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Study of the effectiveness of musical stimulation during intracardiac catheterization

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Summary *Background* Intracardiac catheterization is a routine physical examination. Due to psychological strains, several psychosocial interventions, including music therapy, have been proposed. The aim of the present study was to examine whether the preventive or adjuvant use of music therapy results in a reduction in both subjective and objective anxiety and thus leads to a reduction in sedative medication. *Methods of assessment* N = 83 patients (48 male, 35 female, 66 ± 11 yrs) waiting for scheduled cardiac catheterization were randomly allocated to one of three groups: control group (standard care), exposure group (music stimulation during the procedure), or coaching group (additional music therapeutic coaching). Target variables were subjective anxiety and physiological parameters. *Results* Music intervention did effectively reduce subjective anxiety (STAI-S reduction pre-post: exposure 11 pt, coaching: 4 pt, control: 6 pt; p = 0.033). Physiological values and medication did not differ between groups. *Conclusion* The use of music stimulation during the catheterization has a relaxing and calming effect on patients. It seems to be especially beneficial in a subgroup of patients with higher-than-average psychological strains.

Key words
Cardiac catheterization – anxiety – music therapy – physiological reactions

Background

Cardiac catheterization is a routine diagnostic procedure to depict coronary blood vessels and heart excavates. The latest revision of performance data from heart catheterization laboratories in Germany [25] reveals 652,781 coronary catheterizations in 2003. Even though cardiac catheterization is known as a low risk method [30], frequently cardiovascular and psychological adverse effects occur, which influence both the immediate course of the examination and the subsequent recuperation phase [8, 18, 13, 22]. Patients report strong subjective anxiety before the examination [21]. Coping mechanisms, like information seeking vs. avoidance of information [19] or necessity of control [16], exert considerable influence on subjective experience of the catheterization.

There are many psychotherapeutic and psychoeducative interventions to attenuate psychological strains during the examination. Particularly, extensive patient orientated preparation for cardiac catheterization (written information, video-modeling or behavioral-cognitive interventions) has proved to be beneficial in regard to anxiety and stress level [4, 16, 19, 21]. Detailed information about the forthcoming examination given by empathetic personnel increases faith in medical procedures and counteracts anxiety. Nevertheless, cost-effective novel interventions are needed [18].

Several studies confirm the anxiolytic benefits of adjuvant music therapy before and during cardiac catheter examinations in both children [3, 20] and adults [1, 6, 9, 23, 27]. Although the results regarding adult patients are sparse and heterogeneous, results indicate a possible benefit on both subjective anxiety and physiological values

Based on a detailed compilation of both psychological traits as well as the subjective emotional state before the imminent examination, the German Center for Music Therapy Research designed a music therapeutic intervention and investigated its impact on patients undergoing cardiac catheterization. The aim of the study was to examine whether the preventive or adjuvant use of music therapy results in a reduction in subjective anxiety and a normalization of physiological parameters (blood pressure, heart rate), thus, leading to a reduction in sedative medication. Further hypotheses were that a preparatory coaching outperforms mere musical exposure during the catheterization and that patients with pronounced strains react to the catheterization in a different way than patients with low strains.

Methods

Participants

The pretest-posttest, three-armed (coaching group, exposure group, control group) experimental study was conducted at the SRH Zentralkrankenhaus Suhl over a period of four weeks (February–April 2005). Patients were eligible if they were admitted to the hospital for an in-patient cardiac catheterization for the first or second time, were able to speak and read German, cognitively oriented to person, place and time and had no major auditory deficits.

Due to the effectiveness of music therapy reported in previous studies, a group difference of 20–30% on state anxiety STAI-S [17] was expected. Therefore a sample size of 120 patients would be sufficient to obtain a power of 80% ($\alpha = 0.05$).

Interventions

Usually partients experience the waiting period in advance and the initial phase of the cardiac catheterization as most stressful [18]. Therefore two different interventions were developed in order to optimize preparation of the patients and the examination itself. At the same time this design allows conclusions to be drawn about the dose-effect ratio of adjuvant music therapy during invasive medical procedures.

After admission each patient was allocated to one of the three study groups by permuted block randomization (each block contained six patients). Participants randomized to the *control condition* received standard medical care, but no further verbal or nonverbal interventions. Only health personnel were present during the catheterization. This group can be regarded as an attention-placebo group as well, as all patients had to fill in questionnaires and were asked about their well-being by trained non-medical health personnel.

Participants randomized to the *music exposition group* were provided the opportunity to listen to preselected music via earphones. Music began as soon as the patients lay on the operating table, continued during the whole cardiac catheterization and ended just before the patient left the operating table. A trained music therapist was present during the catheterization. Loudness and fit of earphones were controlled by the music therapist to ensure that patients could easily follow verbal instructions by health personnel (cardiologist or nurses) during the procedure. No additional verbal or nonverbal instructions were given by the music therapist. Apart from the social support claimed in literature [18], the anxiolytic effect of music was supposed to be the main working factor.

Participants randomized to the *coaching group* received music therapeutic coaching on the day prior to the catheterization. The psycho-educative coaching with cognitive-behavioral focus lasted for 50 min and comprised detailed information on the forthcoming procedure, music therapeutic relaxation training [2] and advice on stress management. During the cardiac catheterization a trained music therapist was present. Patients were provided the opportunity to listen to preselected music via earphones, just like the exposure group. Shortly before the procedure the music therapist gave a relaxing briefing and was available for reassurance throughout the procedure. Main working factors for this group (in addition to the factors expected in the exposition group) were improved coping mechanisms and increased information about the examination.

The preselected music was “Relaxation” by Martin Rummel, a piece designed for relaxation based on music psychological principles.

Measures

Target variables were psychological traits, subjective anxiety and physiological parameters.

Main physiological outcome variables were heart rate (HR), systolic and diastolic blood pressure (BP) which were registered three times (at baseline, before

and after the procedure). The psychological target variables were obtained through psychological questionnaires. The main outcome variable was subjective anxiety as measured by the State Trait Anxiety Inventory (STAI-S, [17]). The STAI is based on the distinction between anxiety as a state and anxiety as a characteristic, and raises anxiety as a long-term trait as well as anxiety as a temporary emotional state (both scales: $\alpha = 0.90$, trait-scale: $r_t t = 0.77$ to $r_{tt} = 0.90$, state: $r_{tt} = 0.22$ to $r_{tt} = 0.53$). The STATE form of the STAI questionnaire (STAI-S) was handed out to the patients before and after the procedure.

Because it was assumed that immediate reactions to the catheterization depend on psychological traits, these traits were surveyed by the Symptom Check List according to Derogatis (SCL-90-R, [7]), a widespread and established measure for the subjectively felt interferences to a person caused by somatic and psychic symptoms within a period of seven days ($\alpha = 0.75$ to $\alpha = 0.97$, $r_{tt} = 0.69$ and $r_{tt} = 0.92$); the aforementioned State Trait Anxiety Inventory (STAI-S [17]), the Hospital Anxiety and Depression Scale (HADS, [10]), an instrument widely used in somatic medicine to measure anxiety and depression (both scales: $\alpha = 0.80$, $r_{tt} = 0.84$), and a Visual Analogue Scale measuring well-being (from 0 = worst to 10 = best).

Additional information on medication, complications and duration of the procedure (sheath insertion to sheath removal) were obtained from the patients' records.

Analysis

Data were analyzed by using the statistical software package SPSS 13.0. Level of significance was set at $\alpha = 0.05$. To detect the influence of personality traits on subjective stress and anxiety, baseline personality traits were combined to "impact groups" by use of a hierarchical cluster analysis. Group comparison at baseline was performed by using an analysis of variance (ANOVA) for continuous variables and Kruskal-Wallis χ^2-tests for categorical variables. For assessment of intervention effects, repeated analyses of variance (ANOVA) or Analysis of Covariance (ANCOVA) with baseline data as covariate were carried out in order to control for baseline differences.

In addition to inference statistics, methods of "clinical significance" [12] were applied on STAI-S data (state anxiety). In doing so two statistical values can be estimated: one cut-off, specifying whether the patient belongs to the functional group or to the dysfunctional group, i.e., whether a clinically significant (CS) change occurred, and a value indicating a reliable change (RC). According to the formula for the CS: $CS=(SD_0M_1+SD_1M_0)/(SD_0+SD_1)$, the CS is 38.08 for female participants, and 36.83 for male participants. The reliable change index on the STAI-S was estimated by $RC = (x_{post} - x_{pre})/\sqrt{2 \cdot SE} > 1.96$ to RC = 4.8 points.

Results

Sample

In the course of the study, N = 120 patients facing first or second time cardiac catheterization were asked to participate. Of these, n = 90 were eligible due to inclusion criteria, signed the informed consent and were randomized to the control, exposure or coaching group. N = 83 data sets (n = 27 control group, 15 male; n = 28 exposure group, 18 male; n = 28 coaching group, 15 male) were complete and entered data analysis. Medical and demographic characteristics are summarized in Table 1.

Impact groups

At baseline, all psychological scores exceeded reference values from the normal population on all scales but did not differ between groups (all $p > 0.05$). Baseline personality traits (including Baseline – VAS, STAI-S, STAI-T, SCL: global severity index (GSI), HADS-Anxiety, HADS-Depression) were combined to two "impact groups" by use of a hierarchical cluster analysis. One group of patients (59%) had low values on all scales and one group (41%) had high values on all scales (see Table 2). Statistical comparison by a multivariate analysis of variance (MANOVA) confirmed this result as the groups' mean scores differed significantly on all scales ($F(6.53)) = 16.80$, $p = 0.000$). Impact pattern distribution was identical in the three intervention groups ($\chi^2 = 2.26$, $p = 0.322$).

Overall, about two-thirds of the women belonged to the high impact group as compared to one-fourth of the men ($\chi^2 = 10.79$, $p = 0.001$).

Physiological outcome

Physiologic outcome data was recorded three times. Results are shown in Table 3. At baseline, heart rate and blood pressure were normotom. Group changes by time were estimated via a 2 (time)×3 (intervention group) repeated ANCOVA analysis of covariance (ANCOVA), with baseline data as covariate.

During the catheterization, heart rate changes were marginal at large and did not exceed one beat per minute on average (ANCOVA: $F(1.73) = 0.84$,

Table 1 Characteristics of patients at enrollment

		Control group	Exposure group	Coaching group	Total	p*
Age (years)	Mean ± SD	67.5 ± 14.0	65.8 ± 8.4	66.2 ± 9.0	66.5 ± 10.7	0.832
	Range	28–83	49–83	44–80	28–83	
Sex	Male	15 (56%)	16 (57%)	16 (57%)	48 (58%)	0.963
	Female	12 (44%)	12 (43%)	12 (43%)	35 (42%)	
Diagnosis at admission	CAD suspect	20 (74%)	18 (64%)	17 (61%)	55 (66%)	0.455
	Known CAD	7 (26%)	10 (36%)	11 (39%)	28 (34%)	
Diagnosis after CC	CAD	13 (48%)	17 (61%)	16 (57%)	46 (55%)	0.677
	Cor. sclerosis	6 (22%)	8 (29%)	8 (29%)	23 (28%)	
	Misc.	3 (11%)	1 (3%)	2 (7%)	6 (7%)	
	NAD	5 (19%)	2 (7%)	2 (7%)	8 (10%)	
Access	Art. femoralis	27 (100%)	28 (100%)	24 (86%)	79 (95%)	0.014
	Art. brachialis	0	0	4 (14%)	4 (5%)	
Actual procedure	Angiogramm only	23 (85%)	20 (71%)	22 (79%)	65 (78%)	0.413
	PCI**	4 (15%)	8 (29%)	6 (21%)	17 (22%)	
Duration	Mean ± SD	27 ± 18 min	26 ± 14 min	20 ± 10 min	24 ± 15 min	0.335

* Analysis of group differences by Wilcoxon χ^2-tests
** *PCI* percutaneous coronary intervention

Table 2 Values on the psychological scales in the two impact groups (mean ± standard deviation) and interrelation of impact and intervention groups

	Cluster 1: low impact	Cluster 2: high impact	Total	Reference values (normal population)
Baseline – VAS	7.8 ± 1.5	5.9 ± 1.2	7.0 ± 1.7	–-
State-Anxiety (STAI-S)	39.9 ± 7.5	49.9 ± 8.4	43.3 ± 9.2	37.5*
Trait-Anxiety (STAI-S)	36.6 ± 5.8	46.3 ± 5.0	40.5 ± 7.3	35.8*
Global severity index (GSI – SCL)	0.32 ± 0.20	0.71 ± 0.35	0.48 ± 0.33	0.33*
Anxiety (HADS-A)	4.1 ± 1.9	9.0 ± 2.8	6.1 ± 3.3	5.8
Depression (HADS-D)	3.5 ± 2.8	7.0 ± 2.5	4.9 ± 3.2	3.4*
Control	71.4%	28.6%		
Exposition	52.4%	47.6%		
Coaching	50.0%	50.0%		
Male	77.8%	22.2%		
Female	36.0%	64.0%		
Total	58.3%	41.7%		

* differences "total" – "reference" highly significant as revealed by t-tests (all $p < 0.000$)

Table 3 Physiological values (HR, BP) by group and time

		Control	Exposition	Coaching	Total
Heart Rate (BpM)	Baseline	77.8 ± 12.2	71.8 ± 10.1	71.2 ± 9.8	73.7 ± 11.1
	Pre	74.9 ± 9.8	72.4 ± 12.5	73.0 ± 12.5	73.5 ± 11.5
	Post	72.4 ± 17.2	74.3 ± 12.9	74.6 ± 13.9	73.8 ± 14.6
Systolic BP (mmHg)	Baseline	139 ± 20	129 ± 17	133 ± 21	134 ± 20
	Pre	149 ± 23	153 ± 24	155 ± 22	152 ± 23
	Post	152 ± 20	153 ± 21	147 ± 32	151 ± 25
Diastolic BP (mmHg)	Baseline	80 ± 10	78 ± 11	81 ± 14	79 ± 11
	Pre	79 ± 11	85 ± 15	87 ± 15	84 ± 14
	Post	78 ± 10	81 ± 9	79 ± 11	79 ± 10

p = 0.363). Systolic blood pressure shot up from baseline to pre-measurement, remained static in the music intervention groups but diminished in the control group. These changes and differences proved to be statistically reliable ($F(2.70) = 5.81$, $p = 0.005$), but music intervention groups were identical (Scheffé post hoc test: $p = 0.323$).

Diastolic blood pressure rose in the music intervention groups from baseline to pre-measurement and leveled after the procedure. In the control group, all values remained nearly unchanged during the trial. An ANCOVA with baseline data as covariate confirmed these group differences (statistical tendency interaction intervention×time: $F(2.72) = 3.03$, $p = 0.055$). Again, music groups did not differ (Scheffé post hoc test: $p = 0.171$).

Thus, music interventions led to a decrease in blood pressure but no other physiological parameter. Music intervention groups (coaching vs. exposition) did not differ in any parameter. A further analysis by impact groups showed no influence of psychological strains on physiological parameters (all ANCOVAs $p > 0.05$).

Psychological outcome

The main psychological outcome criterion was reduction in subjective anxiety as measured by the STAI-S. All patients had a significant reduction pre-post in STAI values by 7.3 ± 9.4 points or 18%. A 3 (intervention group)×2 (time) repeated ANOVA resulted in a main factor time ($F(1.53) = 40.87$, $p = 0.000$) and an interaction intervention×time ($F(2.70) = 3.59$, $p = 0.033$), i.e., music intervention led to a stronger decline in STAI values as compared to the control condition. This result is due to the advantage of the exposition group (Scheffé post hoc test: $p = 0.052$).

According to the concept of reliable change [12, 15], STAI-S scores of 62% of the patients decreased by at least 4.8 points ("reliable reduction"), 30% remained unchanged, and scores of 8% deteriorated reliably. Group differences were distinctive but did not reach statistical significance ($\chi^2 = 1.55$, $p = 0.461$) (see Table 2).

This pattern is reconfirmed by the results pursuant to the concept of clinical significance: 40% of the patients' scores moved pre-post from the dysfunctional group to the functional group (clinical significant change, CS), 57% remained unchanged

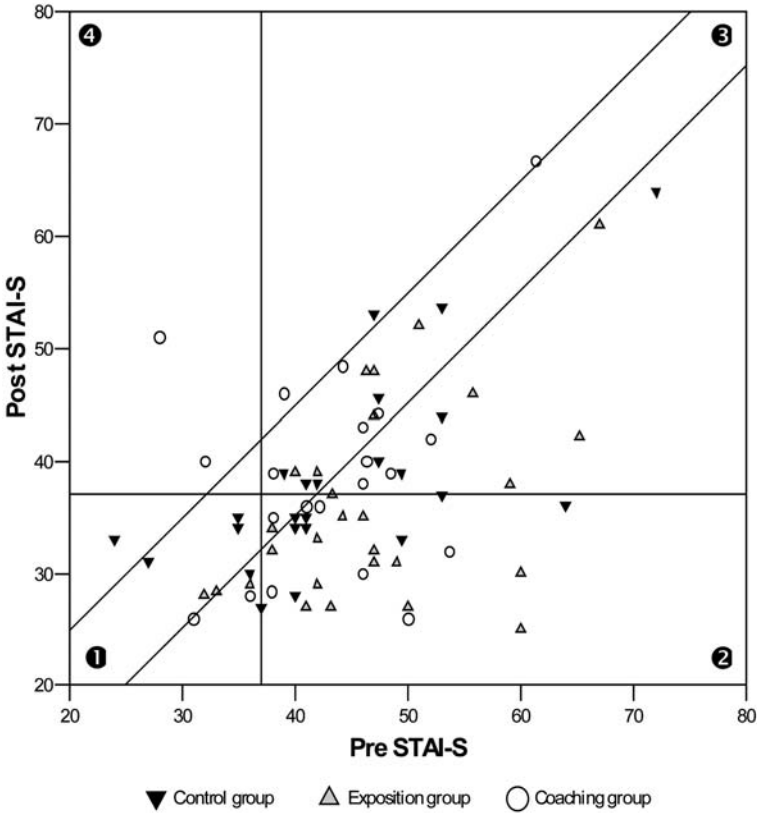

Fig. 1 Reliable and clinically significant change in STAI scores by intervention groups. The graph shows changes in STAI-S scores pre-post. Black lines indicate the cut-off values. Vertical lines represent the borders for reliable change: scores within the lines did not change reliably, scores in the upper half deteriorated reliably, in the lower half they ameliorated. Horizontal lines indicate cut-offs for CS. Scores of patients within the first and third quadrant did not change reliably (❶ = functional group, ❸ = dysfunctional group), scores in the second and fourth quadrant changed clinical significantly (❷: CS amelioration → dysfunctional pre-scores, functional post-scores; ❹: CS aggravation → functional pre-scores, dysfunctional post-scores)

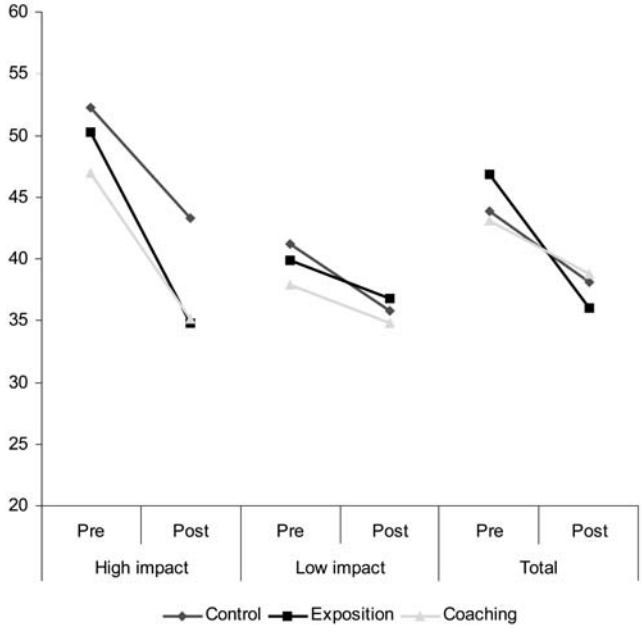

Fig. 2 STAI-S scores pre-post by intervention and impact group

(thereof 50% in the dysfunctional group and 7% in the functional group) and 3% showed clinically significant deterioration (i.e., were within the functional group prior to the intervention but progressed to the dysfunctional group). Differences between intervention groups were not statistically distinguishable ($\chi^2 = 3.99$, $p = 0.135$), but patients from the exposition group outperformed the other groups. Figs. 1 and 2 show these results.

Consideration of the impact groups in a 3 (intervention group) × 2 (impact group) × 2 (time) repeated ANOVA proves that music intervention significantly ameliorated subjective anxiety scores in the high impact group but not in the low impact group (interaction intervention × impact: $F(2.53) = 4.54$, $p = 0.015$). Scheffé post hoc tests indicate that music exposure in particular seems to be beneficial for the high impact group ($p = 0.098$).

As gender might be an intervening variable, a 3 (intervention groups) × 2 (sex) ANCOVA of STAI scores was performed. Responses to the examinations were found to be identical for men and women (no main effect: $F(1.67) = 0.10$, $p = 0.754$), independent of the intervention (no interaction intervention × sex: $F(2.67) = 1.08$, $p = 0.345$).

Medication

Overall 14 different drugs were administered, thereof six specific antihypertensitives (nitroglycerin,) gilustenon, Corinfar, Beloc, Dilzem, Adalat) and two analgesics (Aspisol, Diazepam). N = 34 patients received one or several thereof, n = 47 patients did not receive any of these pharmaceuticals. There were no group differences, neither concerning the number of patients in each group receiving medication ($\chi^2 = 3.41$, $p = 0.820$) nor the applied dose rate (all $p > 0.100$).

Intervening variables

One major source of pacification or discomposure might be the staffs conducting the catheterization. Varieties in physician-patient relationship or different interaction styles might have influenced the outcome of the present study. The sample size allows for a post hoc analysis, in order to rule out that the results of the music exposure were qualified by this intervening variable.

In the course of the study, three physicians, quite diverse in regional origin and skill, were employed at the catheterization laboratory in Suhl. These investigators were engaged equally often in all three intervention groups during cardiac catheterizations ($\chi^2 = 0.01$, $p = 0.993$). Statistical analyses by ANCOVA did not prove an interaction physician × intervention group for STAI scores ($F(4.68) = 0.30$, $p = 0.875$) or any physiological value (all $p > 0.114$). Health personnel consisted of four nurses, present during all examinations; thus, no intervening effects can be expected.

Discussion

All in all the aspired sample size of n = 90 was reached, the drop-out rate was 8%, leading to n = 83 complete data sets. Most patients showed satisfactory compliance. Group allocation was successful and equal. Demographic data indicate that the sample is representative for the population of interest [14, 28, 30].

Implementation of the music stimulation during the catheterization was smooth and did not cause any disturbance of the routine examination. Both the patients and the personnel looked upon the music stimulation favorably. Some difficulties occurred in executing the coaching. Though the coaching lasted only for 50 minutes, the integration into the hospital routine turned out to be difficult sometimes, if patients were very busy with medical and nursing procedures.

At baseline there were no significant differences between the groups according to psychological and physiological data. Thus any changes from pre to

post measurement could be attributed in large part to influences of interventions. Baseline data are concordant with previous results [6, 9, 27].

Physiological outcome measures

Acquisition of physiological data was a matter of routine. Main physiological outcome measures were heart rate, blood pressure and endocrinical values. At baseline, both heart rate (74 BpM) and blood pressure (134/79 mmHg) were within the normal range, though 90% of the participants suffered from arterial hypertension. This finding is possibly to be attributed to pre-medication which unfortunately had not been registered. Comparable studies report similar mean values for blood pressure (127/73 mmHg [6], and 135/74 mmHg [9]) respectively) and heart rate ([6]: 75, [9]: 67).

In the course of the examination, heart rate hardly changed (mean deviation was less than 1 beat per minute) and remained normotom. Comparable studies report similar variations (max. 8 beats [6] and max. 1 beat [9], respectively).

Blood pressure increased from the baseline to the onset of the catheterization. While the systolic blood pressure persisted on this high level, the diastolic blood pressure leveled off to the initial value. Compared to similar studies rather distinctive variation in the systolic blood pressure values of 18 mmHg could be detected (max. 10 mmHg [6] and 6 mmHg [9] respectively). Changes in diastolic blood pressure did not exceed 5 mmHg which agrees with known results (max. 4 mmHg [6], max 3 mmHg [9]).

On the whole, music interventions led to a more distinct normalization in physiological parameters if compared to the control group with the exposition group outperforming the coaching group.

A limitation of the results may be the selective measuring times of the physiological values. Data acquisition was standardized so that the measuring times were identical in all patients. Still, blood pressure and heart rate oscillated rather strongly in many patients, leading possibly to biased results. A continuous recording of physiological parameters is desirable and would allow for more sophisticated analytic procedures such as time series analysis.

Psychological outcome measures

Psychological data were obtained by a trained psychologist. On average, the patients reported noticeable psychological strains, especially somatic complaints as well as anxiety and depression. These findings are reconfirmed by relevant literature [4, 14]. As reported by several other studies (e.g., [11, 18]), women were found to be timider and reported more psychological strains than men prior to a cardiac catheterization.

Main psychological outcome measurement was state anxiety (STAI-S). STAI scores reduced pre-post by 18% or 7.3 points in all patients. Compared to a mean reduction by 7 points reported by another intervention study using the STAI [1], this result is further verified. According to the concept of clinical significance, on average all patients reached a reliable change of at least 4.8 points.

In the intervention groups different psychological reactions were observed. The reason for this finding might be that the patients in the exposition group were effectively distracted resulting in less stress and anxiety. Coaching on the other hand may give catheterization a serious aspect and emphasizes the symptoms.

Further analyses revealed that psychological strains are different in two subgroups – one subgroup comprising about 40% of the patients, with high impact on all psychological scales, and one subgroup comprising about 60% of the patients with low strains. The distribution of the patients in these two groups was independent from all intervening variables apart from gender: Women reported high strains about thrice as often as men. A similar distribution is reported in the literature [14, 18].

The two psychological impact groups reacted to the procedure in different ways: While the anxiety scores of the low impact patients remained constantly within the normal range, the scores in the high impact group were pathological previous to the catheterization but normalized after the procedure. Consequently, the interventions had different efficiencies depending on the impact of the patients. High impact patients could benefit from the music therapy, in particular from the exposition condition, low impact patients reported better results in the control group than in the music groups. A possible explanation may be different coping strategies employed by high and low impact patients. Davis [4] proposed two coping mechanisms during catheterization: “monitors” want to follow the procedure in detail; “blunters” prefer distractive strategies. The more information-avoidant strategies “blunters” used, the higher was the anxiety reduction. On the other hand, “monitors” reached the greatest reduction when utilizing information-seeking strategies. In the present study, patients belonging to the low impact group may be “monitors”, while patients in the high impact group may be “blunters”. More detailed clinical diagnostics focusing on coping strategies could answer this question. Future implementation of music therapeutic interventions should account for these differential coping mechanisms.

For clinical practice the claim for patient-focused treatments [19] is reinforced.

Medication

All groups received similar types and amounts of drugs. Music intervention did not effectively influence the amount of medication as compared to the control group.

Intervening variables

One important intervening variable is the baseline communication between the health personnel and the patient. If the examiner was very empathetic, the presence of additional personnel, increased interaction and musical stimulation might lead to interference in communication between the examiner and the patient and would be experienced as disturbing. If however, communication was insufficient, musical distraction might decrease levels of anxiety. In the present study this problem was invalidated because the effects of music intervention vs. the control group turned out to be independent of examiner or nurses present during the catheterization.

Conclusion

The present study implemented a music therapeutic stimulation technique during intracardiac catheterization. The hypotheses stated could be confirmed only in part.

- The hypothesis that music intervention can effectively reduce subjective and objective anxiety was partially proved. The two music interventions led to significant amelioration in STAI scores with the exposition condition outperforming the coaching. Music intervention could effectively influence blood pressure, but not heart rate.
- The hypothesis that a preparatory coaching outperforms mere musical exposure during the catheterization had to be rejected. On the contrary, patients in the exposition group reported near normal blood pressure values and less subjective anxiety after the procedure and reached higher relative reductions in STAI-S scores.
- The hypothesis that patients with pronounced strains react to the catheterization in a different way than patients with low strains was confirmed. The use of adjuvant music therapy as stimulation during the catheterization (exposition group) seems to be extra beneficial in a subgroup of patients with higher-than-average psychological strains. Patients with moderate to low strains are best off with no additional intervention.
- The hypothesis that music intervention leads to a reduction in sedative medication had to be rejected.

Thus, it can be ascertained that music stimulation has a relaxing and calming effect on patients during cardiac catheterizations. Future prospects are twofold. One consequence might be that a more comprehensive and long-term preparatory strategy comparable to the the music therapeutic coaching developed for patients on hemodialysis [21] seems to be more appropriate. On the other hand, mere musical exposure is very cost-effective and easily implemented. As video modeling [4, 18] is a highly efficient means of patient education, a novel approach could combine this educative procedure and musical stimulation. Great importance has to be attached to the patients of the high impact subgroup who need more comprehensive preparation and accompaniment during the examination.

Incorporation of significant others (e.g., spouses) in preparation and rehabilitation is a necessity [18], hitherto under-utilized. Especially in secondary prevention of CHD interdisciplinary methods are proposed by the AWMF guidelines [5]. One of the main problems in the post-operative treatment is restenosis [22]. As psychosomatic mechanisms aggravate this risk [13, 24, 26], music therapeutic coaching might be an effective prevention in implementing health-oriented behavior and stress management.

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