Applied Cardiopulmonary Pathophysiology 15: 14-23, 2011

Does music harm patients after cardiac surgery? A randomized, controlled study

P. Iblher[1], H. Mahler[1], H. Heinze[1], M. Hüppe[1], K.-F. Klotz[1], W. Eichler[2]

[1]Department of Anaesthesiology at University of Lübeck Medical School, Lübeck, Germany; [2]Schön Clinics Neustadt Dept. of Anaesthesiology and Intensiv Care, Neustadt in Holstein, Germany

Abstract

Background: Positive effects of music on the state of mood as well as on anxiety, pain and physiological measures were described for the postoperative setting on the ICU.
Objectives: To examine the influence of a music intervention in the early postoperative period on patients undergoing open heart surgery.
Methods: We examined 126 patients undergoing open cardiac surgery, randomly assigned to one of five groups: 1) Music intervention transmitted by a closed headphone for 60 minutes immediately after arrival on the ICU, 2) Like (1) but only headphone without music, 3) Music intervention transmitted by a closed headphone for 60 minutes immediately after discontinuation of sedation, 4) like (3) but only headphone without music 5) Control without headphone or music. Music intervention was provided by a conventional CD player. For the self assessment of postoperative complaints and patient satisfaction we used the Anaesthesiological Questionaire (ANP2). Furthermore blood pressure, heart rate and infused catecholamines, peripheral saturation and consumption on opiod analgesics were recorded.
Results: We found no difference between the five groups. In the analysis of variance for the factor music there was a significant increase of pain in the operated area, thirst, nausea and remembrance of the postoperative period with music in the ANP ($p<0.05$ respectively). For the factor early versus late intervention we found a significant improvement of pain in the operated area, discomfort and satisfaction within the perioperative course ($p<0.05$ respectively) when intervention was applied early. There was neither a combined effect of both factors nor differences between further recorded data.
Conclusions: Music intervention seems to pronounce typical perioperative complaints in this setting. This might be explained by an intensified awareness of the situation on the ICU. The difference between early and late intervention may indicate the importance of a sufficient noise protection even during continuous sedation of the patient.

Key words: intensive care, music, cardiac surgery, postoperative complaints, accoustic shielding

Background

Using music as a soothing or healing element in patient treatment has been of great scientific interest over the last years. Would it be possible to improve medical courses just by listening beside pharmacological and physical treatment? The idea seems to be impressive. Interestingly, this idea is not as new as it may appear. In the 18th century the Russian envoy in Dresden, Germany, the earl Hermann Carl von Keyserling, ordered pieces of music arranged for the piano. He was of ailing constitution and wanted his harpsichordist to play for him hours at hours at sleepless nights to soothe and brighten him. Therefore, his musician, Johann Gottlieb Goldberg, needed new material continuously. The result of this "musical treatment" is one of the most famous compositions in music history: The "Goldberg-Variations" from Johann Sebastian Bach [1]. Already 4 millenniums B.C. Egyptian priests used music for medical treatment and this was just the known beginning of this kind of therapy during centuries and different cultures [2]. In modern times the use of image-guided diagnostics and the progress in areas like physiology, psychology or neurology forced different explanatory models for the positive effects on human beings [3-5]. The mechanisms are still not fully understood and different hypotheses are discussed (fig. 1).

Many studies have been investigated positive effects of music focusing on anxiety [6-11], state of health and satisfaction [4,11-15], pain reduction [4,7,12,16-19] and postoperative use of analgesics [7,16]. It was shown that the amount of cortisol as a sign of stress can be reduced by listening to music [7,20,21]. However, the described positive effects of music on blood pressure, heart rate,

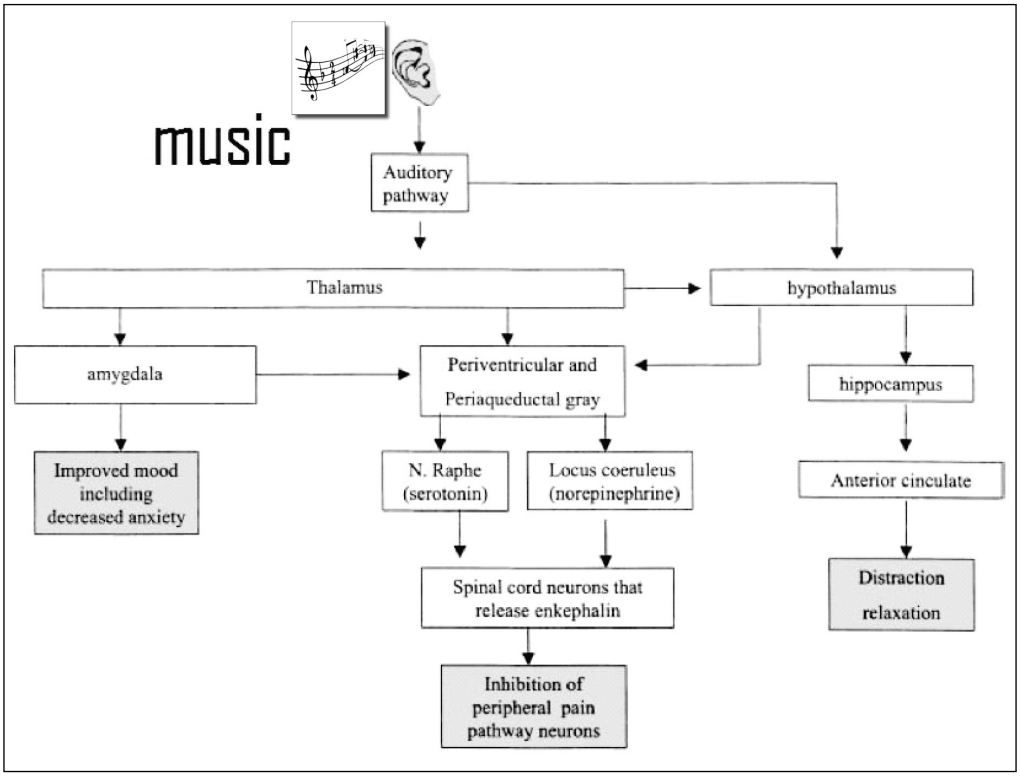

Figure 1: Possible auditory pathways influenced by music application (modified from 4 with kind permission, Copyright Elsevier)

breathing rate, oxygen saturation or body temperature were shown inconsistently [6,8,11,14,16,17,22-25]. Overall, the benefits of musical treatment seem prevailing the disadvantages of this kind of therapy. To our best knowledge no study has shown any hurtful music effects. However, looking at the present state of current studies we find inconsistent results with no reliably repeatable effects. As far as we know no studies exist exploring the effects of post-operative application of music to sedated patients after open-heart surgery.

Question

This study examines the implication of post-operative musical treatment after open-heart surgery at two given times in both sedated and non-sedated patients analysing self-assessment questionnaires, physiological data and drug consumption of catecholamine's and opioid analgesics.

Methods

The study was done in accordance with the ethics committee of study site (approval from the 08th of June, 2005, file number: 05 – 065) and was carried out with the ethical standards set forth in the Helsinki Declaration of 1975.

Patients with scheduled open-heart surgery (coronary bypass, valvular transplant, both combined) were included in the study. Exclusion criteria were amblyacousia, psychological disorders and patients with expected prolonged recovery phase. After obtaining informed consent, participants had to fill out three questionnaires (1. Abbreviated Mental Test/AMT; 2. Confusion Assessment Method/CAM; 3. Condition-scaling using classes and adjectives/BSKE). Furthermore, music was provided by study-player and patients were asked to adjust comfortable loudness to be repeated during study intervention. On day of surgery, patients were randomly allocated to five examination groups (fig. 2), which was done by lot. After surgery, all patients were admitted to ICU Propofol-sedated and mechanically ventilated, following the protocol

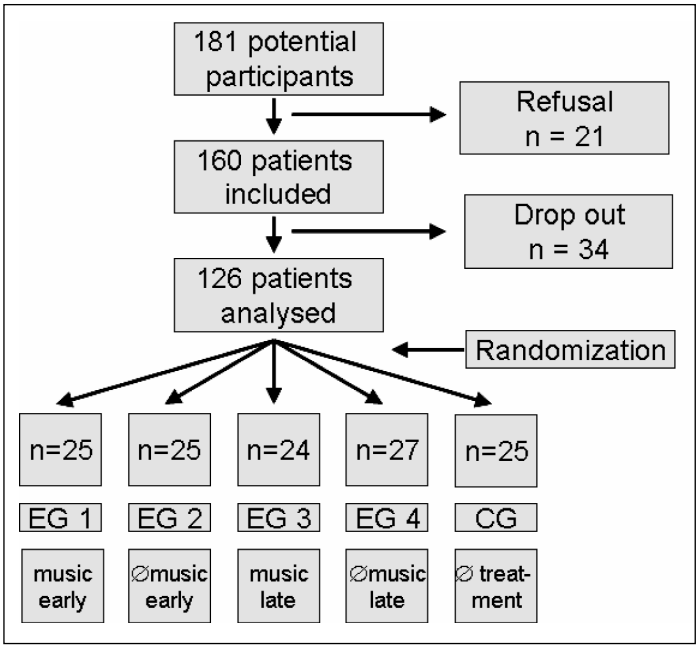

Figure 2: Recruitment and randomization of study participants to study groups (EG= experimental group, CG= control group), kind of treatment (music vs. no music) and time of treatment (early vs. late) (∅ = no).

for treatment of postoperative cardiac surgery patients at study site. Study Treatment was delivered using closed headphones and lasted 60 minutes, respectively (Examination group 1-4). Control group (Examination group 5) received no treatment. For Study Treatment baroque pieces of music played by organ, flute and string orchestra with a tempo of 60 to 80 bpm were used.

Study music was provided using a portable CD-player (EXP2461, Philips). Examination group 1 and 2 were treated immediately after admission with or without music for 60 minutes, respectively. Examination group 3 and 4 were treated immediately after stopping sedation with or without music for 60 minutes, respectively. During stay on ICU, blood pressure, heart rate, oxygen saturation, amount of catecholamines (Norepinephrine and Dobutamin) and frequency and dosage of opioid analgesics (Piritramid and Pethidin) were documented.

Stable patients were discharged from ICU (usually on day 1 after surgery) and transferred to Inter Mediate Care (IMC). On day 3 after surgery, pre-test Evaluation (AMT, CAM, BSKE) was repeated. Furthermore, patients were now asked to answer a questionnaire about their postoperative complaints and satisfaction (Anesthesiological Questionaire for patients after anesthesia/ANP) and were asked if they were able to remember to have listened to music after surgery.

Used questionaires

Abbreviated Mental Test (AMT)
The AMT was developed by Hodkinson 1972 to test for mental impairment in the elderly [26]. Since then, it has been validated in different populations [27,28].

Confusion Assessment Method (CAM)
This list of criteria can be used to identify acute delirium and was published by Inouye et al. in 1990 [29].

Condition-scaling using classes and adjectives (BSKE)
In brief, the BSKE is a multi-dimensional self-assessment questionnaire focusing on the actual psychological and somatic state of health [30]. It consists of 21 items and has to be answered on a 7- point Likert scale (0=not at all – 7=very strong).

Anesthesiological Questionaire for patients after anesthesia (ANP)
This questionnaire focuses on self-assessment of postoperative complaints and satisfaction of patients who underwent surgery [31-33].

Statistics

Before start of study power analysis was performed. It was seen that 25 participants per group were needed. Statistic analysis of variables between the five experimental groups included ANOVA for hemodynamic parameters, catecholamines and opioid analgesic consumption and pre-post-analysis of questionnaires. Dichotomous traits were evaluated using crosstabs. Furthermore, 2x2 ANOVA for independent variables “music” (yes vs. no) and “time of study treatment” (early vs. late) were calculated. Effect sizes for these variables were calculated using Cohen’s formula comparing two independent groups [34]. All p-values <.05 were considered as significant. All calculations were performed using SPSS 15.0 (SPSS Inc., Chicago, USA).

Results

Over a period of 10 months 160 patients were included in this study and allocated to experimental groups (fig. 2). Participants were aged 66.9 years on average (SD: ± 7.8y, Min. 43y, Max. 84y) and were predominantly male (m: 78.6%, fm: 21.4%). Patients received coronary bypass surgery (76.2%), valve transplant (1.6%) or a combination of both (22.2%). 34 patients droped out of the

study because of postoperative complications (n=10) and organizational problems (n=24).

All results of pre-test questioning (AMT, CAM, BSKE) showed homogenous distribution and no abnormalities. There were no significant differences between the five experimental groups with regard to age, sex, height, body weight, type of surgery, hemodynamic parameters, oxygen saturation, consumption of catecholamines and opioid analgesics (table 1), as well as pre-post-analysis of all used questionnaires (AMT, CAM, BSKE). Focusing on the factor "music" there was a significant increase of pain in the operated area, thirst, nausea and remembrance of the postoperative period when music was administered. For the factor early versus late intervention we found a significant improvement of pain in the operated area, discomfort and satisfaction with the perioperative course when intervention was applied early (figure 3 & 4).

Table 1: Differences between the five experimental groups with regard to age, sex, height, body weight, type of surgery, hemodynamic parameters, oxygen saturation, consumption of catecholamines (Arterenol/Dobutamin) and opioid analgesics (Pethidin/Piritramid). (EG = experimental group, CG = control group, fm = female, m = male, ACB = aortocoronary bypass, VT = valvular transplant, BP = Blood Pressure, n.s. = non significant)

	EG 1	**EG 2**	**EG 3**	**EG 4**	**CG**	**Between-group Differences**
Age (years)	65,8± 9,7	66,6±8,4	65,5±6,2	67,6±6,5	68,8±8	n. s. (p= 0,579)
Sex (fm % / m %)	20/80	36,0/64,0	16,7/83,3	11,1/ 88,9	24/76	n. s. (p= 0,257)
Height (cm)	172,3±7,9	171,6± 10,3	175,6±9,4	172,8±8,3	170,8±7,8	n. s. (p= 0,384)
Weight (kg)	83,6±14,4	82,2±15,8	85±14,4	81,3±11,3	81,9±15,6	n. s. (p= 0,897)
Type of surgery (ACB % / VT% / Komb.%)	84/0/16	84/4/12	66,7/0/33,3	81,5/ 0/ 18,5	64/ 4/ 32	n. s. (p= 0,386)
Heart rate (1/min)	94 ± 9	94 ± 9	93 ± 7	92 ± 5	93 ± 7	n. s. (p= 0,860)
BP syst. (mmHg)	124 ±16	119 ± 12	123 ± 16	126 ± 15	123 ± 15	n. s. (p= 0,583)
BP diast. (mmHg)	59 ± 11	58 ± 7	58 ± 6	59 ± 6	59 ± 8	n. s. (p= 0,943)
Oxygen saturation (%)	98 ± 2	98 ± 1	98 ± 3	99 ± 1	99 ± 1	n. s. (p= 0,442)
Arterenol (ml) (1 ml = 100 µg)	0,00	0,00	0,46± 1,56	0,00	0,08± 0,40	n. s. (p= 0,106)
Dobutamin (ml) (1 ml = 5 mg)	0,14± 0,61	0,00	0,31± 0,93	0,19± 0,68	0,08± 0,40	n. s. (p= 0,458)
Pethidin (mg)	45,5 ± 22,8	50,5± 27,4	54,7 ± 38,5	56,0 ± 32,4	47,0 ± 28,3	n. s. (p= 0,670)
Piritramid (mg)	17,6 ± 9,2	19,8 ± 14,0	15,4 ± 7,8	15,7 ± 9,5	13,9 ± 9,1	n. s. (p= 0,287)

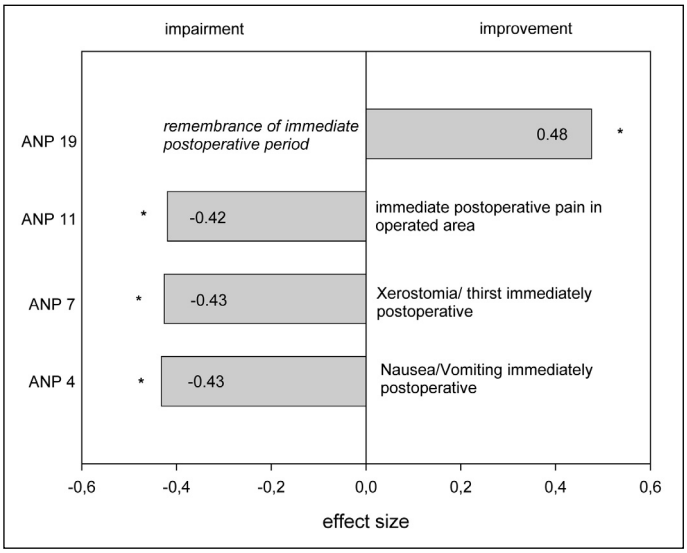

Figure 3: Significant results for the factor music immediately post-operative (music versus no music application): 1. "Pain in the operated area", 2. "thirst", 3. "nausea" and 4. "remembrance of the postoperative period" was significantly increased when music was applied. X-axis: Effect sizes of complaints [34], Ordinate: Items of Anesthesiological Questionnaire for patients after anesthesia (ANP) (= p < 0,05). Data collection was done on day 3 after surgery.*

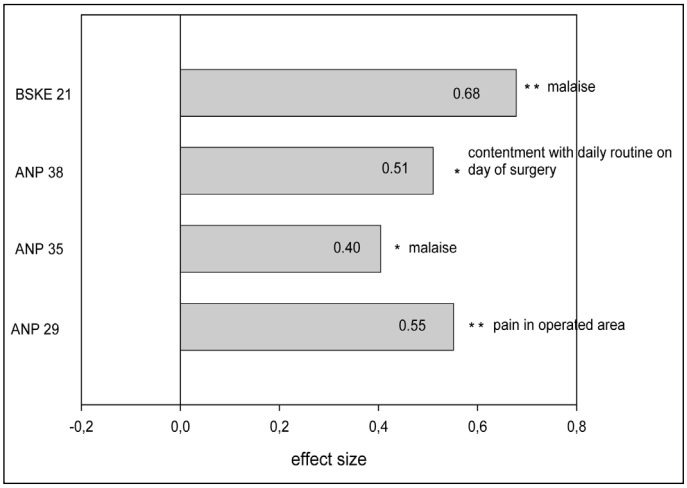

Figure 4: Significant results for the factor "time of intervention" (early versus late) on day 3 after surgery: 1. "Pain in the operated area" and 2. "malaise" was significantly decreased and 3. "Contentment with daily routine on day of surgery" was significantly increased when intervention was applied early. X-axis: Effect sizes of complaints [34], Ordinate: Items of "Anesthesiological Questionnaire for patients after anesthesia" (ANP) and "Condition-scaling using classes and adjectives" (BSKE) (= p < 0,05, ** = p < 0,01). Data collection was done on day 3 after surgery.*

There was neither a combined effect of both factors nor differences between further recorded data.

Discussion

The benefit of musical treatment on patients has been an ongoing matter of discussion as different studies showed either no [14,23-25] or positive effects [22,35-41]. However, at least data is suggestive of not causing negative or harmful effects on treated patients. Although analyses of the five experimental groups in this study showed no significant differences it is worth to take a closer look at the effects of the factors "music" and "time of study treatment". Particularly with regard to sedated patients on ICU the results may lead to the conclusion that firstly, listening to music in this setting may be connected to negative effects and secondly early acoustic baffle could be beneficial. However, as there was no interaction seen between these two fac-

tors it cannot be assumed that early shielding may be the best but early application of music the worst option. Effect sizes were seen as small till medium. Therefore, there is a strong suspicion that significant effects and interaction between both factors may have been demonstrated in a larger random sample. Other studies showed evidence that noise on ICU is a problem by all means. Conversations of staff, alarms of medical devices, ringing phones, and noise during nursing activities are the main factors for sound volumes up to 100 decibels [40,42]. Shertzer et al. explored effects of a quiet environment on patients after surgery in the recovery room. These patients reported significant pain reduction over one hour and higher postoperative satisfaction compared to patients in a "normal" surrounding [4]. Beneficial effects of noise reduction were also demonstrated by Wallace et al exposing healthy volunteers' to a simulated ICU-soundscape [43]. It was seen that in participants using earplugs REM-sleep was seen earlier and more often. Focusing on musical effects on hemodynamic parameters and oxygen saturation inconsistent results exist. Both positive and no effects have been described for blood pressure [7,8,10,11,13, 14,16,35,37,38,40,44], heart rate [7,8,10,13, 14,16,22,35,37,38,40,44,45] and oxygen saturation [7,17]. However, no significant effects on these parameters were seen in this study. Studies exploring musical effects on consumption of opioid analgesics in patients who are awake showed either a significant reduction of dose rate [7,16,46,47] or no effects [17,25,37]. Our study was conducted on Propofol-sedated patients and application of analgesics was not rigid but triggered by clinical appearance of symptoms estimated as pain and was performed by nursing staff. Therefore, it can be assumed that no observable differences were seen between all experimental groups, while different pain levels were reported on day three after surgery. This finding suggests that evaluation of musical effects just using observable effects seems to be insufficient in sedated patients. But why does music in this study seem to be connected with negative effects whereas early application of music or acoustic baffle seems to be beneficial? Although musical treatment showed negative effects, the early application of music seems to have had a kind of shielding effect, too. Nilsson et al showed significant positive effects on pain perception, analgesic consumption, cortisol-levels, anxiety and fatigue in sedated patients exposed to music [46,47,7]. But Nilsson's collective were patients with hernia- or varices-surgery lasting no longer than one to two hours and these patients where sedated and ventilated no longer than one hour. The participants of our study were sedated and ventilated in mean for four hours and underwent open-heart surgery. These patients had a definitely longer period of unconsciousness, and it may be postulated that the phase of sedation could be a vulnerable period especially for acoustic stimuli. This may cause a change in perception of music for instance, which in patients who are awake may be found pleasurable but not in sedated patients. Maybe the immediate post-operative sleeping period is an important phase for recovery which fits to the findings of a better remembrance of the time immediately after surgery in patients with musical treatment. All kind of external stimuli, even music, may disrupt this early recovery. Following this hypothesis, musical treatment would not reduce negative feelings, but would keep the consciousness of this patient's alert, which may lead to a better perception of negative sensations such as pain or malaise. This theory is supported by the finding that although no significant differences between analgesic consumption were seen, early acoustic shielding showed less perceived pain and musical treatment showed more perceived pain described in questionnaires. Furthermore, interpretation of acoustic stimuli as negative or positive is always subjective. Music as a pleasant acoustic stimulus could help to reframe situations which have in general a negative connotation [3]. Unconsciousness induced by hypnotics may prevent reframing and may lead to perception of music simply as noise. Neverthe-

less, different limitations of this study have to be mentioned. Although power analysis was performed prior study start, the results showed effect sizes from small till medium. Therefore, group sizes seem to be too small to show significant results, which may have been obviously significant using larger group samples. Furthermore, intervention time of sixty minutes was chosen arbitrarily. Probably longer shielding or music application may have shown higher significant levels. For post-operative pain management no standardized therapy regime was used but just clinical appearance of symptoms estimated as pain by nursing staff. Although no significant differences were seen between all experimental groups influences on the results of this study can not be definitely excluded.

Conclusion

Typical post-operative complaints after open-heart surgery seem to be aggravated by musical treatment. Given that remembrance of immediate post-operative period was enhanced in these patients this could be due to increased perception of the environment on ICU. The beneficial effects of early intervention may be an indication of the importance of sufficient acoustic baffle especially in sedated and post-operative patients. This should be evaluated in further studies.

References

1. Forkel N. Über Johann Sebastian Bachs Leben, Kunst und Kunstwerke. Leipzig: Hoffmeister & Kühnel, Germany, 1802
2. Spintge RD. Musik-Medizin: physiologische Grundlagen und praktische Anwendungen. Stuttgart, Jena, New York: Gustav Fischer Verlag, 1992
3. Spintge R. Music and anesthesia in pain therapy. Anästhesiol Intensivmed Notfallmed Schmerzther 2000; 35 (4): 254-261
4. Shertzer KE, Keck JF. Music and the PACU environment. J Perianesth Nurs 2001; 16 (2): 90-102. doi:S1089-9472(01)37046-6 [pii] 10.1053/jpan.2001.22594
5. Melzack R, Wall PD. Pain mechanisms: a new theory. Science 1965; 150 (699): 971-979
6. Chlan L. Effectiveness of a music therapy intervention on relaxation and anxiety for patients receiving ventilatory assistance. Heart Lung 1998; 27 (3): 169-176. doi:S0147-9563(98)90004-8 [pii]
7. Nilsson U, Unosson M, Rawal N. Stress reduction and analgesia in patients exposed to calming music postoperatively: a randomized controlled trial. Eur J Anaesthesiol 2005; 22 (2): 96-102
8. Mok E, Wong KY. Effects of music on patient anxiety. AORN J 77 2003; (2): 396-397, 401-396, 409-310
9. Hamel WJ. The effects of music intervention on anxiety in the patient waiting for cardiac catheterization. Intensive Crit Care Nurs 2001; 17 (5): 279-285. doi:S0964-3397 (01)91594-0 [pii] 10.1054/iccn.2001.1594
10. Wang SM, Kulkarni L, Dolev J, Kain ZN. Music and preoperative anxiety: a randomized, controlled study. Anesth Analg 2002; 94 (6):1489-1494, table of contents
11. Updike P. Music therapy results for ICU patients. Dimens Crit Care Nurs 1990); 9 (1): 39-45
12. Siedliecki SL, Good M. Effect of music on power, pain, depression and disability. J Adv Nurs 2006; 54 (5): 553-562. doi:JAN3860 [pii] 10.1111/j.1365-2648.2006.03860.x
13. Heitz L, Symreng T, Scamman FL. Effect of music therapy in the postanesthesia care unit: a nursing intervention. J Post Anesth Nurs 1992; 7 (1): 22-31
14. Heiser RM, Chiles K, Fudge M, Gray SE. The use of music during the immediate postoperative recovery period. AORN J 1997; 65 (4): 777-778, 781-775
15. Cruise CJ, Chung F, Yogendran S, Little D. Music increases satisfaction in elderly outpatients undergoing cataract surgery. Can J Anaesth 1997; 44 (1): 43-48. doi:10.1007/BF03014323
16. Tse MM, Chan MF, Benzie IF. The effect of music therapy on postoperative pain, heart rate, systolic blood pressures and analgesic use following nasal surgery. J Pain Palliat Care Pharmacother 2005; 19 (3): 21-29

17. Nilsson U, Rawal N, Enqvist B, Unosson M. Analgesia following music and therapeutic suggestions in the PACU in ambulatory surgery; a randomized controlled trial. Acta Anaesthesiol Scand 2003; 47 (3): 278-283. doi:064 [pii]
18. Mitchell LA, MacDonald RA. An experimental investigation of the effects of preferred and relaxing music listening on pain perception. J Music Ther 2006; 43 (4): 295-316. doi:0022-2917-43-4-295 [pii]
19. Good M, Stanton-Hicks M, Grass JA, Cranston Anderson G, Choi C, Schoolmeesters LJ, Salman A. Relief of postoperative pain with jaw relaxation, music and their combination. Pain 1999; 81 (1-2): 163-172
20. Miluk-Kolasa B, Obminski Z, Stupnicki R, Golec L. Effects of music treatment on salivary cortisol in patients exposed to pre-surgical stress. Exp Clin Endocrinol 1994; 102 (2): 118-120. doi:10.1055/s-0029-1211273
21. le Roux FH, Bouic PJ, Bester MM. The effect of Bach's magnificat on emotions, immune, and endocrine parameters during physiotherapy treatment of patients with infectious lung conditions. J Music Ther 2007; 44 (2): 156-168. doi:0022-2917-44-2-156 [pii]
22. Guzzetta CE. Effects of relaxation and music therapy on patients in a coronary care unit with presumptive acute myocardial infarction. Heart Lung 1989; 18 (6): 609-616
23. Gaberson KB. The effect of humorous and musical distraction on preoperative anxiety. AORN J 1995; 62 (5): 784-788, 790-781
24. Colt HG, Powers A, Shanks TG. Effect of music on state anxiety scores in patients undergoing fiberoptic bronchoscopy. Chest 1999; 116 (3): 819-824
25. Blankfield RP, Zyzanski SJ, Flocke SA, Alemagno S, Scheurman K. Taped therapeutic suggestions and taped music as adjuncts in the care of coronary-artery-bypass patients. Am J Clin Hypn 1995; 37 (3): 32-42
26. Hodkinson HM. Evaluation of a mental test score for assessment of mental impairment in the elderly. Age Ageing 1972; 1 (4): 233-238
27. Rocca WA, Bonaiuto S, Lippi A, Luciani P, Pistarelli T, Grandinetti A, Cavarzeran F, Amaducci L. Validation of the Hodkinson abbreviated mental test as a screening instrument for dementia in an Italian population. Neuroepidemiology 1992; 11 (4-6): 288-295
28. Linstedt U, Berkau A, Meyer O, Kropp P, Zenz M. The abbreviated mental test in a German version for detection of postoperative delirium. Anästhesiol Intensivmed Notfallmed Schmerzther 2002; 37 (4): 205-208. doi:10.1055/s-2002-25076
29. Inouye SK, van Dyck CH, Alessi CA, Balkin S, Siegal AP, Horwitz RI. Clarifying confusion: the confusion assessment method. A new method for detection of delirium. Ann Intern Med 1990; 113 (12): 941-948
30. Janke W, Erdmann G., Hüppe M., Debus G. Condition-scaling using classes and adjectives (BSKE). Unpublished questionnaire. Institute of Physiology, Julius-Maximilians-University Würzburg, Germany, 1999
31. Hüppe M, Beckhoff M, Klotz KF, Heinzinger M, Prussmann M, Gerlach K, Ocker H, Schmucker P. Reliability and validity of the Anaesthesiological Questionnaire for electively operated patients. Anaesthesist 2003; 52 (4): 311-320. doi:10.1007/s00101-003-0471-5
32. Hüppe M, Klotz KF, Heinzinger M, Prussmann M, Schmucker P. Rating the perioperative period by patients. First evaluation of a new questionnaire. Anaesthesist 2000; 49 (7): 613-624
33. Huppe M, Zollner M, Alms A, Bremerich D, Dietrich W, Luth JU, Michels P, Schirmer U. The Anaesthesiological Questionnaire for patients in cardiac anaesthesia. Results of a multicenter survey by the scientific working group for cardiac anaesthesia of the German Society for Anaesthesiology and Intensive Care Medicine. Anaesthesist 2005; 54 (7): 655-666. doi:10.1007/s00101-005-0853-y
34. Cohen J. Statistical power analysis for the behavioral sciences. 2nd edn. Lawrence Erlbaum Associates, Inc., Hillsdale, New Jersey, 1988
35. Barnason S, Zimmerman L, Nieveen J. The effects of music interventions on anxiety in the patient after coronary artery bypass grafting. Heart Lung 1995; 24 (2): 124-132
36. Voss JA, Good M, Yates B, Baun MM, Thompson A, Hertzog M. Sedative music reduces anxiety and pain during chair rest after open-heart surgery. Pain 2004; 112 (1-2): 197-203. doi:S0304-3959(04)00414-2 [pii] 10.1016/j.pain.2004.08.020

37. Sendelbach SE, Halm MA, Doran KA, Miller EH, Gaillard P. Effects of music therapy on physiological and psychological outcomes for patients undergoing cardiac surgery. J Cardiovasc Nurs 2006; 21 (3): 194-200. doi:00005082-200605000-00007 [pii]
38. Kshettry VR, Carole LF, Henly SJ, Sendelbach S, Kummer B. Complementary alternative medical therapies for heart surgery patients: feasibility, safety, and impact. Ann Thorac Surg 2006; 81 (1): 201-205. doi:S0003-4975(05)01021-0 [pii] 10.1016/j.athoracsur.2005.06.016
39. Twiss E, Seaver J, McCaffrey R. The effect of music listening on older adults undergoing cardiovascular surgery. Nurs Crit Care 2006; 11 (5): 224-231
40. Byers JF, Smyth KA. Effect of a music intervention on noise annoyance, heart rate, and blood pressure in cardiac surgery patients. Am J Crit Care 1997; 6 (3): 183-191
41. Zimmerman L, Nieveen J, Barnason S, Schmaderer M. The effects of music interventions on postoperative pain and sleep in coronary artery bypass graft (CABG) patients. Sch Inq Nurs Pract 1966; 10 (2): 153-170; discussion 171-154
42. McLaughlin A, McLaughlin B, Elliott J, Campalani G. Noise levels in a cardiac surgical intensive care unit: a preliminary study conducted in secret. Intensive Crit Care Nurs 1996; 12 (4): 226-230
43. Wallace CJ, Robins J, Alvord LS, Walker JM. The effect of earplugs on sleep measures during exposure to simulated intensive care unit noise. Am J Crit Care 1999; 8 (4): 210-219
44. Lepage C, Drolet P, Girard M, Grenier Y, DeGagne R. Music decreases sedative requirements during spinal anesthesia. Anesth Analg 2001; 93 (4): 912-916
45. Chlan L, Tracy MF. Music therapy in critical care: indications and guidelines for intervention. Crit Care Nurse 1999; 19 (3): 35-41
46. Nilsson U, Rawal N, Unestahl LE, Zetterberg C, Unosson M. Improved recovery after music and therapeutic suggestions during general anaesthesia: a double-blind randomised controlled trial. Acta Anaesthesiol Scand 2001; 45 (7): 812-817. doi:aas450703 [pii]
47. Nilsson U, Rawal N, Unosson M. A comparison of intra-operative or postoperative exposure to music – a controlled trial of the effects on postoperative pain. Anaesthesia 2003; 58 (7): 699-703

Correspondence address:
Peter Iblher, M.D., MME
Department of Anaesthesiology
University of Lübeck Medical School
Ratzeburger Allee 160
23538 Lübeck
Germany
peter.iblher@uk-sh.de