Journal of Advanced Nursing, 1996, **24**, 905–914

Effects of relaxation and music on postoperative pain: a review

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Accepted for publication 14 November 1995

GOOD M (1996) *Journal of Advanced Nursing* **24**, 905–914
Effects of relaxation and music on postoperative pain a review
Postoperative patients differ in their response to pain and opioids It is therefore important that nurses offer other options as adjuvants to medication Relaxation and music may reduce pain by interrupting the postoperative cycle of pain, muscle tension and sympathetic activity This review summarizes and critiques studies on the effectiveness of relaxation and music use during postoperative pain Relaxation and music were effective in reducing affective and observed pain in the majority of studies, but they were less often effective in reducing sensory pain or opioid intake However, the between-study differences in surgical procedures, experimental techniques, activities during testing, measurement of pain, and amount of practice make comparisons difficult Furthermore, within studies, the problems of inadequate sample size, lack of random assignment, no assurance of pretest equivalence, delayed post-test administration and no control for opiates at the time of testing reduces the validity of the studies' conclusions Randomized controlled studies of the types of relaxation and music that are most helpful to postoperative patients should be explored in various contexts

INTRODUCTION

Each year in the United States of America, 23 million people undergo surgical operations that are accompanied by postoperative pain (Chapman 1985) The most severe pain is associated with abdominal surgery, because of the proximity of the diaphragm (Bonica 1954, 1983, Keats 1956, Bruegel 1971, Sweeney 1977) Twenty-five to 40% of individuals who have surgery in this area report steady moderate pain, 40–70% report steady severe pain, and 85–100% report severe pain on movement (Bonica 1983) Intense pain is also experienced by persons following cardiac, orthopaedic or other major surgeries

Postoperative pain has no functional value after it has signalled the presence of tissue damage, and it can have deleterious psychological and physiological consequences (Phillips & Cousins 1986) For example, it increases stress responses that in turn increase tissue breakdown, coagulation, and fluid retention Pain also interferes with appetite and sleep, which are both essential to the recovery process Furthermore, it can contribute to cardiovascular, gastrointestinal and urinary tract complications, thereby prolonging hospitalization and recovery (Quimby 1968, Wolfer & Davis 1970, Acute Pain Management Guideline Panel 1992, Miaskowski 1993)

Many patients experience moderate to severe pain in spite of analgesic medication (Keeri-Szanto & Heaman 1972, Marks & Sacher 1973, Cohen 1980, Weis *et al* 1983) The unrelieved pain may be due to under-medication, which can be remedied with additional medication followed by careful assessment of relief and reintervention until the balance between analgesia and side effects is optimal However, because patients differ in their response to pain and to opioids, it is important to have other options

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such as relaxation and music to manage their discomfort and achieve a balance between analgesia and side effects (Acute Pain Management Guideline Panel 1992)

Cognitive behavioural intervention

Cognitive behavioural interventions such as relaxation and music are suggested for patients who find these interventions appealing, are anxious, are likely to have prolonged pain, have incomplete relief from optimal amounts of medication, or are likely to benefit from less opioid medication Relaxation and music have been recommended in the acute pain management guideline published by the Agency for Health Care Policy and Research as interventions to be used in addition to opioid medication for moderate postoperative pain However, the recommendations are based on preliminary and quasi-experimental studies, and need to be confirmed by well-designed clinical trials (Acute Pain Management Guideline Panel 1992)

To date there has been no full review of the effectiveness of relaxation and music for post-surgical pain The literature of the effects of relaxation and music on pain is fragmented because studies are reported in journals in nursing, psychology, medicine, and music therapy Furthermore, the studies have covered a broad spectrum of problems from relief of surgical pain to relief of stress, cancer pain and chronic pain Review articles have included numerous interventions and outcome variables, resulting in general findings and recommendations that are not specific to any postoperative population If critiques and recommendations are too general, flawed methods will continue to threaten the validity of the research

THE STUDY

This integrative review summarizes and critiques the research on the effectiveness of relaxation and music on postoperative pain and identifies limitations and gaps to be considered in future studies There were four questions guiding the review

1 What relaxation and music interventions have been studied for relief of postoperative pain?
2 What theories are used to study the effects of relaxation and music on postoperative pain?
3 Do the results show relaxation and music to be effective in reducing postoperative pain?
4 What methodological issues may confound the inferences in these studies?

Sample

Published studies of the effects of relaxation and music on postoperative pain in adults were located by searching Medline Express® from 1966 to 1995, and the Cumulative Index of Nursing and Allied Health Literature — CD, from 1982 to 1995, PsycLit Journal Articles, 1971–95 using the keywords pain, postoperative, relaxation and music In addition, recent reviews of relaxation and music (Cook 1981, 1986, Bailey 1983, Snyder 1988, Hyman *et al* 1989, Acute Pain Management Guideline Panel 1992) and a hand search of all volumes of the *Journal of Music Therapy* were examined to locate articles Book chapters on the empirical bases for these nursing interventions were also searched (Buckwalter *et al* 1985, Laframboise 1989, Scandrett-Hibdon & Uecker 1992, Snyder 1992a, 1992b)

All published research studies of use of a relaxation technique and/or music to reduce acute pain following surgery on the adult human torso were included in the review The sample consisted of 21 studies from 15 journals three in medicine (*Journal of Behavioral Medicine, New England Journal of Medicine,* and *Spine*), and 10 in nursing (*ANPHI Papers, Communicating Nursing Research, Dimensions of Critical Care Nursing, Heart and Lung, International Journal of Nursing Studies, Journal of the New York State Nurses' Association, Nursing Research, Orthopaedic Nursing, Perioperative Nursing Quarterly, Supervisor Nurse,* and *Topics of Clinical Nursing*) and one chapter from a book (Laframboise 1989)

Measures

A survey instrument was used to document the authors' names, publication year, intervention technique, theoretical framework, surgical population, sample size, design, use of randomization, pretest equivalence of groups, patient activity during testing, immediate post-test administration, control for analgesics, measures of pain, other controlled variables, statistical tests and findings

Procedure

The author read each study and recorded data on the survey instrument Effectiveness data were tabulated according to the type of measurement used reported sensory pain, reported affective pain, reported univariate pain, and opioid intake In addition, because equivalence of groups is important for accurate inferences, studies were divided into three classifications (a) studies that were randomized, (b) studies that were not randomized, and (c) pre-experimental studies that had no control group

Studies in each group were arranged in Table 1 in descending order according to sample size so that it would be immediately clear which of the largest studies were randomized, what the results were, and whether pretest equivalence and immediate use of a post-test were reported Information on variables thought most likely

Table 1 Effectiveness and methodological factors of studies of relaxation and music for postoperative pain

Author	Interventions	Surgical procedures	Theories	Effectiveness					Methodological factors						
				Reported sensory pain	Reported affective pain	Reported pain	Pain behaviour	Opoid intake	Treatment group size	Pretest equivalence	Immed post test	Practice	Control for pretest analgesic	Various activities	Data analysis
						Randomized studies									
Wells 1982	>1 Relaxation tech	Cholecystectomy	Gate control	0	+	—	—	0	6	y	y	n	n	Rest	ANOVA
Ceccio 1984	Jaw relaxation	Hip surgery	Gate control	+	+	—	—	+	10	n	y	y	2 h	Turning	ANCOVA
Levin *et al* 1987	1 Rhythmic breathing	Chole	Gate control	0[a]	0[a]	—	—	—	7	n	n	n	Stat	Rest	RM ANOVA
	2 Benson s relaxation			+[a]	+[a]	—	—	—	9						
Mullooly *et al* 1988	Easy listening music	Hysterectomy	Gate control	0/+[b]	+	—	—	—	11[c]	Stat	y	n	3 h	Rest	RM ANOVA
Voshall 1980	Several interventions	Chole	Atheoretical	0	0/+[c]	—	—	—	15	n	n	n	n	Rest	Not specified
Laframboise 1989	Several interventions	Upper abdom	Contingency	0	0	0	—	0	15	n	n	n	n	Rest	*t* tests
Wilson 1981	Progressive relaxation	Chole /hyst	Atheoretical	—	+	—	—	0	18	n	n	n	n	Rest	ANOVA
Good 1995	Jaw relaxation	Abdominal	Gate control	0/+[d]	0/+[d]	0	—	0	21	Stat	y/n[e]	y	Stat	Amb /rest	ANCOVA
	Choice of music			0/+[d]	0/+[d]	0	—	0							
	Relaxation and music			0/+[d]	0/+[d]	0	—	0							
Egbert *et al* 1964	Several interventions	Abdominal	Placebo	—	—	0	+	+	28[f]	n	n	n	n	Rest	*t* tests
Ziemer 1983	Several interventions	Gyn/GI surgery	B Neuman	0	0	—	—	0	33	n	n	n	n	Rest	*t* tests
Mogan *et al* 1987	Several interventions	Chole /hyst	Atheoretical	0	+	—	—	0	40	n	n	y	Stat	Amb	ANOVA
						Nonrandomized studies									
Bafford 1988	Progressive relaxation	Cardiac surgery	↘Anx ↘pain	—	—	—	+	—	10	n	n	n	n	Rest	Not specified
Swinford 1987	Relaxation/imagery	Abdominal	Atheoretical	—	—	+/0[b]	—	—	10	n	y	n	>1 h	Rest	*t* tests
Locsin 1981	Preferred music	Gyn/ob surgery	Gate control	—	—	—	+	0	12	n	y	n	n	Rest	Not specified
Miller & Perry 1990	Slow deep breathing	Cardiac surgery	Endorphins	—	—	+/0[b,g]	—	0	15	Stat	y	y	3 h	Rest	ANOVA
Horowitz *et al* 1984	1 Jaw relaxation	Cardiac surgery	Gate control	0	0	—	—	0	15	n	y	y	n	Amb	ANOVA
	2 Benson s relaxation			0	+	—	—	0	15						
Flaherty & Fitzpatrick 1978	Jaw relaxation	Chole/ hern/haem	Gate control	+/0[h]	+	—	—	+/0[h]	21	n	y	n	3 h	Amb	ANOVA
Locsin 1988	Preferred music	Not specified	Atheoretical	—	—	—	+	0	30	n	y	n	n	Rest	ANOVA
	Guided imagery/music			—	—	—	+	—	30						
Lawlis *et al* 1985	Several interventions	Spinal surgery	Endorphins	—	—	+	—	+	50	n	n	n	n	Rest	*t* tests
						Studies without a control group									
Updyke 1990	Choice of music	Various (ICU)	Endorphins	+	+	—	—	—	13	n	y	n	n	Rest	Paired *t* tests
Herth 1978	Favourite music	Various (ICU)	Atheoretical	—	—	+	—	+	Not spec	n	n	n	n	Rest	Percentages
						Summaries									
Majority totals	Individual interventions	Abdominal/ pelvic surgeries	Gate control	+	+	+	+	0	22 or less per group	n	n	n	n	Rest	ANOVA/*t* tests
n of studies (total = 21)	14	13	8	6 of 12	10 of 13	4 of 7	4 of 4	5 of 15	17	17	11	16	14	16	7 each

NB tech = technique, 0 = not effective, + = effective, — = not tested, y = yes, n = no, h = hours since analgesic given, stat = statistical control, abdom = abdominal, chole = cholecystectomy, hyst = hysterectomy, amb = ambulation, gyn = gynaecologic, GI = gastrointestinal, anx = anxiety, ob = obstetric, hern = herniorrhaphy, haem = haemorrhoidectomy, ICU = intensive care unit

[a]Effective for sensory and affective pain in multivariate analysis, [b]Effective 2nd day, but not 1st day, [c]Effective 3rd day but not 1st and 2nd day, [d]Not effective at 1st ambulation, but helpful for pain in next 2 days, [e]Immediate post-test after 1st ambulation but not in next 2 days, [f]After attrition, [g]Effective using visual descriptor scale, but not visual analogue scale, [h]Effective following cholecystectomy and herniorrhaphy, but not haemorrhoidectomy

to affect the validity of the results also was included in the table

Study findings were analysed in relation to the research questions using frequencies and percentages Each column of Table 1 was summarized at the bottom by noting majority responses

RESULTS

The majority summary at the bottom of Table 1 shows that effectiveness was found following 6 of the 12 studies in which reported sensory pain was measured, 10 of the 13 studies in which reported affective pain was measured, 4 of the 7 studies in which reported unidimensional pain was measured, all of the 4 studies in which observed pain was measured, and only 5 of the 15 studies in which opioid intake was measured This suggests that relaxation and music were effective in the majority of studies for affective pain, and for reported and observed unidimensional pain, but were equivocal for sensory pain and were not effective in the majority of studies for opioid intake

In the majority of the 21 studies in the sample, investigators tested individual interventions ($n=14$), in resting patients ($n=16$), following a variety of abdominal surgery, and had fewer than 22 subjects ($n=17$) The gate control theory was used most frequently The majority used immediate post-tests ($n=11$), but did not establish the pre-test equivalence of groups ($n=17$), provide practice ($n=16$), or control for time since medication ($n=14$) There was no clear majority for method of data analysis ANOVA and *t*-tests were each used in seven studies

Interventions

A wide variety of relaxation and music interventions have been tested for postoperative pain (Table 1) Thirteen investigators have tested relaxation or music as individual interventions and eight tested combinations of non pharmacological interventions Four of those studying individual interventions examined the effects of jaw relaxation on the pain that occurs during activity such as turning or ambulating after surgery (Flaherty & Fitzpatrick 1978, Ceccio 1984, Horowitz *et al* 1984, Good 1995) The relaxation technique consists of lowering the jaw, keeping the tongue quiet and lips soft, reducing thoughts and verbalizations, and breathing slowly and rhythmically

Two investigators used Benson's technique of sitting quietly in a comfortable position with closed eyes, deeply relaxing all muscles progressing from the feet to the face while breathing naturally and saying the word 'one' during exhalation (Horowitz *et al* 1984, Levin *et al* 1987) Two researchers studied the effects of rhythmic breathing on pain Levin *et al* also tested a rhythmic breathing exercise, and Miller & Perry (1990) taught a slow rhythmic deep breathing technique

Two investigators used progressive relaxation Wilson (1981) tested a taped 20-minute narrated exercise in progressive muscle relaxation before and after surgery, while Bafford (1977) used progressive relaxation in two supervised and two taped sessions each day following surgery

Five investigators tested different types of music Updyke (1990) offered a choice between eight types of classical or contemporary music tapes Good (1995) offered a choice among five types of sedative music synthesizer, harp, piano, orchestra or jazz Mullooly *et al* (1988) chose easy listening music, Herth (1978) assessed the favourite type of music, and Locsin compared patient preferred music and non preferred music (Locsin 1981), and in a second study added guided imagery music (Locsin 1988)

Components

Treatment conditions were sometimes comprised of more than one component Wells (1982) included three relaxation techniques in one treatment while others combined relaxation with other experimental approaches Voshall (1980) taught experimental subjects abdominal muscle relaxation plus exercises for 'gas pains' and Laframboise (1989) tested a combination of structured breathing, autogenic muscle relaxation and pleasant imagery Good (1995) combined jaw relaxation and music while Egbert *et al* (1964) taught patients pre-operatively about expected sensations, abdominal relaxation and control of pain during turning, and reinforced the teaching twice daily after surgery Mogan *et al* (1987) combined jaw relaxation and imagery, and Swinford (1987) used a combination of progressive relaxation and imagery Lawlis *et al* (1985) educated patients on the nature of pain, endorphins and healing, and taught them to use progressive relaxation, distraction, and deep breathing

Five investigators have compared two or more interventions Levin *et al* (1987) contrasted rhythmic breathing with Benson's relaxation technique Horowitz *et al* (1984) compared jaw relaxation and Benson's technique, and Good (1995) contrasted individual jaw relaxation and music techniques with the combination of relaxation and music, and a control condition Locsin (1988) compared preferred music and guided imagery music Ziemer (1983) combined information on six coping strategies, including Benson's relaxation, with procedural and sensory information and compared these to procedural and sensory information and procedural information alone

Surgical procedures

Relaxation and music were tested in patients undergoing 12 different kinds of surgery in three body cavities (abdominal, pelvic and thoracic) and two orthopaedic sites (spinal column and hip) (See Table 1) Postoperative pain and its relief may differ in these locations For example, pain in the abdominal cavity may be exacerbated by

distension and respiration Orthopaedic pain is affected less by respiratory and gastrointestinal functions, but may be increased by movement, position or weight Nine (45%) investigators controlled for the type of surgery by limiting the type to one procedure or body site

Theories

Six (30%) of the studies of the effects of relaxation and music on postoperative pain were atheoretical (Herth 1978, Voshall 1980, Wilson 1981, Mogan *et al* 1987, Swinford 1987, Locsin 1988) and nine (45%) were based on the gate control theory (Flaherty & Fitzpatrick 1978, Locsin 1981, Wells 1982, Ceccio 1984, Horowitz *et al* 1984, Levin *et al* 1987, Mullooly *et al* 1988, Miller & Perry 1990, Good 1995) (see Table 1) Two investigators (11%) explained that stress increases pain, and relaxation increases endorphin activity, thereby reducing pain (Lawlis *et al* 1985, Updyke 1990), and one investigator explained the intervention as an active placebo action (Egbert *et al* 1964)

Those who used the broad gate control theory added explanations of the influence of other physical and mental responses on pain perception, including reflex muscle contraction or spasms (Wells 1982, Horowitz *et al* 1984), general muscle tension (Flaherty & Fitzpatrick 1978, Levin *et al* 1987, Miller & Perry 1990, Good 1995), stress, anxiety and sympathetic outflow (Locsin 1981, Levin *et al* 1987, Mullooly *et al* 1988, Miller & Perry 1990, Good 1995), and the endocrine system (Levin *et al* 1987)

Gate control theory

The gate control theory (Melzak & Casey 1968) addresses only how nociception is transmitted and modulated, it does not explain how relaxation and music reduce pain Therefore, investigators using this theory further explained their intervention effects as the result of distraction (Flaherty & Fitzpatrick 1978, Locsin 1981, Ceccio 1984, Mullooly *et al* 1988, Updyke 1990), the relaxation response (Wells 1982, Updyke 1990), reduction of anxiety (Bafford 1977, Flaherty & Fitzpatrick 1978, Locsin 1981, Ceccio 1984, Horowitz *et al* 1984, Levin *et al* 1987, Miller & Perry 1990), a sense of control (Flaherty & Fitzpatrick 1978, Ceccio 1984) or descending modulation of transmission of nociception (Wells 1982) and modulation as the result of endorphin activity (Miller & Perry 1990) Prescriptive theories, however, are also needed for pain intervention studies because they give direction to practicing nurses and can be directly related to the results

Further, none of the theories predict how nurses act to relieve pain Nurses treat pain responses in holistic ways throughout the postoperative period Other health providers may use relaxation and music differently, and although knowledge from their research may have some relevance to the nursing discipline, it does not address the strategic interplay of how and when to use pharmacologic and nonpharmacologic measures in the most effective combination A nursing perspective is needed to develop this unique disciplinary knowledge

Nursing model

To relate the research to a nursing perspective, three investigators used a nursing model Ceccio (1984) and Good (1995) used Orem's (1991) self care deficit theory of nursing to describe patients' use of relaxation and music to regulate their own health and well-being when in pain, and Ziemer (1983) used Neuman's health care systems model (1980) which suggests that primary prevention increases lines of defense prior to the impact of a stressor

Two middle-range nursing models were used Kim's (1980) contingency model of pain care states the effect of a cognitive intervention on postoperative pain is contingent on preoperative anxiety, and a pre- and postoperative coping intervention model suggests that cognitive behavioural preparation will increase coping which decreases anxiety and pain (Laframboise 1989)

Effectiveness of interventions

Though many investigators have been interested in demonstrating the effectiveness of relaxation and music, the findings to date are inconsistent Some investigators have shown that relaxation and music reduce postoperative pain, while others have not, and others have found mixed results (see Table 1) Mixed findings will be reported in the text as having an effect, and in Table 1 are indicated with both + and o and a note describing the context Fourteen investigators in the sample (67%) measured two components of reported pain sensory and affective

In some studies ($n=7$, 33%), relaxation or music reduced patients' reports of both sensory and affective pain (Flaherty & Fitzpatrick 1978, Ceccio 1984, Levin *et al* 1987, Mullooly *et al* 1988, Updyke 1990, Good 1995), however, in others ($n=4$, 19%), relaxation reduced only reports of affective pain (Wilson 1981, Wells 1982, Horowitz *et al* 1984, Mogan *et al* 1987) In three studies (14%), relaxation had no effect on either component of reported pain in resting patients (Voshall 1980, Ziemer 1983, Laframboise 1989)

Not every investigator measured both the sensory and affective components of pain, but rather viewed it as a composite experience Nine (43%) studied reported pain as a single-component concept (Table 1) Six of these used patient reports (Herth 1978, Lawlis *et al* 1985, Swinford 1987, Laframboise 1989, Miller & Perry 1990, Good 1995), three observed behaviour to measure pain (Bafford 1977, Locsin 1981, 1988), one used both (Egbert *et al* 1964), and again, the results were mixed

The interventions were effective in all of the studies in which observed behaviour was measured, but in only four

of the six studies in which unidimensional reported pain was measured (Herth 1978, Lawlis *et al* 1985, Swinford 1987, Miller & Perry 1990) Egbert *et al* (1964) found an effect on observed pain behaviour, but not on reported pain Since some patients in pain may not outwardly demonstrate their discomfort, measurement of behavioural pain may have less validity

Opioid intake (Table 1) has been used as an indicator of pain in most ($n=15$, 71%) studies of relaxation or music, with treatment effects in some ($n=5$, 24%, Egbert *et al* 1964, Flaherty & Fitzpatrick 1978, Herth 1978, Ceccio 1984, Lawlis *et al* 1985, Good 1995), but not in others ($n = 10$, 48%, Locsin 1981, 1988, Wilson 1981, Wells 1982, Ziemer 1983, Horowitz *et al* 1984, Mogan *et al* 1987, Laframboise 1989, Miller & Perry 1990, Good 1995) The effect of these interventions on the amount of opioid intake is confounded, however, by patient variations in response to pain, surgery and opioids Therefore it is not clear that any relaxation and music techniques posses sufficient strength or duration of effect to reduce the amount of opioid obtained

Conflicting results

In 11 (52%) of the 20 studies there were conflicting results on at least two different measures of pain (Egbert *et al* 1964, Flaherty & Fitzpatrick 1978, Locsin 1981, 1988, Wilson 1981, Wells 1982, Horowitz *et al* 1984, Mogan *et al* 1987, Mullooly *et al* 1988, Miller & Perry 1990, Good 1995) In only six (29%) studies were there consistently positive results on all of the measures used (Herth 1978, Voshall 1980, Ceccio 1984, Lawlis *et al* 1985, Updyke 1990) The conflicting results may be due in part to the fact that experimental techniques have differed not only in content, but also in length, method of presentation, method of reinforcement, and preferences of patients

The inconsistent results may also have been due to variations in surgery Cholecystectomy was a surgical procedure used in six studies and these can be examined for consistency of effects (Flaherty & Fitzpatrick 1978, Voshall 1980, Wilson 1981, Wells 1982, Levin *et al* 1987, Mogan *et al* 1987) Relaxation was effective for affective pain in five of these studies, but not in the one by Voshall (1980) However, relaxation was found to be effective for sensory pain in only three of the cholecystectomy studies (Flaherty & Fitzpatrick 1978, Levin *et al* 1987, Mogan *et al* 1987), and not in two others (Voshall 1980, Wells 1982), sensory pain was not measured in the sixth study (Wilson 1981) Interestingly, jaw relaxation was used in the successful studies and abdominal muscle relaxation was used in the unsuccessful ones

Of the four studies of music that used a control group, two measured reported sensation and distress (Mullooly *et al* 1988, Good 1995) and the other two measured observed pain (Locsin 1981, 1988) All of these tested patients both on the first and second postoperative days Locsin found preferred music (1981, 1988) and guided imagery music (1988) effective for observed pain on both days Mullooly *et al* (1988) found that easy listening music was effective for reported sensory pain in hysterectomy patients at rest on postoperative day 2, but not on day 1, and for affective pain on both days Good (1995) found that choice of music was not effective for reported sensory or affective pain during initial ambulation as measured by a pre- and post-test, but was helpful during the next 2 days, as reported in an exit interview Postoperative day may be a surrogate for improvement in pain intensity or recovery, which may affect responses to music

The jaw relaxation technique was studied most frequently and was found effective following several surgical procedures cholecystectomy (Flaherty & Fitzpatrick 1978, Mogan *et al* 1987), herniorrhaphy (Flaherty & Fitzpatrick 1978), hysterectomy (Mogan *et al* 1987), and hip surgery (Ceccio 1984), but not haemorrhoidectomy (Flaherty & Fitzpatrick 1978), or cardiac surgery (Horowitz *et al* 1984) There were mixed findings for abdominal surgery (Good 1995) It is not clear whether anatomical or surgical differences were the reason for the inconsistent effectiveness, or whether these were due to methodological problems

Methodological characteristics of studies

To help explain the inconsistent results within and among studies, methodological factors are summarized in Table 1 Studies in which subjects were often randomized had other methodological limitations Most of the samples were small (Table 1) treatment groups contained 6–50 subjects (median = 15) Of the seven studies with treatment groups larger than the mean, three were not randomly assigned (Horowitz *et al* 1984, Lawlis *et al* 1985, Locsin 1988, Miller & Perry 1990), although random assignment is the most effective way to achieve equivalence of groups

Huskisson (1974) has pointed out that relief of pain as a result of therapeutic interventions is related to the level of pain before intervention Pain is highly variable and is not always controlled by randomization it is therefore critical that, in addition, pretest equivalence of groups be reported and differences controlled (Good 1995) In 11 studies (52%), subjects were randomly assigned to groups, but only two of these reported whether there was equivalence of pain in the groups at pretest (Table 1, Wells 1982, Good 1995), and only three controlled for it statistically (Mullooly *et al* 1988, Miller & Perry 1990, Good 1995) None of the investigators had an adequate sample, based on power analysis, with random assignment to groups and determination of equivalence of pain intensity at pretest

An immediate post-test is the most accurate measurement since memory may vary However, of the 21 studies, in 10 pain was not immediately measured after the treatment (Table 1) Data collectors simply told patients to use the intervention 'whenever needed' and then measured

pain by daily ratings, opioid intake, or number of complaints of pain in the nurse's notes rather than immediately before and after the intervention

Supervised practice

Thirteen of the investigators also did not include supervised practice after teaching the technique and before the actual test (Table 1) even though relaxation has been shown to be more effective with practice (Hillenberg & Collins 1982) Ceccio (1984) taught older adults to relax pre-operatively and returned later that evening to help them practice Good (1995) had subjects practice two or three times in the pre-admission testing clinic

Mogan *et al* (1987) taught subjects to relax in bed the night before surgery, observed for good relaxation, and then asked subjects to practice while getting out of bed They also were asked to practice several times before surgery using written instructions left at the bedside, but were not monitored to ensure that the practice occurred Miller & Perry (1990) instructed patients before surgery, and gave them the opportunity to practice when they were having pain the evening after their surgery and before the test the next day Horowitz *et al* (1984) encouraged patients to practice two or three times a day but also did not monitor to ensure that the practice occurred Though it is also important to ascertain whether subjects actually learn to perform the relaxation technique (Snyder 1992b), mastery of the technique was assessed in only two studies (Mogan *et al* 1987, Good 1995)

All studies were conducted with patients receiving intramuscular (IM) opioids every 2–4 h, although one also included intravenous (IV) injections (Good 1995) However, in most studies ($n=13$, 62%) investigators did not control for analgesic 'on board' at the time of treatment (Table 1) Five tested the intervention 1–3 h after medication administration (Flaherty & Fitzpatrick 1978, Ceccio 1984, Swinford 1987, Mullooly *et al* 1988, Miller & Perry 1990) In three studies investigators used statistical control for medication Good (1995) used opioid intake within 2 5 h of the test, Levin *et al* (1987) used a four-point analgesic effect score, and Mogan *et al* (1987) used time elapsed since last medication None of the investigators studied subjects having patient controlled analgesia (PCA), probably because it was not prevalent when most were conducted The wider use of PCA today allows more accurate monitoring and monitoring of medication in effect at the time of the experimental intervention It is possible, however, that since people respond differently to medication, pretest pain is still the most suitable variable to control

Interventions were tested while patients were doing various activities (Table 1) The brief jaw relaxation was tested either during turning from side to side (Ceccio 1984) or while ambulating (Flaherty & Fitzpatrick 1978, Horowitz *et al* 1984, Mogan *et al* 1987, Good 1995) Good (1995) found that most patients preferred to use relaxation, music or a combination of the two while in bed ($n=56$, 89%) rather than during ambulation, because they had to concentrate on other things when walking Seven (35%) investigators used lengthy relaxation techniques that were most appropriate while patients were resting in bed (Bafford 1977, Wilson 1981, Wells 1982, Horowitz *et al* 1984, Lawlis *et al* 1985, Levin *et al* 1987, Laframboise 1989) In each conditions of activity or rest, investigators who tested relaxation found mixed results some showed positive effects for sensory pain, more showed effects for affective pain, and some showed no effect for either dimension of pain

Data analysis

Most investigators analysed the data with analysis of variance (ANCOVA), comparing the difference in pain between the experimental and control groups Three controlled for pretest pain using repeated measures ANCOVA (Levin *et al* 1987, Mullooly *et al* 1988) or analysis of covariance (ANCOVA) (Good 1995) Good also used *a priori* orthogonal contrasts, which are more powerful than ANCOVA with *aposteriori* tests, and improve the chances of finding a true effect Five investigators used multiple *t*-tests (Egbert *et al* 1964, Ziemer 1983, Lawlis *et al* 1985, Swinford 1987, Laframboise 1989), which increase the alpha and reduce the possibility of finding a true effect

Among the investigators who did not use a control group, Updyke (1990) used paired *t*-tests to compare pretest to post-test scores, and Herth (1978) used percentages of patients helped Four investigators did not specify the method of analysis (Bafford 1977, Voshall 1980, Locsin 1981, 1988)

Methodological improvements

Good (1995) in a recent study, avoided a number of the methodological problems of earlier studies, but the results were still mixed She compared the effects of jaw relaxation, choice of sedative music, and a combination of the two on both the sensory and affective components of postoperative pain, extending the work of Flaherty & Fitzpatrick (1978) Subjects were randomly assigned preoperatively, and were given a choice of music and practice time Following surgery, pretest sensation, distress and analgesic intake were controlled and post-tests were administered immediately after the treatment during the first ambulation

Tape recorded interventions strengthened the reliability of the treatment implementation, and diffusion of treatments was minimized by revealing only the assigned intervention to subjects, controlling room assignments to prevent subjects rooming together, and by educating the nurses Patients kept the tape for two days and were asked on the third day whether use of the tape reduced pain during this time

At the first ambulation after surgery, no significant differences in the sensation and distress of pain or 24-hour opioid intake were found These findings may have been related to the high and variable levels of postambulatory pain, to variation in the method of ambulation, ineffectiveness of the intervention at that time Use of the interventions over the next 2 days was reported to decrease sensation and/or distress in most patients These findings suggest that the interventions may be helpful for postoperative pain, although not at the first ambulation This is being tested in a current study with four controlled tests during rest and ambulation during the first two postoperative days

DISCUSSION

In most of these studies relaxation and music reduced postoperative pain, especially its affective component The numerous methodological problems in the studies, however, raise questions about the validity of the results The interventions were less frequently found effective for sensory pain and opioid intake, but more rigorous methods may be needed to determine this

Recommendations for research

Future research on the effects of relaxation and music on pain should test these in adequately medicated patients using current methods of opioid administration such as PCA The interventions first need to be tested using a cross-sectional design, randomizing the sample and controlling for pretest pain Further, the methods of pain measurement need to be sensitive enough to register relief from these moderate strength interventions After determining whether and when the interventions actually relieve pain, the context in which they are helpful should be explored Good (1995) found that relaxation and music were not effective during the first ambulation, but patients found them helpful later, it may be that the effects should be tested during the second ambulation or when the patient is resting in bed

Several different relaxation interventions should be tested Jaw relaxation and slow rhythmic breathing seem useful during ambulation Clenching the fists, then going limp and yawning, a technique recommended by the Acute Pain Management Guideline Panel (1992), may be more appropriate during rest Relaxation of the abdominal wall has been found effective in some studies in which the investigator combined it with other interventions (Egbert *et al* 1964, Wells 1982) Horowitz *et al* (1984) found that Benson's relaxation response, used before ambulation, reduced the distress of pain measured after ambulation but jaw relaxation did not They reasoned that Benson's technique had a prolonged effect while jaw relaxation had a brief effect, and therefore they suggested using Benson's technique in preparation for ambulation, followed by jaw relaxation during ambulation

Levin *et al* (1987) found that Benson's technique was also more effective than rhythmic breathing Perhaps the technique invokes the relaxation response more readily than do rhythmic breathing or jaw relaxation, reducing pain through decreased sympathetic activity However, the most effective technique for relaxation during postoperative ambulation and rest has not been identified yet

Context of effectiveness

Relaxation and music may be more helpful for some people than others Characteristics of the persons who find them helpful should be identified through empirical studies For example, Laframboise (1989) found relaxation effective for patients with high physical danger trait anxiety In addition, different relaxation techniques or types of music need to be compared, and effects need to be compared on different postoperative days, and with differing activities, medication regimes, surgeries, ambulation directions, and taped or live relaxation instructions

If relaxation and music are to be recommended by the Agency for Health Care Policy and Research in future editions of the acute pain guideline, the recommendations must have a solid research base The strengths of the most recent studies should be the departure point for future research Specific mid-range theories are needed to describe the nature of pain, the action of relaxation and music, and practice theories are needed to predict the timing, context and patients with whom relaxation and music are most effective

Recommendations for nursing practice

Although studies of the effects of relaxation and music on postoperative pain have produced mixed results, these are low risk interventions that are appealing to many patients Because their use may reduce pain and the side effects of analgesic medication in some people, they should continue to be explored in practice and research

Nurses may try them with medicated patients who need additional analgesia or prefer fewer side effects, particularly if they seem interested in and capable of using the techniques Clinical insights gained by practitioners about the optimal context for effectiveness, i e the best time, activity, patient characteristics, postoperative day and pain level, should be communicated to researchers, who can then test these observations in controlled studies

Acknowledgements

This paper is based on a study that was funded by a grant from the Alumni Association of the Frances Payne Bolton School, and by a Sigma Theta Tau International Research grant It is based on the literature review for a second study

funded by the National Institute of Nursing Research, No 1 RO1 NR 3933–01

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