

## Research Article

## Pain relieving effect of music on patients during transrectal ultrasonography: A pilot study

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## ABSTRACT

**Background:** Patient discomfort is often inevitable during transrectal ultrasonography (TRUS), a widely used modality for evaluating benign prostate hyperplasia/lower urinary tract symptoms. Music has been suggested as a method of pain relief during urologic procedures. In this study, we investigated the effect of music on pain relief during TRUS.

**Methods:** In a pilot study conducted from March to June 2019, pain scores of 316 patients who underwent TRUS with or without music were quantified using the visual analog scale (VAS). One-to-one propensity score matching was performed by matching the subjects between the groups. Patients with hemorrhoids of grade  $\geq$  III were excluded ( $n = 4$ ).

**Results:** Among the 312 patients included in the study (VAS score =  $3.3 \pm 2.4$ ), 177 listened to music during the procedure. There were significant differences in age, prostate-specific antigen, prostate volume, International Prostate Symptom Score symptom/life score, and VAS score between the music (+) and music (–) groups. After adjusting for relevant variables, VAS scores were significantly lower in male patients aged  $\geq 65.0$  years who underwent music intervention than in those who did not ( $1.5 \pm 1.4$  vs.  $3.0 \pm 1.4$ ,  $p = 0.002$ ).

**Conclusion:** Age was negatively associated with pain during TRUS, and music had a relieving effect on pain in patients aged  $\geq 65.0$  years. Our findings may help improve the quality of examinations in urologic outpatient offices.

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## 1. Introduction

Benign prostatic hyperplasia (BPH) is a common condition among older men, and it may cause lower urinary tract symptoms (LUTS), which interfere with daily function<sup>1</sup>. Transrectal ultrasonography (TRUS) is a helpful modality to assess the prostate in patients with BPH. TRUS is used to examine prostate volume and transitional volume to determine the hypertrophied component of the gland, but it is commonly associated with patient discomfort and pain. Age, anal tension, physical position, anxiety, and ultrasound probe-related pain are considered factors that influence pain during TRUS<sup>2,3</sup>. However, currently, there are no studies about factors that relieve pain during TRUS. Listening to music engages several cortical and subcortical areas related to pain modulation, including the periaqueductal gray matter<sup>4,5</sup>. Music is known to modify brain

activity in the presence of a painful stimulus<sup>6</sup>. Therefore, clinical trials have been conducted using music to decrease pain during procedures<sup>7,8</sup>. In the field of urology, the efficacy of music in relieving pain during outpatient urological procedures, including TRUS biopsy, shock wave lithotripsy, urodynamic studies, percutaneous nephrostomy tube replacement, and cystoscopy, has been evaluated<sup>7</sup>. However, to the best of our knowledge, no study has investigated the effect of music on reducing discomfort and pain during TRUS. Therefore, the aim of this study was to compare the efficacy of music in relieving pain during TRUS by employing a parallel observational study. In addition, this study identified the risk factors associated with pain during TRUS.

## 2. Materials and methods

## 2.1. Study population

The study was conducted in agreement with applicable laws and regulations, good clinical practices, and ethical principles, as

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described in the Declaration of Helsinki. The study protocol was reviewed and approved by the ethics committee of our hospital (IRB No.: 3-2020-0062). This retrospective observational study was based on records of all patients ( $n = 316$ ) who underwent TRUS from March to June 2019. We collected information on age, history of previous TRUS, the status of urinary symptoms, prostate volume, prostate-specific antigen (PSA) level, and visual analog scale (VAS) score of patients. The status of urinary symptoms was assessed using the International Prostate Symptom Score (IPSS) and quality of life. Prostate volume was calculated using the prostate ellipsoid formula ( $\text{height} \times \text{width} \times \text{length} \times \pi/6$ ) from TRUS data (BK-Medical, Herlev, Denmark). Patients who had previously undergone an anal operation or those with hemorrhoids of grade  $\geq$  III, which indicates that the hemorrhoid tissue has prolapsed beyond the dentate line, were excluded ( $n = 4$ ).

## 2.2. Assessment of VAS score during TRUS in the presence or absence of music

According to our institution's policy, the standard position during TRUS is the lateral decubitus position, and all TRUS procedures were performed while patients were in this position. TRUS was performed by the same surgeon (L.K.S). During the procedure, patients were given a VAS score sheet to rate their sensation of pain on a scale of 0–10, with 0 representing no pain and 10 representing unbearable pain. Popular classical music was played for 177 patients during their TRUS procedure through speakers that were installed in the procedure room, and was not played for 135 patients.

## 2.3. Statistical analysis

Categorical baseline clinical characteristics were compared using Pearson's Chi-square test. For continuous variables, means and distributions or median (IQR: interquartile range) were compared using Student *t* test and Wilcoxon two-sample tests, as appropriate. Logistic regression analysis was used to identify the independent parameters associated with the VAS score. All reported *p*-values were two-sided, and a *p*-value  $<0.05$  was considered statistically significant. All statistical tests were performed with SPSS software, version 25.0 (SPSS, Chicago, IL, USA).

## 3. Results

The baseline clinical and demographic characteristics of the patients who underwent TRUS are shown in Table 1. Among the 312 patients (mean age = 60.9 years) included, 177 (56.7%) patients listened to music (music (+) group) while undergoing TRUS, and 135 (43.3%) patients did not listen to music (music (–) group) while undergoing TRUS. Among the patients, age, prostate volume, PSA, IPSS symptom/life score, and VAS score were significantly different between the music (+) and music (–) groups. Univariate logistic regression analysis revealed that only age ( $\beta = -0.04$  (95% confidence interval (CI):  $-0.063, -0.013$ ),  $p = 0.003$ ) was significantly associated with the VAS score (Table 2).

VAS score was compared between the music (+) and music (–) groups and stratified according to age groups: 40s–50s, 60s, and 70s (Fig. 1). A significant difference in VAS score was observed between the music (+) and music (–) groups for patients in the 70s age group ( $1.5 \pm 1.5$  vs.  $3.2 \pm 2.4$ ,  $p = 0.016$ ). No significant differences in VAS scores were observed between the music (+) and music (–) groups when other age groups were compared.

Propensity score-matching analysis was performed to adjust for subjects' age, prostate volume, and history of TRUS, and 122 subjects (61 patients for each group) were selected (Table 1). In the

**Table 1**  
Characteristics of the study population according to treatment group

	Before propensity score matching	Music (–)	Music (+)	<i>p</i> -value
No. of patients (n)		135	177	
Age (years)		67.5 $\pm$ 8.9	55.9 $\pm$ 8.9	<0.001
History of TRUS (n)		70	74	0.078
Symptom score		14.1 $\pm$ 7.0	10.9 $\pm$ 6.3	<0.001
Life score		3.1 $\pm$ 1.3	2.7 $\pm$ 1.2	0.013
Prostate volume (cc)		32.5 $\pm$ 13.1	25.8 $\pm$ 7.0	<0.001
PSA (ng/mL)		3.2 $\pm$ 7.1	1.12 $\pm$ 1.09	0.001
VAS score		3.2 $\pm$ 2.3	3.4 $\pm$ 2.5	0.034
After propensity score matching		Music (–)	Music (+)	<i>p</i> -value
No. of patients (n)		61	61	
Age (years)		67.7 $\pm$ 7.8	61.9 $\pm$ 7.9	0.900
History of TRUS (n)		24	32	0.149
Symptom score		13.6 $\pm$ 7.0	11.0 $\pm$ 7.2	0.055
Life score		3.1 $\pm$ 1.4	2.9 $\pm$ 1.3	0.445
Prostate volume (cc)		28.3 $\pm$ 9.9	27.8 $\pm$ 8.6	0.751
PSA (ng/mL)		2.1 $\pm$ 1.2	1.4 $\pm$ 1.5	0.045
VAS score		3.0 $\pm$ 1.9	2.8 $\pm$ 2.4	0.660

Data are presented as *n* or mean  $\pm$  standard deviation.

PSA, prostate-specific antigen; TRUS, transrectal ultrasonography; VAS, visual analog scale.

**Table 2**  
Univariate analysis of potential risk factors associated with VAS score during TRUS

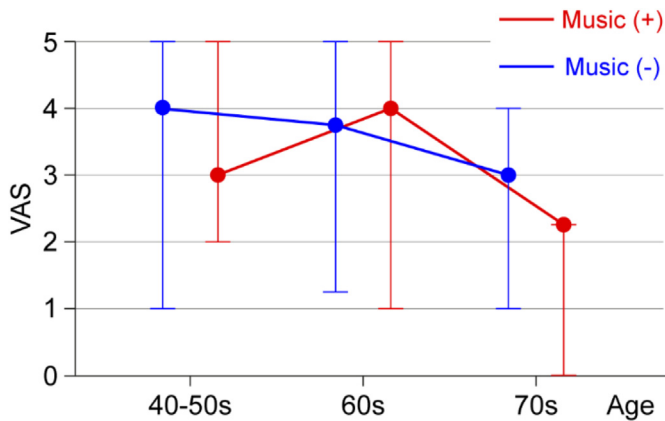
	Univariate	
	B (95% CI)	<i>p</i> -value
Age <sup>a</sup>	–0.051 (–0.099, –0.002)	0.042
History of TRUS	–0.22 (–0.798, 0.753)	0.954
Symptom score <sup>a</sup>	0.01 (–0.049, 0.067)	0.754
Life score <sup>a</sup>	0.09 (–0.220, 0.402)	0.562
Prostate volume <sup>a</sup>	–0.01 (–0.048, 0.036)	0.764
PSA <sup>a</sup>	–0.07 (–0.254, 0.118)	0.471
Music	–0.17 (–0.944, 0.600)	0.660

<sup>a</sup> Continuous variable; PSA, prostate-specific antigen; TRUS, transrectal ultrasonography; VAS, visual analog scale.

matched group comparison, no differences in age, history of TRUS, prostate volume, PSA, IPSS symptom/life score, and VAS score were noted. VAS score was determined for the music (+) and music (–) groups and stratified by age ( $<65.0$  years and  $\geq 65.0$  years; Table 3). VAS score did not significantly differ between the music (+) and music (–) groups in patients with  $<65.0$  years of age. However, in patients aged  $\geq 65.0$  years, VAS scores were significantly lower among patients in the music (+) group compared to those in the music (–) group (Table 3).

## 4. Discussion

This pilot study assessed the effect of music on relieving pain during the TRUS procedure by grouping patients depending on whether music was or was not played during their procedure. In our cohort, the VAS score in the music (+) group was significantly lower than that in the music (–) group; however, basic characteristics showed heterogeneity with regard to age and prostate volume. While prostate volume, history of previous TRUS, and music were not correlated with VAS score in our cohort, age was significantly correlated with VAS score, which was similar to previous findings<sup>9</sup>. However, no differences in VAS scores were noted between the music (+) and music (–) groups after adjusting for relevant variables. Subgroup analysis of patients over 65 years of age was performed to exclude age-related effects, and interestingly, among the patients aged  $\geq 65.0$  years, music was significantly correlated with the severity of pain. Due to the limitation of the



**Fig. 1.** Pain scores of patients according to age group in the presence or absence of music. Data represent the median (IQR: interquartile range); VAS, visual analog scale.

small number of patients in the subgroup, additional experiments are being considered for those over 65 years of age.

With a global increase in the average life span, the number of male patients who require treatment for LUTS has been growing, and the number of urological procedures, such as uroflowmetry and TRUS, performed in the outpatient setting has also increased. For the evaluation of male LUTS, TRUS is performed while the patient is awake. Therefore, pain during the procedure is a cause of concern in clinical practice<sup>9</sup>. Other procedures, such as cystoscopy, TRUS-guided prostate biopsy, and shock wave lithotripsy, as well as urodynamic studies, are performed under local anesthesia<sup>10,11</sup>. Several recent studies have investigated the potential of music to reduce pain and anxiety during some of these procedures. However, the role of music in improving patient discomfort remains unclear<sup>8</sup>.

There may be several mechanisms that cause pain during TRUS. First, pain may originate from the insertion of the TRUS probe and the movement of the ultrasound probe inside the rectum<sup>3,12</sup>.

The insertion of the TRUS probe requires passage through the internal anal sphincter (IAS) and the external anal sphincter (EAS), which are two important sphincters critical for maintaining anal continence<sup>13</sup>. While the EAS controls voluntary continence, the IAS controls involuntary (autonomic) continence<sup>14,15</sup>. Patients with severe anxiety or those undergoing the procedure for the first time may experience severe pain due to involuntary movement of the IAS<sup>16</sup>. Moreover, anal sphincters change anatomically and functionally with age<sup>17</sup>. Younger patients have a relatively high resting anal tone and low anorectal compliance, which causes greater pain during probe insertion and removal<sup>2</sup>. Second, the image of the prostate that is obtained during TRUS is captured by compressing

the rectal probe against the wall of the rectum. When this compression by TRUS probe is excessive, the probe can bend toward the prostate, inducing pain. Pain due to compression may also be caused by an extremely enlarged prostate and be attributable to the operator's skill and experience as well. Finally, several studies reported differences in patients' pain perception depending on the patients' position (lateral decubitus vs. lithotomy) during TRUS-guided prostate biopsy<sup>18–20</sup>. However, the optimal position that minimizes pain remains controversial. Interestingly, Lodeta et al suggest that the lithotomy position may be more unpleasant or embarrassing than the lateral decubitus position; and therefore, the perception of pain may be intensified<sup>20</sup>.

The present study considered age, prostate volume, and history of previous TRUS, as relevant parameters related to pain, during TRUS. Hou et al suggested that prostate sagittal length, external hemorrhoids, and previous anal operation history were significant factors associated with patient discomfort in TRUS<sup>21</sup>. This study excluded patients with external hemorrhoids and history of anal operation. Additionally, in our study, the sagittal length was excluded from analysis due to a multicollinearity issue with prostate volume.

We reaffirmed that patients of older age reported significantly lower pain during TRUS. We also noted that older patients had a lower anorectal muscle tone and a relatively higher anorectal compliance. Additionally, this study suggested that music did not have a consistent effect on pain during TRUS in all age groups. Music is a simple, cost-effective, and noninvasive therapeutic method that allows patients to be treated in a better environment. In a meta-analysis examining the effects of music on urological procedures, Kyriakides et al reported that music reduced anxiety and pain, resulting in increased satisfaction<sup>7</sup>. However, for older patients, by stabilizing the mood of the listener, music may lead to reduced muscle tension, a lower anorectal muscle tone, and a relatively higher anorectal compliance. These factors may facilitate relaxation and consequently reduce discomfort during TRUS.

There were some limitations to our study that are worth mentioning. First, its retrospective design and the inclusion of a small sample size imposed limitations on the statistical power. However, it suggested with sufficient statistical power that TRUS in patients of older age should be performed in the presence of music for reducing pain. Second, despite confirming the efficacy of music in reducing pain in patients aged  $\geq 65.0$  years, this study was inconclusive regarding the optimal genre of music for TRUS. The results of other studies using different genres of music may differ from the results reported in the present study, which used classical music. Third, due to the limitations of the retrospective study, sufficient patient data collection was not achieved. If follow-up studies are conducted, more variables such as a vital sign, after-procedure analgesic intake, and emotional distress from pain

**Table 3**

Characteristics of the study population according to treatment group, stratified by age group

	Age <65.0 years			Age $\geq 65.0$ years		
	Music (-)	Music (+)	p-value	Music (-)	Music (+)	p-value
No. of patients (n)	39	39		22	22	
Age (years)	57.1 $\pm$ 5.4	57.2 $\pm$ 5.0	0.969	70.0 $\pm$ 3.3	70.4 $\pm$ 4.2	0.718
History of TRUS (n)	13	18	0.253	11	14	0.373
Symptom score	12.3 $\pm$ 6.4	10.6 $\pm$ 6.6	0.284	15.6 $\pm$ 7.6	11.6 $\pm$ 8.3	0.118
Life score	3.0 $\pm$ 1.4	2.9 $\pm$ 1.3	0.675	3.2 $\pm$ 1.4	2.9 $\pm$ 1.4	0.502
Prostate volume (cc)	27.6 $\pm$ 9.1	27.3 $\pm$ 8.9	0.074	29.6 $\pm$ 11.4	28.6 $\pm$ 8.1	0.374
PSA (ng/mL)	2.4 $\pm$ 2.9	1.4 $\pm$ 1.6	0.909	1.7 $\pm$ 1.4	1.3 $\pm$ 1.3	0.722
VAS score	3.0 $\pm$ 2.2	3.6 $\pm$ 2.5	0.299	3.0 $\pm$ 1.4	1.5 $\pm$ 1.4	0.002

Data are presented as n, mean  $\pm$  standard deviation, or median (IQR: interquartile range). PSA, prostate-specific antigen; TRUS, transrectal ultrasonography; VAS, visual analog scale.

should be secured. Fourth, this study confirmed that pain relieving effect during TRUS was observed in patients aged 65 years or older, but the exact scientific mechanism was not found. This part is expected to be done through additional psychological and neurologic analyses. Finally, hemorrhoids have been identified as an important factor for the discomfort caused during TRUS, but the evaluation for hemorrhoids was not performed by experts; and only patients with hemorrhoid grade  $\leq$  II, which indicates hemorrhoid tissue prolapse above the dentate line, were included in our study.

In conclusion, during TRUS, the pain was associated with age, and music effectively relieved pain in patients aged  $\geq$ 65.0 years. We identified for the first time that music might relieve pain during TRUS and help perform higher quality examinations. Future studies are required to identify factors that may relieve pain in patients aged  $<$ 65.0 years.

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### Conflicts of interest

The authors have nothing to disclose.

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