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Listening to music during shock wave lithotripsy decreases anxiety, pain, and dissatisfaction

A randomized controlled study

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Summary
Background We analyzed the effects of music on pain, anxiety, and overall satisfaction in patients undergoing a shock wave lithotripsy (SWL) procedure.
Methods A total of 200 patients scheduled to undergo SWL were included in this study. Group 1 consisted of 95 patients who listened to music during the SWL session while group 2 included 105 patients who did not listen music during the procedure. State-Trait Anxiety Inventory (STAI) was used to assess state and trait anxiety (STAI-S/T). A visual analog scale (VAS) was used at the end of the session in order to assess pain, willingness to repeat the procedure, and overall patient satisfaction. Hemodynamic parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were recorded before and after the session.
Results No statistically significant difference was found between the two groups in terms of stone characteristics, SWL parameters, pre-SWL STAI-T/S scores, and pre-SWL hemodynamic parameters. Post-SWL STAI-S scores were found to be lower in patients who listened to music ($p = 0.006$). At the end of the SWL, VAS scores of pain, satisfaction, and willingness to repeat procedure were significantly different in favor of the music group ($p = 0.007$, $p = 0.001$, $p = 0.015$, respectively). SBP, DBP, and HR were significantly higher in patients who did not listen to music ($p = 0.002$, $p = 0.024$, $p = 0.001$, respectively).
Conclusion Music can be an ideal adjunctive treatment modality for patients undergoing SWL treatment. It has the potential to enhance patient compliance and treatment satisfaction by reducing the procedure-related anxiety and pain perception.

Keywords Anxiety · Music · Pain · Satisfaction · Shock wave lithotripsy (SWL)

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Introduction

Shock wave lithotripsy (SWL) has been widely used in the treatment of urinary tract stones for many years [1]. The success of this procedure is closely related to patient's tolerance and compliance as well as other factors such as stone location, composition, urinary tract anatomy, and SWL machine [2].

One of the reasons for patient intolerance or incompliance is patient anxiety [3]. Despite the fact that SWL-related patient anxiety has not been studied in detail, it is known that shock waves may cause pain and their sounds are found 'anxiogenic' by patients [4].

Non-steroidal anti-inflammatory drugs (NSAID), opioids, and local anesthetic agents are used to reduce pain while anxiolytic agents are given to reduce anxiety. These measures are expected to increase

patient tolerance and compliance. However, 'pharmocologic' control of pain and anxiety is not highly recommended due to the costs and side effects of these agents such as hypotension, respiratory depression, confusion, and allergic reactions [5]. These reservations led to the search for complementary nonpharmacological methods in order to relieve pain and anxiety [6, 7].

It has been shown that listening to music during anxiogenic interventions reduces pain and anxiety [8]. In this study, we analyzed the effects of music on pain, anxiety, and overall satisfaction in patients undergoing SWL.

Methods

Patients and study design

This study has been approved by our institutional ethical review board. The target population comprised adult (age ≥18 years), female/male patients who were scheduled to undergo SWL between March 2015 and February 2016. Radio-opaque stones less than 20 mm in diameter, located in upper/middle calices, renal pelvis and less than 10 mm in diameter, located in proximal ureter were considered as indications of SWL. Electrohydraulic extracorporeal lithotripter (EMD E-1000, Ankara, Turkey) was used during the study which was operated by a senior urologist and staff lithotripsy technician. Informed consent was obtained from all individual participants included in the study. Exclusion criteria of this study were previous SWL history, presence of ureteral stent, hearing deficit, uncontrolled hypertension, history of psychiatric disease, and antidepressant drug usage.

A computer-based randomization software was used to assign the patients to one of the two study groups: group 1 (music) consisted of the patients who listened to music during the SWL session while group 2 (control) included the patients who did not listen to music during the procedure. Patients in group 1 listened to music by a headset during the entire session. These patients were provided with a list of available music types such as Turkish folk, classical, popular, relaxing, or slow rhythm. Patients were given the chance to choose one of the music types as per their own preference and they freely adjusted the volume of the played music during the procedure.

Demographic data of all study group patients were recorded in a computer database. Hemodynamic parameters including blood pressure and heart rate were recorded both before and after the session. Parameters regarding the SWL treatment session such as duration and power and number of the shock waves were also entered into the database.

A visual analog scale (VAS) was used at the end of the session to assess the pain (0 = no pain, 10 = maximal possible pain), willingness to repeat the procedure (0 = never, 4 = willing), and overall patient satisfaction (0 = extremely dissatisfied, 4 = extremely satisfied).

The VAS consisted of a horizontal line (100 mm in length) which was anchored by numbers from 0 to 10 (0 corresponded to 'no pain' while 10 implied maximal possible pain).

Anxiety assessment

Patient anxiety was analyzed by State-Trait Anxiety Inventory (STAI) which is a self-reported anxiety inventory [9]. This inventory contains two separate 20-item multiple choice question sets assessing the situational (state) and baseline (trait) anxiety. The 'state' component (STAI-S) assesses the patient's anxiety level at that particular time while the 'trait' component (STAI-T) scores her/his general (baseline) anxiety level. Therefore, study patients were assessed by the STAI-T component only before the procedure while the STAI-S component was applied both before and after the SWL session. Turkish validation of the STAI was performed by Le-Compte and Oner [10].

The STAI scores were calculated based on the patients' answers. The overall score ranges from 20–80 and the higher the score indicates the higher the anxiety level. Patients with the STAI scores of 35 or lower were considered as having 'no anxiety' while patients with scores of 42 or higher were considered as 'severely anxious' as recommended by the practice guidelines [11]. Scores ranging between 36 and 41 suggested 'moderate anxiety'.

Statistical analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) for Windows (Version 18.0; SPSS Inc., Chicago, IL, USA) software. The categorical variables were described by frequencies and percentages and the continuous variables were presented with means and standard deviations. The means were compared by Mann–Whitney U test when the samples were independent and by the Wilcoxon signed ranks test when the samples were dependent. The chi-square test was used to identify the relationship between categorical variables. P -values less than 0.05 were considered statistically significant.

Results

Patients who incompletely or incorrectly filled the questionnaire (n = 25) and who did not tolerate the SWL procedure due to severe pain (n = 3) were excluded from the study. After exclusion of 28 patients, 200 patients were evaluated prospectively. Among these 200 patients, 95 were assigned to group 1 while 105 patients were enrolled in group 2. Demographic patient data, stone location, and SWL parameters are displayed in Table 1. There was no significant dif-

Table 1 Demographic data, stone, and SWL characteristics

Variables	Total ($n = 200$)	Group 1 (Music) ($n = 95$)	Group 2 (No music) ($n = 105$)	p
Age (year) (Mean±SD)	42.9 ± 12.7	42.5 ± 12.7	43.3 ± 12.8	0.442
Gender (n, %)				
Male	137 (68.5)	66 (69.5)	71 (67.6)	0.778
Female	63 (31.5)	29 (30.5)	34 (32.4)	
Stone location (n, %)				
Kidney	118 (59.0)	56 (58.9)	62 (59.0)	0.989
Ureter	82 (41.0)	39 (41.1)	43 (41.0)	
SWL duration (min) (Mean±SD)	24.6 ± 6.6	25.1 ± 6.8	24.2 ± 6.4	0.266
SWL power (kV) (Mean±SD)	17.5 ± 5.4	17.4 ± 5.3	17.5 ± 5.5	0.884
Number of shock waves (Mean±SD)	2771.5 ± 711.0	2764.5 ± 699.1	2777.9 ± 724.9	0.992

Table 2 Pre-SWL hemodynamic parameters and anxiety scores

Variables	Total ($n = 200$)	Group 1 (Music) ($n = 95$)	Group 2 (No music) ($n = 105$)	p
SBP (mm Hg) (Mean±SD)	118.7 ± 13.3	117.6 ± 12.5	119.6 ± 14.0	0.319
DBP (mm Hg) (Mean±SD)	75.7 ± 9.2	75.4 ± 9.7	76.0 ± 8.7	0.607
HR (beats/min) (Mean±SD)	78.8 ± 6.3	78.2 ± 6.2	79.4 ± 6.4	0.114
STAI-T (Mean±SD)	36.6 ± 7.6	36.3 ± 8.0	36.8 ± 7.3	0.732
STAI-S (Pre-SWL) (Mean±SD)	37.6 ± 8.3	37.5 ± 9.6	37.6 ± 6.9	0.968

SBP systolic blood pressure, *DBP* diastolic blood pressure, *HR* heart rate, *STAI-T* State-Trait Anxiety Inventory-Trait, *STAI-S* State-Trait Anxiety Inventory-State

Table 3 Post-SWL hemodynamic parameters, VAS, and STAI-S scores

Variables	Total ($n = 200$)	Group 1 (Music) ($n = 95$)	Group 2 (No music) ($n = 105$)	p
SBP (mm Hg) (Mean±SD)	119.5 ± 10.9	116.4 ± 11.6	120.9 ± 8.7	0.002
DBP (mm Hg) (Mean±SD)	78.2 ± 8.6	74.8 ± 7.7	77.7 ± 7.6	0.024
HR (beats/min) (Mean±SD)	78.4 ± 6.5	75.9 ± 6.3	80.7 ± 5.8	0.001
VAS-Pain (0–10) (Mean±SD)	5.1 ± 2.4	4.6 ± 2.5	5.5 ± 2.7	0.007
VAS-Satisfaction (0–4) (Mean±SD)	1.7 ± 1.2	1.9 ± 1.1	1.4 ± 1.2	0.001
VAS-Willingness to repeat (0–4) (Mean±SD)	1.4 ± 1.2	1.6 ± 1.2	1.2 ± 1.1	0.015
STAI-S (Post-SWL) (Mean±SD)	35.2 ± 8.0	33.5 ± 7.4	36.8 ± 8.3	0.006

SBP systolic blood pressure, *DBP* diastolic blood pressure, *HR* heart rate, *VAS* visual analog scale, *STAI-S* State-Trait Anxiety Inventory-State

ference between the study groups in terms of these variables.

Pre-SWL hemodynamic parameters, STAI-S, and STAI-T scores of the study groups are displayed in Table 2. Comparison of the groups did not reveal any statistically significant difference in terms of these variables.

Post-SWL hemodynamic parameters, STAI-S scores, and VAS scores are shown in Table 3. The comparison between the study groups revealed that patients in group 1 had significantly lower systolic and diastolic blood pressure, heart rate, and STAI-S scores. Furthermore, these patients had lower pain scores with higher satisfaction and willingness to repeat the procedure.

Discussion

Anxiolytic use during SWL is aimed to reduce patient's anxiety which may – at least partially – stem from the irritating sound of the SWL machine while analgesics are used for pain reduction. Pain control helps maintain patient position throughout the procedure.

Listening to music during therapeutic interventions can modify the neurophysiological and emotional responses in a way that procedure-related anxiety and pain are reduced [12]. Therefore, music has been considered as an accessory therapeutic modality in numerous clinical settings including treatment of urinary tract stone disease with SWL [12–23].

Studies evaluating the effects of music on SWL treatment gave conflicting results [20–23]. Yilmaz et al. compared the anxiolytic effects of music with

midazolam and stated that music was as effective as midazolam in reduction of patient anxiety during SWL treatment [22]. In addition, they found that music reduced the analgesic use. On the other hand, the studies reported by Koch et al. and Cepeda et al. concluded that music did not have any effect on the anxiety or pain levels during SWL treatment [20, 21].

Akbas et al. investigated the effect of music on anxiety, pain perception, and overall satisfaction of 400 patients whom underwent SWL treatment [23]. They concluded that music did not only lower the anxiety levels and pain scores of patients but it also provided greater satisfaction with treatment. However, pre-SWL STAI-T scores were not assessed in the context of this study [23]. In our study, we evaluated the preprocedural psychological status of the patients by calculating the STAI-T scores. STAI-T scores were found to be similar (in moderate anxiety level) in both groups indicating no difference in the general (baseline) anxiety levels of patients before SWL. STAI-S scores were also were found to be similar in both groups before SWL.

We also assessed the post-SWL STAI-S scores and the comparative analysis revealed that post-SWL STAI-S scores were significantly lower in group 1 (music). Furthermore, when we compared the changes before and after SWL, reduction in STAI-S scores was statistically significant in patients who listened to music during SWL treatment. Taken together these findings show that music can be considered as a supplemental nonpharmacological anxiety management strategy before some stressful interventions.

Of note, we attributed the statistically insignificant decrease in post-SWL STAI-S scores of the group 2 (control) patients to completion of a stressful procedure.

In our study, we detected a significant reduction in pain perception by addition of music to the treatment strategy. Post-SWL VAS-pain scores were significantly lower and satisfaction and willingness to repeat the procedure were significantly higher in group 1 (music). Therefore, it can be postulated that listening to music during a SWL session bears the potential to enhance patient satisfaction and compliance by reducing the procedure-related anxiety and pain. These findings are in line with the results reported in previous studies [17, 23].

In addition to anxiety and pain, we investigated the effect of music on relevant (i. e., potentially stress-related) hemodynamic parameters such as systolic blood pressure, diastolic blood pressure, and heart rate. Our findings revealed that systolic blood pressure, diastolic blood pressure, and heart rate were significantly lower in patients who listened to music (group 1) during the session compared to patients who did not (group 1). Our results are consistent with the findings of Yilmaz et al. in this regard [22].

We also compared the differences in the pre- and post-SWL hemodynamic parameters in both groups. The post-SWL systolic and diastolic blood pressure levels of the patients in group 1 were lower than their pre-SWL blood pressure levels. However, the difference was not statistically significant. On the other hand, patients in group 1 had significantly lower heart rate after SWL than prior to SWL. These findings may be attributed to the relaxing and anxiolytic effect of music. Nevertheless, the statistically insignificant increase in systolic and diastolic blood pressures and heart rates in group 2 (control) patients may be ascribed to stressful and anxiogenic nature of SWL treatment.

Yilmaz et al. stated that total SWL duration was shorter in patients who listened to music although the number of shock waves applied were similar [22]. Despite the fact that the difference was not statistically significant, these authors attributed this finding to the compliance-enhancing effect of music. However, no statistically difference was found in terms of SWL duration in our study.

This study has several limitations that need to be considered in interpreting the findings. First, we did not assess the analgesic need in our study groups. Second, hemodynamic parameters such as respiration rate and oxygen saturation were not analyzed in contrast to the some previously published reports [18, 22]. In addition, we did not compare the stone-free rates or any other procedure-related outcomes between two groups.

Conclusion

Music can be an ideal adjunctive treatment modality for patients undergoing SWL. It has the potential to enhance patient compliance and treatment satisfaction by reducing procedure-related anxiety and pain perception.

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Conflict of interest O. Cakmak, S. Cimen, H. Tarhan, R.G. Ekin, I. Akarken, V. Ulker, O. Celik, C. Yucel, E. Kisa, B. Ergani, T. Cetin, and Z. Kozacioglu declare that they have no competing interests.

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