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The effect of music on patient anxiety undergoing bronchoscopy: a randomized controlled trial

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Abstract

Background Bronchoscopy is a fundamental diagnostic and therapeutic examination with rare complications which is often associated to anxiety and discomfort.

The aim of our study is to evaluate the effect of music on anxiety levels among patients undergoing bronchoscopy in the pneumology department.

Methods We conducted a prospective, randomized, investigator-blinded, controlled trial performed in two university hospitals. The patients were randomized into two groups: experimental group who had preselected classic Tunisian music during bronchoscopy and control group who had bronchoscopy without music. we assessed anxiety level using Spilberger's State Anxiety inventory (S-STAI) and comfort level using visual analogic scale (VAS). Vital signs and side effects during bronchoscopy were also assessed.

Results One hundred thirty-six patients were equally assigned into the two groups. the anxiety levels before and after bronchoscopy were similar into the two groups. The music had no effect on anxiety level using the S-STAI. There was no significant difference between the two groups regarding side effects and vital signs during bronchoscopy. There was a significant effect of music on mean change of VAS score ($p=0.018$).

Conclusion The music improved comfort level of patients undergoing bronchoscopy.

Trial registration This study was retrospectively registered in the pan African Clinical Trial Registry with the trial number PACTR202309620440045 on 3 September 2023.

Keywords Anxiety, Music, Comfort, Bronchoscopy

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Background

Bronchoscopy is a fundamental examination for both diagnostic and therapeutic purposes in pneumology. The indications of this unavoidable procedure are still dominated by tumoral pathology [1]. Although considered as a safe method with rare major life-threatening complications, bronchoscopy is often associated with anxiety, stress and discomfort [2]. In fact, these negative emotions are quite common among patients undergoing bronchoscopy as well as other invasive procedures [3]. This technique has a variable but considerable effect on the degree of anxiety, which can lead to a more difficult, incomplete procedure, or even to a total refusal of the method by the patient [4]. Adequate and comprehensive information on the procedure, as well as adequate premedication and anesthesia, are necessary but may not be sufficient to reduce the patient's anxiety and discomfort [5]. Indeed, this feeling of stress, fear and discomfort is multi-factorial and depends not only on the education and information provided to the patient [6] but also on the operator's experience [7] and the patient's history [8]. Bronchoscopy itself can also be a source of anxiety for the patient. It is well known that these patients carry a heavy psychological burden due to the symptoms of the underlying disease, the uncertain diagnosis, the fear of the unknown or the unexpected [3]. However, acting on these factors may not be enough. Several pharmacological and non-pharmacological methods can therefore be implemented in order to win this care challenge. Currently, sedation can be used during endoscopic procedures to reduce patient anxiety and discomfort, but with a significant rate of cardiorespiratory side effects and cost. [9]. Several non-pharmacological methods have been suggested for this purpose, such as hypnosis, [10] acupuncture [11] and audio-visual distraction. [12]. Music therapy is a form of therapy that uses music as a therapeutic process. Listening to music appears to be beneficial in reducing anxiety in patients undergoing pleural procedures [13]. It has been suggested as a safe and accessible non-pharmacological means to reduce stress and anxiety in patients, across a number of endoscopic procedures. Its effect has been studied mainly in digestive endoscopy [14]. Very few studies have investigated the effect of music during Bronchoscopy, with conflicting findings. A study conducted in Denmark showed that music during Bronchoscopy reduces anxiety in patients with suspected lung cancer, especially when the music is self-selected. [15]. In contrast, Colt & al concluded that there was no significant effect of music on anxiety during bronchoscopy [16]. Results from RCTs can provide healthcare professionals with evidence-based information to make informed decisions about incorporating music interventions as a non-pharmacological intervention into clinical practice such

as bronchoscopy. This can lead to improved patient comfort and satisfaction.

The aim of this study was to evaluate the effect of music on anxiety levels among patients undergoing bronchoscopy in the pneumology departments at the university hospital of Kairouan and Sousse in 2023.

Methods

Study design

This study was a prospective, randomized, investigator-blinded, controlled trial performed from April 2, 2023 to October 2, 2023 at the two pneumology department of Farhat Hached University Hospital and Ibn El Jazzar University hospital in the centre of Tunisia.

Participants

All inpatients and outpatients at the two study centres, scheduled for bronchoscopy under local sedation, were eligible. Were included, Patients aged ≥ 18 years who could understand and give consent. Patients with hearing or memory impairment, consciousness disorders, undergoing psychiatric treatment for anxiety disorders and/or taking anxiolytic or sedative medication were excluded from the study. Participants with a history of major depressive disorder, bipolar disorder, generalized anxiety disorder, panic disorder, obsessive-compulsive disorder, post-traumatic stress disorder, or schizophrenia were excluded. These conditions were excluded to minimize potential confounding factors that could influence anxiety levels and responses to the intervention. Patients were also excluded if bronchoscopy had been interrupted for any reason. Verbal and written informed consents about the bronchoscopy procedure and the research study were obtained from all participants prior to enrolment in the study. All participants had the possibility to ask the investigators about the study protocol. Randomization was carried out using a computer-generated randomization list to have the same number of participants in the two groups. To reduce the likelihood of bias in the assignment of participants to groups, a collaborator not involved in the study allocated the patients into two groups: Experimental for the patients undergoing bronchoscopy with music and control group for patients undergoing bronchoscopy without music. He maintained a confidential register of assignments.

Intervention

Before entering the endoscopy unit, the investigator completed the first part of the pre-established questionnaire including the characteristics of consenting participants. Once installed in the endoscopy room, the patient receives two Bluetooth earphones according to the randomization process. For the control group, the two headsets played no

music. For the experimental group, the headsets played a playlist of preselected traditional Tunisian music. For this group, to ensure blinding to the investigator and the bronchoscopist, a collaborator not participating in the study will adjust the volume so that the music does not interfere with patient communication, before the entrance of the investigator and the bronchoscopist. All patients were told not to disclose the allocation. The earphones were placed on both ears approximately 10 min before the bronchoscopy and were not removed until 10 min after the end of the bronchoscopy. The conditions for performing bronchoscopy were similar in the two study centres. Bronchoscopy was performed using a flexible bronchoscope (Olympus BF-XP290) inserted through the nose. The procedure included performing various diagnostic sampling techniques, such as cytological analysis from bronchial aspirate or bronchoalveolar lavage fluid, as well as bronchial and transbronchial biopsies. All patients received local anaesthesia by gargling 5 ml of 2% lidocaine. Lidocaine gel 2% was also used to lubricate the bronchoscope. The total dose of lidocaine during bronchoscopy was limited to 0.8 mg/kg. [17]. The choice of music was made with a music therapist who selected a 30-min playlist of 6 Tunisian songs that are known for their frequent use of traditional instruments such as the oud, violin, and percussion, which add an authentic touch to the music, reinforcing the patients' cultural link with music. In addition to the instrument used, the choice was made according to the rhythm, the crescendo then decrescendo, and tempo. The Tunisian classical songs selected for this study were carefully chosen for their rhythm, starting with a moderate tempo, then progressing to a musical crescendo, followed by a gradual decrescendo. This progression can be seen as a resonant representation of the patients' emotional experience. The initial rhythm can help to establish a sense of stability, the crescendo can elicit positive emotions, and the decrescendo can provide a sense of gradual relaxation.

Outcomes

The primary outcome was changes in anxiety level as measured by the STAI-S before and after the bronchoscopy (Δ STAI). The secondary outcomes were changes in comfort level as measured by VAS, the blood pressure, heart rate and the oxygen saturation (Sat O₂), before and after bronchoscopy. The duration of the procedure and side effects (desaturation, tachycardia) during the procedure were also recorded. Anxiety was measured using the State trait anxiety inventory, state subscale (STAI-S) in his Arabic version [18]. This scale includes 20 questions with scores ranging from 20 to 80. The highest score corresponds to the highest degree of anxiety. [19]. Comfort was assessed using a visual analogic scale (VAS), which provides a subjective evaluation of patient satisfaction. It

consists of a 10 cm horizontal or vertical line whose two extremities represent the minimum and maximum comfort scores (0: very uncomfortable/not at all comfortable), 10: no discomfort (very comfortable). [20].

Data collection tool

The data was collected using a pre-established questionnaire developed based on the literature. This questionnaire consists of 4 parts: the first part is related to general characteristics of the patients (age, gender, education level, comorbid disease, and symptoms), the second part is related to vital parameters (HR, BP, and Sat O₂) before and after bronchoscopy. The third part is related to the bronchoscopy procedure (duration and side effects during bronchoscopy). The fourth part is related to the evaluation of anxiety and comfort using the STAI-S and a VAS.

Statistical analysis

All statistical analyses were performed using SPSS (Version 21, SPSS Inc., Chicago, USA). Kolmogorov–Smirnov test was used to determine if the data were normally distributed. The central tendencies of the variables studied were summarized by means \pm Standard Deviations (SD) and medians \pm Inter Quartile Intervals (IIQ). Chi square test was used to compare categorical variables between the two groups. Student t test or Mann–Whitney U test were used to compare continuous variables as appropriate. Statistical significance was determined at the 0.05 level and confidence intervals (CIs) set at 95%.

Sample size determination

The sample size was set at 136, estimating a 20% drop-out and using Statistical significance at the 0.05 level, a confidence interval (CIs) at 95% probability and a power of 80%. The standard deviation was set at 10.4 for STAI State, and a count of 5 was interpreted as a clinically relevant difference [16].

Ethical considerations

The study protocol was approved by the ethics committee of the faculty of medicine of Sousse (Tunisia) and registered in the pan African Clinical Trial Registry, on 3 September 2023, with the trial number PACTR202309620440045.

Results

From April to October 2023, 146 participants were assessed for eligibility. Three patients refused to participate, and 2 patients were aged < 18 years. Participants with psychiatric disease ($n=2$) and hearing impairment ($n=3$) were excluded. The remaining 136 participants were randomly assigned to the control ($n=68$) and experimental group ($n=68$) (Fig. 1).

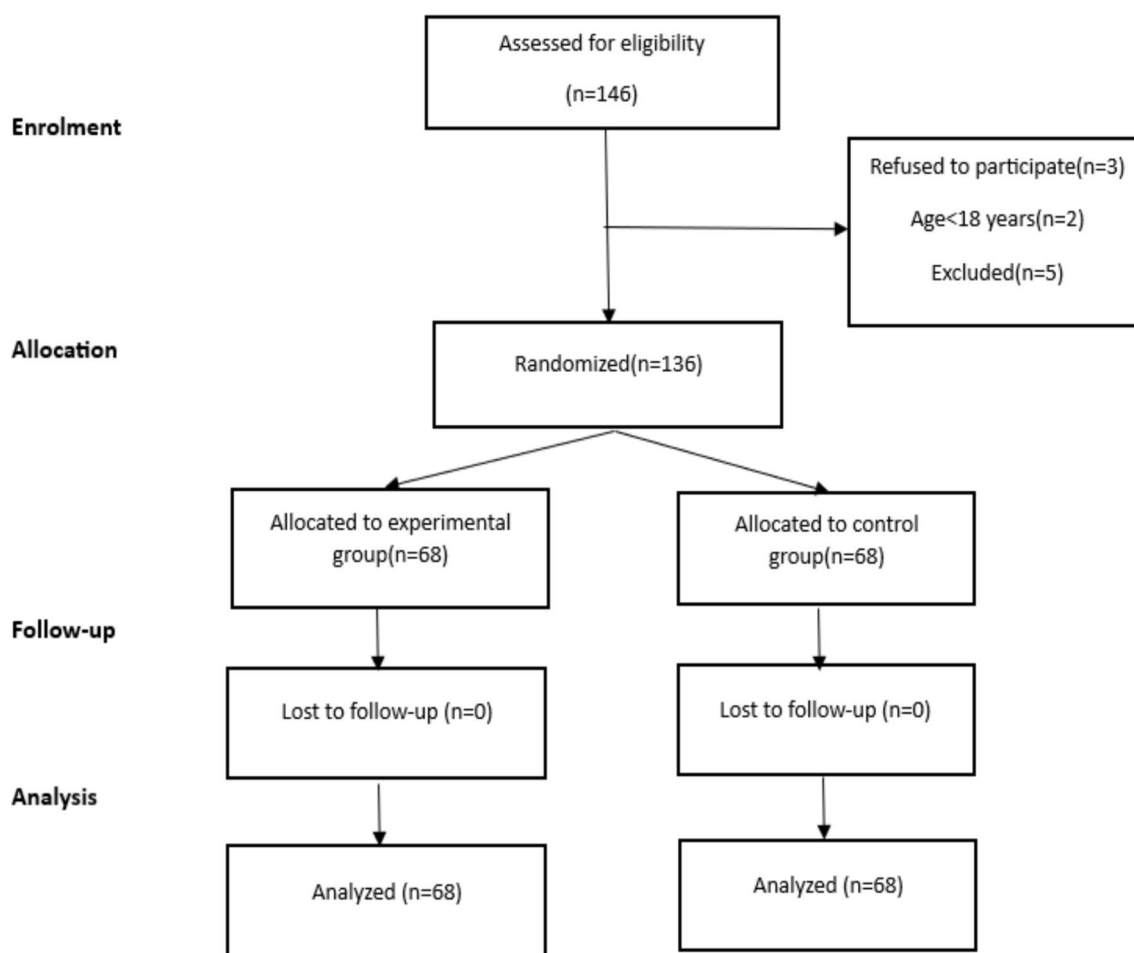


Fig. 1 Flowchart of the study

The baseline characteristics of the study participants (Table 1)

There were no statistically significant differences in age, gender and comorbidities between the control and experimental group. More than half of participants had low level of education (illiterate or primary school level) with no difference between the two groups ($p=0.24$). The most common respiratory symptoms were cough, chest pain and dyspnea. The main indication for bronchoscopy in both groups was suspicion of lung cancer, which was found in 58.5% of cases.

Comparison of procedure related variables between experimental and control group (Table 2)

Pre and post bronchoscopy vital signs as blood pressure, heart rate and oxygen saturation, were similar in the two groups. No statistically significant difference was found between the two groups in terms of side

effects, including tachycardia and desaturation, during bronchoscopy. The mean duration of bronchoscopy was similar in the control and experimental group.

Comparison of variation of vital signs between experimental and control group (Fig. 2)

There was no difference in the Δ SBP and Δ DBP, measured as difference between constants after and before bronchoscopy, between the control and experimental group. The music didn't have a significant effect on the mean change of SatO₂ and HR.

Anxiety and comfort evaluation

There were no significant differences between the two groups on the absolute values of STAI before bronchoscopy ($p=0.97$), nor after the procedure ($p=0.34$) (Table 2). Moreover, the music didn't have a significant effect when analyzing the Δ STAI ($p=0.41$) (Fig. 3). When analyzing the VAS before and after bronchoscopy, there was no difference between the

Table 1 Baseline characteristics of the participants

| Characteristics | Control Group, n (%) (N = 68) | Expérimental group, n (%) (N = 68) | p |
|-------------------------------------|----------------------------------|---------------------------------------|-------------------|
| Age(year) | | | |
| > 65 | 30(44.1%) | 25(36.8%) | 0.38 ^b |
| < 65 | 38(55.9%) | 43(63.2%) | |
| Age (mean ± SD) | 59.78 ± 15.77 | 56.68 ± 15.52 | 0.22 ^c |
| Gender n (%) | | | |
| Female | 11(16.2%) | 18(26.5%) | 0.14 ^b |
| Male | 57(83.8%) | 50(73.5%) | |
| Education level | | | |
| Illiterate | 17(25%) | 15(22.1%) | 0.24 ^b |
| Primary school | 34(50%) | 27(39.7%) | |
| Secondary or high school | 17(25%) | 26(38.2%) | |
| Comorbid disease^a | | | |
| Yes | 17(25%) | 16(23.5%) | 0.84 ^b |
| No | 51(75%) | 52(76.5%) | |
| Respiratory symptoms | | | |
| Dyspnea | 19(27.9%) | 21(30.9%) | 0.7 ^b |
| Cough | 34(50%) | 30(44.1%) | 0.49 ^b |
| Chest pain | 27(39.7%) | 21(30.9%) | 0.28 ^b |
| Hemoptysis | 18(26.5%) | 16(23.5%) | 0.69 ^b |
| Preliminary diagnosis | | | |
| Lung cancer | 40(58.8%) | 40(58.8%) | 1 ^b |
| Other | 28(41.2%) | 28(41.2%) | |

SD Standard deviation

^a Hypertension, Diabetes mellitus, heart diseases^b Chi square test^c Student t-test

two groups. (Table 2). Interestingly, there was a significant effect of music on change of VAS score ($p = 0.018$) (Fig. 3). On average, music improved the VAS score by 0.85 points compared with the control group.

Discussion

This study that aimed to evaluate the effect of music on anxiety during bronchoscopy, showed a decrease of anxiety level using the VAS, in patient listening to music, when compared to the control group. This result was not found when using the S-STAI (Fig. 3).

The effect of music on anxiety has been the subject of several studies in various fields including psychiatry [21], oncology [22], cardiology [23] and surgery [24] and procedures such as endoscopy [25]. In fact, the use of music during surgery under local anesthetic has been shown to reduce patient's stress levels by masking unpleasant sounds. [26].

In a previous study, it has been demonstrated that the use of music can reduce pre-operative anxiety during short waiting periods. [27].

Table 2 Procedure related variables

| | Control group (N = 68) | Music group (N = 68) | p |
|---|---------------------------|-------------------------|-------------------|
| Pre- bronchoscopy | | | |
| STAI-S | 46.56 ± 5.65 | 46.59 ± 5.88 | 0.97 ^a |
| VAS | 6.15 ± 2.36 | 5.74 ± 2.62 | 0.33 ^b |
| HR, Mean ± SD | 87.31 ± 14.77 | 85.09 ± 16.55 | 0.41 ^a |
| DBP, Mean ± SD | 73.38 ± 11.79 | 73.97 ± 13.62 | 0.78 ^b |
| SBP, Mean ± SD | 129.12 ± 24.23 | 130.44 ± 22.81 | 0.74 ^b |
| SatO2, Mean ± SD | 97.07 ± 1.94 | 97.06 ± 2.27 | 0.96 ^b |
| Post-bronchoscopy | | | |
| STAI-S, Mean ± SD | 46.29 ± 5.68 | 45.32 ± 6.25 | 0.34 ^a |
| VAS, Mean ± SD | 7.90 ± 1.73 | 8.32 ± 1.72 | 0.15 ^b |
| HR, Mean ± SD | 97.65 ± 17.45 | 95.94 ± 18.37 | 0.58 ^a |
| DBP, Mean ± SD | 75.15 ± 14.40 | 74.41 ± 12.50 | 0.75 ^b |
| SBP, Mean ± SD | 130.29 ± 21.3 | 130.0 ± 21.44 | 0.93 ^b |
| SatO2, Mean ± SD | 95.16 ± 2.84 | 95.12 ± 2.99 | 0.93 ^b |
| Side effects | | | |
| Desaturation, n (%) | 14(20.60) | 18(26.50) | 0.41 ^c |
| Tachycardia, n (%) | 23(33.80) | 33(48.50) | 0.08 ^c |
| Bronchoscopy duration (min), Mean ± SD | 12.12 ± 6.19 | 11,04 ± 4,46 | 0.24 ^b |

SD standard deviation, HR heart rate, DBP diastolic blood pressure, SBP systolic blood pressure, SatO2 Oxygen saturation, STAI-S Spielberger' State Trait Anxiety Inventory (State form), VAS Visual analogic scale

^a Student t-test^b Mann-Whitney U test^c Chi square test

Bronchoscopy is a procedure that frequently elicits feelings of anxiety and stress among patients [28], potentially resulting in diminished satisfaction and compliance. [6] Previous studies using music has failed to reduce anxiety levels among patients undergoing bronchoscopy [16, 29]. In the other hand a previous study reported a positive effect of music on STAI level [9]. A systematic review showed that music during bronchoscopy reduced patients' blood pressure and heart rate, but no conclusive results were obtained on the effect of music on anxiety levels [30].

Several different scales, therefore, were used to evaluate the anxiety outcome. In our study we opted to assess anxiety using two types of indicators: psychological, subjectively measured using the STAI and VAS, and physiological, objectively measured using the HR, SatO2 and BP. The STAI is a very widely known and reliable self-report scale that has been used extensively to assess anxiety. [31]. the State portion of this questionnaire including 20 questions may be more complex for our participants who mainly have a low education level when compared to the VAS.

The discrepancy between the results obtained from the STAI and the VAS may partly be explained by their

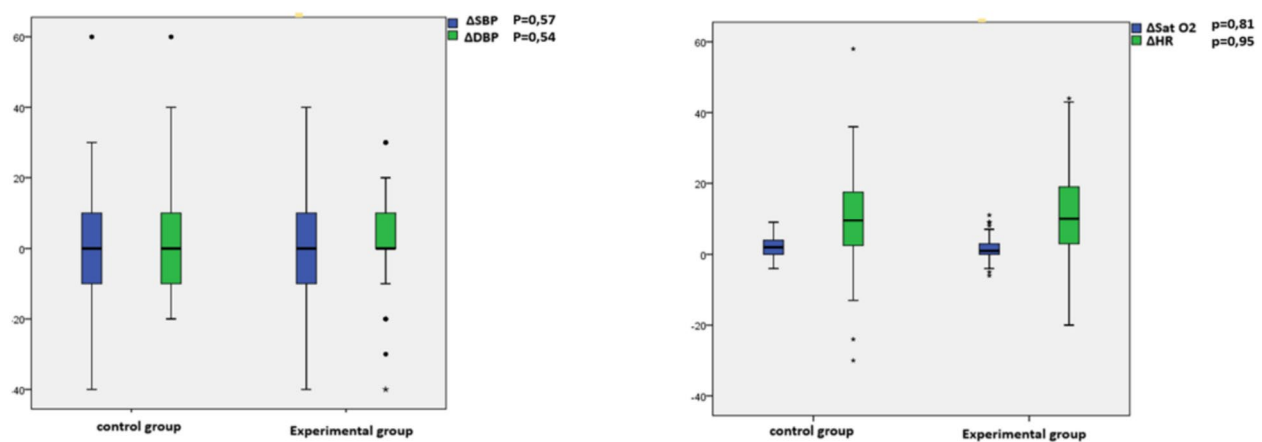


Fig. 2 Comparison of variation of vital signs between experimental and control group

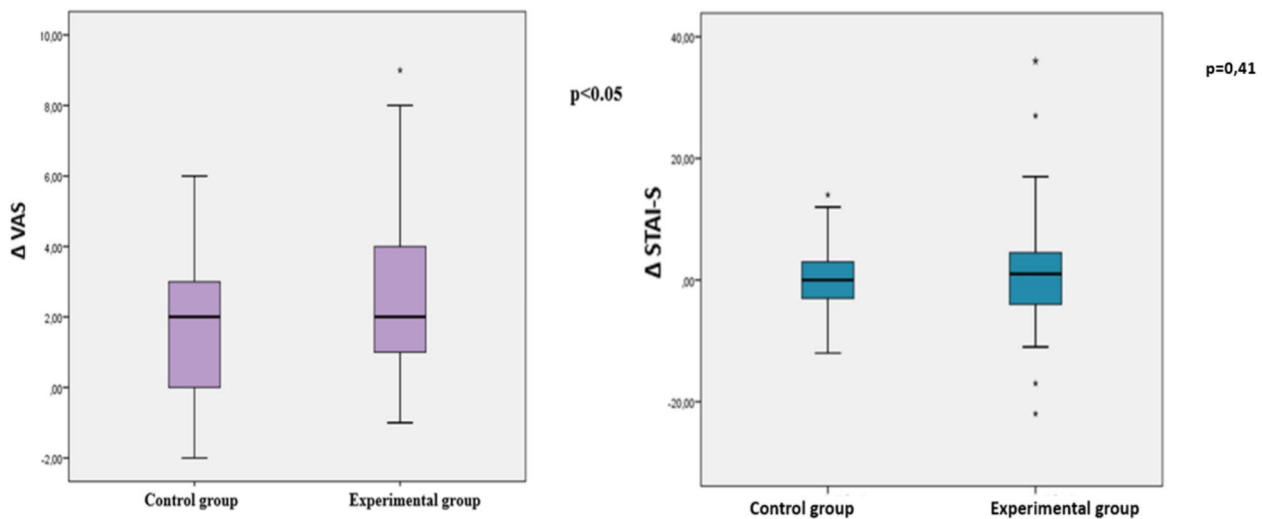


Fig. 3 Comparison of the variation on the VAS and STAI-S scores between experimental and control group

differing levels of complexity and the cognitive effort required to respond accurately. The VAS, being a simpler and more intuitive tool, might better reflect participants' immediate emotional states, particularly for individuals with lower literacy levels. Conversely, the STAI's more detailed structure could lead to challenges in comprehension, potentially influencing the accuracy of responses.

Additionally, in some situations, individuals may underestimate their anxiety levels when responding to self-report tools like the STAI. This may be due to self-protective strategies, where participants adopt defensive attitudes that prevent them from fully recognizing or admitting their emotional state, particularly fear. For some patients, expressing discomfort through the VAS might feel more acceptable than explicitly identifying fear through the STAI [32].

These potential limitations underscore the value of using multiple measures to assess anxiety, as they provide complementary insights into the participants' experiences. While the STAI offers a robust framework for anxiety evaluation, the VAS may offer a practical and culturally sensitive alternative for populations with limited literacy levels. Further exploration of these tools' limitations and strengths within this context could help refine future studies in this area. To overcome this anxiety during bronchoscopy, different types of music have been studied like binaural beat audio [9], piano improvisation [16], soft music [30] or even self-selected music [15]. Music therapy uses various musical elements, including melody, timbre, rhythm, harmony and pitch, to enhance physical and psychological well-being [33]. In fact, music acts as a distractor, diverting the patient's attention from negative stimuli

to something pleasant and encouraging, thereby improving anxiety. [34]. The underlying theory behind the use of music as an anti-anxiety intervention method is its ability to trigger relaxation by stimulating the autonomic nervous system. [27]. It has been shown that in addition to the intrinsic perception of music, the feeling of well-being is linked to symbolic, iconic and behavioral meanings. [35].

For these reasons, we have opted in our study, for Tunisian classical music, which is characterized by its authentic dimension, manifested in its respect for formal structure, poetic texts, rhythms, melodic modes and Tunisian musical intonation, resulting from technical elements characteristic of the traditional musical language of each region. This heritage reflects an aspect of Tunisian culture rooted in the depths of history. This music is part of the "oriental" music movement and is a synthesis of the Tunisian own cultural heritage and external contributions, mainly from the Andalusian and Oriental traditions. In other words, Tunisian music is music that lives, it's full of feeling and its music that supports people in their daily lives.

Strength and limitations

To the best of our knowledge, it's the first study that involves music therapist in the choice of the music, thus meeting the exact definition of music therapy, as distinct from music medicine, used in the majority of previous studies. Furthermore, double blinding to the investigator and the bronchoscopist is one of the strong points of our study. Moreover, anxiety was assessed using two different subjective scales (STAI and VAS) and objective measurement like oxygen saturation and blood pressure.

However, some limitations of the study should be mentioned. The time given to the patient to listen to the music (10 min) before bronchoscopy maybe insufficient to relax the patient. One notable limitation is the duration of the music intervention. This time, may have been insufficient to achieve a meaningful relaxation effect. Longer exposure to music might have allowed patients to engage more deeply with the intervention, potentially enhancing its anxiolytic benefits. Future studies should consider evaluating the optimal duration of music exposure needed to maximize its calming effects in this clinical context.

Although the STAI is still the most widely used for assessing anxiety, it may not be suitable for our population, as this questionnaire can be confusing for illiterate patients, who make up the majority of our population. To mitigate this limitation, we have included the use of VAS. By using both the STAI and the VAS, we aimed to provide a more comprehensive assessment of anxiety and to account for potential limitations associated with either measure alone. However, it is important to acknowledge that the VAS also has limitations. While it is less dependent on literacy, it may be susceptible to anchoring effects

and may not capture the nuances of anxiety as effectively as a more structured self-report measure.

In future research, exploring additional methods for assessing anxiety in populations with low literacy levels, such as behavioral observations or interviews, could provide valuable insights into the most appropriate assessment tools for diverse populations.

The use of pre-selected music can reduce the expected positive effect of music.

Another important consideration is the cultural specificity of the music used. While traditional Tunisian music was chosen to align with the cultural context of the participants, individual preferences for music genre and style were not assessed or incorporated into the intervention. This may have impacted the degree to which participants connected with the music, potentially influencing the intervention's effectiveness. Future studies should consider a more personalized approach to music selection to better cater to individual preferences while maintaining cultural relevance. Broader cultural factors may have influenced participants' responses to both the music intervention and the self-report tools. For example, cultural norms surrounding emotional expression or familiarity with music as a therapeutic tool might have affected the participants' receptiveness and reported outcomes. These aspects merit further exploration in future research to better understand their influence on study results.

In addition, we didn't use subjective direct measurement to assess anxiety like blood cortisol.

While the absence of sedation in our study allowed us to isolate the effects of music on anxiety, it is important to acknowledge that this may limit the generalizability of our findings to clinical settings where sedation is routinely used. Future studies should investigate the effects of music on anxiety in patients undergoing sedated bronchoscopy procedures.

Implication for practice and research

Future studies can address these limitations. The positive effect of the music can be enhanced by giving the choice to the patients to select the preferred music and increasing the amount of time the music is played. In addition, the use of subjective measurement like blood cortisol or salivary indices may be an interesting prospect for future research.

Conclusion

This study that aimed to evaluate the effect of music on anxiety during bronchoscopy, showed an improvement of comfort level using the VAS, in patient listening to music, when compared to the control group.

Our study supports the findings that music, as a simple, safe and inexpensive complementary methods can in addition to sedatives and analgesics, improve comfort and reduce anxiety of patients undergoing bronchoscopy.

Abbreviations

| | |
|--------------------|---|
| BP | Blood pressure |
| DBP | Diastolic blood pressure |
| HR | Heart rate |
| RCT | Randomized controlled trial |
| Sat O ₂ | Oxygen saturation |
| SBP | Systolic blood pressure |
| S-STAI | State subscale of the Spielbergers' State trait anxiety inventory |
| STAI | Spielbergers' State trait anxiety inventory |
| VAS | Visual analogic scale |

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12906-025-04861-7>.

Supplementary Material 1

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Authors' contributions

A.K, S.A, D.C, A.M, A.A, W.J and R.B contributed to the design and the conception of the study. A.K, S.A, W.B, I.K, A.K, B.B, I.G and D.C contributed to the implementation and analysis plan. All authors have critically read the text and contributed with inputs and revisions. All authors read and approved the final manuscript.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the ethics committee of the faculty of medicine of Sousse (Tunisia) and registered in the pan African Clinical Trial Registry on 3 September 2023, with the trial number PACTR202309620440045. Verbal and written informed consents about the bronchoscopy procedure and the research study were obtained from all participants prior to enrollment in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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