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RESEARCH ARTICLE

THE EFFECTIVENESS OF MUSIC AND MOTHER'S VOICE ON PAIN REDUCTION DURING VENEPUNCTURE IN NEONATES- A RANDOMIZED CONTROL TRIAL

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Manuscript Info

Abstract

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Introduction:-

Until few decades ago, pain was considered as an inappropriate term for neonates and so pain assessment and management was not part of routine care in NICU. In NICU, neonates are exposed to environment stress. During their stay in the NICU, on an average 14 painful procedures are experienced by neonates during the first 2 weeks of life¹. Studies have shown that repeated painful stimuli can lower pain threshold in neonates². Repeated painful stimuli alters neurodevelopment and programming of the stress system thereby increasing the pain perception in neonates who are born as preterm³. Repeated painful stimuli causes abnormalities in brain maturation which persists through childhood and adolescence leading to adverse neuro developmental outcomes⁴. Hence minimizing pain helps in prevention of occurrence of long term neurological outcome.

Musical intervention acts as a source of distraction and positively affects the distress levels and pain perception in neonates⁵. Studies on the positive effect of mother's voice (infant directed speech/singing) on pain reduction and better oxygen saturation, improvements in heart rate and respiratory rates are also available^{6,7}. But studies comparing mother's voice and music are not available in Indian context and so, we studied effectiveness of music and mother's voice (infant directed speech) in pain reduction during venepuncture in neonates.

Methodology:-

The study was registered in Clinical Trials Registry - India and the Institutional Human Ethics Committee (No: PG/2014/47). After the informed consent was taken this open labeled randomized controlled study was carried out at neonatology unit at Mahatma Gandhi Medical College & Research Institute (MGMCRI), Pondicherry, South India from January 2014 to December 2014. All neonates undergoing venepuncture in the post natal ward were included in this study. The neonates were in awake state. Neonates 1) with intravenous cannula, 2) critically ill, 3) associated with painful conditions, 4) immunized within 24 hrs were excluded. Total 300 neonates were included in the study. They were divided into music, mother's voice and control groups by block randomization method. Each group consisted of 100 subjects. All the neonates were checked for hearing loss by startle reflex given by them to the auditory stimulus in the form of clapping hands by the investigator. The neonates without any hearing loss were included in the study. The neonates in music group were exposed to pre recorded lullaby 5 minutes before starting the venepuncture and during the procedure of venepuncture. Music was played through music player using

speakers placed 30 cm from the neonate. The speaker used was JBL Flip 2 portable wireless stereo speaker with maximum SPL of 86dB and frequency response of 100Hz-20 KHz. The sound decibel of the music played was checked using Benetech GM 1351 digital sound level meter. The volume of the speaker was adjusted such that the NICU environment sound level never exceeded beyond 65 dB.

The neonates in mother's voice group received pre recorded mother's voice [infant directed speech⁸] 5 minutes before and during venepuncture procedure. Both the music group and the mother's voice group received in total 15 minutes of intervention each. The control group received no intervention but received only the standard nursing care during the venepuncture procedure. The pain levels were assessed using NPASS by the investigator. The physiological parameters were assessed by an independent observer. The NPASS was done 5 minutes before, during and 5 minutes after the procedure. NPASS used in our study was commonly used to assess pain response in infants during painful procedures⁹ as the score evaluated 5 parameters – crying, behavioural state, facial expression, extremities tone and vital signs. The heart rate, oxygen saturation were monitored using pulseoximeter and the respiratory rate was counted manually. Minimum and maximum possible scores were -10 and 10 respectively. The investigator also noted the duration of crying spells when neonates started and stopped crying by using a stop clock. No neonate was sedated during the venepuncture procedure. Eight neonates were excluded from this study as they were in sleep state and didn't awake after venepuncture. 292 neonates were analyzed. The other neonates were in awake state during the study.

Statistical Analysis:-

The results were analyzed by using Kruskal Wallis for comparing all the three groups. Mann Whitney U Test was done for intergroup comparison.

Results:-

Results of Neonatal pain, agitation and sedation scale (NPASS) for each of five domains crying, behavior state, facial expression, extremities tone and vital signs), 10-point NPASS for music and control groups are shown in table 1. NPASS score of mother's voice and control group are shown in table 2 and mother's voice and music group are shown in table 3.

All five domains of NPASS- vital signs, irritability, facial expression, behavioral state, tone and the total NPASS have shown significant lower pain perception in music group when compared to control group ($P=0.000$). All the five domains of pain – vital signs, irritability, facial expression, behavior state, tone and the total NPASS were lower in mother's voice group when compared to control group ($p=0.000$). There was significant difference in the heart rate, respiratory rate, facial expression and behavioral state and the total NPASS ($p=0.000$) between the mother's voice and music group. Music was better than mother's voice and control group in pain reduction during venepuncture.

Table 1:- Comparison of clinical and behavioural parameters between control and music group

Parameter	Group 1 (Control)	Group 2 (Music)	p value
BEFORE INTERVENTION			
NPASS	0.01±0.102	0.07±0.412	0.316
DURING INTERVENTION			
Vitals signs	1.65±0.542	1.22±0.682	0.000
Irritability	0.99±0.102	0.82±0.389	0.000
Facial expression	1.6±0.513	1.20±0.609	0.000
Behavioral state	1.51±0.754	0.73±0.635	0.000
Tone	1.46±0.767	0.64±0.63	0.000
NPASS	7.21±2.16	4.62±2.137	0.000
AFTER INTERVENTION			
NPASS	0.74±1.028	0.55±0.954	0.188

Table 2:- Comparison of clinical and behavioral parameters between control and mother's voice group

Parameter	Group 1 (Control)	Group 3 (Mother's Voice)	p value
BEFORE INTERVENTION			
NPASS	0.01±0.102	0.05±0.297	0.319
DURING INTERVENTION			
Vital signs	1.65±0.542	1.476±0.522	0.010
Irritability	0.99±0.102	0.91±0.345	0.019
Facial expression	1.6±0.513	1.47±0.502	0.052
Behavior state	1.51±0.754	1.35±0.644	0.021
Tone	1.46±0.767	0.74±0.438	0.000
NPASS	7.21±2.16	5.94±1.899	0.000
AFTER INTERVENTION			
NPASS	0.74±1.028	0.64±1.115	0.409

Table 3:- Comparison of clinical and behavioral parameters between music and mother's voice group

Parameter	Group 2 (Music)	Group 3 (Mother's voice)	p value
BEFORE INTERVENTION			
NPASS	0.07±0.412	0.05±0.300	0.983
DURING INTERVENTION			
Vital signs	1.22±0.609	1.47±0.522	0.014
Irritability	0.80±0.389	0.91±0.324	0.077
Facial expression	1.20±0.609	1.47±0.502	0.003
Behavior state	0.73±0.635	1.35±0.644	0.000
Tone	0.64±0.63	0.74±0.438	0.082
NPASS	4.62±2.137	5.94±1.899	0.000
AFTER INTERVENTION			
NPASS	0.55±0.954	0.64±1.115	0.700

Discussion:-

Venepuncture is the one of the most common recurring painful health-related procedures in clinical practice. Various measures to reduce pain during venepuncture have been explored, including positioning and restraining the neonate in relatively flexed posture, kangaroo care, breastfeeding, use of oral analgesics, oral sucrose / saccharine solutions, tactile stimulation, skin-cooling techniques, skin-to-skin care, non nutritive sucking pacifiers, music therapy, etc⁽⁷⁻¹²⁾. Music therapy offers a safe and harmless intervention for reducing pain in neonates.

Joanne Loewy¹⁶ recorded use of culturally based musical tunes in the form of lullabies can improve neonatal function and hence in our study we used lullabies in Tamil language as most of the patient population visiting the hospital spoke Tamil language.

In our study the peak HR(heart rate) was lowest in the music group when compared to mother's voice and control group. The peak HR in the mother's voice group was lower than the control group. This signifies that both music and mother's voice decrease the heart rate during painful intervention and music had more positive effect than pre-recorded mother's voice infant directed speech. These findings were in consistent with the study by Coleman et al¹⁷, Arnon et al¹⁸ where there was decrease in heart rate after the neonates were exposed to music. Statistically significant difference was found with regard to heart rate when music intervention was done in studies conducted by McIntosh et al¹⁹ and Bo LK²⁰.

In our study, the music group had better oxygen saturation than control group with a p value of 0.000. Similar findings were found in Cassidy et al's²¹ study where there was statistically significant difference between recorded music and control group. In studies by Burke et al²², Chou et al²³ and Standley et al²⁴, the degree of fall of oxygen saturation was less in music group when compared to the control group. Caine et al²⁵, Collins et al²⁶, Whipple et al²⁷, Butt et al²⁸ and Arnon et al¹⁸ recorded statistically significant difference in the behavioural parameters between the mother's group, music group and the control group.

Our study showed significant improvement in all five parameters of Neonatal pain, agitation and sedation scale (NPASS); i.e., facial expression, cry and movements and also in duration of crying spells. There was statistically significant difference in the peak HR, RR(respiratory rate), lowest recorded oxygen saturation, behavioural parameters and NPASS during intervention between the music and control groups. There was statistically significant difference in the maximum NPASS, peak HR, peak RR, least recorded and all the behavioural parameter between control and mother's voice group.

Proposed mechanism of action of music Therapy:-

When auditory stimuli of music passes through the sound pathway to the cerebral cortex, there is reduction in the signalling in the amygdale. The reduced signalling of amygdale causes reduced level of stimulation of the hypothalamus, pituitary and endocrine glands. Hence there is decreased secretion of the cortisol and glucocorticoids thereby having effect on the autonomic system²⁹. This explains the lower heart rate and better oxygen saturation in the music therapy group when compared with the control group. The underlying mechanism is explained by Farhat et al³⁰ that music has its effects on the limbic and the autonomic system thus music reduces the stress and inducing comfort and relaxation in neonates.

Limitation of our study was the fact that the study was conducted in NICU and not in a sound proof room. Blinding could not be done in this study.

Conclusion:-

Music and mother's voice reduce the pain perception in neonates during venepuncture and they have beneficial effects on the physical and behavioural parameters. Pre recorded music is better than mother's voice in decreasing pain perception. Hence for routine painful procedures like venepuncture, music therapy could be helpful in neonates in reducing the pain perception.

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