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Original article

THE EFFECTS OF DIFFERENT ORCHIECTOMY TECHNIQUES ON POSTOPERATIVE PAIN IN CATS

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Summary

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Orchiectomy is one of the surgical procedures used to prevent uncontrolled reproduction and unwanted behaviours in cats. This study aimed to define the appropriate technique of ligation, square knot and 8-shaped knot techniques, which are commonly used orchiectomy techniques, in terms of postoperative pain, postoperative short-term complications and patient welfare. Thirty-six healthy cats of different ages and breeds were brought to the Surgery Clinic of the Animal Hospital. These cats were randomly allocated into three groups. The ligation technique was applied to the first group (GI, n=12), the square knot technique to the second group (GII, n=12), and the 8-shaped knot technique to the third group (GIII, n=12). Venous blood was collected from the cats in the study to determine blood cortisol levels, and a blinded investigator evaluated the groups according to the Glasgow Feline Composite Pain Scale (CMPS-Feline). There was no statistically significant difference between the groups in blood cortisol levels. A statistically significant difference between the groups according to CMPS-Feline was found in Group I. As a result, Group II and III techniques were found to be recommendable due to the low postoperative pain. However, when using these techniques, the age of the patient undergoing orchiectomy, the spermatic cord's resistance, and the operator's experience should be considered.

Key words: cat, cortisol, orchiectomy, postoperative pain, spermatic cord

INTRODUCTION

Orchiectomy is one of the most frequently performed surgical procedures to prevent uncontrolled breeding in male cats (Kustriz, 2007; De Olivera *et al.*, 2010; Yanmaz *et al.*, 2022; Şenocak, 2023). It also prevents undesirable behavioural changes such as hormonal pathologies, testicular neoplasms and territorial markings, nocturnal habits, and aggression in adult cats (Kustriz, 2007; De Oliveira *et al.*, 2010; Baran *et al.*, 2016; Şenocak *et al.*, 2019). Various surgical orchiectomy (open and

closed) techniques have been described. These techniques are named according to whether the tunica vaginalis is incised from the layers of the testicle or not (Şenocak *et al.*, 2019). Since orchiectomies are relatively simple, they are often performed by practitioners or professionals who do not practice the basic principles of aseptic surgical technique. However, lack of antisepsis and insufficient haemostasis of the vessels can lead to significant postoperative complications such as infection, bleeding, and even death of the animal (De Oliveira *et al.*, 2010; Romeo *et al.*, 2023; Şenocak, 2023).

Orchiectomy in cats is a surgical procedure that causes moderate pain. Therefore, it requires pre- and postoperative analgesia (Cicirelli *et al.*, 2022). Analgesia is very important in surgical procedures, as pain adversely affects healing, quality of life, human-animal bond, the body's stress response to traumatic injury, and metabolic and endocrine functions (Yayla *et al.*, 2019; Cicirelli *et al.*, 2022).

Pain assessment in cats is more complex than in other animal species. However, various methods to evaluate and measure pain in cats have been developed. Pain scales such as the Glasgow Feline Composite Pain Scale (CMPS-Feline), the UNESP–Botucatu Multidimensional Composite Pain Scale (UNESP-Botucatu MCPS), and the Colorado State University Feline Acute Pain Scale (CSU-FAPS) have been developed and approved specifically for acute pain. Although they are widely used and seem simple, there is inherent subjectivity when used. One of the limitations is that, especially when cats are evaluated in an unfamiliar setting such as a veterinary hospital, they may show behavioural differences influenced by fear and anxiety such as posture, facial expressions, and response to stroking/palpation. In recent years, the use of CMPS-Feline has increased in assessing pain in cats. This scale is accepted as a valuable and reliable scale used to determine postoperative analgesia quality (Nicholls *et al.*, 2022).

This study aimed to define the appropriate technique of ligation, square knot and 8-shaped knot techniques, which are common surgical orchiectomy techniques, in terms of postoperative pain, short-term postoperative complications, and patient well-being.

MATERIALS AND METHODS

Ethical approval

This study is not an experimental study and does not involve the use of experimental animals. Consent forms were filled out and signed by cat owners.

Animals

A total of 36 healthy male cats who underwent orchiectomy in the Surgery Clinic of University Animal Hospital were included in the study. The age of the cats with a body weight of 3-5 kg was between 10 and 24 months, and they were of different breeds (Tabby, Siamese, Scottish, British, Van, Persian, crossbreeds).

Group design

Cats were randomly divided into three groups. The ligation technique was applied to the first group (GI, n=12), the square knot technique was used in the second group (GII, n=12), and the figure-8 knot technique was applied to the third group (GIII, n=12).

Pre-operative procedures and anaesthesia

All cats included in the study were subjected to clinical examination before sur-

gery. Before the surgery, food intake was restricted for 12 hours and water intake – for 4 hours. Cats were sedated with 1 mg/kg xylazine HCl (Rompun 2%®, Vetilac/Türkiye, IM) and 10 minutes later were anesthetised with 10 mg/kg ketamine HCl (Ketasol 10%®, Richter Pharma/ Türkiye, IM). Intramuscular (IM) injections were administered between semitendinosus and semimembranosus muscles. The scrotum and its surroundings were shaved under sedation. Anaesthesia was not maintained in any of the cats included in the study.

Surgical procedures

Cats were placed in dorsal recumbency, and antisepsis of the scrotal region was performed. A small skin incision was made in the ventral part of the scrotum. The tunica dartos and parietal tunica vaginalis were incised, and the testis was carefully exposed with gentle traction. With the help of haemostatic forceps, the epididymal ligament and visceral tunica vaginalis were released, and the funiculus spermaticus was exposed. In this way, the open technique was applied for ligation and haemostasis. The surgical procedures up to this stage were the same for all groups.

In Group I (GI), double ligation was performed with 2-0 absorbable polyglactin 910 (Coated Damacryl 910®, GMD Group Medikal /Türkiye) suture material into the funiculus spermaticus of cats (Fig. 1A). For this procedure, the released funiculus spermaticus was compressed with haemostatic forceps. The testis was cut and removed after the ligation of funiculus spermaticus.

In Group II (GII), the ductus deferens and spermatic vessels, which form the funiculus spermaticus of the testis removed from the scrotal excision, were used to make square knots (Fig. 1B). After the ductus deferens was dissected and its entrance into the testis was cut, this segment was held in one hand, and three simple square knots were made with these structures by connecting it to the testicular vascular cord in the other hand. Then, the testis was removed by cutting distal to the nodes.

In Group III (GIII), the funiculus spermaticus itself was used to make an eight-shaped knot (Fig. 1C). After the funiculus spermaticus was wrapped over a curved haemostatic forceps, the forceps was rotated under the spermatic cord, and the testis was cut away after pinching the most distal part. By withdrawing the

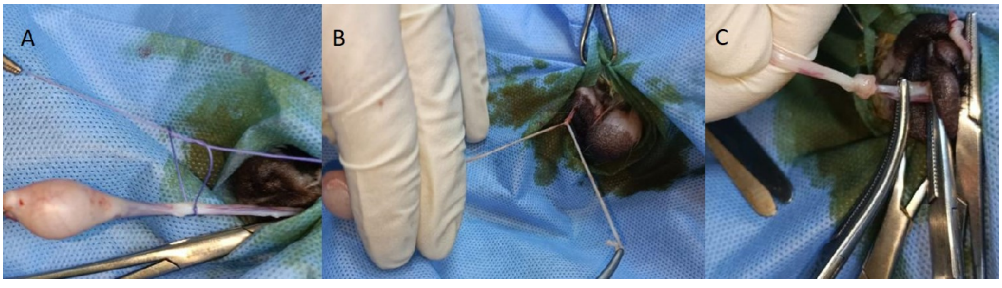

Fig. 1. Techniques used in the study. **A.** Ligation of the funiculus spermaticus with suitable absorbable suture material; **B.** Separating the vas deferens from the part where it attaches to the testis and knotting it with the spermatic cord (square knot technique); **C.** Applying an 8-shaped knot on the funiculus spermaticus.

spermatic cord surrounded by the haemostatic forceps, eight nodes were formed on the funiculus spermaticus. After bleeding control was performed in all groups, the funiculus spermaticus was released and 0.5 mL povidone iodine (Baticonol®, Dermosept/Turkey) was injected into the scrotal pouch. The surgical incision was left open.

Evaluation of postoperative pain

To assay the cortisol level in the blood, venous blood samples from cats were collected by applying a catheter to the *vena cephalica antebrachii* at 0, 30, 60, 90 minutes and 2, 4, 6, 12, 24 hours and centrifuged to obtain blood serum. Cortisol levels were determined by chemiluminescence (immunological test, immunoassay) measurement method on a biochemical hormone analyzer (Abbott Architect İ2000) in the laboratory.

Throughout the study, pain control was assessed by a single investigator who was unaware of the performed surgical procedure using the Glasgow Feline Composite Pain Scale (CMPS-Feline) to determine the pain levels. Before surgery, a baseline pain assessment was performed. Then, the pain status of the cats was evaluated at post operative hours 2, 4, 6, 12 and 24. Behavioural observation procedures were standardised. The blinded researcher determined the cat's posture, movement, and response to being called before the cats were anesthetised. Then, the differences were recorded by approaching the cat. After approaching the cat, the researcher tried to communicate by calling its name in a friendly way, and the animal's movements and posture were evaluated by fthe CMPS-Feline. Next, the investigator observed cat\s responses by softly palpating the wound site and recorded the pain scores on the CMPS-Feline form. When the score obtained from this pain scale was 5/20 and above, a single dose of 0.2 mg/kg meloxicam (Bavet Meloxicam, Bavet, Türkiye) was administered subcutaneously.

Statistical analysis

Statistical analysis of the data was performed using the Minitab-17 package programme. One-way ANOVA analysis was used for parametric values, Kruskal-Wallis test was used for non-parametric values. Differences were considered significant at $P<0.05$.

RESULTS

Operation times were close to each other in all three groups, and after the cat was anesthetised and antisepsis of the area was ensured, this time was found to be around 5 minutes.

There were no serious problems in the application of all three surgical techniques and they were easy to apply. However, in the postoperative period, the area was oedematous and painful in 5 of the cats in Group I, and oedema was observed in only 1 cat from Group II. Local oedema did not develop in any of the cats from Group III.

When the blood cortisol levels of the groups were examined in the preoperative and postoperative periods, no statistical difference between the groups was observed (Table 1). However, such a difference was determined within the time intervals in Group I. When the groups were compared in terms of pain (Table 2), there was a statistical difference between the groups at the 4^{th} , 6^{th} , and 12^{th} hour when the pain score of Group I was statistically significantly higher compared to those of the other two groups. Within-group comparison showed significant differences

Table 1. Blood cortisol levels (mean ± SD) after orchiectomy in cats from group I (ligation technique); group II (square knot technique) and group III (8-shaped knot technique)

Time post-orchiectomy	Group I (n=12)	Group II (n=12)	Group III (n=12)
min 0	1.75±1.38 ^{ab}	1.08±1.10 ^{a}	1.16±0.76 ^{a}
min 30	0.45±0.21 ^{a}	0.96±1.37 ^{a}	0.91±0.72 ^{a}
min 60	0.43±0.23 ^{a}	0.96±1.45 ^{a}	1.0±0.93 ^{a}
min 90	1.85±1.47 ^{ab}	2.07±1.79 ^{ab}	1.62±1.27 ^{ab}
hour 2	2.19±1.02 ^{bc}	2.35±1.68 ^{ab}	2.30±1.64 ^{ab}
hour 4	3.34±1.68 ^{c}	3.55±2.38 ^{b}	3.91±2.22 ^{b}
hour 6	3.05±1.68 ^{c}	3.55±2.38 ^{b}	3.91±2.22 ^{b}
hour 12	3.59±1.23 ^{c}	3.25±1.64 ^{b}	2.56±1.29 ^{ab}
hour 24	4.07±1.79 ^{c}	3.14±1.61 ^{b}	2.40±1.37 ^{ab}

Different superscripts within a row indicate statistically significant difference by time for each group ($P<0.05$).

Table 2. Evaluation of pain in cats after orchiectomy according to the Glasgow Feline Composite Pain Scale (CMPS-Feline) in group I (ligation technique); group II (square knot technique) and group III (8-shaped knot technique). Scores are given as median (minimum-maximum range)

	Hour post-orchiectomy				
	2	4	6	12	24
Group I (n=12)	2 (0–4) ^{a}	5 (3–6) ^{a}	9 (4–10) ^{b}	8.5 (3–11) ^{b}	2 (0–9) ^{a}
Group II (n=12)	0.5 (0–3) ^{ac}	3.5 (1–4) ^{ab}	4 (2–8) ^{b}	2 (0–5) ^{ac}	0 (0–4) ^{c}
Group III (n=12)	0 (0–3) ^{a}	2 (1–4) ^{a}	2.5 (1–6) ^{a}	1 (0–8) ^{a}	0 (0–2) ^{a}
		$P_{I-II}<0.05$; $P_{I-III}<0.05$	$P_{I-II}<0.05$; $P_{I-III}<0.05$	$P_{I-II}<0.05$; $P_{I-III}<0.05$	

Different superscripts within a row indicate statistically significant difference by time for each group ($P<0.05$).

with time in Group I. Pain scores in Group II differed at the 6th and 12th post-operative hours, while no difference was observed for Group III.

DISCUSSION

Orchiectomy is a standard surgical procedure performed in male cats. Different orchiectomy techniques are applied in cats. In the traditional technique, following a separate longitudinal incision on each scrotal sac, the funiculus spermaticus is released, ligated, and the testis removed. The scrotal incisions are not sutured. Binding methods of funiculus spermaticus for haemostasis are as follows: tying of the funiculus spermaticus with an 8-shaped knot on itself, separating the vas deferens from the part where it attaches to the testis and knotting it with the spermatic cord, and double ligation of the funiculus spermaticus with the appropriate absorbable suture material (El-Sherif, 2017). The ligation technique is recommended for orchiectomy procedures in very young cats, as it provides satisfactory haemostasis in the spermatic cord.

However, the eight-shaped and square knot techniques may be inadvisable due to the weak and fragile spermatic cord (De Oliveira *et al.*, 2010; El-Sherif, 2017). This study was performed in adult cats, and no complications were encountered in the spermatic cord. In a study which compared these three techniques, De Oliveira *et al.* (2010) reported no qualitative difference between them and higher local oedema in the ligation technique. In this study, the oedema findings were also reported in line with results of De Oliveira *et al.* (2010),. While present in 5 cases in Group I and one case in Group II, local oedema was not detected in group III.

Pain assessment in cats is more complex than in other pets. Underestimating pain in cats can be a clinical problem, resulting in inadequate analgesia and poor patient care (Steagall & Monteiro, 2019; Nicholls *et al.*, 2022). For this purpose, many scales have been developed and examined. The CMPS-Feline is the most commonly used scale among these scales and is reported to be reliable (Gordon-Evans *et al.*, 2020; Nicholls *et al.*, 2022). Nicholls *et al.* (2022) reported that two different investigators obtained different CMPS-Feline scores in their evaluation of postoperative pain in cats undergoing ovariohysterectomy, raising some concerns about its reproducibility and objectivity. In this study, the assessment of postoperative pain in all cases was performed by a single investigator. When assessing pain, behaviours such as crouching behind the booth or wheezing at the examiner, which may be caused by stress/anxiety and fear, can be considered pain symptoms (Porters *et al.*, 2015; Nicholls *et al.*, 2022). Nicholls *et al.* (2022) reported that this situation can be relatively prevented when the cat is accustomed to the environment in which it will stay for >15 min before the operation, but this can be a complicated procedure in busy clinics. In this study, orchiectomy was performed before the patient was accustomed to the department in the postoperative period, which can be seen as limitation of our study.

Gonadectomy (ovariohysterectomy, orchiectomy, etc.) is a procedure that causes moderate pain. Therefore, it is recommended to administer analgesic drugs in the preoperative, intraoperative, or postoperative period (Farnworth, 2014). Brugines *et al.* (2016) reported that kittens showed fewer pain symptoms and that recovery after castration was faster in a study conducted on cats under six months of age and adults. Postoperative pain in animals is significant for the overall recovery process. It can cause decreased food intake, increased protein catabolism, depression of respiratory functions, cardiac arrhythmias, and hypersensitivity to harmful stimuli. Slingsby *et al.* (2001) emphasised that regional sensitivity is high in cats who underwent orchiectomy and received no analgesic.

Many studies (Wagner *et al.*, 2008; Huuskonen *et al.*, 2013; Binder *et al.*, 2018) show an increase in regional sensitivity, lethargy, restlessness, decreased appetite etc. after gonadectomy. It was reported that analgesics should be administered if there were pain symptoms. In this study, the effects of castration such as ligation, square knot, and 8-shaped knot-tying techniques in the funiculus spermaticus on postoperative pain were examined, and a statistical difference was determined for Group I among these three groups. This may be due to the formation of regional oedema and the fact that the suture used for ligation may create a foreign body effect. Cortisol is a significant steroid produced by the adrenal gland. Its

production and secretion are regulated by the hypothalamic-pituitary-adrenal axis (Salavati *et al.*, 2018). Cortisol levels in the body can be affected by many factors such as race, gender, environment (Sandri *et al.*, 2015; Salavati *et al.*, 2018), sterilisation status, blood collection and time taken during blood collection (Cobb *et al.*, 2016; Salavati *et al.*, 2018). Salavati *et al.* (2018) reported that the cortisol level increased after castration and that the reason for this might be the stress of surgery. This study showed a slight increase in cortisol levels, but without statistical difference between preoperative and postoperative cortisol levels between the groups.

As a result, the three orchiectomy techniques are frequently used in cats. When evaluated in terms of postoperative pain, techniques applied in groups II and III can be recommended compared to group I. However, these two techniques should be preferred when the spermatic cord is well-evaluated, and its resistance is good. In addition, applying the spermatic cord in the form of 8 requires more experience than other techniques, which is a disadvantage.

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