



**THE EFFECT OF MUSIC AFTER HIP OR KNEE REPLACEMENT ON
MORPHINE CONSUMPTION**

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DECLARATION

I hereby declare that this dissertation is my own work. It has not been submitted for any other degree at any other institution.

A handwritten signature in black ink, appearing to read "Dwayne Möhr".

Dwayne Möhr
December 2009

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TABLE OF CONTENTS

Summary	5
Opsomming	6
Introduction	7
Aim	7
Literature review	8
Hypotheses	10
Methods	11
Statistical methods	13
Results	14
Discussion	15
Conclusion	18
References	19

SUMMARY

Introduction

Alternative medicine has been employed in the treatment of several diseases. Listening to music after minor surgery has been beneficial regarding pain control.

Aim

The aim of this study was to determine the effect of music on intravenous patient-controlled (PCA) morphine consumption after hip or knee replacement.

Methods

This was an open label, randomized controlled trial. Forty (twenty per group) consecutive patients scheduled for arthroplasty were included. A standardized anaesthetic technique was used, consisting of propofol, sufentanil, rocuronium, and isoflurane. Postoperatively patients were allocated to one of two groups: Group M listened to music during the first 24 postoperative hours, while Group C did not listen to music. The PCA dose consisted of morphine 1.5 mg and droperidol 83.3 µg with a lockout time on seven minutes. Rescue doses of morphine 15 µg/kg intravenously every one-minute until the patient was pain free was administered by a nurse according to a visual descriptive pain score. Both groups received paracetamol 1 g intravenously six hourly. After 24 hours the total (PCA plus rescue) morphine dose was recorded. Morphine consumption in groups was analysed using the one-sided Student two-sample t test. The significance level was 0.05 and the power 0.95.

Results

Neither the PCA usage ($p = 0.4138$) nor the rescue doses of morphine ($p = 0.9163$) differed significantly between the groups.

Conclusion

Although a statistical difference could not be shown in this study, music during the postoperative period does offer a pleasant distraction from this overall undesirable experience.

OPSOMMING

Inleiding

Alternatiewe medisyne word dikwels gebruik vir die hantering van verskeie siektetoestande. Daar is al aangetoon dat deur na musiek te luister voordelig is na geringer chirurgie ten opsigte van pynbeheer.

Doel

Die studie het ten doel gehad om die effek van musiek na heup- of knievervanging op intraveneuse pasiënt- beheerde morfienvverbruik (PBA) te bepaal.

Metodes

Hierdie was 'n enkel-blinde gerandomiseerde gekontroleerde studie. Veertig (twintig per groep) agtereenvolgende pasiënte geskeduleer vir gewrigsvervanging is by die studie ingesluit. 'n Standaard narkosetegniek is gebruik, bestaande uit propofol, sufentaniel, rokuronium en isofluraan. Die pasiënte is postoperatief aan een van twee groepe toegedeel: Groep M het gedurende die eerste postoperatiewe 24 uur na musiek geluister terwyl Groep K nie na musiek geluister het nie. Die PBA-dosis het bestaan uit morfien 1.5 mg en droperidol 83.3 µg met 'n uitsluitingstyd van sewe minute. Addisionele dosisse morfien is toegelaat. Dit is intraveneus deur die verpleegkundige volgens 'n verbaal beskrewe pynskaal toegedien en het bestaan uit 15 µg/kg IV elke een minuut totdat die pasiënt volgens haar oordeel pynvry was. Beide groepe het ook sesuurlik paracetamol 1 g intraveneus ontvang. Vier en twintig uur na die operasie is die totale morfienvverbruik (PBA plus bykomende dosisse) aangeteken. Die morfienvverbruik in groepe is geanalyseer met behulp van die eenkantige tweestekproef-t-toets. Die beduidenheidspeil was 0.05 en die onderskeidingsvermoë 0.90.

Resultate

Daar was tussen groepe geen beduidende verskil ten opsigte van die PBA ($p = 0.4138$) en die bykomende dosisse ($p = 0.9613$) morfien nie.

Gevolgtrekking

Alhoewel daar geen statisties beduidende verskil tussen groepe aangetoon is nie, bied musiek gedurende die postoperatiewe fase 'n aangename afleiding van die andersins onaangename ondervinding.

INTRODUCTION

Alternative medicine has received prominent coverage in the media in recent years. These alleged entities include reflexology, aromatherapy and music therapy. The real value of these alternative or complimentary measures has, however in many instances, not been subjected to scientific scrutiny.

The idea of the medicinal influence of music dates back to the times of Aristotle and Plato. The modern concept of music therapy was introduced during World Wars I and II when musicians, both amateur and professional, visited hospitals to play for war victims suffering from physical and psychological effects of combat. The salutary effects of music on these patients have lead doctors and nurses caring for these patients to employ musicians as part of the convalescence of war victims.¹

AIM

The aim of this study was to determine the effect of music on morphine consumption after hip or knee replacement.

LITERATURE REVIEW

Pain is as old as time itself. In the book of Genesis it is written: Then He said to the woman: I will sharpen the pain of your pregnancy, and in pain you will give birth.^a Yet, in this modern era of medicine we still fail to treat pain adequately. With all the modalities available to us, too many patients suffer unnecessary pain after surgery.

Pyati et al reviewed perioperative analgesia.² According to them inadequate postoperative analgesia is associated with delayed recovery and prolonged hospital stay. Despite the recognition of the importance of postoperative analgesia, up to seventy percent of patients complain of moderate to severe pain postoperatively. They explored the concept of multimodal analgesia, which includes pharmacological and non-pharmacological components. Music is mentioned as part of non-pharmacological adjuvant to the conventional and well-documented pharmacological means of analgesia.

The prevention of post-operative pain and the promotion of comfort are some of the challenges facing practitioners working in the postoperative care setting. Surgical pain produces autonomic, psychological, immunological, and behavioural responses that can delay healing and promote the development of chronic pain.³

Conventional pharmacological methods are being challenged by the so-called holistic approach.⁴ Emotional stress is associated with increased postoperative pain after mastectomy.⁵ Music attenuates anxiety and improves mood perioperatively and may therefore impact positively on the postoperative experience of pain.⁶ Music may reduce pain by interrupting the postoperative cycle of pain, muscle tension and sympathetic activity.⁷ This leads to a decrease in consumption of drugs such as morphine, which may have serious side effects (especially in the elderly population).

Music has been recommended by the United States Agency for Health Care Research and Quality Guidelines as an intervention to be used in addition to opioid medication in the management of acute pain.⁸

^a Genesis 3:16. New Living Translation

Distraction from unpleasant stimuli may be an effective pain-relieving strategy, and can be implemented by several means, including music. Tse et al played music intermittently to members of an experimental group during the first 24 postoperative hours. Pain intensity was measured using the Verbal Descriptive Pain Scale (VDPS). A significant reduction in pain intensity over time and consumption of analgesic were observed in the experimental group compared to the control group.⁹

Pain is accompanied by a neuroendocrine response, including suppression of immune function.¹⁰ The immune-modulating effect of pain is probably caused by activation of the hypothalamo-pituitary-adrenocortical axis, which activates corticotrophin-mediated secretion of cortisol.¹¹ Morphine inhibits both cellular and humoral immune function.¹² Stress modulation by sedatives and analgesics may impact on the adverse effects of the stress response. Decreased morphine use may improve immune function.¹³

The effect of postoperative analgesia on the stress response is probably influenced by the method of analgesia. Kehlet has reviewed this aspect. Afferent neural blockade is the most effective technique for reducing the stress response, but only if the block covers the receptive field responsible for sympathetic activation. Systemic opioids and non-steroidal anti-inflammatory drugs (NSAIDS) bring about only a modest attenuation of the stress response. Although low-dose balanced analgesic methods may offer complete pain relief, they fail to exert significant effects on the stress response. Inhibition of both neural and humoral release mechanisms is probably necessary for a significant attenuation of the stress response to tissue injury.¹⁴

Listening to music for treatment of pain offers potential advantages including cost and safety. In a systematic review Cepeda et al included 51 studies involving 3663 subjects. Although listening to music reduced pain and opioid consumption, the magnitude of the effect was small and of uncertain clinical significance.¹⁵

Nilsson et al found that music alone and music in combination with therapeutic suggestion during general anaesthesia had beneficial effects on postoperative recovery, including analgesia.¹⁶ They also found that the beneficial effect of music did not differ whether patients were exposed to music intra-operatively or postoperatively.¹⁷

Subsequently, Nilsson et al compared the effect of intraoperative music, postoperative music and silence (control group) on postoperative pain, anxiety and stress response. Pain, anxiety, cortisol levels, and morphine consumption were significantly lower in the postoperative music group than in controls. In the intraoperative music group patients experienced less pain, while the other variables did not differ from controls.¹⁸

A selection of music with *largo* tempo indications was used, as this has been found to reduce pain more effectively.¹⁹ A minimum exposure (dose) of 90 minutes of music intervention during physiotherapy appears to be adequate.²⁰

HYPOTHESES

Null hypothesis

Listening to music in the postoperative period does not affect morphine consumption.

Alternative hypothesis

Listening to music in the postoperative period reduces morphine consumption.

METHODS

Study design

This was an open label, randomized controlled trial.

Setting

A tertiary university hospital (Steve Biko Academic Hospital)

Inclusion criteria

Patients presenting for elective first hip or knee arthroplasty

Exclusion criteria

Hard of hearing

Established diagnosis of dementia

A known psychiatric disorder

Drug abuse

Peripheral sensory neuropathy

Morphine allergy

Inability to operate the patient controlled analgesia (PCA) pump

Sampling

Non-probability convenience sampling of consecutive patients was done to compile the target population for this study. Patients were randomized using a computer program (Microsoft Excel).

Interventions

A total of forty consecutive American Society of Anaesthesiologists grade I or II patients were included. The institutional ethics committee approved the study and all patients gave their informed consent. The patients were scheduled for either knee or hip replacement surgery under general anaesthesia. Pre-medication was omitted. Anaesthesia was induced with propofol 1 mg/kg to 2 mg/kg and sufentanil 0.1 µg to 0.3 µg/kg. Tracheal intubation was facilitated with rocuronium 0.6 mg/kg. Anaesthesia was maintained with isoflurane 0.7 MAC (minimum alveolar concentration) to 1.3 MAC in a mixture of oxygen and air. Prior to emergence a loading dose of Morphine 100 µg/kg to 200 µg/kg and paracetamol 1 g was administered intravenously (IV).

Postoperatively patients were admitted to a high care unit for at least 24 hours. Patients were randomly allocated to one of two groups: Group M listened to music during the first 24 postoperative hours, while the control group (Group C) was exposed to the usual postoperative environment.

The PCA pump (Disposable Vygon PCA pump, Vygon pharmacological laboratories, B.P. 7-95440, Ecouen, France) was connected to a dedicated IV cannula. The pumps had a lockout period of seven minutes and a maximum preset bolus of 1 ml, containing morphine 1.5 mg and droperidol 83.3 µg. Rescue analgesia was administered if the visual descriptive pain score^b was ≥ 3. Rescue analgesia consisted of morphine 15 µg/kg intravenously at one-minute intervals until the patient was pain free. Apart from the PCA and rescue morphine patients in both groups received paracetamol 1 g IV every six hours.

Data was collected during the first 24 hours postoperatively. At the end of the study period the total morphine consumption was recorded, which included the rescue boluses and the total used with the PCA pump.

Music used was of a melodious nature, low frequencies (tones), which mostly consisted of music for strings and at a maximum level of approximately 60 dB.²¹ Music was taken from the album Largo from the Naxos Music label and included the following tracks:²²

Händel

- Largo from Xerxes
- Alexander's feast
- Concerto Grosso in D Major opus 6 no 5
- Concerto Grosso in A Minor opus 6 no 4
- Concerto Grosso in B Minor opus 6 no 12

Corelli

- Concerto Grosso in D Major opus 6 no 1

JS Bach

- Piano Concerto in F Minor, BWV 1056
- Double Concerto in D Minor, BWV 1043

Vivaldi

- Violin Concerto in C Major opus 8 no 6

Telemann

- Concerto for 3 violins in F Major
- Viola Concerto in G Major

^b Visual descriptive pain scale: 1 = no pain; 2 = mild pain; 3 moderate pain; 4 = severe pain.

STATISTICAL METHODS

This was a superiority study. The response variable was morphine consumption. Calculation of the sample size made use of the standard deviation = total variation/6, i.e. the range of the morphine consumption. For a standard deviation of 42, resulting from an expected consumption range of 250 µg/kg/hour (50 µg/kg/hour to 300 µg/kg/hour), and a clinical relevant reduction of 40 µg/kg/hour (approximately 3mg reduction per hour for a patient with a body mass of 70kg), a sample size of 20 subjects per group has a power of 0.90 at the one-sided significance level of 0.05.

Morphine consumption in groups was analysed using the Student two-sample t test for unequal variance (Welch). Categorical variables were analysed using Fisher's exact test. Groups M and C were compared with respect to rescue, pump, and total morphine consumption. Differences between the two groups were assessed using p-values and the 95% confidence interval (CI) for the difference between M and C.

RESULTS

Continuous data are reported as means and standard deviation and categorical data as percentages. All recruited subjects, twenty per group, completed the study and complete data sets were collected from all recruited subjects. Summary and inferential statistics of continuous variables are presented in Table 1. There were six men in Group M and 4 in Group C ($p = 0.7164$). Rescue doses of morphine were necessary in eleven patients in Group M and in sixteen in Group C ($p = 0.1760$).

	Group M (n = 20)	Group C (n = 20)		
Variable	Mean (SD)	Mean (SD)	95% CI of difference	P
Age (year)	67.40 (8.92)	67.20 (13.26)	-7.07; 7.47	0.9668
Body mass (kg)	85.00 (21.7)	82.65 (19.34)	-10.82; 15.51	0.7198
Intraoperative dose (mg)	11.45 (3.44)	12.19 (2.83)	-2.75; 1.28	0.4344
PCA dose (mg)	36.66 (18.03)	31.85 (18.43)	-6.85; 16.48	0.4138
Rescue dose (mg)	2.23 (3.24)	2.23 (3.24)	2.07; 2.07	0.9613
Total morphine dose (mg)	38.89 (18.32)	34.08 (18.32)	-6.91; 16.54	0.4162

Table 1 Summary and inferential statistics

There were no significant differences between groups regarding age, body mass and gender. The morphine doses did not differ significantly between groups (Table 1 and Figure 1).

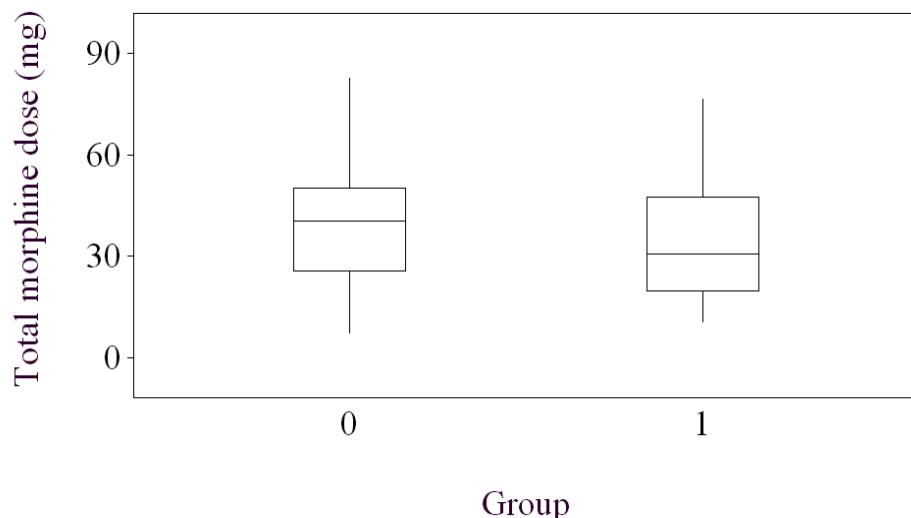


Figure 1 Total ward morphine dose over 24 hours, including the PCA and rescue doses, but excluding the intraoperative dose. 0 = Group M and 1 = Group C

DISCUSSION

This study failed to demonstrate any significant differences between the groups with regards to postoperative morphine consumption. We therefore accept the null hypothesis, namely that listening to music postoperatively does not affect morphine consumption after hip or knee arthroplasty.

The study by Nilsson and co-workers used music intraoperatively and found that it may have some beneficial effect on postoperative recovery after hysterectomy.¹⁶ Their results showed that patients in the music group used less analgesic (ketobemidone^c). However, the difference between groups was not significantly less ($p = 0.123$). The music group had less pain on day one ($p < 0.001$). We did not however analyse pain scores in our study. The music group experienced significantly less fatigue at discharge ($p = 0.001$) and postoperative mobilization was easier ($p = 0.008$).

Nilsson et al made use of intra- and postoperative music exposure and revealed significant positive findings regarding the pain scores after 1 and 2 hours ($p = <0.001$) and morphine consumption after 1 hour ($p < 0.05$). That study included 151 patients and the surgery carried out was either varicose vein surgery or inguinal hernia repair.¹⁷ The music was also played via headphones. This was the first study of its kind that demonstrated the possible pain-reducing effect of music.

Nilsson et al reported notable findings regarding the effect of peaceful music (intraoperative and postoperative) on the surgical stress response and its analgesic effect.¹⁸ That study included a total of 75 patients, who all underwent inguinal hernia repair under standardized general anaesthesia and using the same surgical team for all the procedures. That study involved the first postoperative hour in the postoperative care unit. They found statistically significant differences in anxiety, pain and morphine consumption. They also found that patients who were exposed to music had significantly lower cortisol levels.

^c A synthetic opioid, which is equipotent to morphine, and is widely used in Scandinavia

Our study differed from previous studies in several aspects. Firstly, our sample consisted of major orthopaedic surgery, which is, contrary to previous studies not superficial surgery, but major arthroplasty. Arthroplasty is accompanied with extensive bone and soft tissue dissection and resection, with significantly higher release of inflammatory mediators, including nociceptive substances.²³ The studies by Nilsson et al^{17 18} did not use PCA exclusively but morphine was also administered according to the judgement of the attending nurse. Bainbridgea et al found PCA to be superior to NCA (Nurse-controlled analgesia)²⁴. The PCA pumps used in our study rely on the patient's own perception of pain and need for analgesia and could thus be viewed as a more reliable indicator of postoperative pain.

Pain and anxiety are subjective variables with wide inter-individual variation, which are difficult to assess objectively. We recorded morphine consumption only and assumed it to be a surrogate of postoperative pain. Boluses of morphine and the use of paracetamol might have influenced the morphine consumption and any differences between groups. Intravenous paracetamol is an effective analgesic for moderate to severe pain; 1 g of IV paracetamol has an analgesic effect of about 10 mg of morphine intramuscularly.²⁵

Clear protocols dictated the administration of rescue boluses of morphine according to a VDPS. This, of course contains an element of NCA, which can be a confounding factor. It is not possible to be sure whether the nursing staff adhered to the instructions. At times they might have wrongly perceived that the patient was experiencing pain that warranted a rescue bolus. Although this was done in both groups, the nursing staff changed all the time. It is possible that boluses had an equalizing effect on the PCA component of analgesia.

In our study patients listened to music postoperatively for a minimum of ninety minutes. However, patients listened to the music most of the first 24 hours. This was not documented. It may be that intraoperative music may exert a pre-emptive effect on the inflammatory response. No study testing this effect of music in the perioperative scenario could be found.

The music taste of patients was not taken into account. It may therefore be that the music acted as an irritant rather than a pleasant experience. The effects of techno and classical music on the release of stress hormones and emotional state have been studied in healthy volunteers. Gerraa et al found that techno music caused a significant increase in the levels of β -endorphin, corticotrophin, noradrenalin, growth hormone and cortisol. This was accompanied by a significant increase in heart rate, systolic blood pressure and changes in self-rated emotional states. Classical music induced an improvement in emotional state, but no significant changes in hormonal concentrations.²⁶ It may be that the salutary effect of a stimulus surface only in the presence of nociception.

Around one in ten people claim to be tone deaf, but despite this characteristic they can hear music perfectly well. Music capacity, like language capacity is coded in the human genome. Congenital amusia (commonly known as tone deafness) affects 4% of the population and patients with this condition frequently describe music as an irritant.²¹ We did not enquire about this condition in our study.

Social, cultural, and education background may play a role in music appreciation, acceptance, or even tolerance of certain genres of music. In our study we used classical music that may not appeal to all patients. There are, however, indications that persons with naïve music taste, i.e. inherent, not previously exposed to the Western classical music repertoire, are more tolerant and even appreciative of the music used in our study, than persons with a “premorbid” music taste. The right hemisphere (non-analytical, artistic) is associated with music perception, especially in *musically naive* subjects.²⁷

Patients with auditory problems were excluded from the study. This was not done by formal audiometry. Subtle deficits in hearing may affect music perception. Presbycusis (age related hearing loss) is not always clinically apparent and may not always be revealed by routine audiometry. People with this disorder can have various social difficulties, including music appreciation.²²

The Vygon PCA pumps used in our study are very simple to operate and their use was clearly explained to all patients. This would probably eliminate poor understanding of the concept and use of the PCA.

Based on the findings of this study we would like to make the following recommendations:

- Clear protocols or guidelines for postoperative pain should be followed as far as possible by all staff involved. This can improve the quality of postoperative pain management and avoid the side effects of opioids.
- Music has a positive effect on most individuals. Whether it distracts from unpleasant experience such as major surgery or from the general hospital environment needs further investigation. Noise levels in a ward can be disturbing to patients and staff alike; soothing background music may have a salutary effect.
- When deciding on the therapeutic use of music it is important to consider the patient's personal preferences and it is advisable to involve a music therapist. This was not possible in our study. To our knowledge this was not the case in the other studies either. This aspect needs further investigation.
- The therapeutic application of music is not necessarily limited to surgical patients and researchers at the European Society of Cardiology 2009 Congress showed that in patients with acute coronary syndrome after myocardial revascularization procedures, music therapy reduces blood pressure, heart rate, and patient anxiety and has a significant reducing effect on future events, including reinfarction and sudden death.²⁸

CONCLUSION

Although a statistical difference could not be shown in this study, music during the postoperative period does offer a pleasant distraction from this overall undesirable experience. Music is inexpensive, non-invasive and has no side effects. Some of the literature does show a reduction in the surgical stress response.

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