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Soothing music can increase oxytocin levels during bed rest after open-heart surgery: a randomised control trial

Ulrica Nilsson

Aim. To evaluate the effect of bed rest with music on relaxation for patients who have undergone heart surgery on postoperative day one.

Background. Music intervention has been evaluated as an appropriate nursing intervention to reduce patients 'pain, stress and anxiety levels in several clinical settings, but its effectiveness in increasing patients' subjective and objective relaxation levels has not been examined.

Design. A randomised controlled trial.

Method. Forty patients undergoing open coronary artery bypass grafting and/or aortic valve replacement surgery were randomly allocated to either music listening during bed rest ($n = 20$) or bed rest only ($n = 20$). Relaxation was assessed during bed rest the day after surgery by determining the plasma oxytocin, heart rate, mean arterial blood pressure, PaO_2, SaO_2 and subjective relaxation levels.

Results. In the music group, levels of oxytocin increased significantly in contrast to the control group for which the trend over time was negative i.e., decreasing values. Subjective relaxation levels increased significantly more and there were also a significant higher levels of PaO_2 in the music group compared to the control group. There was no difference in mean arterial blood pressure, heart rate and SaO_2 between the groups.

Conclusion. Listening to music during bed rest after open-heart surgery has some effects on the relaxation system as regards s-oxytocin and subjective relaxations levels. This effect seems to have a causal relation from the psychological (music makes patients relaxed) to the physical (oxytocin release).

Relevance to clinical practice. Music intervention should be offered as an integral part of the multimodal regime administered to the patients that have undergone cardiovascular surgery. It is a supportive source that increases relaxation.

Key words: coronary artery bypass, music, nursing, oxytocin, postoperative care, relaxation

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Introduction

Patients undergoing surgical treatment for coronary artery disease and valvular heart disease begin to experience anxiety when the decision to undergo surgery is made and they remain anxious for up to three months after surgery (Burg *et al.* 2003, Twiss *et al.* 2006). Studies indicate that there is a correlation between high preoperative anxiety levels and acute pain following breast surgery (Katz *et al.* 2005). In addition, patients with higher anxiety and depression levels preoperatively have higher postoperative pain and analgesic requirements (Ozalp *et al.* 2003). Postoperative anxiety can cause increased sensitivity to noise, which results in increased autonomic response, sensory overload and sleep deprivation leading to physiological problems that can increase the duration of hospital stay (Caumo & Ferreira

Author: *Ulrica Nilsson*, PhD, RNA, Assistant Professor, Department of Cardiothoracic Surgery and Centre for Health Care Sciences, Örebro University Hospital and School of Health, Örebro University, Örebro, Sweden

Correspondence: Ulrica Nilsson, Assistant Professor, Centre for Health Care Sciences, P.O. Box 1324, SE 70113 Örebro, Sweden. Telephone: +4619602844.
E-mail: ulrica.nilsson@orebroll.se

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2003). There is a need for interventions to reduce stress, pain and anxiety by providing an environment that is more conducive to healing and can be used as an integral part of the multimodal regime administered to the patients undergoing surgery. One possible treatment could be music intervention, used as an 'audioanalgesia', 'audioanxiolytic' and/or 'audio relaxation' defined as ' a supportive source of environmental sound that stimulates and maintains relaxation as well reduces or controls distress by a self-management technique' (Nilsson 2008, *p. 708*). Music intervention should not be mistaken for music therapy, which is an expressive therapy that focuses on means of contact and communication to achieve therapeutic relationships (Batt-Rawden 2007).

Literature review

Studies with music intervention in the perioperative care have shown evidence that soothing music by inhibiting stress by reducing anxiety, sedative use (Nilsson 2008) and neurohormonal responses to psychological stress (Nilsson *et al.* 2005), as well as postoperative pain (Good *et al.* 2001, Nilsson *et al.* 2003, 2005, Cepeda *et al.* 2006, Nilsson 2008). However, soothing music seems to have minor effect on vital signs as reduction of heart rate, blood pressure and respiratory rate (Nilsson 2008). Studies with patients in the cardiac surgery care, have found that music has some beneficial effects. Cadigan *et al.* (2001) reported that patient who listened to 30 minutes of symphonic music with nature sounds during bed rest because of procedural sheaths or an intra-aortic balloon pump had reductions in blood pressure, respiratory rate and psychological distress. Reduction in pain, heart rate and respiratory rate was found after 45 minutes of self-selected relaxing music in patients undergoing application of a C-clamp after percutaneous coronary intervention (PCI) treatment. However, oxygen saturation was also reduced when listening to music (Chan 2007). Anxiety in coronary artery bypass grafting and valvular surgery patients can be reduced and intubation time can be decreased when listening to self-selected relaxing music continuously throughout the surgery and postoperatively in the intensive care area (Twiss *et al.* 2006). Subjective anxiety levels can also decrease if patients, after a brief session of relaxation, listen to 20 minutes of relaxing music postoperatively twice a day after open-heart surgery. However, in this study, the music intervention did not have any influence on blood pressure and heart rate (Sendelbach *et al.* 2006). Voss *et al.* (2004) have reported decreased anxiety and pain levels in patients who listen to 30 minutes of self-selected soothing music during chair rest after open-heart surgery.

If music can reduce anxiety and pain as reported above, a new challenge is to study if music can influence the relaxation system, which incorporates oxytocin. Oxytocin is a hormone synthesised in the hypothalamus and transported down axons of the posterior pituitary for secretion in the blood (Evans 1997) (Petersson & Uvnas-Moberg 2007). The oxytocin system operates in parallel with the stress response systems by inhibiting sympathetic and hypothalamic–pituitary–adrenal activity during stress (Evans 1997). Oxytocin also takes part in cardiovascular regulation and its effects are exerted both within the central nervous system and through peripheral effects (Petersson & Uvnas-Moberg 2007). Oxytocin is produced in both male and females, with similar central oxytocinergic pathways and connections across genders. Low oxytocin levels are present in children with abdominal pain and there is a connection between low levels of oxytocin and pain and anxiousness (Evans 1997). Furthermore, oxytocin concentrations increase in amateur and professional singers who have been attending singing lessons (Grape *et al.* 2003) and also in males who have undergone tactile massage (Wikstrom *et al.* 2003). Oxytocin has been measured during bed rest in intensive care patients. Two groups were compared; one with standard care and one intervention group with tactile touch and standard care. No differences were reported in oxytocin levels between the groups. However, both groups included relaxing music (Henricson *et al.*, [unpublished]). It is therefore of interest to study if relaxing music alone can enhance oxytocin release although, at present, no such data have been presented.

Aim

The aim of the present trial was to compare the effect of bed rest with or without music on relaxation after coronary artery bypass grafting and/or aortic valve replacement surgery on postoperative day one, by measuring changes in plasma levels of oxytocin, haemodynamic parameters, oxygen saturation and subjective relaxation levels.

Method

Sample and setting

A sample of 40 consecutive open-heart surgery patients on their first postoperative day following a coronary artery bypass grafting (CABG) and/or aortic valve replacement (AVR) under general anaesthesia were considered for the study. All patients were scored III on the American Society of Anaesthesiologists (ASA) physical status classification system i.e., patients with severe systemic disease. The patients were consecutively and prospectively enrolled between May 2006–November 2006. Exclusion criteria were: undergoing an emergency operation; start of surgery after 12 noon; previous cardiac surgery; being treated with corticosteroids; the need of an intra-aortic balloon pump or temporary pacemaker; not extubated in the evening of the day of surgery; participation in other studies any hearing impairment or difficulties with cooperating during measurements.

Intervention

The patients were randomly allocated to two groups, one music group (n = 20) and one control group (n = 20), using a computer generated randomisation list drawn up by the statistician. Three special research nurses allocated the next available number on entry into the trial and conducted all interventions and outcome assessments. The code was revealed to the researcher only after recruitment, data collection and laboratory analyses were complete.

All participants received scheduled rest in bed at 12 noon at the first postoperative day. The patients in the music group were also listening to music distributed through a music pillow connected to a MP3 player (Wellness Musicpillow) during the rest (Fig. 1). The music, MusiCure, (Musi Cure) was soft, relaxing, and included different melodies of 60 to 80 beats per minute (bpm) and was for 30 minutes with a volume of 50–60 dB. Before rest, all patients were sitting in a chair and received chest physiotherapy as conventionally used at the clinic. All patients also received oxygen support. At 11·45 a.m., the research nurses assisted the participants to lie down in the bed and turn over to a relaxing position on their back, supine position, with the bed head at 20–30 degrees. During the rest, for all participants, the environment was enhanced to reduce stimuli and facilitate rest by closing the door and posting a sign to prevent being disturbed by visitors and health care personnel. However, no changes of the environmental light were made.

Figure 1 Music pillow.

Outcome assessment

Pre values were obtained at 12 noon and first post values after 30 minutes of rest with or without music i.e., 12·00 and second post value for another 30 minutes i.e., 13·00.

The arterial blood samples for blood gas and s-oxytocin analysis were drawn in a radial artery cannula that was inserted into each patient's left arm on the day of surgery. Blood gas, i.e., PaO_2 and SaO_2 was measured at 12·00 (pre value) and 13·00 (post value) (Radiometer ABL 505; inter Bio-Lab, Orlando, FL, USA). The concentration of serum oxytocin was measured at all three time points. It was determined by blood collected in tubes containing EDTA and Trasylol® (Bayer AB, Solna, Sweden), which were immediately centrifuged at 4 °C. The plasma was stored at −70 °C prior to analysis. Oxytocin was extracted from plasma using ethanol, all stages being carried out at 4 °C. A total of 0·6 ml of sample was mixed with 1·2 ml of 95% ethanol and subsequently centrifuged at 3000 × g for 15 min. The ethanol was allowed to evaporate at room temperature overnight and the residue was reconstituted in the assay buffer. Oxytocin was determined using an enzyme immunoassay kit from Assay Designs, Ann Arbor, MI, USA according to the manufacturers instructions. The mean recovery of oxytocin, using spiked samples, was 103%. The total CV was 5·3% at 215 ng/l.

At all three time points, mean arterial blood pressure (MAP) and heart rate were measured by the GE Carescape Datex-Ohmeda monitor (GE Healthcare ANANDIC MEDICAL SYSTEMS AG/SA, Basel, Switzerland). The patients rated their relaxation levels on a numeric rating scale (NRS) scored from 0 = no relaxation to 10 = complete relaxation. The NRS for relaxation has not been validated; however, NRS for pain has been validated and tested for reliability (Lundeberg *et al.* 2001).

Ethical considerations

The study followed common ethical principles in clinical research and was approved by the local Ethics committee in Uppsala. The research nurse explained the study to potential participants. All patients gave their informed consent and were provided with written information notifying them that any individual was permitted to discontinue participation in the study after receiving the information. The participants were also entitled to make individual decisions on how long they wished to participate and under what conditions. They were also told that they could withdraw from the study at any time without adverse consequences on their care.

Statistics

Calculation of sample size was based on the following assumptions concerning a one-way analysis for the primary endpoint: s-oxytocin, significance level at 5%, power at 80%, an estimated medium effect size of 0·14. These assumptions suggested a sample size of 31 patients that resulted in a sample size of 20 patients in each group for covering attrition. Statistics are presented as arithmetic means, standard deviation and range. Student *t*-test and Kruskal Wallis tests were used to examine the differences between the groups on patients' characteristics, surgical factors, analgesia and oxygen consumption. A Student *t*-test was used to determine whether any statistically significant differences for s-oxytocin, MAP, heart rate, PaO_2 and SaO_2 between the music and control group at each time point. Student *t*-test followed by a *post hoc* test with a Bonferroni correction was used to test for any significant changes in s-oxytocin, MAP and heart rate over time within groups. Wilcoxons Signed Rank test followed by a *post hoc* test with a Bonferroni correction was used to analyse the change in relaxation score in music and control group as a between subject factor and time points as a within subject factor. Mann–Whitney test was used in the analysis in comparing differences in changes of levels of s-oxytocin and relaxation scores between two times; between baseline i.e., 12 noon value vs. values at 12·30 and 13·00. A *p*-value of $<0·05$ was considered statistically significant. The computer program SPSS (SPSS Inc., Chicago, IL, USA) for Windows was used for all statistical analysis.

Results

Among 168 patients undergoing open-heart surgery, 40 fulfilled the inclusion criteria and included in the analysis (Fig. 2). The two groups were comparable with respect to age, gender, duration of aortic occlusion (AoO) and extracorporeal circulation (ECC) time, O_2 and intra- and postoperative analgesia. However, there was a significantly longer duration of surgery, 241 vs. 190 minutes, in the music group compared with the control group, which could be explained by a significant difference in type of surgery between the groups (Table 1).

Oxytocin

The pre value of s-oxytocin was significantly lower in the music group compared with the control group; 62·2 vs. 73·4 pml/l. There were no differences in post values at 12·30 and 13·00. between the groups (Table 2). There was a different trend over time with regards to levels of s-oxytocin (Fig. 3) between the groups. For patients who were listening to music during rest, levels of oxytocin increased by 3·95 pml/l at 12·30 and 5·90 pml/l at 13·00. compared with levels at 12 noon. For patients in the control group, there was

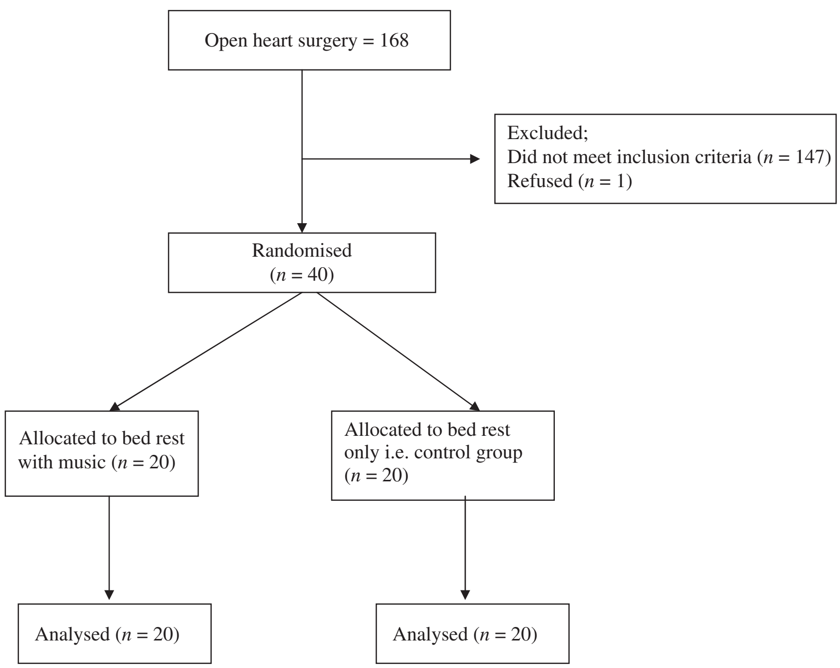

Figure 2 Study flow chart of the trial.

Table 1 Comparison of patients' characteristics surgical factors, analgesia consumption and oxygen support

	Music group (n = 20) Mean (±SD)	Control group (n = 20) Mean (±SD)	p-value
Age (year)	64 (10·0)	67 (7·5)	0·297
Gender *			
Male	17	15	0·435
Female	3	5	
Type of surgery*			
CABG	17	11	0·030
AVR	3	6	
CABG & AVR	0	3	
Duration of surgery (min)	241 (85·8)	190 (55·6)	0·031
Duration of ECC (min)	97 (66·3)	86 (37·3)	0·529
Intraoperative circulation			
ECC	17	17	1·000
Off-pump*	3	3	
Duration of AoO (min)	68 (53·8)	49 (25·1)	0·162
Intraoperative use of fentanyl (μg)	755·0 (187·7)	679·4 (174·1)	0·195
Intraoperative use of alfentanil (mg)	1·0 (1·1)	1·1 (1·0)	0·882
Postoperative use of ketobemidone the day of surgery (mg)	11·7 (6·5)	13·4 (6·2)	0·391
Postoperative use of ketobemidone day one of surgery (mg)	1·9 (2·7)	2·4 (2·9)	0·538
O_2 (L/min)[†]	3·1 (1·7)	3·1 (1·2)	0·914

CABG, coronary artery grafting; AVR, aortic valve replacement; AoO, aortic occlusion; ECC, extracorporeal circulation.
*Number of patients.
[†]During bed rest the day one of surgery.

Table 2 Comparison of oxytocin, haemodynamic parameters, arterial blood gases and subjective experience of relaxation between patients listening to music during rest and controls before and after intervention

	Music group (n = 20) Mean (±SD)	Control group (n = 20) Mean (±SD)	p-value
Pre value; 12 noon			
s-Oxytocin (pmol/l)	62·2 (15·8)	73·4 (11·3)	0·013
MAP (mmHg)	79·8 (12·4)	78·3 (13·8)	0·802
Heart rate (bpm)	77·2 (13·3)	76·6 (10·2)	0·885
PaO_2 (kPa)	11·2 (2·4)	10·5 (1·5)	0·225
SaO_2 (%)	95·7 (2·2)	95·1 (2·0)	0·407
Relaxation (0–10)	5·2 (3·4)	8·1 (2·1)	0·008
Post value 1; 12·30 p.m.			
s-Oxytocin (pmol/l)	66·2 (18·6)	68·1 (11·8)	0·694
MAP (mmHg)	72·8 (10·4)	73·8 (11·6)	0·795
Heart rate (bpm)	76·4 (11·7)	76·5 (8·3)	0·975
Relaxation (0–10)	8·8 (2·4)	8·5 (2·3)	0·662
Post value 2; 13·00 p.m.			
s-Oxytocin (pmol/l)	68·1 (14·3)	69·7 (10·9)	0·705
MAP (mmHg)	73·2 (8·7)	75·1 (10·0)	0·595
Heart rate (beats/min)	76·4 (12·4)	76·2 (8·4)	0·960
PaO_2 (kPa)	12·1 (2·2)	10·8 (1·7)	0·036
SaO_2 (%)	96·3 (1·5)	95·4 (1·3)	0·580
Relaxation (0–10)	8·3 (3·0)	8·2 (2·5)	0·360

MAP, mean arterial pressure; PaO_2, arterial oxygen tension; SaO_2, arterial oxygen saturation.

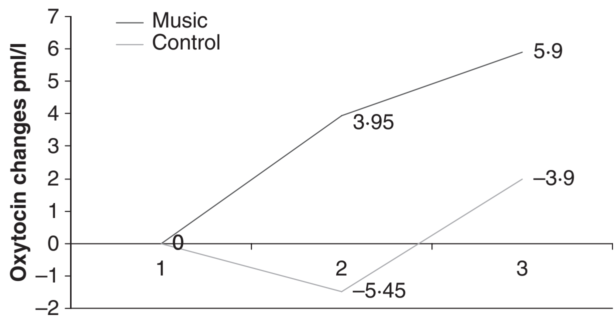

Figure 3 Comparison of oxytocin levels between patients listening to music and controls during rest. 1 = Pre value at 12 noon. 2 = Post value at 12·30 p.m. after 30 minutes of bed rest. 3 = Post value at 13 p.m. after 60 minutes of bed rest.

an opposite trend i.e., decreasing values of oxytocin; −5·45 pml/l at 12·30 pm and −3·90 pml/l at 13 p.m. compared with levels at 12 noon. These changes were statistically significant between the groups (Table 3), but not over time within subjects in each group.

Haemodynamic parameters

There were no differences in pre and post values in MAP and heart rate between the two groups (Table 2). A decrease over

Table 3 Mean differences between pre value and post value in serum oxytocin and subjective relaxation levels between participants in the music group vs. control groups

	Pre value vs. post value 1 mean (range)	*p*-value	Pre value vs. post value 2 mean (range)	*p*-value
s-Oxytocin (pmol/l)				
Music (*n* = 20)	+3·95 (−10–28)	0·004	+5·90 (−22–22)	0·024
Control (*n* = 20)	−5·45 (−29–8)		−3·90 (−43–19)	
Relaxation (0–10)				
Music (*n* = 20)	+3·5 (−4–10)	0·003	+2·6 (−8–10)	0·009
Control (*n* = 20)	+0·4 (−6–7)		0·0 (−6–2)	

Pre value = before intervention.
Post value 1 = after 30 minutes bed rest with or without music.
Post value 2 = 30 minutes after posts value 1, no intervention.

time compared with the baseline levels was seen in MAP in the music group ($p < 0{\cdot}002$) i.e., pre values vs. values at 12·30, $p = 0{\cdot}01$ and pre values vs. values at 13·00, $p = 0{\cdot}002$. This decrease over time was not seen in the control group. There were no significant changes over time within subjects in heart rate.

Oxygen saturation

There were no differences in pre and post values at 12·30 between the groups. At 13·00, there were significantly higher PaO_2 levels in the music group compared with the control group; 12·1 kPa vs. 10·8 kPa; $p = 0{\cdot}036$. There was also a trend towards higher SaO_2 in the music group compared to the control group, 96·3% vs. 95·4%; $p = 0{\cdot}058$ (Table 2). In comparing pre and post values within subjects, there was a significant increase in PaO_2 levels in the music group11·2 kPa vs. 12·1 kPa; $p = 0{\cdot}039$. This increase was not seen in the control group or in SaO_2.

Relaxation

Also pre value levels of relaxation were significantly lower in the music group; 5·2 vs. 8·1. There were no differences in post values at 12·30 and 13·00 between the groups (Table 2). There was a different trend over time with regards to subjective relaxation levels (Fig. 4) between the groups. There were statistically significant differences in changes over time between the groups in subjective relaxation levels. This changes in subjective relaxation levels followed the same trends as s-oxytocin. In the music group, levels of relaxation had increased by 3·5 at 12·30 and 2·6 at 13·00 compared with levels at 12 p.m (Table 3). In the music group, this increase in subjective relaxation levels, changed significantly over time ($p < 0{\cdot}001$) i.e., pre values vs. values at 12·30, $p = 0{\cdot}001$ and pre values vs. values at 13·00, $p = 0{\cdot}003$. For patients in the control group, there were no significant changes over time within subjects.

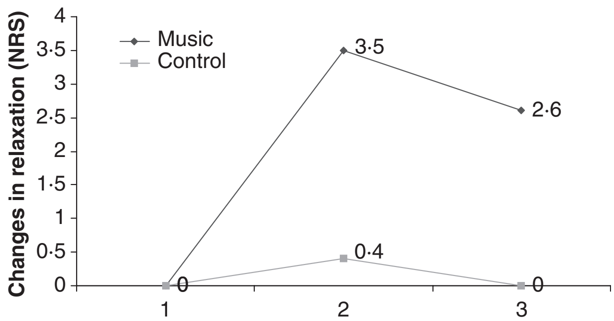

Figure 4 Comparison of subjective relaxation levels between patients listening to music and controls during rest. 1 = Pre value at 12 noon. 2 = Post value at 12·30 p.m. after 30 minutes of bed rest. 3 = Post value at 13 p.m. after 60 minutes of bed rest.

Discussion

The major finding of this study was that music listening used as audio-relaxation increased oxytocin levels and relaxation in patients undergoing CABG or AVR surgery. However, there were significant differences in oxytocin and relaxation levels at the pre test. One possible explanation to these different pre levels could be that the type of surgery and the duration of surgery were significantly longer in the music group. On the other hand, it cannot be explained why this different time of duration in spite of the group allocation by a computer generate randomisation list. All other pre values including analgesic use did not differ. When taking this discrepancy of pre values of s-oxytocin and subjective relaxation levels into account, the results show that music listening during bed rest increases oxytocin secretion while bed rest only decreases oxytocin levels. It is also interesting to notice that the participants in the music group valued their pre level of subjective relaxation significantly lower than the control group, which is in line with their objective measurement of relaxation, i.e., oxytocin levels. It has been noticed that administration of oxytocin decreases anger, fatigue, anxiety and pain and that there is a connection between physiology (pain) and behaviour (anxiousness) interpreted as a low levels of oxytocin (Evans 1997). This would mean that the previous belief that the causal relation is from the physiological (oxytocin) to the psychological (less anxiousness) should be reconsidered. If music listening increases oxytocin secretion, then the causal relation is from the psychological (music makes patients feel good) to the physical (oxytocin release). It is hard to find any studies that confirm these results as the majority of studies on music intervention use subjective stress and pain indicators (Cepeda *et al.* 2006, Nilsson 2008). However, Henricson *et al.* (accepted 2008) reported no differences in s-oxytocin levels between ICU patients with bed rest, tactile touch and relaxing music in comparison with bed rest and relaxing music only. The study was performed over a period of six days. The researchers reported that there was a trend of increased oxytocin levels after every event of bed rest in both groups. Could this increase be because of the relaxing music? Further studies are needed to test if relaxing music can enhance oxytocin release.

The results from the present study also found higher PaO_2 levels and a trend towards higher SaO_2 in the music group compared with the control group. These results are in line with an earlier study involving patients who had undergone minor day care surgery who were listening to music during their first postoperative hour after surgery (Nilsson *et al.* 2003). The explanation for these results is unknown. Perhaps the patients in the music group took deeper breaths although there were no differences in respiratory rate between the groups. Further research is needed.

There was a decrease over time compared with the baseline levels seen in MAP in the music group, but not in the control group. However, there were no statistically significant effects of music intervention on MAP and heart rate. This is in line with a systematic review on music in perioperative care (Nilsson 2008), which concludes that music has a minor effect on vital signs. In a study by Bernardi *et al.* (2006), it was discovered that respiratory rate, heart rate and blood pressure were increased by musical inputs and that these increases were proportional to the tempo of the music. However, more interestingl was that random intervals of silence (two minutes) between the different styles and tempo of music lead to a decrease in respiratory rate, heart rate and blood pressure below the baseline level. It seems that music acts more like a 'driving input' and therefore, the effect is minor of music with slow tempo on vital signs. In the present study, the baseline of the heart rate was 75–76 bpm, which is the same as the beats of the music i.e., 60–80 bpm, which can be an explanation for the non-effect.

It is of great importance that the music listening equipment is of good quality, easy to use and hygienic. Health care associated infections, such as Methicillin-resistant *Staphylococcus aureus* (MRSA) can be transmitted indirectly by sharing items that contain the organism (Romero *et al.* 2006). Therefore, allowing patients to use equipment such as headphones can increase the risk of cross infection. In the present study, the pillow and the MP3 player connected to it were covered with a pillowcase that was changed between the patients. In the majority of earlier studies with music intervention, headphones connected to a CD, MP3 or cassette player have been used and no discussion of new equipment have been made (Cadigan *et al.* 2001, Voss *et al.* 2004, Sendelbach *et al.* 2006, Twiss *et al.* 2006, Chan 2007, Nilsson 2008). The music pillow (Wellness Musicpillow) offers an adjustable patient focused sound environment without 'shutting off the external world' as well as it enables the patient to rest in any position without the inconvenience induced by some types of headphones. The implementation of music during bed rest in the present study was smooth and did not cause any disturbance for the other patients and staff in the recovery room of the cardiothoracic ward. However, the quality of the sound in the music pillow could be better as well as the maximum volume limitation of 60 dB. This volume is acceptable in a silent environment, such as in the present study, but in a noisier environment, for example in a Cardiac Radiology Department, there is a need of higher volume. Another aspect of the equipment is the user friendliness. To change volume of the music pillow during music listening, the nurse had to help the patient as the cord between the pillow and the MP3 player was too short so the patient had to lift the pillow to reach the MP3 player. Therefore, more innovations from the industry to handle these requirements; hygiene, quality of sound, volume, user-friendliness etc., are needed and here should the industry, music researchers and the Health Care staff work together.

The importance of the genre of music has been discussed in the literature. Some authors have allowed patients to select the genre of music from a list covering around five different types, whereas others used the same type of music, often new age or classical, for all participants. The results of these studies are not strictly comparable, as different methods of investigation have been used such as the length of the intervention, volume, time period and choice of sound source (Nilsson 2008). In the present study, only one type of music MusiCure® (MusiCure, Gefion Records, Copenhagen, Denmark), a specially composed music designed for perioperative settings (MusiCure). Descriptions used to describe music perceived as relaxing; 'quiet', 'peaceful', 'soft', 'dreamy', 'soothing', 'serene', 'un-dramatic', 'slow speed', 'regular rhythm', 'pleasant combination of instruments' and 'low volume' (Wolfe *et al.* 2002) are in line with the type of music (MusiCure) and volume, 50–60 dB, used in the present study. In the present study, the duration of the intervention lasted in 30 minutes and was only performed once. Perhaps the positive effect is greater if the music interventions are repeated and the duration is longer. More studies with the aim of comparing duration and repeated interventions of the music as well as the effect of different genre of relaxing music are needed.

Limitation of the study

There are some limitations of the present study. First of all, in the present study, the research nurse remained in the room during the 60 min for all participants to unobtrusively obtain data on interruptions and the reliability of music intervention use. This may have affected patient responses through a Hawthorne effect (Mayo 1933). The research nurses and the participants were aware of the interventions and this may have also affected the result. It has been shown, that studies, which are un-blinded can overestimate the treatment effects by about 17% (Nilsson 2008). Furthermore, the NRS scale has not been psychometric tested for measuring relaxation. However, in the present study, pre values and changes over time in levels of subjective relaxation (NRS) and levels of objective relaxation (oxytocin) followed each other. This can be used as an indication of agreement between the two measurements of relaxation.

Although there was a small size in the present study, it was based on a calculation of the sample size, which is a method to maximise the chance of detecting a statistically and clinically significant difference between the interventions when a difference really exists. The Consolidated Standard of Reporting Trials (CONSORT), which this manuscript follows, documents a set of recommendations for reporting of clinical trials also identifies that the method for determining sample size should be identified in publications (Moher *et al.* 2001).

Conclusion

In conclusion, listening to music during bed rest after open-heart surgery has some effects on the relaxation system as regard s-oxytocin, subjective relaxations levels and PaO_2. This effect seems to have a causal relation from the psychological (music makes patients feel good) to the physical (oxytocin release). From a practical point of view, these positive effects are sufficiently evident to suggest the proposed regimen of music listening after open-heart surgery in clinical practice.

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Contributions

Study design: UN; data collection and analysis: UN and manuscript preparation: UN.

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