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A COMPARISON OF THREE TECHNIQUES FOR OVARIAN PEDICLE HEMOSTASIS IN FELINE OVARIOHYSTERECTOMY

AYAD E. MAHMOOD AND M.I. YASIN
Department of Medicine and Surgery, College of Veterinary Medicine, Duhok University Kurdistan Region/Iraq

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ABSTRACT

The aim of this study is to clinically evaluate three techniques for hemostasis of the ovarian pedicle (OP) in cats in relation to efficacy, practicability, and surgical time. Ovariohysterectomy (OVH) was performed through a ventral midline incision on 36 intact adult female cats randomly divided into three groups, each of 12. In Group1, hemostasis of the OP was done by using single pedicle ligation (SL) using 2-0 polyglycolic acid. Ligation of the OP with 2-0 polyglycolic acid was done using three clamps (TC) technique, and in group 3, ovarian pedicle tie (PT) was used for OP hemostasis. The results showed that the three techniques used for OP hemostasis were safe and effective in preventing bleeding; the PT technique was economic and significantly ($P< 0.05$) faster in application than the TC and SL techniques.

Keywords: *Ovariohysterectomy; ovarian pedicle hemostasis; cats.*

INTRODUCTION

Elective OVH is one of the most frequently performed procedures to control overpopulation in cats which is a well-recognized problem all over the world (Spain *et al.*, 2004, Kustritz, 2007; Levy *et al.*, 2014); it is also done to prevent neoplasia of the mammary gland, ovaries and uterus, decrease in pregnancy and parturition related disorders, noisy heat cycles and undesirable sexual behaviors (Root Kustritz, 2012).

Corresponding author: M.I. YASIN
E-mail address: mariam.yassin@uod.ac
Present address: Department of Medicine and Surgery, College of Veterinary Medicine, Duhok University Kurdistan Region/Iraq

Hemorrhage is one of the complications of OVH, it can occur from different sources mainly from the ovarian pedicles (OP), uterine vessels, and broad ligament (Howe, 2006). Hemostasis of the OP is the most important and difficult step in OVH in cats and dogs, especially if done by an inexperienced surgeon (Miller *et al., 2016*; Bushby and White, 2019). Several hemostatic techniques of the OP, including single pedicle ligation (SL), double pedicle ligation (DPL), ligation using triple clamp technique (TC), or pedicle tie (PT) were used to achieve hemostasis and prevent bleeding from the OP (Appel and Scarlett, 2013; Kiani *et al.*, 2014; Frasson, 2018). The PT technique is a relatively new technique done by ligating the OP on itself without using suture material (Miller *et al.*, 2016).

The objective of this study was to compare the safety, efficiency, practicality, and the speed of three hemostatic (SL, TC, and PT) techniques used for the ovarian pedicle (OP)

MATERIALS AND METHODS

This randomized controlled, blinded study was reviewed and approved by the scientific committee of the College of Veterinary Medicine/Duhok University.

A total of 36 intact adult female local breed cats were used for this study. They were recruited from client-owned cats and two cat shelters in Duhok governorate that admitted to the surgery department teaching hospital/ College of Veterinary Medicine/Duhok university for elective OVH.

The cats included in the study had no previous laparotomy or existing disease, non-pregnant and aged not less than 7 months. The cats were considered healthy based on the history of the animals and the results of a thorough physical examination. The age and weight of the animals were recorded. The cats were randomly assigned into three equal groups (each of 12) according to the technique used for hemostasis of the ovarian pedicle.

In group 1, SL was used for the OP; in group 2, ligature of the OP was done using TC technique and, in group 3 PT was used for OP hemostasis.

The cats fasted from food and water the night before the operation. Atropine sulfate (Atrovap®, veterinary & Agricultural Products MFG. CO, Jordan) in a dose of 0.02 mg/kg was administered intramuscularly (IM) 10 minutes before anesthesia. Ketamine sulfate (Ketamin. Dutch Farm International BV, Holland) in a dose of 15mg/kg with xylazine (Xyla®, Interchemie werken "De Adelaar" B.V, Holland) in a dose of 2mg/kg were loaded into the same syringe and given IM to induce and maintain anesthesia. Spectinomycin + Lincomycin (SPECTIN-LIN, TIZO Vet, China) was given IM in a dose of 0.2 ml/kg 1 hour before the operation. The ventral midline abdominal area from the umbilicus to the pubis was prepared aseptically by clipping the hair and scrubbing the skin with povidone-iodine. Each animal was placed in dorsal recumbency on the operating table with the limbs tied to the table by straps. four-corner draping technique was used and clamped to expose the surgical site.

All the operations were performed by one surgeon and one assistant using sterile surgical instruments.

No. 2/0 polyglycolic acid (WEGO-PGA, WEGOSUTURES, China) with swaged-on taper point needles were used for ligation of the ovarian pedicle and uterine with the use of Mayo-Hegar needle holder and straight atraumatic thumb forceps. For all ligatures and suturing of the abdominal wall and skin incision, a surgeon's knot was used followed by three throws of square knots to tie it.

The skin and subcutaneous incision was made in the middle third of the distance between the umbilicus and the pubis. The linea alba was exposed and tented outward with Allis tissue forceps. A small stab incision was made in the linea alba by a sterile scalpel blade with its cutting edge directed upward. The stab incision was enlarged cranially and caudally by scissors and the abdomen was opened. A spay hook was used to locate and exteriorize the right uterine horn (fig.1), the was followed proximally to expose the right ovary. The suspensory ligament was severed by scissors to release the ovary and isolate the OP for hemostasis (fig. 2).

Figure 1. Exteriorization of the uterine horn by spay

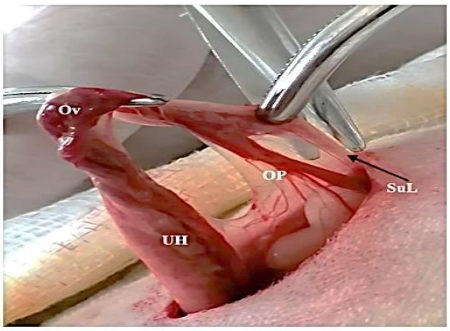

Figure 2. cutting the suspensory ligament (SuL). OP: ovarian pedicle; Ov: ovary; UH: uterine horn

In group1, hemostasis of the OP was done by placing a single transfixation ligature around the pedicle; a surgeon knot was made followed by three throws to tie the knot. A hemostatic clamp was then placed across the OP between the ligature and the ovary and the OP was transected between them. Bleeding was checked before cutting the suture ends and releasing the ligated OP into the abdominal cavity (fig. 3).

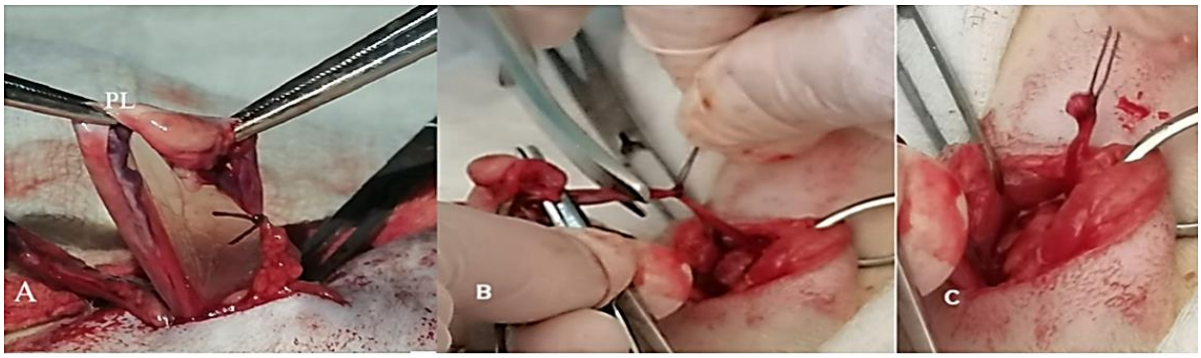

Figure 3. SL technique. A: placement of SL around the OP. B: cutting the OP between the ligature and the hemostatic clamp. C: the ovarian stump after resection. PL: proper ligament

In group 2, three triple clamp technique (TC) was used for hemostasis. The clamps were placed across the OP. transfixation ligature was loosely placed below the proximal clamp (furthest from the ovary). This clamp was then removed and the ligature was tightened in the place of tissue crushed by the removed clamp. The ligature was tied similar to that made for animals of group 1. The OP was transected between the two remaining hemostatic clamps and the OP was checked for bleeding before release. (fig. 4).

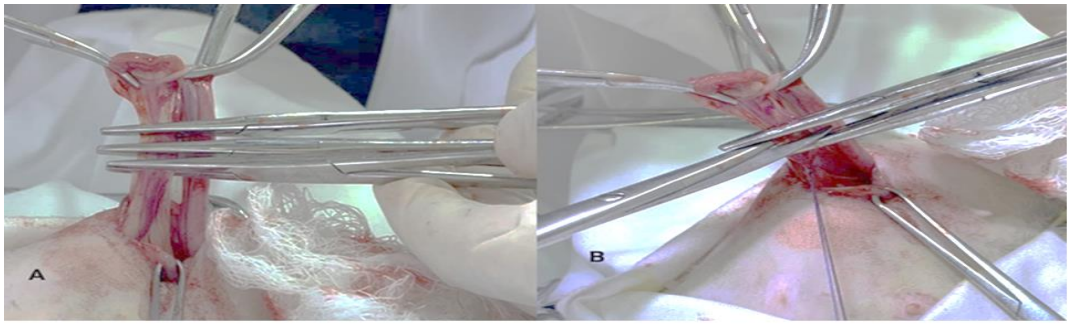

Figure 4. TC technique. A: triple clamp placement across the OP. B: placement of ligature at the site of the removed clamp furthest from the ovary.

In group 3, a pedicle tie (PT) was used for the hemostasis of the OP. A curved hemostatic clamp was first placed medial to the OP, then it was twisted 360° on its own axis in a medial to the lateral direction to form a simple loop of the OP around the clamp. The tip of the hemostatic clamp was then fixed transversally to the proximal end of the OP. The OP was severed over the clamp. The loop formed around the clamp was then slipped over the end of the clamp to complete the knot using sterile gauze (fig.5).

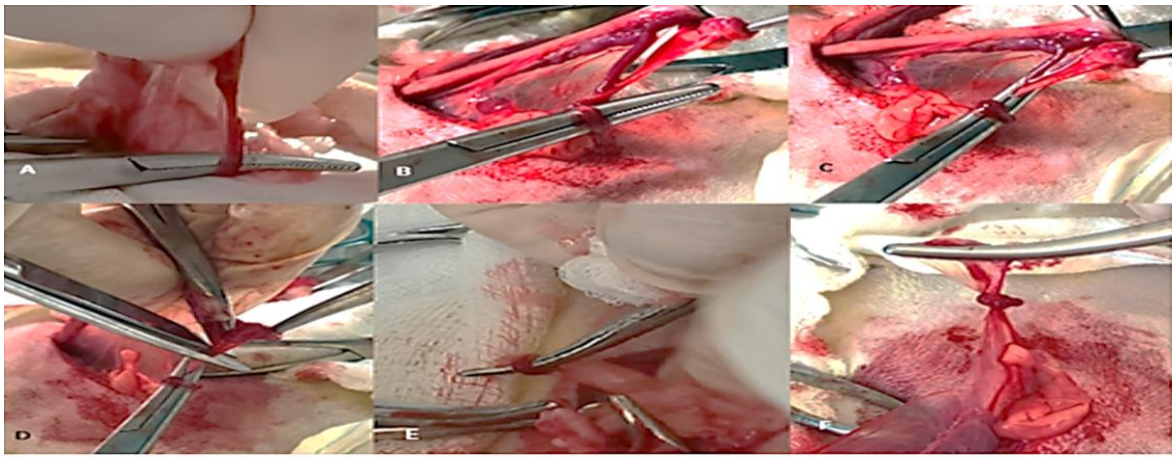

Figure 5. PT hemostasis technique A: placement of the hemostatic clamp medial to the OP. B: twisting the clamp around the OP to form the knot. C: fixing the proximal end of the OP by the tip of the hemostatic clamp. D: Cutting the OP over the clamp. E: slipping the knot over the end of of the clamp using gauze. F: the tie is formed

The left ovary was then identified and the same procedure of hemostasis of the right OP was done. The uterine body with the cervix was exteriorized after tearing the broad ligament parallel to the uterine blood vessels toward the cervix. A transfixation ligature was applied directly around the uterine body proximal to the cervix, a hemostatic clamp was then applied proximal to the ligature (fig. 6) and the uterine body was severed between the ligature and the clamp; the uterine stump was checked for hemorrhage and then replaced into the abdomen.

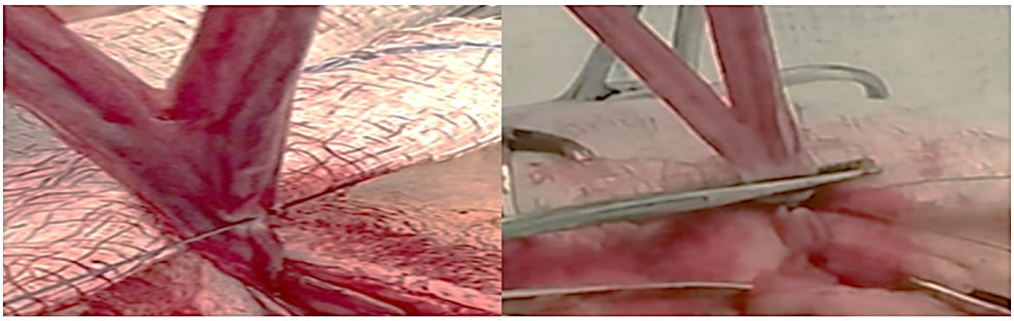

Figure 6. Left: application of transfixing ligature around the uterine body. Right: placement of hemostatic clamp over the ligature.

The abdominal wall was closed by three layers closure. In all animals, the linea alba with the rectus sheath was closed with Ford interlocking pattern. The subcutaneous layer was closed with simple continuous suture using 2-0 polyglycolic acid and finally the skin.

The practicality and difficulty of the three hemostatic techniques used for the OP and uterine pedicle was evaluated. The surgical time (in minutes) spent for the removal of the ovaries and uterus was recorded. The skin incision was measured (cm) at the end of the operation. The animals were monitored daily to detect any postoperative complications.

STATISTICAL METHODS

The variables were expressed by the mean ± standard deviation. One Way Analysis of Variance in the form of RCBD design was used for comparing differences in surgical time for pedicle hemostasis. Pairwise between-group comparisons were performed using the 'Tukey test' method. The level of significance (p-value) was set at ≤ 0.05. Data analysis was performed using Minitab software package 19.

RESULTS

The mean age of the cats was 10.805 (ranged from 7-16 months) and their mean weight was 3.35 kg (ranged from 2.2 – 4.1 kg). The mean length of skin incisions was 3.258 (ranged from 2.1– 5 cm) as shown in table 1.

There was no significant difference in the mean age, the weight of the animals and the length of skin incision. All cats were healthy with physical status I.

Table 1. Assessment of the age, weight of the animals and length of the skin incision within the three groups

Variables	Group 1	Group 2	Group 3
Age (month)	10.83	10.75	10.83
Weight (Kg)	3.225	3.425	3.415
Incision length (cm)	3.33	3.18	3.258
There were no statistically significant differences between treatments for any of the variables listed ($P > 0.05$).			

In this study, there were no complications recorded due to anesthesia; none of the cats died and all were recovered uneventfully. No damage or cutting of OP or uterus occurred due to placement of the hemostatic clamps across the OP and the uterine pedicle; no pedicle loss during the ligation and no intraoperative hemorrhage was detected; all the hemostatic techniques used for the OP and uterine pedicle were effective and efficient in preventing hemorrhage

There were statistically significant differences in the surgical time required for the removal of the ovaries and uterus between the three groups (P<0.001). The surgical time was significantly shorter in the PT group (4.000 ± 0.74 minutes) when compared to the SL group (5.542 ±1.62 minutes) and the TC group (8.042 ± 0.99 minutes) (table 2; fig.7).

Table. 2: Surgical time for removal of the ovaries and uterus.

	Time (minutes)
Group	Mean ± SD
1 (SL)	5.542 ±1.62b
2 (TC)	8.042 ± 0.99a
3 (PT)	4.000 ± 0.74c
P-value	<0.001
Mean having different letters in each row are significantly different at P < 0.05.	

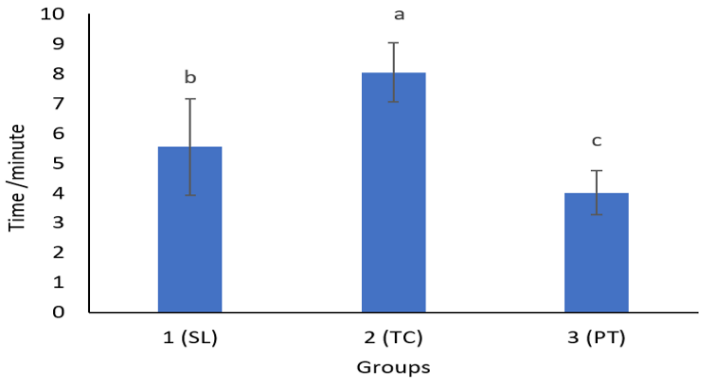

Figure 7. Graphical illustration of the surgical time required for removal of the ovaries and uterus.

DISCUSSION

In this study, no intraoperative bleeding was encountered using the 3 techniques of OP hemostasis. Most studies reviewed by Adin showed that the incidence of intraoperative hemorrhage of OVH in dogs and cats was very low and death due to hemorrhage was extremely rare (Adin, 2011). Similarly, a study by Pollari *et al.*, showed that postoperative death due to hemorrhage occurred in 1 of 1459 cats after elective OVH.

Traditionally, double pedicle ligation (DPL) is used for hemostasis of the OP (Fransson, 2012; Miller *et al.*, 2016). In a previous study from a teaching institute, intraoperative hemorrhage was experienced in 4% of cats when DPL was used for hemostasis of the OP performed by inexperienced fourth-year students (Berzon, 1979). Another study stated that 16.3% of cats undergoing OVH with traditional PDL experienced postoperative complications including intraoperative hemorrhage (Pollari *et al.*, 1996). The results of these studies showed that the main factor in preventing hemorrhage was the skill of the surgeon to place the ligature correctly.

The result of this study showed that placement of a single encircling ligature around the OP was found to be easy and effective in preventing bleeding. Similarly, Shivley *et al.*, 2019, found that a single ligation can provide adequate hemostasis for canine OP and uterine body with no perioperative complications.

In this study, the use of 3 clamps across the OP was done easily and caused no tear or damage to the OP, and provide adequate space for creating a secure ligation by cutting the OP between the clamps far from the site of ligature preventing its slipping, but it consumed longer time than the other two techniques. Similar results obtained by (Silva *et al.*, 2021) showed that the TC technique had a significantly longer time to apply compared to the PT technique.

The time for removal of the ovaries and uterus using the PT technique in this study was significantly faster and had a shorter surgical time when compared to the SL and TC techniques. An investigation by Miller *et al.*, 2016, showed that OVH performed by experienced surgeons in 2000 cats using PT was 30% faster than ligation by suture material and caused bleeding only in one cat (0.023% rate of complication). Another study showed that hemorrhage occurred in only 19 of 15,927 (0.12%) cats when PT was used for hemostasis (Brestle *et al.*, 2022). In contrast to this study, no significant difference in surgical time was observed by Silveira *et al.*, when comparing the PT and TC techniques (Silveira *et al.*, 2015).

The PT technique is particularly beneficial in saving time. Time-saving is useful and should be taken into consideration in clinics performing massive surgeries and the large number of OVH, but time-saving is not an important factor when performed in clinics performing individual surgeries (Toledo-Valdez *et al*., 2021).

The PT technique is economic because no suture material is used for ligation reducing the amount of foreign material placed in the abdominal cavity (Miller *et al.,* 2016; Bushby and White, 2019) but it is risky if performed by an inexperienced surgeon. It needs experience in rotating the hemostatic clamp to form a loop of OP which needs a gentle traction of the OP due to its short length (Silva *et al.,* 2021).

CONCLUSIONS

All the techniques used for hemostasis of the OP in this study were proven to be safe and effective in preventing hemorrhage. The PT technique was the most suitable and economic and recommended to be used and should be considered in veterinary practice.

REFERENCES

Adin, C.A. (2011): Complications of Ovariohysterectomy and Orchiectomy in Companion Animals, Veterinary Clinics of North America: Small Animal Practice. 41(5): 1023–1039.

Appel, L. and Scarlett, J. (2013): Pediatric neutering. In Shelter Medicine for Veterinarians and Staff. 2nd ed. Eds Miller, L. and S. Zawistowski, S. John Wiley and Sons, Inc. pp 647–669.

Berzon, J.L. (1979): Complications of Elective Ovariohysterectomies in the Dog and Cat at a Teaching Institution: Clinical Review of 853 Cases. Veterinary Surgery, 8(3): 89–91.

Brestle, K.R.; Accornero, V.H.; Amtower, M. and Slater, M.R. (2022): Retrospective review reveals few complications of ovarian pedicle tie in 15,927 cats undergoing ovariohysterectomy at a large HQHVSN clinic and training facility in the United States: 2017–2018. AVAM. 260(52): 28–35

Bushby, P. and White, S. (2019): Dog spay/cat spay. In: White S. High quality, High volume spay and neuter and other shelter surgeries. Hoboken, NJ, USA: John Wiley & Sons. pp. 239-265

Frasson, B.A. (2018): "urogenital System. Ovaries and Uterus," Veterinary Surgery: Small Animal. 2 (2): 2109–2129.

Fransson, B.(2012): Urogenital system. In: Tobias KM and Johnston JA (eds). Veterinary surgery: small animal. St. Louis, MO: Elsevier Saunders, pp1876-1878.

Howe, L.M. (2006): "Surgical methods of contraception and sterilization, Theriogenology, 66(3): 500–509.

Kiani, F.A.; Kachiwal, A.B.; Shah, M.G.; Nizamani, Z.A.; Khand, F.M.; Lochi, G.M.; Haseeb, A.; Khokhar, A.M.; Oad, A. and Ansari, M.I. (2014): Comparative Study on Midline and Flank Approaches for Ovariohystrectomy in Cats. Journal of Agriculture and Food Technology, 4(2): 21–31.

Kustritz, M.V. (2007): Determining the optimal age of gonadectomy of dogs and cats.J Am. Vet. Assoc.,231 (11):1665- 16675.

Levy, J.K.; Isaza, N.M.; Scott, K.C. (2014): Effect of high-impact targeted trap-neuter-return and adoption of community cats on cat intake to a shelter. Vet. J. 201, 269-274.

Miller, K.P.; Rekers, W.; Ellis, K.; Ellingsen, K. and Milovancev, M. (2016): Pedicle ties provide a rapid and safe method for feline ovariohysterectomy. Journal of Feline Medicine and Surgery, 18(2): 160–164.

Pollari, F.L.; Bonnett, B.N.; Bamsey, S.C.; Meek, A.H. and Allen, D.G. (1996): Postoperative complications of

elective surgeries in dogs and cats determined by examining electronic and paper medical records. Journal of the American Veterinary Medical Association. 208(11): 1882–1886.

Root Kustritz, M. (2012): Effects of Surgical Sterilization on Canine and Feline Health and on Society. Reproduction in Domestic Animals, 47(SUPPL.4): 214–222.

Shivley, J.M.; Richardson, J.M.; Woodruff, K.A.; Brookshire, W.C.; Meyer, R.E. and Smith, D.R. (2019): Sharp transection of the suspensory ligament as an alternative to digital strumming during canine ovariohysterectomy. Veterinary Surgery, 48(2), pp. 216–221.

Silva, M.T.F. da; Melo, A.C. de; Nascimento, C.F.B. do; Silva, F.A.D.N.; Borges, T.B.; Quessada, A.M. and Rodrigues, M.C. (2021): Ovarian pedicle hemostasis techniques in cats. Acta Cirúrgica Brasileira, 36(3):e360308

Silveira, CPB.; Araújo, MSC.; Horr, M.; Alencar, EAM.; Rigaud, R. and Oriá, AP, et al. (2015): Validação de técnica hemostática do complexo arteriovenoso ovariano na ovariosalpingohisterectomia de gatas. Cienc Anim Bras. 2015;16(1):81–92. Cited by: Silva, M.T.F. da, Melo, A.C. de, Nascimento, C.F.B. do, Silva, F.A.D.N., Borges, T.B., Quessada, A.M. and Rodrigues, M.C. (2021) "Ovarian pedicle hemostasis techniques in cats," Acta Cirúrgica Brasileira, 36(3). e360308.

Spain, C.; Scarlett, J.M. and Houpt, K.A. (2004): Long-term risks and benefits of early age gonadectomy in cats. J. Am. Vet. Med. Assoc. 227:372- 379.

Toledo-Valdez, C.; Rivera-Barreno, R.; Talamantes-Lima, I.; Bustos-Varela, J.; García-Herrera, R. and Rodriguez-Alarcón, C. (2021): Systemic review of different surgical contraception techniques in queens. Abanico Veterinario. 11: 1-16

مقارنة ثلاث طرق لغلق أوعية المبيض الدموية لعملية أزالة المبايض والرحم في القطط

أياد عصام الدين محمود ، مريم إبراهيم ياسين

Email: mariam.yassin@uod.ac Assiut University web-site: www.aun.edu.eg

الهدف من هذه الدراسة هو مقارنة ثلاث طرق لغلق أوعية المبيض الدموية (OP) في القطط فيما يتعلق بالفعالية والتطبيق العملي والوقت الجراحي.

تم إجراء عملية استئصال المبايض والرحم (OVH) من خلال شق خط الوسط البطني على ٣٦ أنثى بالغة سليمة تم تقسيمها عشوائيًا إلى ثلاث مجموعات كل منها ١٢.

في المجموعة ١، تم غلق ال (OP) باستخدام ربط عنيق واحد (Single ligation SL) باستخدام خيوط جراحية ممتصة من نوع (2-0 polyglycolic acid).

تم إجراء غلق ال (OP) في المجموعة ٢ باستخدام خيوط ممتصة من نوع (2-0 polyglycolic acid) بتقنية المشابك الثلاثة (Three clamp techniqueTC).

في المجموعة ٣ ، تم استخدام ربطة أوعية المبيض الدموية الذاتي (Pedicle tie PT) لغلق (OP).

أظهرت النتائج أن الأساليب الثلاثة المستخدمة في غلق ال (OP) كانت فعالة في منع النزيف. كانت تقنية (PT) اكثر اقتصادية وأسرع في التطبيق بفرق معنوي ($P < 0.05$) من تقنيات (TC) و(SL) .