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Monochord sounds and progressive muscle relaxation reduce anxiety and improve relaxation during chemotherapy: A pilot EEG study☆

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Summary
Background: Chemotherapy is the most distressing form of cancer treatment in oncology, but listening to music can be an adjuvant during chemotherapy. Monochord (MC) sounds are used in music therapy for the alleviation of pain, enhanced body perception, and relaxation. This study investigated the relaxation effect of MC sounds for patients during chemotherapy compared with progressive muscle relaxation (PMR), an established relaxation technique.
Methodology/principal findings: Two randomized groups of patients were observed during chemotherapy. One group listened to recorded MC sounds ($n = 20$) and the other group listened to recorded PMR ($n = 20$). Each session was investigated pre and post using Spielberger's State Anxiety Inventory (SAI) and a questionnaire about the patient's physical and psychological states. Further, for the first and the last session, multivariate electroencephalogram (EEG) signals were recorded.

Patients in both MC and PMR groups showed significant improvement in their physical and psychological states and in state anxiety. The EEG data showed that the MC and the PMR groups were associated with an increase of posterior theta (3.5—7.5 Hz) and a decrease of midfrontal beta-2 band (20—29.5 Hz) activity during the end phase of relaxation treatment. Further, the MC group was associated with decreased alpha band (8—12 Hz) activity in comparison with PMR group.
Conclusions: This study shows that both listening to recorded MC sounds and practising PMR have a useful and comparable effect on gynaecologic oncological patients during chemotherapy, with partially overlapping but also notably divergent neural correlates. Future research should establish the systematic use of MC in oncological contexts.

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Introduction

Several studies show that patients diagnosed with gynaecological carcinomas have a high level of distress,[1–3] both physical and psychological, with a multitude of side effects.[4,5] Further, a recent psycho-oncological study shows that the most distressing form of cancer treatment is chemotherapy.[2] For patients undergoing chemotherapy, psychological support is especially required to help patients overcome their illness status by reducing their anxiety, alleviating their pain, and strengthening them psychologically. The provision of such support can also minimize post-treatment psychological distress.[6]

Music is a powerful and effective medium which can assist in reducing anxiety, pain, and stress.[7–9] Listening to music can improve the psychological state of patients and promote their physical well-being in different oncological contexts, including palliative care[10] and radiotherapy.[11] Several studies demonstrate the positive effects of music in alleviating anxiety,[12] reducing nausea and emesis,[13,14] and inducing relaxation in patients undergoing chemotherapy.[15] However, an evidence-based concept for the use of music still needs to be established. In particular, the specific illness situation of patients should be considered when assessing how music is used in the clinical context. An adequate explanation of this music-psychological and music-physiological phenomenon needs to be elaborated to develop the clinical use of music. Moreover, none of these current studies[11–15] have analysed the subjective psychological feedback from patients in combination with neurophysiological data to gain deeper insights into the positive effects. Therefore, little information is available on the possible neural mechanisms underlying the therapeutic effects by music in the oncological context.

The current study attempted to address these limitations by recording large scale neural responses (producing an electroencephalogram (EEG)) from oncological patients undergoing chemotherapy with special emphasis on the general therapeutic effects of monochord (MC) sounds. The MC is an ancient instrument with approximately 30 strings that is tuned to one base tone while nevertheless producing many overtones. MC sounds merge into one continuous sound with varying overtones and do not have definite scale, harmony, or accords, unlike what we usually associate with music. MC sounds are generally perceived as calming or pleasant, and listeners express positive feelings of a physical and psychological nature.[16] Although MC sounds are often used in music therapy, especially in Germany, it has rarely been studied in the clinical context. One clinical study in the context of oncological rehabilitation was conducted regarding the effect of sound meditation, which is a relaxation method combining mainly the MC with a variety of other sounds such as a gong, sound bowls, and (overtone) singing. 75.6% of oncological patients ($n = 105$) reported positive body sensations from 'sound meditation'.[16]

Since research into the effects of music in the clinical context is still in its infancy, the actual effect of relaxation through music can only be shown reliably by comparing — as in previous studies[17,18] — against a proven psychological relaxation method.[19] Comparison with a non-treatment control group could lead to distorted results due to the placebo effect in the group receiving treatment. Furthermore, since the main purpose of this study is to find out the effect of relaxation during chemotherapy, this excludes comparison with a waiting list control group. Ethical considerations prohibited the use of a placebo control group. Jacobson's progressive muscle relaxation (PMR) exercise is a relaxation method that has been demonstrated to be effective among oncological patients.[20,21] In this study, we have therefore compared the relaxing effect of monochord sounds against that of PMR on gynaecological cancer patients undergoing chemotherapy.

The current study had two principal objectives: (i) to investigate — from both subjective and neurobiological perspectives — the extent of therapeutic effects of monochord sounds in gynaecologic oncological patients undergoing chemotherapy and (ii) to compare these effects against those achieved with PMR.

Methods

Participants

This study was conducted in the Oncological Outpatients Clinic of the University Women's Hospital of Heidelberg, Germany. For patient selection, we have sought the participation of patients who had been diagnosed with breast cancer or gynaecological cancer, such as ovarian carcinoma and cervical carcinoma, who were about to receive chemotherapy for the first time in their life. Further, chemotherapy needed to be conducted for a minimum of 6 times (at 3-week intervals) and a maximum of 9 times (at 2-week intervals). Exclusion criteria were: previous experience with chemotherapy, regular practice of relaxation techniques, exceeding the age of 65 years, brain tumour or other metastases, other neurological diagnosis or prior brain operation, and pregnancy. The patients were randomly assigned to the MC group or the PMR group by means of permuted-block randomization. The group allocation was not communicated to the patients until the first relaxation treatment (Fig. 1).

Procedure

From the second to the fifth sessions of chemotherapy, relaxation treatment for both groups was provided after their premedication and in sync with the start of chemotherapy. To ensure that the first chemotherapy session ran as smoothly as possible, the relaxation treatment was provided only from the second chemotherapy session. During relaxation treatment, patients were instructed to remain awake in supine position with eyes closed. They listened to professionally recorded MC sounds or instructions for PMR by in-ear-phones (Sennheiser CX300II) from an iPod for a period of 30 min. The PMR instructions and MC sounds both lasted for approximately 25 min. There was a verbal introduction (4 min) before and a silent period (5 min) after each treatment, producing a total listening time of 34 min.

In each session, both before and after the relaxation treatment, patients in MC and PMR groups completed the German version of the State Anxiety Inventory (Spielberger's STAI-G Form X-1[22]) and a questionnaire about their physical and psychological states and their perception of the relaxation treatments (FB).[16] The State Anxiety Inventory (SAI)