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Original article

ANALGESIC EFFECT OF 25% GLUCOSE AND NON-NUTRITIVE SUCKING IN TERM NEWBORNS - COMPATIVE ANALYSIS

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ABSTRACT:

Non-nutritive sucking and oral uptake of glucose 25% are often non-pharmacological methods used to manage procedural pain in newborns.

Aim: To compare the effect of using non-nutritive suction (NNS) and Sol.Glucosae 25% for reducing/eliminating neonatal pain due to heel prick.

Material and methods: Term infants were studied: group (A), NNS, n = 40, and group (B) oral uptake of Sol.Glucosae 25%, n = 40. The severity of procedural pain was assessed using the Neonatal Facial Coding System (NFCS) scale: 30 seconds before the procedure, at the 30th second and at the 5th minute after the procedure. Physiological pain markers were monitored at these intervals: respiratory, heart rate, transcutaneous saturation ($tSpO_2$), arterial blood pressure.

Results and Discussion: Newborns in a group (B) had a lower evaluation at the 5th minute compared to those treated with non-nutritive suckling (A). There are significant differences in heart rate, breathing frequency and $tSpO_2$ before the procedure. The intake of Sol. Glucose 25% compared to NNS causes a higher heart rate and a decrease in $tSpO_2$ at the 30th second after the painful procedure. In contrast to the heart rate, for respiratory rate and $tSpO_2$ at 5th min. we reported lower than the norms in both groups A and B.

Conclusion: Unlike NNS, glucose intake eliminates pain within 5 minutes after a heel prick. Excluding arterial blood pressure, all other physiological pain markers undergo changes before the procedure but not after it.

Keywords: neonatal pain, non-nutritive suckling, sweet solution, physiological markers of pain,

INTRODUCTION:

The use of non-pharmacological methods for the treatment of procedural pain in newborns is important for clinical practice. With proven analgesic effect, NNS and sweet solutions are often used in clinical practice. Various studies have shown the analgesic effect of oral sweet solution and NNS for painful procedures in newborns, but few have compared the effect between 25% glucose solution and non-nutritive sucking [1].

AIM:

To compare the effect of using non-nutritive suction (NNS) and Sol. Glucosae 25% for reducing/eliminating neonatal pain due to heel prick.

MATERIAL AND METHODS:

The study is prospective. 80 healthy full-term infants, with average age of72-84 hours and weight of 3288,475g ± 359, were studied: group (A), NNS, n = 40, and group (B) oral uptake of Sol.Glucosae 25%, n = 40. According to the mechanism of normal birth were born 39 (48.72%) babies, 41 (51.25%) - by cesarean section. Both methods were applied for 2 min before the heel stick. The child's response to pain is recorded by video surveillance before, during and after the procedure. Its severity was assessed using the single-modal scale for neonatal pain assessment - Neonatal Facial Coding System (NFCS) / at values above 3 /: 30 seconds before the procedure, at the 30th second and at the 5th minute after the procedure. The physiological markers for pain were reported at the indicated intervals: respiration, heart rate, transcutaneous saturation, and arterial blood pressure using a Biocare iM /2014 monitor.

STATISTICAL METHODS:

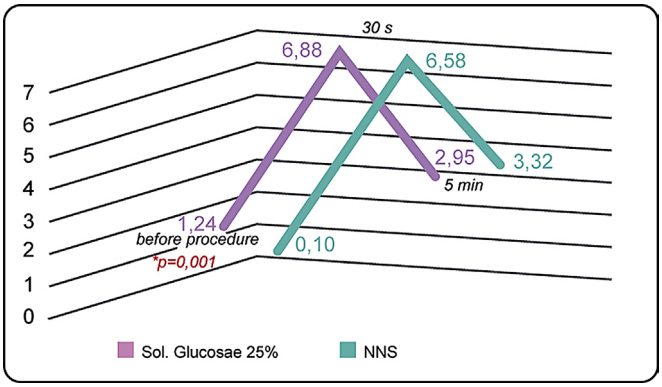
The primary information was processed using the statistical software IBM SPSS Statistics 21.0 and the graphs - with Microsoft Office 2007. Statistical analysis used: descrip-

tive statistics at quantitatively measurable values (arithmetic mean and standard error). The level of significance of the null hypothesis was assumed to be p <0.05.

RESULTS AND DISCUSSION:

The use of NFCS to compare the severity of procedural pain in both groups found that newborns in a group (B) had a higher evaluation score before the procedure and at the 30th second but lower at the5th minute compared to those treated with non-nutritive suckling (A). A significant difference was reported only at the interval before the procedure (p = 0.001). (Fig.1)

Fig. 1. Comparison of the analgesic effect of oral administration of Sol. Glucose is 25% and non-nutritive sucking using the NFCS score



Published evidence shows that two minutes after sucrose administration, the sensation of pain reaches its lowest level, and the analgesic effect continues for 3-5 minutes and disappears after about five to eight minutes [2, 3]. A review by Pillai Riddell [4] concluded that suckling effectively reduces the pain response in newborns and leads to its immediate regulation. It is hypothesized that the analgesic mechanism of NNS is due to the fact that it can activate tactile receptors and reduce pain through the mechanism of controlling the input of pain inhibition, i.e. non-nutritive sucking leads to activation of neopoid systems, while sucrose stimulates taste receptors and reduces the sensation of pain by releasing endogenous opioids in the central nervous system [2]. Unlike sweet solutions, NNS has a shorter effect. [2, 5] A review of recent clinical analyses and reviews indicates the need for additional studies to compare the effect of Sol.Glucosae 25% and non-nutritive sucking due to heterogeneity of previous studies, discrepancies in methodology and the insufficient number of studies as a basis for comparison. These reasons gave grounds to compare the two methods in our study. According to the NFCS, infants anesthetized with glucose solution had a higher score before the procedure than those who received non-nutritive suckling (p = 0.001). We associate this result with the calming effect of the pacifier, and the significant difference is probably due to the specifics of the method of non-nutritive sucking, which does not allow the consideration of most features of the NFCS scale in the pacifier group. On the 5th min. those who received glucose solution registered a lower score, but without a statistically significant difference, i.e. there is a tendency for a more pronounced analgesic effect of 5th min. compared to the group with non-nutritive sucking, in which a score corresponding to pain persists, regardless of its reduction compared to 30th second. Unlike 5th, at 30th sec. there is no lower severity of pain in glucose patients, i.e. there is no difference between the two methods immediately after the procedure. A study by Liaw JJ et al. [6] with NFCS reported a lower score on glucose solution intake and non-nutritive sucking compared to the control group but a significantly lower score on NFCS after sweet solution analgesia compared to NNS, which is consistent with our trend. We connect the obtained data with the difference in the mechanism of pain modulation and the duration of action of the two non-pharmacological approaches. In a meta-analysis, Hui Liang et al. [7] similar to our results did not show a statistical difference, despite lower NIPS, PIPP, and DAN scores when orally administered glucose compared to NNS for neonatal pain reduction. The tracking of the physiological parameters when comparing the two groups registered: before the procedure, a higher heart rate was registered in the group anesthetized with glucose solution compared to non-nutritive sucking and a significant difference was observed (p = 0.001). (Table 1)

Table. 1 Comparison of physiological indicators

Physiological markers	**Groups**	**Before the procedure** (mean±SE)	**p**	**At 30th sec.** (mean±SE)	**p**	**At 5th min.** (mean±SE)	**p**
Heart rate	Sol. Glucosae25%	139,50±3,67	0,001	170,70±4,01	0,269	137,18±4,89	0,647
	NNS	122,22±2,76		165,28±2,79		140,20±4,40	
Oxygent saturation	Sol. Glucosae25%	94,58±0,81	0,049	86,08±1,75	0,863	93,08±1,09	0,277
	NNS	96,68±0,67		86,49±1,58		91,18±1,35	
Breath rate	Sol. Glucosae25%	30,15±2,51	0,007	31,54±2,17	0,997	35,02±3,58	0,662
	NNS	40,72±2,85		31,55±2,24		33,08±2,63	
Diastolic blood pressure	Sol. Glucosae25%	52,27±2,65	0,795	-	-	57,62±2,82	0,828
	NNS	51,21±3,12		-		56,56±3,94	
Systolic blood pressure	Sol. Glucosae25%	90,03±3,17	0,273	-	-	101,10±2,63	0,342
	NNS	94,91±3,07		-		105,38±3,50	

At the 30th sec. this trend continues but has no statistical significance. Unlike the pacifier group, which registers a higher heart rate at the 5th minute, neonates with a sweet solution have a frequency close to that before the procedure. The higher heart rate values we reported before and after the procedure were associated with the hypothesis that endorphins released after glucose solution affect this marker. [1] In a randomized, double-blind, placebo-controlled study of Gradin M. [8] demonstrates a significant increase in heart rate after taking 1ml of 30% glucose compared to taking 1ml of water in healthy newborns up to 3min. after the application of the sweet solution, without the application of any procedure. Possible explanations for this are activation of the sympathetic nervous system due to the pleasure of sweet taste, as well as stimulation of brain centers of pleasure with the release of serotonin and dopamine, as well as endogenous opioids. In contrast to our data, the study by Gao H, et al. [9] recorded higher heart rate values in the non-nutritious sucking group during the procedure and in the recovery phase, despite the absence of a significant difference. Our results are consistent with those of Lima et al. [1], who also found higher heart rate values after the reception of glucose solution. Prior to the procedure, the glucose solution group had a lower respiratory rate than the non-nutritive suction group. A significant difference was reported for this follow-up period ($p = 0.007$). At the 30th second in both groups, we have almost the same values of the physiological marker. At the 5th minute, its value in a group with NNS remains lower than in those who received a sweet solution. In a study by Liaw JJ, et al. [6] reported a decrease in the respiratory rate in analgesia with non-nutritive sucking and glucose solution and its significant stabilization during follow-up periods. Prior to the procedure, we recorded lower oxygen saturation in neonates anesthetized with a sweet solution and a significant difference ($p = 0.049$). We associate this result with the effect of glucose solution, despite the fact that both groups have normal values of the marker. At the 30th second and 5th min, transcutaneous saturation ($tSpO_2$) in both methods has similar values without significant differences in these intervals. In all follow-up periods, higher systolic blood pressure values were reported in neonates with non-nutritive sucking, while in diastolic blood pressure, the values in both groups before screening and at 5th minutes were very close. We were unable to compare the data we received because our available literature lacks reporting and comparison of blood pressure with these two non-pharmacological approaches.

The use of these non-pharmacological methods contributes to the proper management of pain. They are an easily accessible and inexpensive tool for humanizing neonatal care. Based on our results and the established effect of combining these two non-pharmacological approaches in other studies [9, 10, 11, 12], we suggest that the two methods can be combined to achieve a better analgesic effect compared to their use alone.

CONCLUSION:

1. Taking Sol. Glucosae 25% leads to the elimination of procedural pain in its follow-up to the fifth minute, while non-nutritive sucking reduces its severity.

2. Excluding blood pressure, all other physiological markers for pain-(heart rate, tSpO2, breathing frequency) undergo changes before the procedure. These changes are not observed during their dynamic monitoring until the fifth minute after the pain stimulus.

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