Original Article

Effect of post-operative clothing, bandage, and collar application on stress after ovariohysterectomy in cats

Çağatay Esin[1*] Seba Raouf[1] Gülşah Saral[2] Büşra Uzun[1]

Abstract

Ovariohysterectomy is a common surgical procedure in veterinary medicine, not only for reproductive control but also for conditions like pyometra, metritis, mammary tumors, and other reproductive disorders. Pain in cats occurs as a response of the body and is accompanied by various physiological and behavioral changes. Pain in cats, though prevalent, is often under-recognized and inadequately treated. The Glasgow pain scale is a psychometrically designed tool for assessing acute pain in veterinary patients. Serotonin (5-HT), a biogenic monoamine derived from tryptophan, functions as a mood-regulating neurotransmitter and may decrease following surgical interventions. This study aimed to evaluate post-operative pain and stress levels in female cats using the Glasgow pain scale and serum 5-HTmeasurements after different wound protection methods: bandage, Elizabethan collar, and postoperative clothing. A total of 60 healthy female cats aged 1–5 years, pre-treated for internal and external parasites, were randomly assigned into three equal groups. The same anesthetic, surgical, and postoperative care protocols were applied across all groups. As a result of this study, it was revealed with the Glasgow pain scale and 5-HT serotonin values that the use of collars in the postoperative period caused more stress in cats (p<0.05). In addition, the use of post-operative wound protection corset/clothing caused less stress than collars and bandages, as demonstrated by the Glasgow pain scale and 5-HTserotonin values (p<0.05).

Keywords: ovariohysterectomy, pain, serotonin, stress

[1]*Department of Internal Medicine, Faculty of Veterinary Medicine, Ondokuz Mayıs University, TR-55200 Samsun, TÜRKİYE*
[2]*Department of Obstetrics and Gynaecology Medicine, Faculty of Veterinary Medicine, Ondokuz Mayıs University, TR-55200 Samsun, TÜRKİYE*
****Correspondence**: cagatay.esin@omu.edu.tr* (Ç. ESIN)
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Introduction

Ovariohysterectomy (OVH) is one of the most common operations performed in veterinary medicine. In addition to reproductive control, this procedure is also indicated in conditions such as pyometra, metritis, mammary tumors and reproductive disorders (Oliveira *et al.*, 2014). OVH in cats produces pain of varying severity depending on the degree of surgical trauma. General anesthesia and appropriate analgesia protocol are recommended. There are several options for perioperative management (Mathews *et al.*, 2014).

Postoperative care after OVH in female cats and dogs is of great importance for animal welfare. Pain and stress are sensory and emotional experiences in cats that occur when stimuli that are damaging or potentially damaging to tissues are perceived. Pain in cats occurs as a response of the body and is accompanied by various physiological and behavioral changes (Hansen and Streltzer, 2005). Despite the prevalence of painful conditions in veterinary practice, pain in cats is still under-recognized and under-treated. However, although various tools have been used to assess pain expression in cats, there is still no consensus on when and whether these tools should be used and whether they truly distinguish painful from non-painful conditions.

In order to recognize and treat pain in cats, adequate and consistent assessment of pain is mandatory (Pang and Bell, 2022). In human medicine, there are various processes on psychometric approach, anamnesis and questionnaire, validity, reliability and responsiveness in the scales used for measuring complex and intangible structures such as pain and quality of life. Glasgow pain scale (CMPS) is a very important method designed using psychometric principles for the assessment of acute pain in veterinary medicine (Holton *et al.*, 2001). In the studies, the stages of the Glasgow pain scale used in the evaluation of acute pain in cats were presented (Nicholls *et al.*, 2022; Reid *et al.*, 2017).

Known as the "'mood-regulating neurotransmitter", serotonin, also known as 5-hydroxytryptamine (5-HT), is a biogenic monoamine. 5-HT is a neurotransmitter derived from the amino acid tryptophan, which is responsible for regulating mood, appetite and sleep at the central nervous system level (Domínguez-Oliva *et al.*, 2021; Nichols and Nichols, 2008; Salavati *et al.*, 2018). Serotonin plays a role in vasoconstriction, gastrointestinal motility, bone homeostasis, inflammation and lactation in the peripheral nervous system (Bruschetta *et al.*, 2024). Surgical oxidative stress can cause changes in enzymes such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione reductase (GSR), which play a role in serotonin and antioxidant processes (Hydbring-Sandberg *et al.*, 2021). Therefore, serum serotonin (5-HT) levels may decrease after surgical operations.

Routine applications are carried out to keep the incision area clean and to ensure wound healing in female cats after OVH (Bierbrier and Causanschi, 2018). Among these applications, bandage application causes stress in animals due to the necessity of keeping the bandage constantly clean and the trauma and stress it will create when removing it since it is stuck on the hair, and the constant desire to remove it by wearing a collar (Brown, 2006). Another application method, the use of Elizabethan collars, also has stress effects such as not being able to reach food and difficulty in walking. Therefore, it can be thought that wearing post-operative clothing will cause lower pain and stress levels in cats since it will not create stress when removing it, is sterile, and is economical in terms of reusability.

The aim of this study is to examine the application of bandage, wearing a collar and wearing post-operative clothing after OVH in female cats by determining the pain level with Glosgow pain scale and serum 5-HT measurements. This study aims to objectively evaluate pain and stress by comparing three commonly used methods for postoperative suture line protection in animals.

Materials and methods

Ethical Statement: All procedures performed in this study were non-invasive and conducted in full compliance with national and international animal welfare guidelines. No experimental interventions beyond routine clinical care were implemented, and all steps were carried out within ethical boundaries. All procedures were carried out in accordance with national legislation and institutional ethical guidelines governing the scientific use of animals, and in compliance with the 3Rs principles (replacement, reduction, refinement).

Animal Selection and Housing Conditions: Sixty healthy female cats aged between 1 and 5 years, with internal and external parasite treatments performed 10 days before the operation, were included in the study. The cats were divided into three groups of 20. A power analysis was conducted prior to the study, and it was determined that a sample size of 20 cats per group would be sufficient to achieve the desired statistical power and significance level. Therefore, the chosen sample size is statistically justified. The first group consisted of the bandage group, the second group consisted of the Elizabethan collar group, and the third group consisted of the post-operative clothing group. The cats were housed in single groups in cages specially prepared for the operation. In our study, animals were randomly assigned to groups using a computer-generated randomization list created in Excel. Additionally, outcome assessors were blinded to the group allocations to minimize observational bias. To ensure a homogenous and clinically stable study population, all animals underwent thorough physical examinations, complete blood counts, and comprehensive serum biochemistry profiling prior to inclusion. Cats exhibiting any signs of systemic illness or abnormalities in hepatic, renal, metabolic, endocrine (e.g., diabetes mellitus, hyperthyroidism), infectious (e.g., FIV, FeLV), or hematologic parameters were excluded from the study. Additionally, animals with a history of prior surgeries, chronic medical conditions, or any ongoing treatment were not included. These measures were taken to eliminate potential

confounding factors that could influence stress responses.

Pre-operative Preparation and Surgical Procedure: The OVH procedure was performed in a special operation room on cats that were restricted to food and water 12 hours before the operation. Complete blood and biochemical analyses were performed on all cats included in the study for routine health screening before the operation. Cats whose physical examination parameters, complete blood and biochemical analyses were within the reference ranges before the operation were included in the study. Cats that were administered intramuscular kitty magic (butorphanol-ketamine-medetomidine) as a pre-anesthetic were anesthetized with inhalation anesthesia technique (isoflurane) after entering sedation and the operation was performed by approaching from the median abdominal line. Suture application was performed by performing a minimally invasive procedure on the operation line. Post-operatively, Meloxicam was administered subcutaneously at a dose of 0.2 mg/kg as part of a multimodal analgesic protocol due to its well-documented anti-inflammatory and analgesic effects as well as favorable pharmacokinetic properties in the feline species.

Post-operative Study Design: In order to prevent the cats from damaging the wound line in the post-operative period, a bandage was applied between the abdominal and inguinal regions in the cats in the first group. Elizabethan collars were applied to the cats in the second group without applying a bandage. Post-operative clothing was worn in the cats in the third group. Subcutaneous antibiotics (Convenia®, Zoetis pharmaceutical) were applied to all cats in the three groups as a prophylactic measure against possible infections after the operation. In the cats in the first group, the bandage was changed on the 2nd and 4th days after the operation. The bandage was removed and the stitches were removed on the 10th day after the operation. In the cats in the second group, povidone-iodine was applied to the wound line on the 2nd and 4th days after the operation. The Elizabethan collar was removed and the stitches were removed on the 10th day after the operation. In the cats in the third group, povidone-iodine was applied to the wound line on the 2nd and 4th days after the operation and the post-operative clothing was removed and the stitches were removed on the 10th day after the operation.

Pain and Stress Assessment: In order to reveal the stress and pain status in cats after the operation, blood was taken into a yellow gel blood tube on the 0th and 10th days after the operation and serum 5-HT serotonin analysis was performed. 5-HT serotonin was studied in Thermo scientific®, Quantum Access Max spectrometer device. 180 ul serum sample was added to 20 ul water. 40 ul trifluoroacetic acid (TFA) was added. It was vortexed for 30 seconds. It was centrifuged at 12000 rpm for 10 minutes. The supernatant was given to the device. (Injection volume is 20 ul). During the study of the samples, 0.2% TFA was used in mobile phase A and Acetonitrile was used in mobile phase B. In addition, Glasgow pain test was performed on the 0th and 10th days and the data was recorded. Glasgow pain test was applied independently by three observers to ensure objectivity and inter-observer consistency. This scale was selected as it is one of the most widely accepted and validated tools for assessing acute pain in cats, particularly in postoperative settings. The stitches were removed on the 10th day after the operation in all three groups. All cats were operated on by a single expert operator. All cats were treated with the same brand of parasite treatment before the operation. All cats were cared for in the same cage, in the same environment and by the same animal keepers for 10 days after the operation. In addition, all cats were given the same brand of food during this period.

Statistical Analysis: SPSS software package (SPSS Inc. IBM® Corp., Chicago, IL, USA) was used in the statistical analyses of the study. Normality of the data was assessed using multiple methods to ensure robustness. The Shapiro-Wilk test was applied to evaluate the conformity of the data to a normal distribution. In addition, visual inspections were performed using Quantile-Quantile (Q-Q) plots and histograms. Descriptive measures such as skewness and kurtosis values were also examined. Skewness and kurtosis values within the range of ±1 were considered indicative of normal distribution. The combination of statistical and visual methods allowed for a comprehensive assessment of the data distribution. Since there were values that did not have a normal distribution among the data, Kruskal Wallis test was applied to the values between the groups. For intra-group evaluation, Wilcoxen Sum Rank test was applied for statistical evaluations between measurements on different days (post-operative 0th day and post-operative 10th day). Descriptive statistics are given in the tables as mean±standard deviation. Additionally, median values are given for data that do not have a normal distribution. $P<0.05$ value was considered statistically significant.

Result

Descriptive statistics of the breeds and ages of the cats included in the study are given in Table 1. No statistical difference was found between the groups in terms of age and live weight ($p > 0.05$).

Table 1 Descriptive statistics of age and live weight of cats included in the study

Groups	Age (year)	Body Weight (kg)
Bandage	2.4±1.31	3.7±0.81
Elizabethan Collar	2.65±1.46	4±0.87
Postoperative Clothing	2.1±1.2	3.7±0.8
***P* Value**	$p > 0.05$	$p > 0.05$

When the Glasgow scales between the groups were compared on days 0 and 10, no statistical difference was found. However, a statistically significant decrease was observed between days 0 and 10 in the Glasgow pain scale measurements of the cats in the bandage, collar, and postoperative clothing groups within the group ($p < 0.05$) (Table 2).

When the 5-HT serotonin values between the groups were compared on the 0th and 10th days, a statistically significant difference was found between the groups (lowercase letters in the table). Statistically significant increases were also observed between the 0th and 10th days in the intragroup measurements of 5-HT serotonin values of cats belonging to the bandage, collar, and postoperative clothing groups ($p < 0.05$) (Table 3).

Table 2 Glasgow pain score findings of the cats included in the study

Groups	Day 0 Glasgow Scale	Median	Day 10 Glasgow Scale	Median	*P* Value
Bandage	3±0.72[a]	3	1.4±0.99[b]	1,5	***p* < 0.05**
Elizabethan Collar	2.82±1.08[a]	3	1.7±1.17[b]	2	***p* < 0.05**
Postoperative Clothing	3±0.97[a]	3	1.5±0.88[b]	2	***p* < 0.05**

The *P* value in the table indicates the statistical difference in the measurements within the groups. Different lowercase letters (a, b) indicate the statistical difference in the measurements between the groups, while the same lowercase letters indicate that there is no statistical difference.

Table 3 5-HT serotonin findings of the cats included in the study

Groups	Day 0 5-HT Serotonin	Median	Day 10 5-HT Serotonin	Median	*P* Value
Bandage	1,204.46±45.,22[b]	1,197.42	1,879.70±350.85[b]	1,810.25	***p* < 0.05**
Elizabethan Collar	591.29±288.64[a]	637.53	1,042.88±387.49[a]	1,029.88	***p* < 0.05**
Postoperative Clothing	1,608.11±722.27[c]	1,771.25	2,769.29±554.06[c]	2,622.80	***p* < 0.05**

The *P* value in the table indicates statistical differences in within-group measurements. Lowercase letters (a,b) indicate statistical differences in between-group measurements.

Discussion

There is no scientific study on the optimal age range for OVH in female cats (Kustritz, 2007). However, this operation is generally preferred between the ages of 1-4 (Diep *et al.*, 2020; Gözer *et al.*, 2023). In this study, female cats between the ages of 1-4 were preferred for this operation, consistent with similar studies.

Pain assessment scales are generally used to determine whether an animal is in pain or stressed and whether it needs analgesia (Calvo *et al.*, 2014). The most commonly preferred pain assessment scale used for this purpose is the Glasgow pain scale. The Glasgow pain scale is most commonly used in the evaluation of postoperative processes in animals that have undergone surgery (Reid *et al.*, 2017). In this study, the process after OVH surgery was evaluated with the Glasgow pain scale, which is the most commonly preferred pain scale for pain and stress scaling.

Since the same anesthesia protocol was applied to all three groups of cats in this study, the postoperative Day 0 Glasgow pain scale data gave similar results and this did not indicate a statistical difference. However, when the Day 10 Glasgow scales were examined, more significant decreases were obtained in the bandage and postoperative clothing group compared to the Elizabethan collar group on Day 0. This suggests that bandage and postoperative clothing applications cause less pain and stress in cats. Studies on the placement of collars, leashes and similar devices around the neck of cats have shown that excessive tightness, compulsive disorders, difficulty in reaching food, or dermatological disorders resulting from inability to clean themselves are stress factors (Arhant *et al.*, 2022; Landsberg, 2003). This shows that the use of collars creates a stress factor and explains why the postoperative Day 10 Glasgow pain scale values of the cats in the collar group in our project were higher than the other two groups.

The use of a post-operative clothing after the operation is generally preferred to accelerate the healing process and prevent complications. The biggest advantage of these clothes over bandage application is that there is no need to change the bandage at regular intervals. It also contributes to the preservation of body temperature in the short post-operative period. When compared to the Elizabethan collar, it does not cause any difficulty during food intake (Campbell, 2006; Tobias, 2017).

There are not enough studies on how 5-HT serotonin levels change after surgery in cats. However, there is information from more extensive studies on the role of 5-HT serotonin in the body, especially regarding stress, pain and recovery after surgical interventions. According to this information, 5-HT serotonin may be lower due to pain and stress after surgery. However, it tends to increase under appropriate conditions (Evangelista *et al.*, 2014; Mohammad-Zadeh, Moses, and Gwaltney-Brant, 2008). The reason why 5-HT serotonin levels were higher on the 10th day postoperatively in all three groups compared to the 0th day is supported by this literature. In addition, it is believed that the reason why the 10th day postoperative 5-HT serotonin levels of cats in the clothing group were higher than those in the bandage and Elizabethan collar group is that there is less stress as mentioned above. In addition, considering that studies on cats wearing collars and similar devices around their necks have shown that excessive tightness, compulsive disorders, difficulty in reaching food, or dermatological disorders resulting from inability to clean themselves are stress factors (Arhant *et al.*, 2022; Landsberg, 2003), it was expected that cats

in the collar group had the lowest 5-HT serotonin levels in this study.

Although the primary focus of our study was on the assessment of stress and post-operative analgesia, we acknowledge that evaluating wound healing could provide additional clinical relevance. This is an important consideration for future studies, which may include both physiological and histological parameters to assess tissue recovery more comprehensively.

In conclusion, Various precautions are taken to protect the wound line after OVH in cats. The most commonly used methods for this purpose are bandage applications, the use of Elizabethan collars or the use of post-operative wound protection corsets/garments. All three of these methods have various advantages and disadvantages. As a result of this study, it was revealed that the use of Elizabethan collars in the post-operative process caused more stress in cats with Glasgow pain scale and 5-HT serotonin values. In addition, it was revealed with Glasgow pain scale and 5-HT serotonin values that the use of post-operative clothing caused less stress than Elizabethan collars and bandages. As a result of this study, if the wound or suture line needs to be protected after operative interventions that may cause pain or stress in cats, it would be more appropriate to recommend the use of post-operative clothing in order to contribute to the best management of this process.

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Author Contributions: ÇE: Writing – original draft, Project administration, Methodology, Data curation, Conceptualization, Writing – review & editing. SR, GS and BU: Methodology, Data curation, Conceptualization.

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