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The Effects of Maternal Voice on Anxiety and Physiologic Parameters among Children Undergoing Tonsillectomy

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Abstract

Background: Tonsillectomy is an effective surgical technique for managing obstructive sleep apnea and sleep-disordered breathing. Perioperative period is extremely stressful for most children who are candidates for surgeries. Anxiety enhances sympathetic activity and psychological problems. Listening to music is beneficial to patients and children and effect on preoperative anxiety. One of the auditory therapies is maternal voice. Maternal voice is the first and the most important low-frequency sound that can be heard by fetus Objectives.

Objectives: This study sought to assess the effects of maternal voice on anxiety and physiologic parameters among children who were candidates for tonsillectomy.

Methods: This quasi-experimental study was made in 2015 on sixty 4-8 year-old children who were going to undergo a tonsillectomy surgery. Children were conveniently and consecutively recruited and randomly allocated to an experimental or a control group based on the day of their surgery. A demographic questionnaire, the Child Rating of Anxiety scale, and a checklist for physiologic parameters were used to collect data. The children in the experimental group received voice therapy twice. Children's anxiety was assessed before and six hours after the surgery while their physiologic parameters were evaluated eight times before, during, and after the surgery.

Results: After the intervention, the groups differed significantly in terms of anxiety mean score ($P<0.05$). While in the experimental group, the posttest value of anxiety was significantly lower than the pretest one ($P<0.05$). The results of the repeated measures analysis of variance also illustrated that the study groups differed significantly regarding the mean values of children's heart rate, diastolic and systolic blood pressures, and arterial oxygen saturation ($P<0.05$).

Conclusions: The findings of the present study indicate the positive effects of recorded maternal voice on children's anxiety and physiologic parameters during the perioperative period. Therefore, maternal voice can be used for alleviating anxiety and improving physiologic status among children who undergo tonsillectomy

Keywords: Maternal voice; Anxiety; Physiologic parameters; Tonsillectomy; Nurse; Child

Introduction

Tonsillectomy, with or without adenoidectomy, is an effective surgical technique for managing obstructive sleep apnea and sleep-disordered breathing. This technique reduces throat pain among children who frequently develop sore throat. It is among the commonest surgical operations. Annually, more than half million tonsillectomy surgeries are performed in the United States on children who are less than fifteen [1,2].

Perioperative period is extremely stressful for most children who are candidates for surgeries [3]. Accordingly, they experience high levels of anxiety before surgeries. Because of their comparatively poor understanding about diseases and treatments, children experience much more severe preoperative stress and anxiety [4]. More children experience preoperative anxiety [5]. And induction of anesthesia is one of the stressful perioperative events for children [6].

Anxiety enhances sympathetic activity and elevates serum levels of catechol amines, adrenocorticoids, prolactin, cortisol, and prostaglandin and consequently, increases heart rate, respiratory rate, blood pressure, and myocardial oxygen demand [7]. Besides, anxiety can cause refusal of treatment, sleep disorders, delirium, interpersonal conflicts, and mental and psychological problems, particularly among children. On the other hand, it lowers pain threshold and thus, heightens postoperative pain perception. Therefore, preventing perioperative anxiety can reduce the likelihood of negative post-operative complications among children [3,5].

There are many non-pharmacological therapies for alleviating anxiety. The findings of previous studies revealed that non-pharmacological therapies such as psychological preparation [8] and distraction can significantly alleviate anxiety among children [5,9-11]. One of the most widely-used distraction-based therapies for anxiety is music therapy. Auditory stimuli, such as music therapy, can reduce the need for tranquilizers and decrease sympathetic tone during general and local anesthesia [12]. Listening to music is beneficial to patients and children and effect on preoperative anxiety [13,14]. Music therapy can alleviate children's preoperative separation anxiety. However, reported that it may be ineffective in alleviating children's anxiety during induction of anesthesia [15].

Another distraction-based auditory therapy is maternal voice. Maternal voice is the first and the most important low-frequency sound that can be heard by fetus. Fetus can understand and learn sounds. Moreover, neonates who age just three days can differentiate their own mothers' voice and heart beat among other sounds [16]. A study reported that such sounds positively affect neonates' physiologic and behavioral responses [17]. A result of one study showed that maternal voice significantly reduces preterm neonates' heart rate and improves their autonomic stability [18]. Furthermore, a study showed

listening to recorded maternal sound effective in alleviating children's perioperative anxiety [19].

Previous studies have mainly focused on preoperative interventions for anxiety management. Moreover, the effects of maternal voice have been investigated mainly among neonates who were hospitalized in neonatal intensive care units. Accordingly, it has remained almost unknown whether intraoperative maternal voice therapy can significantly affect perioperative outcomes among children. This study sought to assess the effects of maternal voice on anxiety and physiologic parameters among children undergoing tonsillectomy.

Materials and Methods

This quasi-experimental study was made in 2015 on sixty 40-8 year-old children who were going to undergo a tonsillectomy surgery in Ghamar-e Bani-Hashem hospital, Neyshaboor, Iran. Sampling was done purposively and consecutively and was completed until thirty children were recruited to each study group. The eligibility criteria included an age of 4-8 years, no history of underlying conditions or previous surgeries, and class I of the American Society of Anesthesiologists Physical Status Classification System. Children were excluded if they developed serious intraoperative complications (such as excessive bleeding) or needed endotracheal re-intubation or another tonsillectomy surgery. The children were randomly allocated to either an experimental or a control group based on the day of their surgery. In other words, children who underwent the surgery in odd and even days of the week were randomly allocated to the control and the experimental groups, respectively. The groups were matched in terms of anesthetics, anesthesia techniques, surgical techniques, and surgeons.

A demographic questionnaire, the Child Rating of Anxiety (CRA) scale, and a checklist for physiologic parameters were used to collect the data. The demographic questionnaire contained eleven items including children's age, gender, birth rank, and history of hospitalization as well as their parents' age, educational status, and employment.

The CRA is a self-report scale which contains the image of a rabbit, its hole, and a ladder in between. A child is told that, "The rabbit is escaping from another animal and wants to go into its hole under the ground by using the ladder. If you were in its shoes, on which step would you stand?" Then, the child is allowed to show one of the steps. The ladder has six steps which are scored from 0 to 10; the closer the selected step to the hole, the higher the level of anxiety [20]. Martin et al. reported a significant positive correlation ($r=0.436$ and $P<0.05$) was found by Tiedeman and Clatworthy between the CRA scale and the State Anxiety Inventory for Children Scale [21]. Anxiety assessment for each child was performed in the pediatric care unit both before transferring him/her to the operating room and six hours after the tonsillectomy surgery.

The physiologic parameters checklist included items such as heart rate, diastolic blood pressure (DBP), systolic blood pressure (SBP), and saturation of peripheral oxygen (Spo2). These parameters were measured and documented in eight time points namely in the pediatric care unit (T1), at entrance to the operating room (T2), before induction of anesthesia (T3), immediately before the surgery (T4), immediately after the surgery (T5), at entrance to the recovery room (T6), after being discharged from the recovery room (T7), and six hours after the surgery (T8). The demographic questionnaire for each child was completed through interviewing one of his/her parents and then, the intended child was asked to respond to the CRA.

Children in the experimental group were provided with a maternal voice therapy intervention. Primarily, each mother was informed about the process of recording her voice and playing it for her child. Then, her voice was recorded by using the Smart Voice Recorder (v.1.7) mobile application. After that, the voice was played for her child twice, i.e. from mother-child separation to the onset of surgery (fifteen minutes) and from the end of the surgery to the time of entrance to the recovery room (five minutes). In order to determine the to-be-recorded content, we interviewed five children and their mothers. Four children noted that they wanted their mothers to freely speak with them while one child preferred his mother to recite poetry for him. Accordingly, we decided to let mothers freely speak during voice recording. These pieces of maternal voice were played for their corresponding children during the fifteen-minute preoperative phase. However, for the five-minute postoperative phase, we provided all mothers with a same text to read while we recorded their voice. The text was similar to what a nurse usually tells to a patient who is regaining consciousness: "You are awakening. This is your mother's voice. Your surgery has successfully finished. Breathe deeply and swallow your spittle. You are very fine and in a very good condition. Your body knows what to do and it is feeling well and convenient. Here you are not alone. All staffs are doing their best in order to enable you to return to me. Here all people are kind and want you to feel better very soon. You can see me in a few minutes. Avoid crying; otherwise you will feel pain in your throat. Stay calm. I will give you ice cream. You will achieve complete recovery and we will return to our home. You will play with your friends." Each mother's voice was played for her child by using a headphone. The study data were analyzed by using the SPSS (V. 20) software.

This study was approved by the Research Administration and the Ethics Committee of Tarbiat Modares Faculty of Medicine, Tehran, Iran. The flow and the steps of the study were explained to the mothers and their informed consent was secured.

Results

The means of the participants' age in the control and the experimental groups were 6.56 ± 1.35 and 6.68 ± 1.18, respectively. The results of the Mann-Whitney U and the Chi-square tests illustrated that the groups did not differ significantly in terms of family size, children's age, history of hospitalization, and birth rank, as well as their mothers and fathers' age, education, and employment status ($P>0.05$).

Before implementing the study intervention, the mean anxiety scores in the control and the experimental groups were 5.00 ± 3.19 and 6.13 ± 3.05, respectively. The Mann-Whitney U test revealed that this difference was not statistically significant ($P>0.05$). However, after the intervention, the mean anxiety score in the experimental group was significantly lower than the control group (4.26 ± 2.76 vs. 6.66 ± 3.03; $P<0.05$). Moreover, within-group comparisons through running the Wilcoxon test revealed that in the control group, the posttest value of anxiety was significantly greater than the pretest value while in the experimental group, the posttest value of anxiety was significantly lower than the pretest value ($P<0.05$; Table 1).

Time Group	Before	After	P value (The results of the Wilcoxon test)

	Mean	SD	Mean	SD	
Experimental	6.13	3.03	4/26	2.76	P=0.000
Control	5.00	3.19	6/60	3.03	P=0.002
P value (The results of the Mann-Whitney U test)	P =0.061		P=0.003		

Table 1: Comparing the study groups in terms of the pretest and posttest mean scores of anxiety.

	Time Variables	T1	T2	T3	T4	T5	T6	T7	T8
SBP	Control	97.83 ± 13.43	134.33 ± 16.08	108.93 ± 13.31	107.76 ± 13.31	113.16 ± 15.64	113.16 ± 19.27	112.66 ± 19.41	117 ± 14.20
	Exp.	98.66 ± 13.32	105.50 ± 11.41	102.16 ± 12.22	98.50 ± 11.97	107.50 ± 13.50	102 ± 9.34	98.66 ± 10.08	97.66 ± 11..27
	P value	0.79	0.74	0.06	0.04	0.08	0.01	0.00	0.00
DBP	Control	97.83 ± 13.43	65.86 ± 11.69	69.06 ± 12.56	68.83 ± 13.24	71.37 ± 13.88	72.00 ± 13.42	72.33 ± 13.56	76.66 ± 10.00
	Exp.	98.66 ± 13.32	66.66 ± 9.49	65.550 ± 9.50	60.50 ± 18.64	68.00 ± 11.03	64.00 ± 8.84	58.50 ± 13.20	61.83 ± 9.78
	P value	0.56	0.56	0.27	0.01	0.36	0.01	0.00	0.02
HR	Control	103.43 ± 15.10	124.03 ± 19.68	134.8 ± 22.27	161.13 ± 27.37	130.93 ± 27.52	132.87 ± 30.70	130.13 ± 23.98	116.56 ± 25.1
	Exp.	101.96 ± 10.54	121.96 ± 17.82	106.36 ± 16.32	107.76 ± 17.61	109.6 ± 25.46	116.73 ± 18.04	101.73 ± 16.43	99.30 ± 12.02
	P value	0.67	0.67	0.00	0.16	0.00	0.03	0.00	0.09
SPO2	Control	95 ± 1.6	97 ± 1.77	98 ± 1.68	99 ± 0.61	98 ± 2.04	97 ± 3.28	96 ± 1.67	96 ± 1.7
	Exp.	96 ± 1.42	97 ± 1.98	98 ± 1.30	99 ± 0.89	99 ± 0.80	98 ± 1.18	98 ± 1.33	96 ± 0.93
	P value	0.23	0.30	0.52	0.86	0.00	0.09	0.04	0.11

Table 2: Comparing the study groups in terms of the pretest and posttest mean values of SBP, DBP, HR and SPO2.

The results of the repeated measures analysis of variance indicated that the study groups differed significantly from each other regarding the mean of their heart rate, DBP, SBP, and Spo2 (P<0.05). Moreover, there were significant differences between the groups across the eight measurement time points concerning the means of HR, DBP, and SBP variations (P<0.05). However, the groups did not significantly differ across the eight measurement time points regarding the mean value of Spo2 (P>0.05; Table 2 and Figures 1-4).

The independent-sample t test was used for pairwise comparisons at different measurement time points regarding the mean values of the physiologic parameters. The results of this test illustrated that at T1,T2 there were no significant differences between the groups regarding the children's HR, DBP, and SBP. However, at T3, T5, T6, T7, and T8, the mean of heart rate in the experimental group was significantly lower than the control group (P<0.05). Besides, the means of DBP and SBP in the experimental group were significantly lower than the control group at T4, T6, T7, and T8 (P<0.05). Furthermore, the mean of Spo2 in the experimental group was significantly higher than the control group at T5 and T7.

Discussion

The present study was made to assess the effects of maternal voice on anxiety and physiologic parameters among children undergoing tonsillectomy. The findings indicated that recorded maternal voice alleviated children's anxiety, reduced their heart rate, DBP, and SBP, and enhanced their Spo2.

Study findings revealed an insignificant difference between the groups regarding the pretest mean score of children's anxiety. Moreover, posttest value of anxiety in the control group was significantly higher than the pretest value while in the experimental group, the posttest value of anxiety was significantly lower than the pretest value. Additionally, posttest value of anxiety in the experimental group was significantly lower than the control group. All these findings indicate the effectiveness of maternal voice in alleviating children's perioperative anxiety. In the present study, maternal voice therapy was provided both before and after tonsillectomy. Preoperative voice therapy can help alleviate postoperative anxiety because the lower the preoperative anxiety is, the lower the postoperative anxiety would be. a review study showed that music therapy can significantly alleviate anxiety in some patient populations [22]. Other study also

reported the effectiveness of preoperative music therapy in alleviating separation and preoperative anxiety among children [23]. Moreover, a study found that music therapy significantly alleviated procedural anxiety among children undergoing lumbar puncture [24]. Not only music therapy can significantly affect patient outcomes after minor surgeries, but also it has been found to be effective in improving outcomes related to major surgeries [25]. For instance, a study showed that preoperative music therapy reduced the need for morphine administration among children in postoperative care units, alleviated their perioperative stress, and provided them with deeper relaxation [26]. The results of a study also illustrated that playing recorded maternal sound in the preoperative waiting room significantly alleviated preoperative anxiety among children. Moreover, it had positive effects on children's anxiety in the operating and the recovery rooms. Besides, the mothers of these children felt that they were more actively involved in the process of care delivery to their children [19].

The findings of the present study also revealed that maternal sound significantly lowered children's heart rate. Figure 1 shows that compared with T2, heart rate at T1 was higher probably due to child-mother separation as well as children's entrance to the alien environment of the operating room. At T6, the participants' heart rate was higher than T4. This increase can be attributed to the fact that at T6, the participants were in the recovery room and were regaining consciousness. Accordingly, their heart rate increased due to the effects of anesthesia reversal agents (such as atropine) and removal of endotracheal tube.

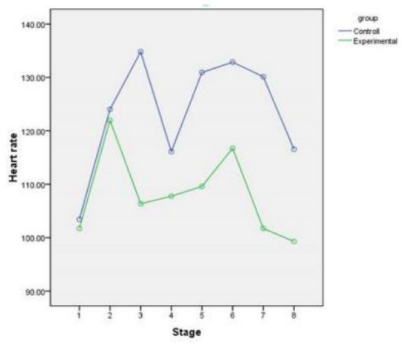

Figure 1: Heart variation in both groups across the eight measurement time points.

We also found that at T3, T5, T6, T7, and T8, the means of heart rate in the experimental group were significantly lower than the control group. Insignificant between-group difference regarding children's heart rate at T4 is probably due to the fact that at this time point, the children were under the deepest level of sedation and thus, experienced neither pain nor anxiety. Similarly, insignificant between-group difference at T5 was probably due to the similar effects of anesthesia reversal agents on heart rate in both groups. Other study also reported that maternal voice lowered preterm neonates' heart rate [18] Besides, a study reported that children who received distraction-based therapy showed minimal heart rate variations during venipuncture [27]. Moreover, other study showed that music therapy effective in lowering preterm neonates' heart rate [13]. The results of another study also illustrated that sound therapy significantly lowered the heart rate among unconscious patients who were hospitalized in intensive care unit [28].

Study findings also revealed that maternal voice significantly reduced DBP and SBP. As shown in Figures 2 and 3, children's blood pressure increased at T2 probably due to their entrance to the alien environment of the operating room. However, it reduced at T4, i.e. when the children were under the deepest level of sedation. After the operation, i.e. at T5, the children were regaining consciousness and experiencing different stimuli and hence, their blood pressure re-increased. Thereafter, the trend of their blood pressure variations became downward due to the elimination of surgery-related stimuli. The study findings also revealed that at T4, T6, T7, and T8, the mean values of DBP and SBP in the experimental group were significantly lower than the control group. The insignificant difference between the groups regarding DBP and SBP at T5 can be attributed to the fact that at this time, the anesthesia maintenance agents had been discontinued and the children were regaining consciousness. Previous studies also reported the effectiveness of different sound or distraction-based therapies in reducing blood pressure [4,28-30].

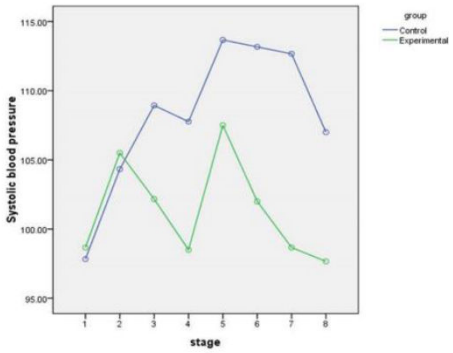

Figure 2: SBP variation in both groups across the eight measurement time points.

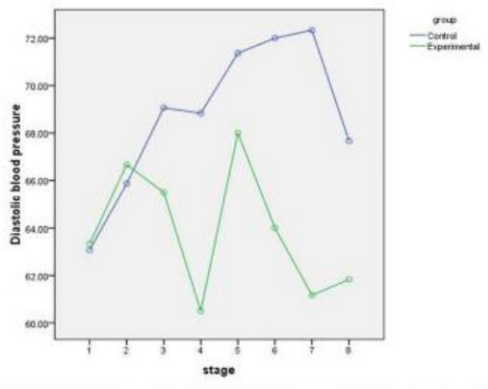

Figure 3: DBP variation in both groups across the eight measurement time points.

Our findings also showed a significant improvement in Spo2 after maternal voice therapy. Figure 4 shows that the level of Spo2 at T1 was very low. This low Spo2 value may be due to the fact that at this time,

the children were in inadequately-ventilated small rooms of the pediatric care unit and received no supplementary oxygen therapy. The highest level of Spo2 was observed at T4, i.e. when the children were mechanically ventilated and received 100% oxygen. At T5, the children breathed spontaneously and received supplementary oxygen while between T5 and T6, i.e. when they were being transferred from the operating room to the recovery room, they received no oxygen therapy. Therefore, the level of Spo2 at T6 was lower than T5.

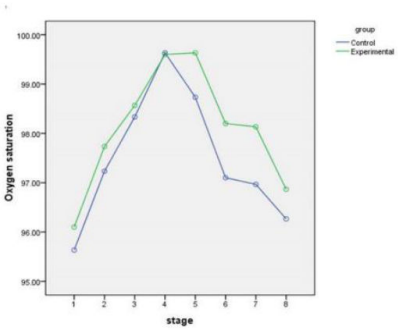

Figure 4: Spo2 variation in both groups across the eight measurement time points.

The findings also revealed that at T5 and T7, the mean values of Spo2 in the experimental group were significantly higher than the control group. The significant difference between the groups at T5 can be attributed to the effects of the second maternal voice therapy session which was held for each child immediately after tonsillectomy. The between-group difference regarding the level of Spo2 was also statistically significant at T7. At this time, children were being transferred from the recovery room to the pediatric room while receiving no oxygen therapy. Accordingly, the children in the experimental group might have had better oxygenation in this phase due to the effects of maternal voice therapy. Other studies also revealed the significant effects of voice therapy and distraction-based interventions on Spo2. Although the difference between the groups at T5 and T7 was significant, it was insignificant at T6. This finding can be attributed to the fact that before T6, the children were being transferred from the operating room to the recovery room while receiving oxygen therapy. Such oxygen therapy might be the explanation for insignificant between-group difference at T6.

Conclusion

The findings of the present study indicate that recorded maternal voice can alleviate children's anxiety and improve their physiologic parameters during the perioperative period. Therefore, maternal voice can be used as a beneficial and safe intervention for alleviating anxiety and improving physiologic status among children who undergo tonsillectomy.

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