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MATERNAL-FETAL MEDICINE

Does music during labor affect mode of delivery in first labor after epidural anesthesia? A prospective study

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Abstract

Key message **Listening to music during labor increases the likelihood that primiparas will have a spontaneous vaginal delivery.**

Purpose To examine the effects of exposure to music during labor on the mode of delivery and parturients' stress levels.

Methods This prospective, interventional study included 124 low-risk women who were recruited during latent phase of their first labor after epidural anesthesia. Patients were grouped according to their preference to receive music intervention or not. The music intervention included two subgroups: soft classical music and rhythmic music. We evaluated cortisol levels in saliva as a surrogate for stress level and State-Trait Personality Inventory at enrollment and 1–3 h later in all women who were still in labor. Delivery and perinatal outcomes were collected from electronic medical records. Correlations between the music intervention and maternal and perinatal outcomes were evaluated.

Results Spontaneous vaginal delivery was significantly more frequent among women listening to music compared to the non-music group ($P=0.035$). A trend towards lower rates of cesarean delivery was noted in the music group ($P=0.08$), with no difference in instrumental vaginal delivery rates. Stress levels, as measured by questionnaires and by cortisol levels, blood pressure and pulse rate, remained similar throughout the study. No differences were noted between the different genres of music when examining obstetric and perinatal outcomes and stress levels.

Conclusion Listening to music during labor, improves the likelihood of primiparas to have a vaginal delivery regardless of stress level. As this treatment is simple, easy, and harmless to administer, we suggest it may be offered to all patients during labor.

Keywords Anxiety · Cesarean section · Music · Spontaneous vaginal delivery · Stress

Abbreviations

STPI State-Trait Personality Inventory
SVD Spontaneous vaginal delivery

Introduction

For centuries, music has been known to have therapeutic effects on the body and the mind [1]. A large body of findings is related to the therapeutic potential of music in clinical settings, mainly among patients undergoing surgical and dental procedures, and in other medical environments, such as intensive care, psychiatry, and geriatrics [2–4]. Using music interventions in clinical settings has been associated with fewer negative outcomes. Objective stress and anxiety indices, such as reduced heart rate, blood pressure, myocardial oxygen consumption, gastrointestinal function, anxiety, pain, and increased oxytocin levels, were improved as well [5, 6].

Regarding the effect of music in the field of Obstetrics, Kushnir et al. [7] found that women who listened to music before a cesarean section had significant increases in positive

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emotions and decreases in systolic blood pressure, as compared with significant increases in diastolic blood pressure and respiratory rates in the control group. Li and Dong concluded that preoperative music intervention can reduce anxiety and pain in women undergoing cesarean delivery [8, 9].

Various studies have examined the relation of music during labor to subjective stress and pain relief. One study found that women participating in music therapy had significantly lower anxiety and pain and higher finger temperatures during the latent phase of labor [10]. Yet, information regarding the effect of music during labor on the obstetric and perinatal outcomes is lacking. In addition, no study has examined physiological stress levels (measured by salivary cortisol) while music is played in the delivery room.

This study evaluated the effect of music on obstetric and perinatal outcomes and evaluated stress levels during labor while music was played in the delivery room.

Materials and methods

This prospective study was conducted from January to June 2018. Primiparas during the latent phase of labor (cervical dilatation < 6 cm), were recruited in the delivery room at least 20 min after receiving epidural anesthesia. We included only women after epidural analgesia to reduce the effect of pain-induced stress related to contractions.

Inclusion criteria were primiparas ages 18–45 years in latent phase after epidural anesthesia. Exclusion criteria were women with a multiple pregnancy, or at high risk due to gestational diabetes, pre-eclampsia or intrauterine growth restriction. Preterm deliveries, malpresentations and antepartum fetal death were excluded as well. Patients were also excluded if the music was stopped for technical reasons or because the patient changed her mind before the end of delivery.

After signing a consent form, the patient chose whether she wanted to listen to music until the end of the third stage of delivery or whether she preferred not to have music in the delivery room. The group who wanted to listen to music during delivery chose either rhythmic or classical music. The same playlist for each genre of music was played from the moment of consent until delivery via two speakers that were in each delivery room.

Physiological stress levels were evaluated by salivary cortisol. We used salivary cortisol because serum cortisol diffuses freely into saliva. Therefore, salivary cortisol measurements reflect serum-free cortisol concentrations more accurately than does total serum cortisol [11]. It is a simple, nonintrusive test, as well. The saliva samples were collected in Salivette tubes (Sarstedt International, Nümbrecht, Germany) and then centrifuged at 1459*g* for 10 min and stored at − 20 °C for further analysis. Salivary cortisol concentrations were measured in mcg/dL using an electro-chemiluminescence immunoassay (Elecsys Cortisol Kit, Roche Diagnostics, Rotkreuz, Switzerland) in a Cobas c6000 analyser (Roche Diagnostics, Rotkreuz, Switzerland). The sensitivity limit for the cortisol assays was 0.018 µg/dL.

The State-Trait Personality Inventory (STPI) was used to evaluate level of stress state [12]. It consists of 10-item scales for measuring state and trait anxiety, anger and depression. The STPI state scales assess the intensity of these emotional states at a particular moment. Participants respond to the STPI trait items by reporting how often they experienced the personality characteristics that each item described, on the 4-point frequency scale. Scores range from 0 to 40, with score > 20 suggesting high level of anxiety.

The cortisol and STPI stress measurements were assessed at 2 time points: before the music was played and 1–3 h after the music started. Blood pressure and pulse were recorded at recruitment and when the second cortisol sample and STPI were taken, as additional objective measurements of stress.

Data regarding the process of labor, delivery and perinatal outcomes were collected from the medical files.

Power analysis

We calculated the sample size required to note a decrease in the rate of high stress levels, as expressed by above-average STPI scores. We estimated that 30% will express STPI level above average when recruited to the study and that after listening to music only 10% of the patients will still express this high stress level based on STPI score. To achieve 80% power, 124 patients were required to show a treatment effect at a 2-sided alpha level of 5%.

Statistical analysis

Statistical analysis was performed using SPSS 20.0 package for Windows. Categorical variables were analyzed by means of Chi-square test or Fisher's exact test. Continuous variables were analyzed with *t* test. A P value < 0.05 was considered statistically significant. All statistical tests were two-tailed.

Results

A total of 124 patients were recruited to the study. Among them, five were excluded: four because of technical audio failures and one withdrew consent. Of the 119 women included in the study, 48 chose not to listen to music during labor. Among the 71 women who wanted to be in the music group 31 requested the rhythmic playlist and 40 the classical playlist.

Clinical and demographic characteristics of the groups are shown in Table 1. Delivery and perinatal outcomes are presented in Table 2. There were no significant differences between groups in maternal characteristics except for age. The group who chose music during labor was older (30.0 ± 5.0 years vs. 27.9 ± 5.5 years, $P = 0.03$). All other characteristics, including ethnicity, BMI and gestational age were similar between groups. There was no difference in clinical characteristics during labor and delivery, including dilation at recruitment, and whether the labor was spontaneous or induced, or whether pitocin was used for augmentation. Additionally, no difference was noted between groups regarding presence of meconium or if amino-infusion was used because of recurrent variable decelerations.

We found that the group listening to music experienced spontaneous vaginal delivery (SVD) more often, as compared to those not listening to music (64% vs. 43%, $P = 0.035$). A trend toward lower rates of cesarean section was noted in the music group (14% vs. 27%, $P = 0.08$). No difference in instrumental delivery rate was noted between groups.

Subjective stress levels, as measured by questionnaires and objective stress levels, as measured by cortisol levels, blood pressure and pulse rate, remained similar throughout the study (Table 3).

Clinical and demographic features, obstetric and perinatal outcomes and mode of delivery did not differ according to the genres of music played.

Table 1 Clinical and pregnancy-related characteristics

Characteristic	Music intervention ($N = 71$)	No music ($N = 48$)	P value
Mean ± SD			
Age (years)	30.0 ± 5.0	27.9 ± 5.5	0.03
Body mass index (BMI), kg/m^2	22.8 ± 3.5	23.0 ± 4.4	0.79
Gestational age (weeks)	39.4 ± 1.1	39.4 ± 1.2	0.945
Dilation at recruitment (cm)	3.1 ± 1.2	3.2 ± 1.3	0.53
N (%)			
Induction of labor	38 (53.5)	28 (58.3)	0.60
Pitocin during labor	67 (94.3)	43 (89.6)	0.33
Meconium-stained fluid	11 (15.5)	11 (23.4)	0.28
Use of amino-infusion	13 (18.3)	12 (25.0)	0.38

Categorical variables were analyzed using Chi-square test or Fisher's exact test. Continuous variables were analyzed with *t* test

Table 2 Obstetric and perinatal outcomes

Characteristic	Music intervention ($N = 71$)	No music ($N = 48$)	P value
N (%)			
Spontaneous vaginal delivery	45 (63.3)	21 (43.8)	0.04
Vacuum extraction	16 (22.6)	14 (29.2)	0.4
Cesarean section	10 (14.1)	13 (27.1)	0.08
Intrapartum fever	7 (9.9)	2 (4.2)	0.25
Postpartum hemorrhage	6 (8.4)	2 (4.1)	0.36
Postpartum fever	2 (2.8)	0 (0)	0.52
Mean ± SD			
Active phase duration (h)	2.2 ± 1.4	1.74 ± 1.1	0.19
Second stage duration (h)	2.1 ± 1.1	2.2 ± 1.2	0.69
Third stage duration (min)	12.6 ± 9.7	11.0 ± 6.9	0.35
Umbilical artery pH	7.25 ± 0.07	7.27 ± 0.06	0.29
1-Min Apgar Score	8.8 ± 0.8	8.8 ± 0.5	0.64
5-Min Apgar Score	9.8 ± 1.1	9.9 ± 0.4	0.53
Neonatal weight (g)	3195 ± 430.0	3130 ± 397.3	0.41

Categorical variables were analyzed using Chi-square test or Fisher's exact test. Continuous variables were analyzed with *t* test

Table 3 Objective and subjective stress parameters

Characteristic	Music intervention ($N=71$)	No music ($N=48$)	P value
Mean ± SD			
Cortisol level at recruitment (mcg/dL)	1.65 ± 1.44	1.59 ± 2.55	0.89
Cortisol level 1–3 h after music played (mcg/dL)	0.98 ± 0.60	1.04 ± 1.06	0.74
SPTI total score at recruitment (*N*)	22.19 ± 8.1	22.3 ± 6.8	0.93
STPI total score 1–3 h after (*N*) music played	20.26 ± 8.1	19.29 ± 6.5	0.49
Systolic blood pressure at recruitment (mmHg)	115.23 ± 12.89	115.56 ± 11.85	0.89
Systolic blood pressure 1–3 h after music played (mmHg)	116.53 ± 12.44	114.61 ± 10.44	0.41
Diastolic blood pressure at recruitment (mmHg)	69.9 ± 9.9	70.29 ± 9.0	0.84
Diastolic blood pressure 1–3 h after music played (mmHg)	70.13 ± 8.4	69.22 ± 8.8	0.60
Pulse at recruitment (beats/min)	81.25 ± 12.5	82.88 ± 13.3	0.50
Pulse 1–3 h after music played (beats/min)	82.40 ± 12.6	81.25 ± 12.5	0.65

Variables were analyzed using *t* test

STPI State-Trait Personality Inventory

Discussion

We observed a significantly higher rate of SVD among patients listening to music during labor as compared to those not listening to music. Although the effect of music on obstetric outcomes has not been examined previously, this positive effect of music joins a long list of the positive physiological outcomes related to music found in other disciplines. One study found that music therapy positively affected physiologic indicators, feeding, length of stay, and pain outcomes for preterm infants [13]. A Cochrane review suggested that listening to music consistently reduced respiratory rate and systolic blood pressure and had a possible beneficial impact on the consumption of sedatives and analgesics [14].

It is notable that the rate of vaginal deliveries in our study population was lower than international averages. Data from deliveries in the USA reveal that low-risk, nulliparous women at term, with a singleton, vertex presentation have a cesarean delivery rate of 26% and an operative delivery rate of 3.2% [15]. A possible explanation is that eligibility required that patients would be in latent phase at least 20 min after epidural anesthesia was placed; hence, all labors that progressed quickly and were more likely to further progress to SVD, were excluded.

Childbirth is a complex life event that can be associated with positive and negative psychological responses [16]. Various conditions and complications related to stress—from lactation disturbances to post-traumatic stress disorders (PTSD)—have been described in previous studies [17–20].

In light of the potential harmful consequences of stress during labor, we examined whether music reduces stress during labor by assessing objective as well as subjective measures. As opposed to prior studies that found that music has the ability to reduce anxiety [10] during labor and cesarean delivery [9] or during surgical and dental procedures, and in other medical environments, such as intensive care, psychiatry, and geriatrics [2–4], our data did not show this decrease. Studies regarding physiological stress showed that total and free plasma cortisol levels increase dramatically throughout labor and delivery at term [20–22]. Therefore, it is possible that the effect of labor on stress levels is so strong, that even modalities such as music, which reduces anxiety in other medical conditions does not have a strong enough effect to overcome the high stress levels contributed by the labor process. In addition, most participants received pitocin during labor (110/119, 92.4%), with no significant difference between groups. This factor could affect stress levels, as shown by a study that demonstrated higher ACTH levels in women who received oxytocin for labor induction as compared to those who experienced spontaneous labor [22]. It is reasonable to assume that other stress markers might be reduced by the intervention of music and are related to higher rate of SVD in the music group. A prospective study of primigravid women showed that epinephrine levels were positively correlated to state anxiety scores and to total length of labor, while plasma cortisol was unrelated to duration of labor [23].

Another interesting finding was that no difference was found in the stress measurements and obstetric outcomes between the two genres of music. A study by Höller et al. [24] asked subjects to bring their favorite relaxing music and their favorite stimulating music. They found inter-individual differences in response patterns even though the stimuli provoked comparable subjective emotions (relaxation, activation) and even when the same somatosensory stimulus was used for all subjects. Therefore, it was suggested that brain responsivity to music should be examined individually by

considering individual characteristics. In the same way, the preferred genre of music chosen by the participants might have had individual physiological effects.

To the best of our knowledge, this is the first study to examine the influence of music on mode of delivery and on obstetric and perinatal outcomes. This was a relatively large, prospective study, performed in a single academic institution with homogenous labor protocols. Data were extracted from electronic medical records which reduce recall and collection bias.

There are some potential limitations to the study. Our study focuses on specific subgroup of nulliparas which are under epidural anesthesia which most of them were either augmented or induced by pitocin. Another limitation is that the patients were not under the same protocol from the spontaneous start of labor. Therefore, other variables besides music possibly effected the course and outcome of labor and delivery, as well as the amount of anesthesia taken by parturients. Finally, there might be a selection bias because the study was not designed as a blinded, randomized control trial and the patients were allocated to the study groups—with or without music during labor, according to their own preferences. This potential bias was not expressed in the demographic or clinical data (except for maternal age, which was statistically, but not clinically different between groups).

The findings of this study indicate that listening to music during labor improves the likelihood of primiparas having a vaginal delivery regardless of their stress levels. As this is a harmless treatment that is simple to implement, it may be offered to each patient during labor.

We suggest future studies to investigate the effect of music on other laboring populations, as well as among patients who choose not to use epidural anesthesia during labor as well as parturients whose labor is not augmented or induced. As stress level during labor and the best methods to measure it remain unanswered, we suggest that future studies examine epinephrine levels during labor and their correlation to obstetric outcomes as well as establish a valid questionnaire to describe anxiety during labor.

Author contributions YP contributed to the study design, patient recruitment, data acquisition and interpretation and drafting of the manuscript. NM contributed to the conception and design of the study, patient recruitment, data acquisition and interpretation and revised the manuscript critically for important intellectual content. As well, she approved the version of the manuscript submitted. AA took a part in the design of the study, recruited patients to the study, revised it critically for important intellectual content. YY took a part in the design of the study, recruited patients to the study, revised it critically for important intellectual content. OW took part in the design of the study, recruited patients to the study, revised it critically for important intellectual content. MN contributed to data acquisition and analysis, revised it critically for important intellectual content. YP contributed by analyzing and interpreting the data and by revising the draft critically for important intellectual content. AB contributed to the analysis of the data, revised it critically for important intellectual content. TB-S contributed to the study design, and by revising the work critically for important intellectual content. All authors gave final approval of the version submitted and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical standards The study was approved by the local Ethics Committee (Approval No. 0198-17-MMC).

Informed consent Informed consent was obtained from all individual participants included in the study.

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