack of credible differences does not confirm the role of this factor on the intensity of pain in new-borns, although this may be influenced by insufficient caffeine intake through the coffee consumed by the mothers in the current study.

There is no evidence in literature for the role of bacterial vaginosis on the severity of pain in healthy new-borns. The present study found no significant differences between the pain immediately after the procedure and 5 min later. This is reason to assume that bacterial vaginosis does not significantly affect the intensity of procedural pain.

Birth is a physiological stressor for the new-born. It is believed that the mechanism of birth influences pain perception. Previous research has found that new-borns born by assisted vaginal birth have the highest severity of pain, compared to those born by the normal mechanism or Caesarean section [10,11]. The comparison of the severity of pain in children born by normal birth and Caesarean section in this study supports the results of our study, i.e. new-borns carried to term and vaginally delivered showed a higher response to stress and pain expression, than infants born through elective Caesarean section.

It is well known that the different blood groups of the human population may be associated with the manifestation of certain diseases. Arterial and venous thromboembolisms are more common in individuals with blood groups A, B and AB, in comparison to individuals with the blood group O. Carriers of the latter are less likely to suffer from severe malaria, but more

often have peptic ulcers of the stomach [12]. Our findings in this regard have shown a connection between the maternal blood group and a short-term reduction of procedural pain in new-borns of mothers with the blood group O.

The relationship between gender, gestational age, clinical status and severity of procedural pain has also been investigated [13]. According to Unruh and literature data, there are gender differences in the perception of pain in the adult population [14]. It has been found that women are more likely than men to experience a variety of recurring pains. The data from our study showed higher pain sensitivity in males immediately following the procedure. Although in other studies, it has also been found that male new-borns have a higher physiological reactivity to painful stimuli, the evidence is not sufficient to confirm the influence of gender on the bio effective response to pain in new-borns [15]. The results of studies on pain, depending on the gestational age of the new-born at birth, are mixed. The new-born expresses pain, perception, and the ability of self-regulation based on the degree of maturity of the nervous system and the clinical condition [13]. An increased gestational age implies better perception and response to pain. This corresponds to the results of the present study, according to which new-borns with a greater gestational age, although for a short period after the procedure, have a more pronounced response to the pain stimulus.

There is increasing evidence of the role of genetic factors in significant differences in pain response. For example, studies on twins have shown that genetic factors partake in the etiology of pain [12]. According to the study of Shankar et al., the physiological perimeter of pain perception does not differ in individuals according to their blood group [12]. The authors associate this finding with the small number of patients in their study. The insufficient number of new-borns in the present study also most likely determines the lack of reliable differences in the response to pain in new-borns with different blood groups.

It is necessary to note that the results obtained in our study are likely to be influenced by the severity of the procedure itself, the capabilities of the NIPS and the time of screening (72-84 h), when the connection and influence of the mother's body on the new-born is less than in the first hours after birth.

Conclusion

The basis for this study is the idea of expanding the spectrum of maternal and new-born-related factors that increase stress and pain in the new-born. Coffee consumption during pregnancy, birth mechanism, bacterial vaginosis, maternal Rhesus factor and gender of the new-born do not influence the severity of procedural pain in new-borns. The blood group of the pregnant woman briefly influences the new-born's pain sensitivity. A higher gestational age leads to increased pain sensitivity, respectively a response immediately after the painful procedure. We did not find detailed factual material on this issue in our available literature. This made it difficult to

compare our results, but also motivated us to continue our scientific search in the same direction. Knowledge of the factors, which modify pain sensitivity in the new-born, helps to improve the prevention and management of pain and its negative consequences.

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