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ANALGESIC EFFECT OF MUSIC THERAPY DURING THE POSTOPERATIVE PERIOD IN BITCHES UNDERGOING OVARIOHYSTERECTOMY

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ABSTRACT

This study aimed to evaluate the effects of music therapy on the postoperative pain of bitches undergoing elective ovariohysterectomy (OVH). Eighteen bitches were randomly distributed into two groups (Music therapy group and Control group). The animals of both groups received pre-anesthetic medication (PAM), administration of meloxicam (intravenously 0.2 mg/kg), antibiotic therapy and were anesthetized then subjected to OVH. PAM was performed intramuscularly with morphine (0.3 mg/kg), midazolam (0.2 mg/kg) and acepromazine (0.03 mg/Kg). Anesthetic induction was performed with intravenous infusion of ketamine, lidocaine and propofol; the anesthetic maintenance was performed with inhalational anesthesia with isofluorane. Animals from the Music therapy group received ambient music of classical, reggae, soft rock, and relaxation and meditation styles, through a sound box for 7 hours, while they were at the anesthetic and surgical recovery room. The animals of the Control group did not receive any music during the postoperative period. All animals in the experiment were evaluated for pain before PAM (M0) and 3 (M3), 5 (M5), 8 (M8), 12 (M12) and 24 hours (M24) after PAM. The Music therapy group scored significantly lower than the Control group at M8, M12 and M24, although there was no statistically significant difference in the number of administrations of additional

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analgesics in the postoperative period of the animals. Music therapy had an analgesic effect during the postoperative period in bitches submitted to OVH.

KEYWORDS: pain, surgery, analgesia, complementary therapies

INTRODUCTION

Appropriate pain management is fundamental and the most important component of postoperative care, because poorly treated pain can lead to complications, prolonged recovery time, poor quality of life, and postoperative morbidity (DIMITRIOU et al., 2017). Traditionally, pharmacological therapy comprising anti-inflammatory drugs and opioids, which is considered effective and safe, is used to promote analgesia in the postoperative period, although they may induce some adverse effects such as nausea, vomiting, apnea and sedation (DIMITRIOU et al., 2017; NENADOVIC et al., 2017).

To assist in the postoperative pain management, some complementary therapies, such as acupuncture (GROPPETTI et al., 2011) and Reiki therapy (PACHECO et al., 2021) have been proven to be effective in promoting analgesia in dogs and cats. These are therapeutic practices characterized as not integrating the conventional allopathic medical system because they are based on explanations of action different from those traditionally adopted. Such practices do not intend to exclude the use of conventional medicines and therapies, but can reduce the frequent use of analgesics, antidepressants, anxiolytics, antibiotics, steroidal anti-inflammatory drugs, chemotherapy and suppressive drugs (PACHECO et al., 2021).

Currently, music has been the subject of study owing to the incessant search for better quality of life, sense of well-being, pain relief, reduction of anxiety and fatigue both in humans and animal therapy. These effects are possible to be attained using music therapy and started to be understood worldwide in Veterinary Medicine for promoting environmental enrichment and reducing stress levels in animals (LINDIG et al., 2020)tais como controle da dor, aumento na sensação de bem-estar, diminuição da fadiga e da ansiedade, entre outras. Pesquisas realizadas com recém-nascidos, crianças e idosos mostraram que a terapia envolvendo sons é capaz de produzir alterações fisiológicas e comportamentais como diminuição da frequência cardíaca, redução do cortisol e melhora do humor. Esses efeitos positivos também começaram recentemente a ser estudados mundialmente na Medicina Veterinária. Nela, a música tem sido utilizada e estudada como um recurso para promover o enriquecimento ambiental, atuando como reforço positivo e diminuindo os níveis de estresse dos animais durante o manejo. Esse estudo busca promover um maior conhecimento a respeito da musicoterapia e do seu uso na abordagem terapêutica e na produção animal.","author":[{"dropping-particle":"","family":"Calamita","given":"Silvia Cristina","non-dropping-particle":"","parse-names":false,"suffix":""},{"dropping-par-

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The *American Music Therapy Association* defines music therapy as the clinical and evidence-based use of musical interventions to achieve individualized goals within a therapeutic relationship and performed by a credentialed professional who has completed a music therapy program (BOJORQUEZ et al., 2020).

Considering the little information about the analgesic efficacy of music therapy in animals, the need to improve postoperative analgesia in bitches and decrease the use of drugs in this period, this study aimed to evaluate the analgesic efficacy of music therapy during the postoperative period in bitches that were subjected to ovariohysterectomy.

MATERIAL AND METHODS

This research was approved by the Ethics Committee on Animal Use of the Centro Universitário Mater Dei – UNIMATER, prior to its execution (approval number: AP002/21). In a controlled, prospective, randomized and double-blind clinical study, 18 non-pregnant and clinically healthy bitches were randomly assigned by lot into two groups (Music therapy group and Control group). These bitches went through a screening process 1 week before the experiments. They also were subjected to clinical examination and laboratory tests such as hemogram, serum alanine aminotransferase, urea and creatinine.

The animals arrived at the hospital 4 hours before the surgical procedure and remained in individual cages in an acclimatized room, aiming to promote familiarization with the place and team, and alsoto reduce fear and anxiety. During this adaptation period, 1 hour before PAM, the first assessments of pain, sedation, physiological parameters and M0, were performed. To this end, we used the sedation scale suggested by Wagner et al. (2017), which is the shortened form of the scale used by Grint et al. (2009), two pain scales [visual analog scale (VAS) and short form Glasgow composite measure pain scale (CMPS-SF)], and measured respiratory and heart rates, in this order, which were performed by a trained male evaluator who was blinded to the groups. This evaluator made a 2-minute filming of the animals' behavior in the cage, moving outside the cage, and during pain assessment. The videos were sent for further evaluation by 2 other evaluators. The filming equipment used was a Canon 60D camera with a wide-angle lens. A stethoscope was used to measure respiratory and heart rates.

The sequence of activities performed by the evaluator was always the same, in the following order: 1) turn on the camera; 2) observe the animals in their cages and fill in the sedation scale and VAS; 3) put a guide on the animals and observe how they move outside the cage; 4) palpate the abdomen and flanks of the animals and fill in the CMPS-SF; 5) turn off the camera; 6) measure the respiratory rate; and 7) measure the heart rate.

After the first evaluation, PAM was performed with the use of 0.3 mg/kg morphine (Morphine sulfate, Hipolabor farmacêutica Ltda, Sabará, Brazil), 0.03 mg/kg acepromazine (Apromazin®, Syntec do Brasil, Santana de Parnaíba, Brazil) and 0.2 mg/kg midazolam (Dormium®, União Química Farmacêutica Nacional S/A, Pouso Alegre, Brazil), via intramuscular route. Subsequently, the patient was prepared with venous access (cephalic vein) and abdomen trichotomy. At this time, the animals received intravenously 0.2 mg/kg meloxicam (Flamavet®, União Química Farmacêutica Nacional S/A, Brazil) and intramuscularly a combination of 10,000 IU/kg Benzylpenicillin benzathine, 10,000 IU/kg Benzylpenicillin procaine and 20 mg/kg dihydrostreptomycin (Shotapen®, Virbac, France).

Twenty minutes after PAM, the animals were subjected to anesthetic induction with 1 mg/kg ketamine (Cetamin®, Syntec do Brasil, Santana de Parnaíba, Brazil), 1 mg/kg lidocaine (Anestt®, Syntec do Brasil, Santana de Parnaíba, Brazil) and 2 mg/kg propofol (Propotil®, Dongkook pharm. Co, ltd., South Korea), all intravenously, and subsequently intubated with endotracheal tube. Anesthesia was maintained by continuous infusion of 1.2 mg/kg/h of ketamine and 4 mg/kg/h of lidocaine, administered using a continuous infusion pump (Sdamed model sda101, Sdamed, Campinas, Brazil) of 10 μg/kg/h of fentanyl (Fentanest®, Cristália produtos químicos farmacêuticos Ltda, Itapira, Brazil), and inhalational anesthesia with isofluorane (Isoforine®, Cristália produtos químicos farmacêuticos Ltda, Itapira, Brazil) diluted in 100% oxygen and adjusted vaporization in a universal vaporizer. Ten minutes after induction, the surgical procedure was initiated, using the hook technique, with a standard duration of 15 minutes, always by the same surgeon

During the procedure, vital signs such as heart rate, respiratory rate, temperature, hemoglobin saturation, systolic and diastolic blood pressures, and mean arterial pressure were monitored through a multiparameter monitor (Deltalife model DL1000).

At the end of the procedure, after extubation, the animals were taken to an anesthetic and surgical recovery room and remained there for 24 hours. For the animals of the Music therapy group, music was provided through a portable bluetooth sound box (Harman International Industries INCO, Canada) for 7 hours, from the moment they arrived in the recovery room. The volume was 60 decibels and a playlist from the Spotify apptm was played randomly. This playlist consisted of 54 songs divided into four musical styles: reggae (27.7%), soft rock (29.6%), classical music (14.8%), and songs for meditation and relaxation (27.7%). The animals of the Control group did not receive any music postoperatively. No experiments were performed in animals of both groups on the same day.

Postoperative pain, sedation and physiological parameters of all animals in both groups were evaluated as in M0 after 3 hours (M3), 5 hours (M5), 8 hours (M8), 12 hours (M12) and 24 hours (M24) of PAM by the same evaluator of M0. Footage of these evaluations was also taken. During the evaluations, the music was turned off so that the evaluator was not aware which animals belonged to the Music therapy group. If the animal presented a CMPS-SF score in the on-site evaluation ≥ 6, an additional analgesic dose (morphine 0.2 mg/kg by IM) was administered. The animals that received the additional analgesia were not excluded from the experiment.

All the filmed videos, including that of M0, were sent to two other trained female evaluators who were also blinded to the groups. These evaluators used only the pain scales. Initially, they filled out the VAS, followed by the CMPS-SF. The pain scores of each animal were the averages of the scores of the three evaluators. None of the three evaluators had knowledge of the scores given by the other evaluators.

The data obtained from the pain scales, sedation scale, and measurements of physiological parameters were subjected to normality verification using the D'Agostino & Pearson test. To compare the results of the pain and sedation scales between the two groups, the Mann–Whitney test was utilized. To compare the results of pain and sedation within the same group between the various instances, the Kruskal–Wallis test followed by Dunn's multiple comparison test was performed. The values of the physiological parameters of the two groups were compared using the unpaired *t-test* and to compare the results within the same group between the various times, the analysis of variance (ANOVA) one way test was performed followed by Dunnet's multiple comparison test. To compare the number of additional analgesic administrations in the postoperative period in each group, the Chi-square test and Fisher's test were performed. The results obtained from the pain and sedation scales are presented as median, and maximum and minimum values. The physiological parameters are presented as mean ± standard deviation. Differences were considered significant when $P<0.05$. All tests were performed using the test version of Graphpad Prism 8 software (Graphpad Software, San Diego, USA).

RESULTS AND DISCUSSION

Observing the pain scores obtained with the CMPS-SF (Figure 1), and comparing the Music therapy group with Control group, there was a significant difference between the groups at M8 (P= 0.0068), M12 (P=0.0071) and M24 (P= 0.0090); the Music therapy group presented less pain when compared to Control group. Based on VAS, the pain scores of the Music therapy group were lower than the Control group only at M8 (P=0.0455) and M12 (P=0.0112) (Figure 2).

Figure 1. Glasgow compact pain scale scores of female dogs subjected to elective ovariohysterectomy without any further treatment (Control) and of those treated with music (Music therapy) immediately after surgery, before pre-anesthetic medication (M0); and 3 (M3), 5 (M5), 8 (M8), 12 (M12) and 24 hours (M24) after pre-anesthetic medication. n= 9 for both groups. Different letters indicate significant differences ($P < 0.05$) between groups, where b<a. The maximum score of this scale is 24. Results are presented as median, and minimum and maximum values.

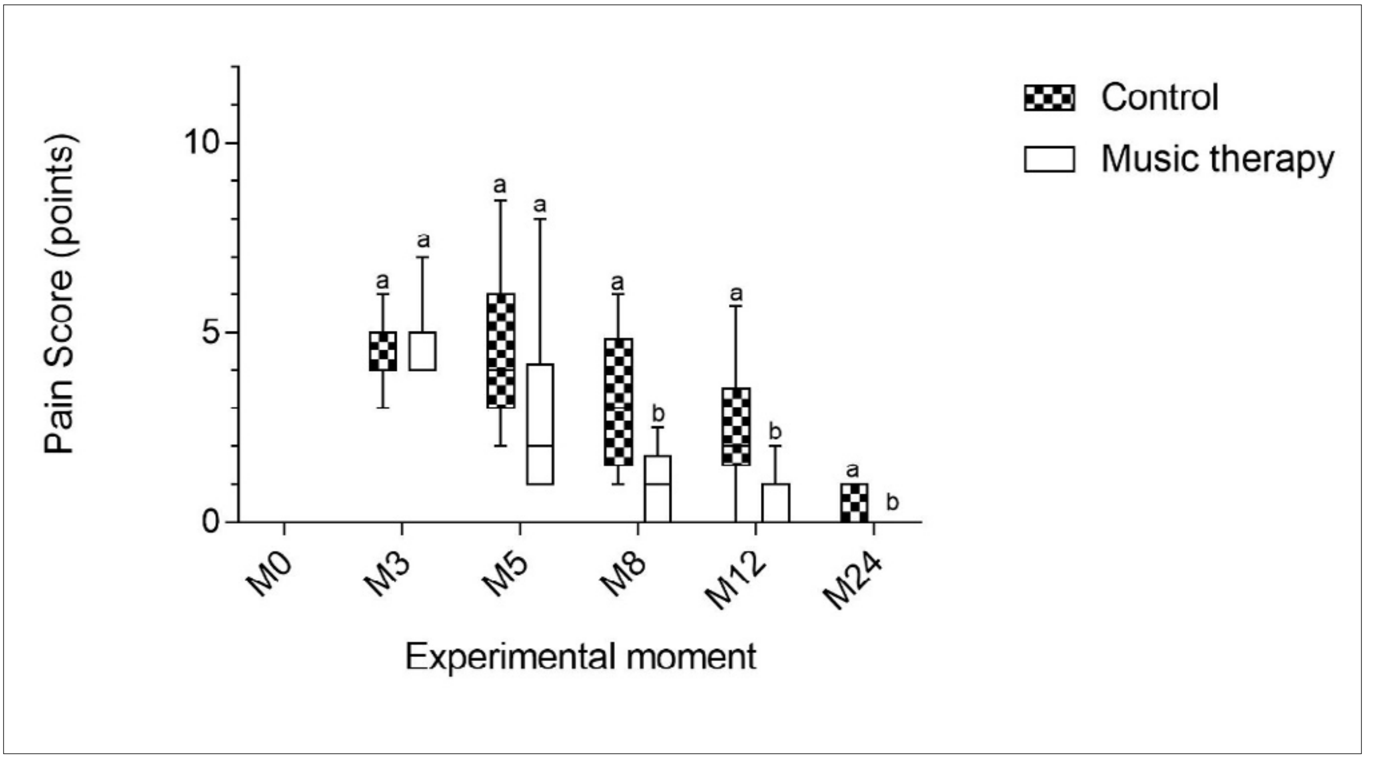
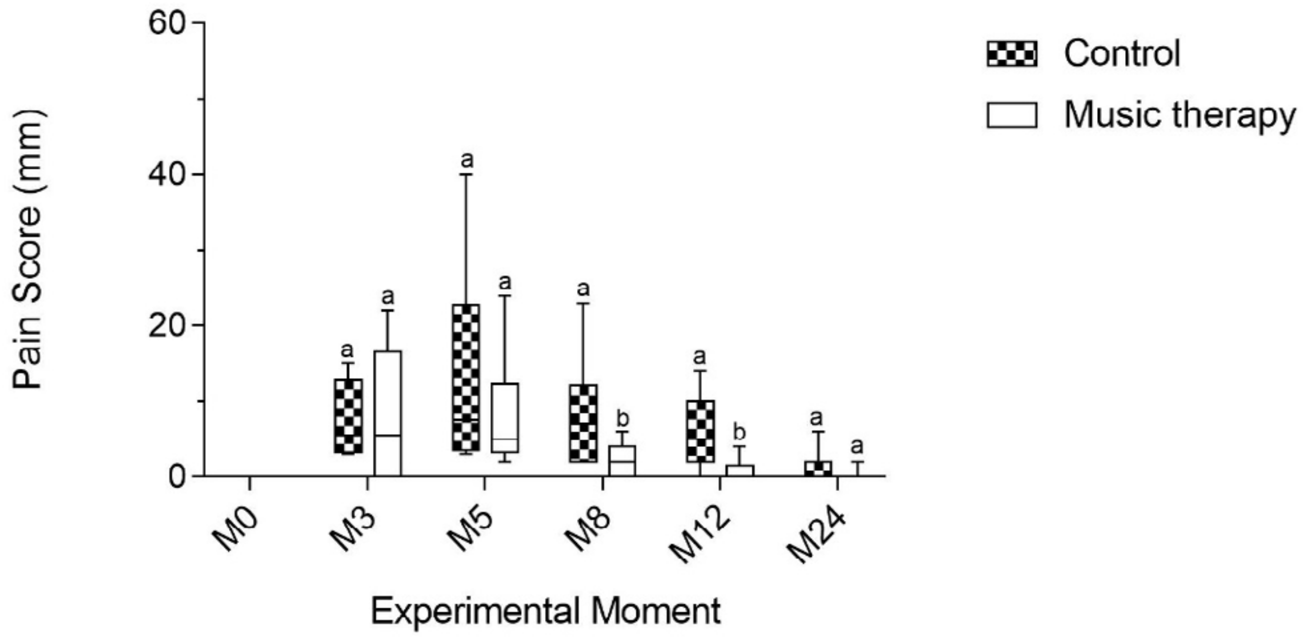


Figure 2- Scores in the visual analogue pain scale of bitches subjected to elective ovariohysterectomy without any subsequent treatment (Control) and of those treated with music (Music therapy) immediately after surgery, before pre-anesthetic medication (M0); and 3 (M3), 5 (M5), 8 (M8), 12 (M12) and 24 hours (M24) after pre-anesthetic medication. n=9 for both groups, being b<a. The maximum score for this scale is 100 mm. Results are presented as median, and minimum and maximum values.



Although there was a significant difference in pain scores at certain postoperative period between the two groups, there was no significant difference (P=0.5987) in the number of additional analgesia administrations in the postoperative period of bitches (Table 1). There were two administrations in the Music therapy group, one at M3 and one at M5, and four administrations of analgesics in the control group, three at M5 and one at M8. It was expected that analgesic administrations would occur between M3 and M8, since the first 6 hours of the postoperative period are critical and there is a need for additional analgesia (STEAGALL AND MONTEIRO, 2019). In a previous study, the period of greatest pain in bitches submitted to OVH was 3 to 8 hours after MPA (PACHECO et al., 2021). Music therapy was administered exactly during this period of greatest pain in the animals submitted to OVH, and the pain was evaluated for 24 hours to verify the residual effect of music therapy.

Table 1 - Number of additional analgesic administrations performed in female dogs subjected to elective ovariohysterectomy without any treatment (Control) and those treated with music (Music therapy) immediately after surgery, before pre-anesthetic medication (M0); and 3 (M3), 5 (M5), 8 (M8), 12 (M12) and 24 hours (M24) after pre-anesthetic medication. n= 9 for both groups. Music therapy = Control (P=0.6766)

GROUP	M0	M3	M5	M8	M12	M24	Total
Control	0	0	3	1	0	0	4
Music Therapy	0	1	1	0	0	0	2

Probably, the association of reduced surgical time of approximately 15 minutes of the surgical technique employed with the analgesic/anesthetic protocol used, providedpostoperative pain scores < 6 in the CMPS-SF, which is the “cutoff score” for the administration of additional analgesics, in most of the bitches, including the control group; thereby, this association favored the lack of statistically significant difference between the additional administrations of analgesics and also between the two groups. A similar study demonstrated that postoperative pain was detected in 100% of cats submitted to OVH without preventive analgesic treatment, requiring supplemental analgesia (BRONDANI et al., 2013).

Perhaps we could have observed a difference in pain scores between the two groups at M3 and M5 if music therapy had been applied for a few hours before the beginning of surgery, but further investigation is needed for this.

The analgesic effect of music therapy has been well studied in human patients, from newborns to adults; however, the results are very heterogeneous, probably because the methodology employed in the experiments varies greatly, such as the musical styles used, the time of treatment with music — before, during or after surgical procedures — single or multiple treatments; the duration of exposure to music, which ranges from 15 minutes to 3 hours; and the volume of music, which varies from 45 to 70 decibels. Musical styles that have been shown to possess analgesic effects in humans and animals have been classical music (FRANCO E RODRIGUES, 2019; GAO et al., 2016; HURTADO et al., 2018), music for relaxation and meditation (SIN AND CHOW, 2015) and music with heartbeats, especially for children- (ROSSI et al., 2018; KÜHLMANN et al., 2020). Reggae and soft rock musical styles have already been shown to be effective in reducing stress in kennel dogs (BOWMAN et al., 2017). Lee (2016), in his review of the analgesic effect of music therapy in humans, suggested that music therapy may be beneficial in reducing pain in patients, although current results are inconsistent. This author also found that music had a small effect on reducing opioid analgesics used and a moderate effect on reducing non-opioid analgesics administered to patients. Kühlmann et al. (2018) noted that music therapy had a moderate effect on reducing pain in surgical patients and Bojorquez et al.. (2020) concluded that music therapy had a mild-to-moderate effect (44%) on reducing pain in surgical patients and these patients received fewer opioids.

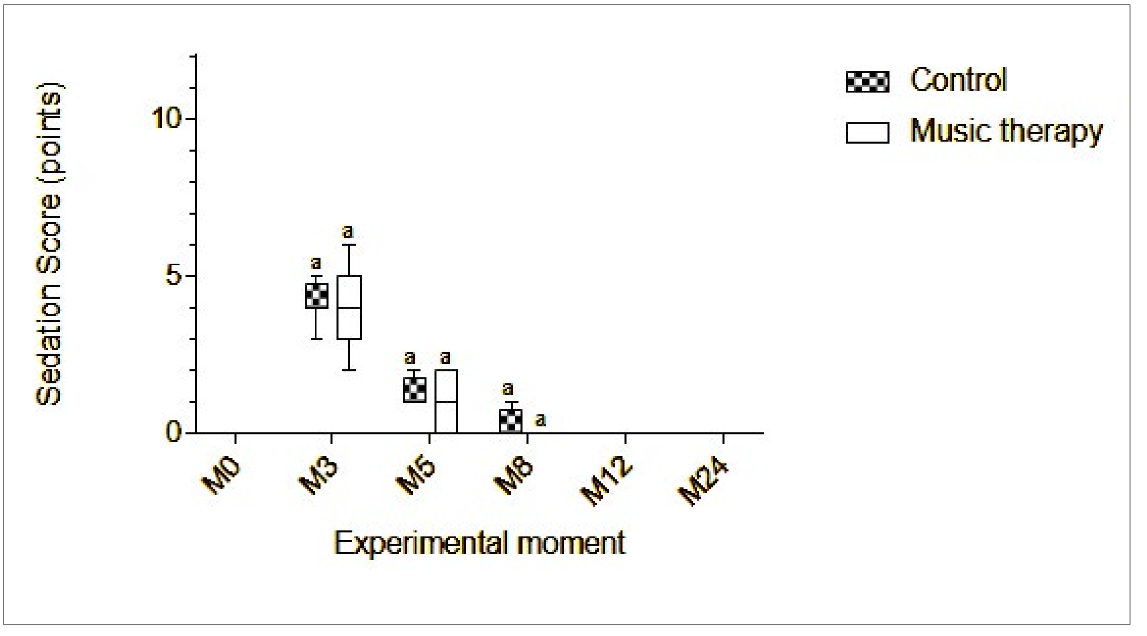
The mechanisms by which music therapy can promote analgesia are still uncertain. Kain et al. (2004) observed that music affects the right side of the brain and can cause the release of endorphins, resulting in pain relief in the individual. Another possible mechanism is the influence of the frequency of the sound waves of each musical style, as observed by Akimoto et al. (2018), who showed that music with frequency of 528 Hz modulated the autonomic nervous system and the endocrine system in reducing stress. Akiyama and Sutoo (2011) discovered that music with high frequencies increased dopamine synthesis, which can affect or modify various brain functions. Although this study did not have the objective of verifying the influence of musical sound frequencies on pain, this is a possible mechanism that deserves further investigation.

Chai et al. (2017), in a literature review, elucidated that music: 1) changes neuronal pathways in patients suffering from pain conditions; 2) provided increased activity of reward areas and response to learned stimuli, the caudate, nucleus acumbens, and striatum; 3) provided increased dopaminergic response in the striatum; and 4) caused increased circulation of endogenous opioids and increased expression of opioid receptors.

Goswami (2006) made a suggestion based on quantum physics that pain is a sensation linked to the repression of vital energy in any structural part of the body and interpreted by the mind as pain, which is undesirable. Perhaps an energy rebalancing is the mechanism by which some energy therapies have an analgesic effect, as is the case with acupuncture (GROPPETTI et al., 2011), Reiki therapy (PACHECO et al., 2021) and probably music therapy.

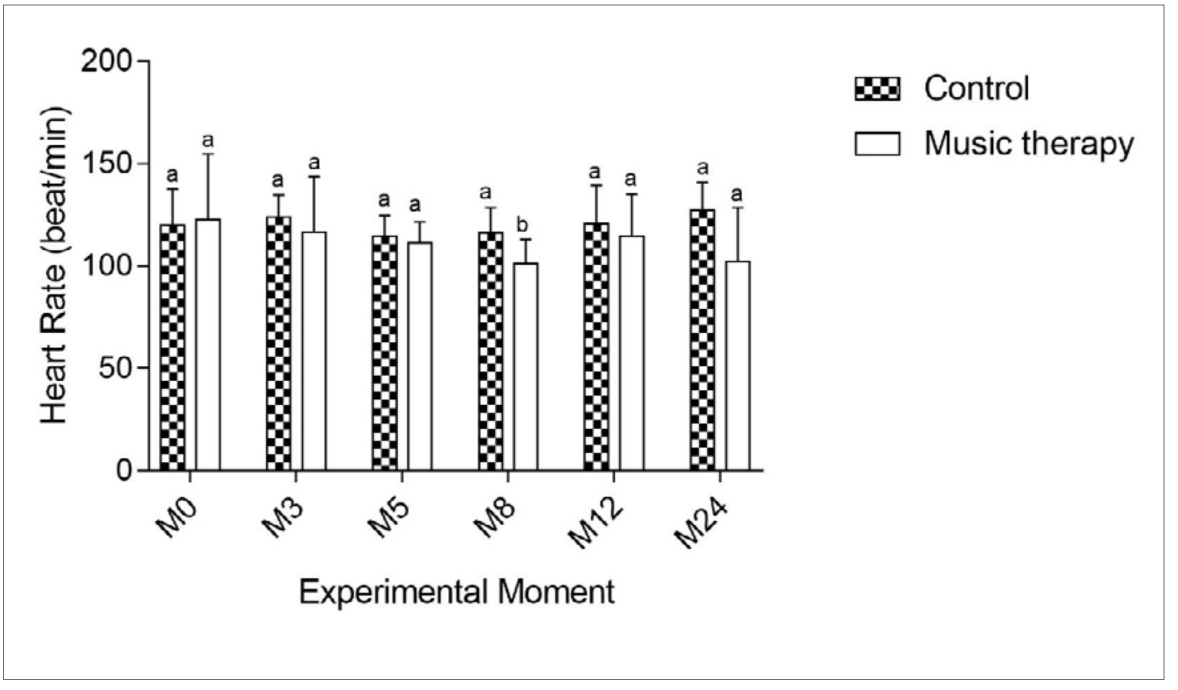
Analyzing the scores obtained with the sedation scale, there was no statistically significant difference between the two groups at any postoperative period (Figure 3). Albright et al. (2017) verified that, in dogs that have been sedate but have not undergone surgery, classical music did not increase the sedative effect of Dexmedetomidine, corroborating with the results found in this experiment. In general, the effect of music therapy on sedation levels in animals still needs to be better investigated.

Figure 3. Scores in the sedation scale of bitches subjected to elective ovariohysterectomy without any subsequent treatment (Control) and of those treated with music (Music therapy) immediately after surgery, before pre-anesthetic medication (M0); and 3 (M3), 5 (M5), 8 (M8), 12 (M12) and 24 hours (M24) after pre-anesthetic medication. n=9 for both groups. The maximum score for this scale is 20 points. Equal letters represent no statistically significant difference. Results are presented as median, and minimum and maximum values.



Observing the heart rate values of both groups, the Music therapy group had a lower heart rate than the Control group only at M8 (P= 0.0482) (Figure 4). This effect may have occurred indirectly, since the bitches had lower pain scores at that experimental instance. This difference between the two groups may also have occurred by the decrease in anxiety, an effect of music therapy in humans cited in reviews by Lin et al. (2019) and Garza-Villareal et al. (2017), who sought to show the effect of music therapy as an analgesic and also the decrease of stress, as verified by Bowman et al. (2017), who concluded that the musical genres, soft rock and reggae decreased heart rate variability in dogs.

Figure 4. Heart rate of female dogs subjected to elective ovariohysterectomy without any subsequent treatment (Control) and of those treated with music (Music therapy) immediately after surgery, before pre-anesthetic medication (M0); 3 (M3), 5 (M5), 8 (M8), 12 (M12) and 24 hours (M24) after pre-anesthetic medication. n=9 for both groups. Different letters indicate significant differences (P <0.05) between groups, being b<a. Results are presented as mean and standard deviation.



Kühlmann et al. (2020) also found that music therapy decreased the heart rate of children undergoing elective surgery and Lee (2016), in his review of the effects of music therapy on pain in humans, reported that this treatment decreased the heart rate of patients; however, the results are heterogeneous. A possible mechanism of this effect is a modulation of the autonomic nervous system, as observed by Akimoto et al. (2018), who demonstrated a decrease in the ratio between maximum and minimum heart rates and an increase in the R-R interval in the electrocardiogram of human patients when listening to music with a frequency of 528 Hz.

There was no statistically significant difference in respiratory rate at any postoperative moment assessed.

CONCLUSION

Music therapy administered during the postoperative period in bitches undergoing elective ovariohysterectomy had an analgesic effect at some instances of the postoperative period, but did not decrease the amount of analgesic drugs administered during this period.

CONFLICT OF INTERESTS

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript and in the decision to publish the results.

EFEITO ANALGÉSICO DA MUSICOTERAPIA NO PÓS-OPERATÓRIO DE CADELAS SUBMETIDAS À OVARIOHISTERECTOMIA

RESUMO

Esse estudo teve como objetivo avaliar os efeitos da musicoterapia na dor no período pós-operatório de cadelas submetidas à ovariohisterectomia (OVH) eletiva. Foram utilizadas 18 cadelas distribuídas aleatoriamente em dois grupos (grupo Musicoterapia e grupo Controle). Os animais dos dois grupos receberam medicação pré-anestésica (MPA) administração de meloxicam (0,2 mg/Kg por via endovenosa), antibioticoterapia e foram anestesiados e submetidos à OVH. A MPA foi realizada por via intramuscular com morfina (0,3 mg/Kg), midazolam (0,2 mg/Kg) e acepromazina (0,03 mg/Kg). A indução anestésica foi feita com infusão endovenosa de cetamina, lidocaína e propofol e a manutenção anestésica foi realizada com anestesia inalatória com isofluorano. Os animais do grupo Musicoterapia receberam, na sala de recuperação anestésica e cirúrgica, música ambiente através de uma caixa de som, durante 7 horas, dos estilos musicais Clássica, Reggae, Soft Rock e Relaxamento e Meditação. Os animais do grupo Controle não receberam nenhuma música durante o período pós-operatório. Todos os animais do experimento foram avaliados quanto à dor antes da MPA (M0), 3 horas (M3), 5 horas (M5), 8 horas (M8), 12 horas (M12) e 24 horas (M24) após o procedimento cirúrgico. O grupo Musicoterapia obteve uma pontuação significativamente menor que o grupo Controle em M8, M12 e M24, embora não tenha existido diferença estatisticamente significativa na quantidade de administrações de analgésicos adicionais no período pós -operatório dos animais A Musicoterapia teve efeito analgésico no período pós-operatório de cadelas submetidas à OVH.

PALAVRAS-CHAVE: dor, cirurgia, analgesia, terapias complementares

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