

# Reduction in Salivary Cortisol Level by Music Therapy during Colonoscopic Examination

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## ABSTRACT

**Background/Aims:** Premedication for endoscopy promotes patient cooperation and makes subsequent examinations more acceptable. Music therapy is widely used in the treatment of acute and chronic pain. Therefore, we investigated the effects of music therapy on pain and on salivary cortisol levels in patients undergoing screening colonoscopy.

**Methodology:** The subjects were 29 consecutive patients undergoing colonoscopy for various reasons. Patients were randomly assigned to undergo colonoscopy while listening to music (n=15) or while not listening to music (n=14). Cortisol levels were

measured in samples of saliva obtained before and after colonoscopy. After colonoscopy, patients were asked to rate their maximum pain during colonoscopy.

**Results:** Patients who listened to music during colonoscopy tended to have lower pain scores. Salivary cortisol levels increased significantly less in the group receiving music.

**Conclusions:** Music therapy during colonoscopy markedly reduces fear-related stress, as indicated by changes in salivary cortisol levels.

**KEY WORDS:**  
 Music therapy;  
 Colonoscopy;  
 Salivary cortisol

## INTRODUCTION

With instrumental advances in videoendoscopy and improvements in endoscopic techniques, colonoscopy is now less painful and better tolerated. However, premedication promotes patient's cooperation and makes subsequent endoscopies more acceptable (1-3)

Several studies have demonstrated that music can induce physiologic relaxation, as indicated by decreases in heart rate, blood pressure, respiratory rate, and galvanic skin response (4-10). In 1994, Palakanis *et al.* (11) reported that patients who listen to self-selected music tapes while undergoing flexible sigmoidoscopy have significantly less anxiety and lower heart rates and mean arterial pressure. In 1998, Lembo *et al.* (12) found that audio and visual stimulation reduces the abdominal discomfort associated with flexible sigmoidoscopy. Their results indicate that music is an effective anxiolytic for flexible sigmoidoscopy. However, few studies have examined changes in "stress hormones," such as cortisol (13), with music therapy. Therefore, we investigated the effects of music therapy on salivary cortisol levels in patients undergoing colonoscopy.

## METHODOLOGY

### Patients Selection

Subjects were recruited from among patients aged

40 to 69 years who were to undergo screening colonoscopy at the gastrointestinal endoscopy unit of the Osaka Medical Center for Cancer and Cardiovascular Diseases and were able to give informed consent for participation. Patients were excluded if they had endocrine disorders, chronic renal failure, or psychiatric disorders or were receiving glucocorticoids. The study protocol was approved by the Ethics Committee of the Osaka Medical Center for Cancer and Cardiovascular Diseases, and written informed consent was obtained from all patients.

### Randomization

Subjects were randomly assigned to undergo colonoscopy while listening to music (music-therapy group) or while not listening to music (control group). The music was of the "easy-listening" style and was played from the beginning of colonoscopy and continued throughout the examination. No patients were receiving anxiolytic medications, and no anticholinergic agents were administered to avoid antisecretory effects and the prick of a needle. All colonoscopic examinations were performed by one senior, experienced endoscopist (N.U.) with a standard technique and a video colonoscope (CF200I, Olympus, Tokyo, Japan). Care was taken to avoid creation of a sigmoid loop by application of clockwise torque, frequent deli-

cate suction, and scope withdrawal. Biopsies were performed as indicated, but no polypectomies were done.

**Grade of Pain**

After the examination, patients were asked to rate their maximum pain on a scale from 0 to 3 (0 = none;

1 = mild; 2 = moderate; and 3 = severe) (14). The grades of maximum pain were compared between the two groups.

**Salivary Cortisol Levels**

Saliva samples were collected just before and just after examinations. To collect a sufficient quantity of saliva, "Salivette" sampling devices (Sarstadt, Inc., Rommelsdorf, Germany) were used (15). The Salivette includes a small cotton swab and stimulates saliva flow to a rate that enables a sufficient amount to be collected within 1 minute. After centrifugation at 3000 rpm for 10 minutes, saliva was stored at -80°C until assay. Saliva cortisol levels were determined with a commercial enzyme immunoassay kit (CIRON, Tokyo, Japan) (16).

**Statistical Analysis**

Data are given as mean ±SD. The data were analyzed with a computer software program (StatView, version 5.0, SAS Institute Inc., North Carolina, USA). Fisher's exact probability test and the Student's *t*-test were used to compare clinical data of the groups. Repeated measured ANOVA was used to compare changes in salivary cortisol levels between the groups. Spearman's rank correlation was used to analyze correlation between cortisol level and grades of pain. One-way ANOVA was used to compare changes in salivary cortisol levels with grades of pain and Bonferroni/ Dunn test was performed to find which groups were significantly different each other after rejection of equality by the ANOVA. Calculated *p* values of less than 0.05 indicated statistical significance.

**RESULTS**

**Effect of Music on Patient Pain**

Thirty consecutive outpatients fulfilling the criteria were asked to participate; one patient declined. Therefore, 29 patients were enrolled. There were no significant differences between the control group (n=14) and the music-therapy group (n=15) in age, sex, starting time of colonoscopy, duration of endoscopy, or incidence of previous abdominal surgery or colonoscopy. Reaching the cecum was achieved in all patients. Mean levels of salivary cortisol before colonoscopy in each group were also similar (Table 1).

Patients' perceptions of maximal pain during colonoscopy were reduced by a slight, but not significant degree, in the group receiving music (*p*=0.076, Table 2).

**Effect of Music on Salivary Cortisol Levels**

Changes in salivary cortisol levels immediately after colonoscopy was significantly lower in the music-therapy group than in the control group (*p*=0.039, Figure 1).

Cortisol levels in patients who reported severe pain were significantly higher than those in patients who reported no pain or mild pain (*p*=0.022, Figure 2).

**TABLE 1 Clinical Data for Patients undergoing Screening Colonoscopy With and Without Music**

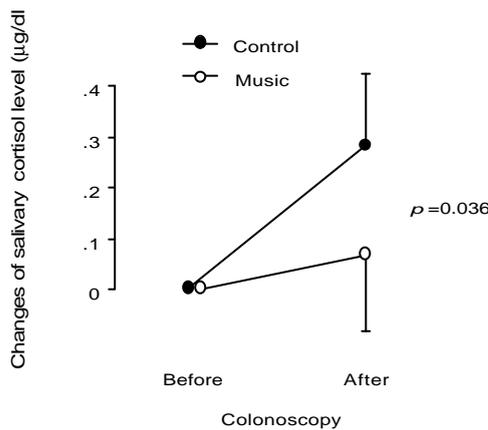
Therapy	Control	Music	<i>p</i> -value
Number	15	14	
Mean age (years old, ±SD)	54±8	54±6	0.927
Sex (male/female)	11/4	7/7	0.181
Mean examination time (minutes, ±SD)	36±19	31±10	0.484
History of abdominal surgery (yes/no)	3/12	3/11	0.639
History of colonoscopy (yes/no)	6/9	7/7	0.434
Mean initial cortisol level (µg/dL, ±SD)	0.20±0.15	0.23±0.20	0.919

**TABLE 3 Response to EFS before Blockade of the Adrenergic Cholinergic Nerves**

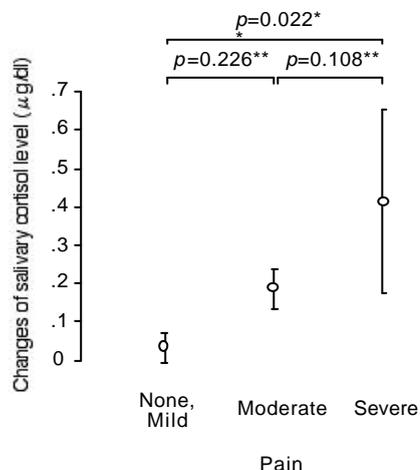
Grade of pain	Control	Music
None, mild	2	6*
Moderate	10	6
Severe	3	2

\*: *p*=0.076 for Control vs. Music groups comparing none, mild with moderate and severe.

**FIGURE 1** Salivary cortisol levels in the music-therapy group (●) and the control group (○). *p*-values were given by Fisher's exact probability test and Student's *t*-test.



**FIGURE 2** Salivary cortisol levels and patients reported levels of pain. *p*-values were given by one-way ANOVA.



## DISCUSSION

Our results show that salivary cortisol levels increase significantly less in patients who listen to music during screening colonoscopy. We conclude that music therapy markedly reduces endoscopy-related stress, as reflected by changes in salivary cortisol levels.

Lembo *et al.* (12) report that audio and visual stimulation significantly reduces, principally through distraction, abdominal discomfort during flexible sigmoidoscopy. Distraction techniques are widely used to treat acute (17) and chronic pain (18). Distraction is thought to reduce pain by decreasing the amount of attention a person gives to painful stimuli (19). In our study, there was a trend toward lower pain scores during colonoscopy in the music therapy group, but this was not statistically significant. We suppose music is not so powerful that it could not reduce subjective pain during colonoscopy. Actually, half of the patients who listened to the music still had moderate to severe pain. To make colonoscopy less painful and better tolerated, intravenous administration of sedative agents is widely used. Sedation for colonoscopy is associated with a small but definite risk of cardiorespiratory complication (2). Although, music alone does not have enough effect on reducing subjective pain, it may lead to prevent complications of sedatives through reduction of

administered dose.

Music therapy has been successfully used to help patients overcome anxiety and, thus, to reduce stress. However, few studies have examined changes in the "stress hormone" cortisol, because blood sampling itself might increase anxiety (13). McKinney *et al.* (20) have found that music therapy reduces cortisol levels in healthy adults and have suggested that such changes in hormonal regulation may affect the health of persons feeling constant stress. Mockel *et al.* (21) found that cortisol levels in serum were lower after subjects had listened to a Strauss waltz. Escher *et al.* (22) reported that the increase in plasma levels of cortisol during gastroscopy were significantly less when patients listened to music. Cortisol levels can now be measured reliably and accurately in saliva (23); measuring cortisol in saliva provides a better index of adrenal function than does measuring cortisol levels in blood (24,25). Furthermore, we found that salivary cortisol levels were correlated with the pain levels during colonoscopy. It suggests that it may be a convenient and feasible biomarker for assessing patients' pain during colonoscopy.

In conclusion, music therapy is a noninvasive and inexpensive technique and an effective anxiolytic adjunct to colonoscopy.

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