

**"Histopathological Insights, Surgical Comparisons, and Post-Operative
Healing in Ovariohysterectomy Approaches for Pyometra in Cats"**



**A clinical report submitted in partial of the requirements for the degree of
Doctor of Veterinary Medicine (DVM)**

A Clinical Report Submitted By

Md. Adnan Omar Alvi

Roll No: 19/45

Reg. No: 03249

Intern ID: 30

Session: 2018-19

Faculty of Veterinary Medicine

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram-4225, Bangladesh.

December, 2024

"Histopathological Insights, Surgical Comparisons, and Post-Operative Healing in Ovariohysterectomy Approaches for Pyometra in Cats"



A clinical report submitted as per approved styles and contents

Approved by

Dr. Mohi Uddin

Professor

Department of Anatomy and Histology

Faculty of Veterinary Medicine

Chattogram Veterinary and Animal Sciences University

Khulshi, Chattogram-4225, Bangladesh

December, 2024

Table of contents

Acknowledgement	Error! Bookmark not defined.
List of abbreviation	vii
Abstract	viii
1. Introduction	1
2. Materials and methods	4
2.1 History and Clinical Examination	4
2.2 X-Ray examination	5
2.3 Ultra-sonographic examination	6
2.4 Clinical intervention.....	6
2.4.1. Restraining.....	6
2.4.2. Anesthesia protocol	7
2.4.3. Preparation of the surgical site	7
2.4.4. Preparation of surgeon and co-surgeon	7
2.4.5. Surgical Instruments	7
2.4.6. Surgical procedure.....	8
2.4.6.1. Midline approach	8
2.4.6.2. Flank approach.....	12
2.4.7. Post-Operative Care.....	15
2.4.7.1. For midline approach surgery	15
2.4.7.2. For flank approach surgery	15
2.5. histopathological procedure	16
3. Result	17
3.1. Wound healing	17
3.2 Histopathological findings	18
4. Discussion	20
4.1. Surgical Access and Visibility	20
4.2. Wound Healing	20
4.3. Post-Operative Recovery and Complications	20
4.4. Clinical Implications	21
4.5 Histopathology findings	21
5. Conclusions	22

6. Limitation	23
References	24
Biography.....	25

List of figures

Figure 1: Pus present in vulva region	4
Figure 2: Multiple sacculated radio-opaque fluid-filled structures.	5
Figure 3: Multiple anechoic fluid-filled sacs are present in pictures a and b.	6
Figure 4: Cleaning and shaving the operating area.....	8
Figure 5: Incision in the operating site (caudal to the umbilicus).	9
Figure 6: Finding the uterus horn.	9
Figure 7: Expose uterus horn and ovary.	10
Figure 8: Removal of uterus and ovary (a: holding the ovary & b: ligation of uterus)	10
Figure 9: Different suture patterns on muscle and skin (a & b).	11
Figure 10: Finally closed muscle and skin.....	11
Figure 11: Cleaning, shaving the operating area and wearing draper to patient to avoid contamination.....	12
Figure 12: Incision in the operating site (a) and finding the left uterus horn (b).....	13
Figure 13: Expose the uterus horn, and ovary (a); remove them from the body (b).	13
Figure 14: Stamping (bifurcation of uterus horn site) and different suture patterns on muscle (a & b)	14
Figure 15: Finally closed muscle and skin.....	14
Figure 16: Comparison wound healing %, NS $P>0.05$	17
Figure 17: (a)Microscopic structure of endometrium of the queen with pyometra; shedding of epithelium and endometrial atrophy are obvious. (i) Neutrophil and (ii) Lymphocyte.(b) Microscopic structure of endometrium of the normal queen showing intact epithelium and glands (H & E; $\times 4$)	18
Figure 18: (a)Microscopic structure of ovary of the queen with pyometra; shedding of epithelium and endometrial atrophy are obvious. (i) Dead neutrophil containing pus, (ii) Proliferation of medulla. (b) Microscopic structure of the normal queen showing intact epithelium and glands (H & E; $\times 4$).....	19

Acknowledgment

All praises are due to the Almighty God, whose blessings have been enabled the author to accomplish this work.

The author expresses his wholehearted senses of gratification, a sincere appreciation to his respected teacher and supervisor **Dr. Mohi Uddin**, Professor, Department of Anatomy and Histology, Chattogram Veterinary and Animal Sciences University, whose ingenuous and scholastic advice, judicious recommendations, continuous encouragement and untiring assistance have guided the author from the beginning of inception of intern studies until to the completion of this report.

Prof. Dr. Mohammad Lutfur Rahman, Vice Chancellor and Dean (Addi. Charge) of FVM, and **Prof. Dr. A.K.M Saifuddin**, Director of External Affairs, deserve special gratitude for providing this exceptional internship and research experience to the author.

I am very grateful to intern, **Sunil Yadav** for their kind cooperation during the work.

List of abbreviation

B

Body weight (BW)

C

Chittagong Veterinary and Animal Sciences
University (CVASU)

I

Intramuscularly (I/M)

Intravenously (I/V)

N

Non significant (NS)

O

Ovariectomy (OVE)

Ovariohysterectomy (OHE)

P

Per oral (PO)

S

Subcutaneous (S/C)

Abstract

This study compares and contrasts the midline and lateral flank methods for ovariohysterectomy (OHE) in cats with pyometra, concentrating on surgical efficacy, recovery, wound healing, and histological findings. Pyometra, a serious uterine infection, demands surgical removal of the reproductive organs to avoid systemic consequences. Histopathological examination indicated severe uterine abnormalities, such as endometrial shrinkage, epithelial shedding, and localized inflammation. Ovarian tissues showed cystic follicles and structural abnormalities, indicating that the disease produced systemic hormonal imbalances.

Both surgical methods were applied to two Persian cats. Post-operative recovery, wound healing, and surgical visibility were monitored over 15 days. The lateral flank approach resulted in quicker recovery and less post-operative discomfort, whereas the midline approach provided enhanced access to reproductive structures. Despite similar wound healing outcomes between the approaches, histopathological findings emphasized the importance of timely surgical intervention to mitigate pyometra's systemic effects. The choice of surgical method should align with the patient's clinical needs, with the midline approach preferred for complex cases and the flank approach for faster recovery in routine scenarios.

Keywords: Pyometra, ovariohysterectomy, histopathology, midline approach, lateral flank approach, wound healing.

"Histopathological Insights, Surgical Comparisons, and Post-Operative Healing in Ovariohysterectomy Approaches for Pyometra in Cats"

1. Introduction

Pyometra is an intrauterine pus accumulation that is associated with an ongoing corpus luteum and an inability to ovulate. "Pyometra" is a Greek word that means "pus-filled uterus"; the words "pyo" and "metra" signify "pus" and "womb" or "uterus!" More mature, intact female cats than other small animal species are affected by this disease (Hagman, 2012). Pyometra is typified by a range of pathologic and clinical symptoms that can be localized or systemic. The uterine lumen's accumulation of inflammatory exudate and a suppurative bacterial infection are the causes.

According to (Hollinshead & Krekeler, 2016) state that most queens get uterine lesions after the age of 5-7 years (average 7.6 years, range 1-20 years). Clinical symptoms usually show up 4 weeks after the start of estrus (hormone induction or mechanical stimulation) in queens that mate, ovulate naturally, or are forced to ovulate.

It was demonstrated that estrogens and progesterone both affect pyometra. Estrogens widen the uterine cervix and enhance progesterone receptors in the endometrium, which can affect endometrial alterations and allow bacteria to ascend. Chronic estrogenic stimulation from recurring estrous cycles which do not terminate in pregnancy influences these endometrial alterations (Agudelo et al., 2005).

Ovariohysterectomy (OHE) is a common surgical operation for cats. The two most common methods are a midline approach and a lateral flank approach. In addition to reproductive control, surgery is suggested for pyometra, metritis, and problems with reproduction. Estrous symptoms, like rolling on the ground, increased vocalization, and a very short inter-estrous gap, can negatively affect a cat's bond with its owner and make them seek out ways to limit reproduction. all of them (Oliveira et al., 2014).

The sympathetic-adrenal axis is activated by surgical trauma, which leads to a disruption of homeostasis and a longer recovery period. To improve surgical recovery, less intrusive methods

are being used in veterinary surgery. Oliveira and associates (2014). Ovariectomy (OVE), ovariohysterectomy (OVH), laparoscopy, or through the flank or linea alba are surgical procedures in which the gonads are removed (Davidson et al., 2004).

The most popular strategy, the ventral approach, offers both benefits and drawbacks. The main reason the midline technique is better is that the uterus may not always be visible from the flank approach, and without searching from a midline approach, it is hard to tell if this is a technical issue or if the cat has already been neutered. It may also be challenging to diagnose or treat some uncommon congenital anomalies using the flank approach, such as uterine unicornis. It could be challenging to recover from the flank approach if the cervical or ovarian pedicles are lost prior to ligation (Coe et al., 2006).

The lateral flank approach for OHE is recommended for conditions such as hyperplasia of the mammary glands or excessive growth of the glands as a result of lactation. When performing an OHE on a nursing animal, the lateral flank approach can help prevent problems that could arise from the ventral midline approach. These problems include excessive bleeding from the skin and subcutaneous tissue, infection or inflammation of the wound, and leakage from the mammary tissue. Furthermore, lactating animals are more likely to continue nursing well following surgery when the lateral flank technique is used because it reduces disruption to the mammary glands (McGrath et al., 2004).

Pyometra in cats is histopathological characterized by endometrial atrophy, epithelial shedding, and glandular degeneration. Inflammatory infiltration of neutrophils and lymphocytes, along with ovarian abnormalities like cystic follicles, indicates systemic hormonal imbalance and chronic inflammation (Dong et al., 2013). These changes highlight the critical need for timely surgical intervention to prevent further systemic complications (Hagman, 2012)

According to (McGrath et al., 2004), the lateral flank approach for OHE has the advantage of allowing for distant monitoring of the surgical wound and decreasing the risk of evisceration in the event of wound dehiscence. The present study was designed to compare flank and midline approaches in cats for ovariohysterectomy.

Objectives

- ❖ To assess the histopathological changes in uterine and ovarian tissues of cats with pyometra following ovariohysterectomy.
- ❖ It provides an overview of two common surgical approaches used in OHE in cats: the midline and lateral flank methods.
- ❖ OHE is performed for reproductive control and in medical conditions such as pyometra, dystocia, and mammary tumors.
- ❖ The midline approach is often preferred because it allows for better access to the uterus and avoids potential complications related to identifying reproductive organs.
- ❖ The lateral flank approach is advantageous in specific situations, such as in lactating animals, to avoid disrupting mammary glands and reduce complications like hemorrhage or wound inflammation.
- ❖ The study's objective is to compare the two approaches to evaluate their effectiveness, recovery time, and potential complications during surgery.

2. Materials and methods

2.1 History and Clinical Examination

An eight-year-old and three-year-old Persian breed cat was admitted to the Teaching and Training Pet Hospital and Research Centre, Chittagong Veterinary and Animal Sciences University (CVASU), Bangladesh, with a history of anorexia, and chronic emaciation. At first, a general physical examination was done, then a special examination was done. On physical examination, body temperature was found 102⁰C, heart rate 173 beats per minute and respiratory rate 42 breaths per minute. The vulva was moist and discharge was noted.



Figure 1: Pus present in vulva region

2.2 X-Ray examination

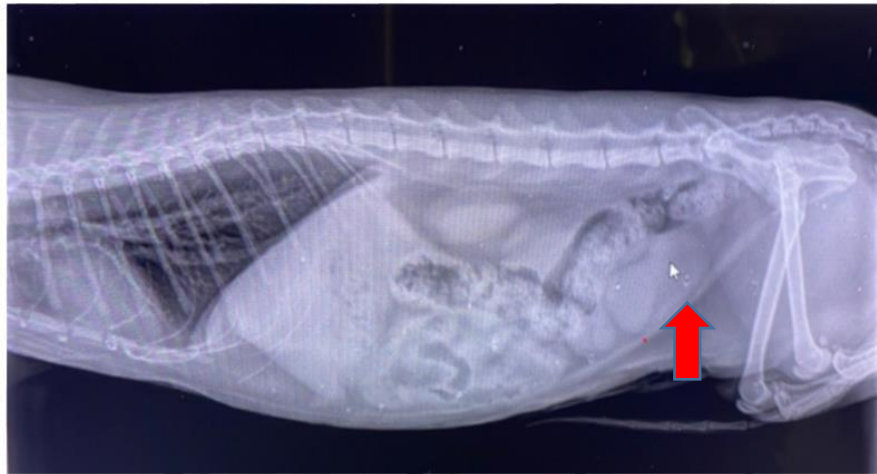


Figure 2: Multiple sacculated radio-opaque fluid-filled structures.

On abdominal palpation, the uterus felt harder and enlarged than normal. Lateral radiograph revealed multiple sacculated opaque fluid-filled structures from caudal to the mid abdomen, many places superimposed with the urinary bladder.

2.3 Ultra-sonographic examination

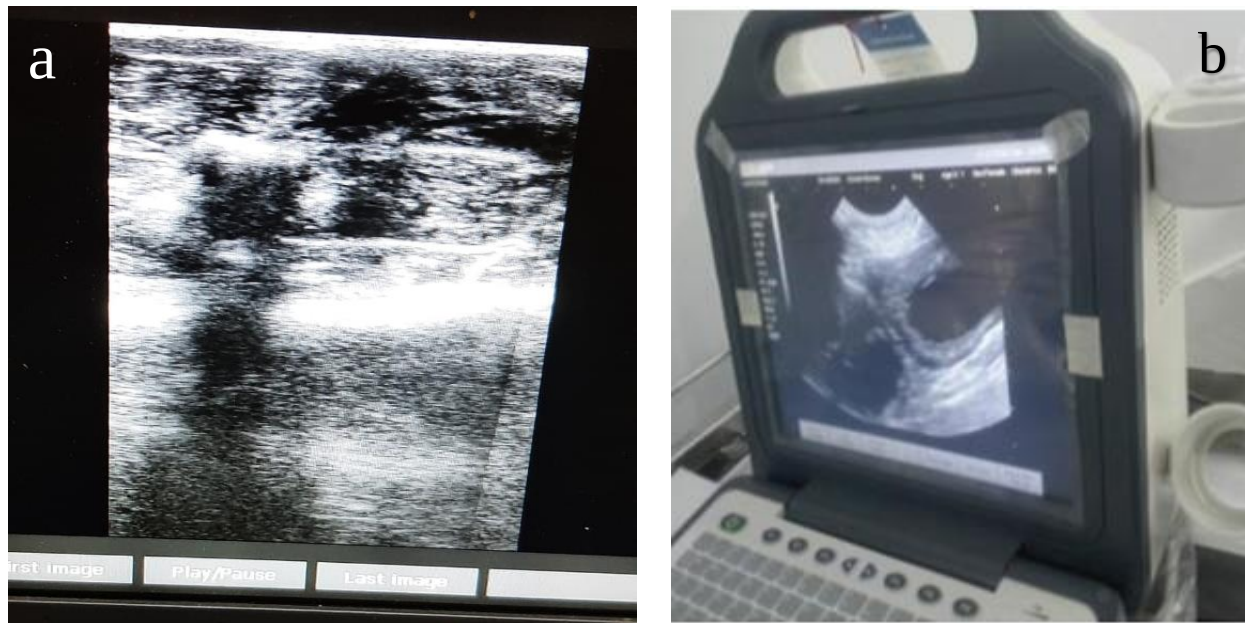


Figure 3: Multiple anechoic fluid-filled sacs are present in pictures a and b.

Ultra-sonographic examination of abdomen showed multiple anechoic areas presented within the uterine lumen.

2.4 Clinical intervention

The suggested method of treatment for the cat with pyometra was an ovariohysterectomy. These were the steps that were taken:

2.4.1. Restraining

- The cat is placed on its side with its back against the handler.
- The handler holds the cat's front and back legs and places a forearm across the neck to secure it.

2.4.2. Anesthesia protocol

- Pre-anesthetic: Xylazine hydrochloride (1.5 mg/kg BW) is administered intramuscularly (I/M).
- General anesthesia: Ketamine hydrochloride (6 mg/kg BW) is administered intravenously (I/V).
- During the surgery, a maintenance dose of anesthetics (ketamine; 3mg/kg BW), half of the initial dose, is given (I/V).

2.4.3. Preparation of the surgical site

- The area is shaved to remove hair.
- 70% alcohol is scrubbed onto the skin to sterilize the surgical area.
- After cleaning, the area is covered to maintain sterility until surgery begins.

This standard surgical preparation ensures the cat is properly anesthetized and the surgery site is sterile.

2.4.4. Preparation of surgeon and co-surgeon

Hands were scrubbed with an antiseptic solution, cleaned with soap, and covered with sterile gloves and a sterile gown after removing the bracelet, watch, and other items. Also, careful mental preparation was made to ensure the successful completion of the surgical procedure.

2.4.5. Surgical Instruments

- Sterilized gauze
- 4 clamps
- 2 scissors
- Suture (vicryl, nylon)
- BP handle
- Needle holder
- 4 artery forceps
- IV Cannula (18 gauge)

- Saline set
- Syringe with needle
- Kidney tray
- Scalpel blade
- 4 Towel clamp
- Myoscissors and madzenbam scissors

2.4.6. Surgical procedure

2.4.6.1. Midline approach

The cat was placed in a dorsal recumbent position and covered with a sterile drape. Vital signs such as temperature, blood pressure, heart rate, gum color, pulse strength, and anesthetic level were continuously checked during the procedure. The skin incision was performed through the Linea-alba, 2 inches distally from the umbilicus. A transverse incision was made along the midline of the abdomen. Using fingers, a big incision was produced in the broad ligament exposing the blood vessels of the ovarian connection. The ovarian and uterine blood vessels were safely closed off after a laparotomy was performed to remove the ovaries, uterine horns, and uterus, exposing the abdominal cavity. The uterine bifurcation was ligated. The abdominal wall was sutured with vicryl (size 2-0), and the skin was sutured with horizontal sutures made of nylon. Following surgery, the sutured incision was treated with povidone-iodine cream.

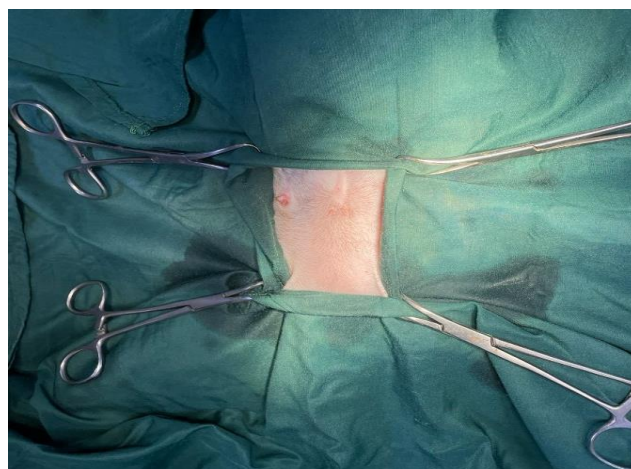


Figure 4: Cleaning and shaving the operating area.

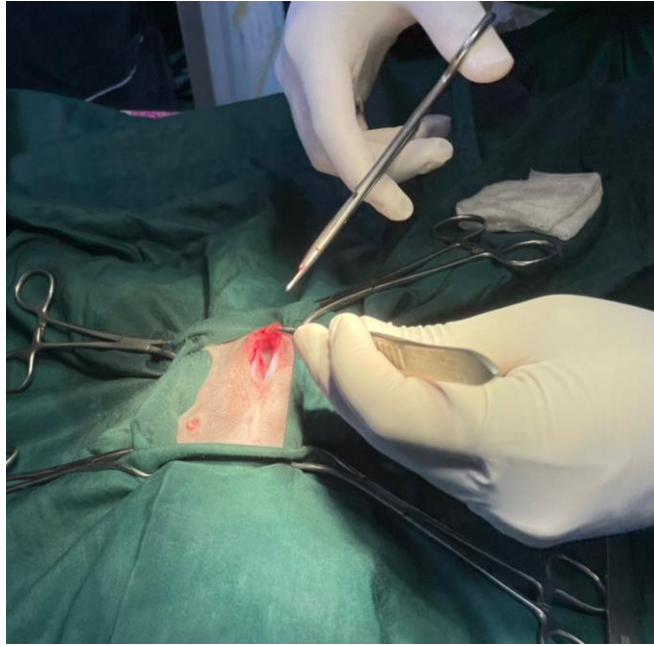


Figure 5: Incision in the operating site (caudal to the umbilicus).



Figure 6: Finding the uterus horn.

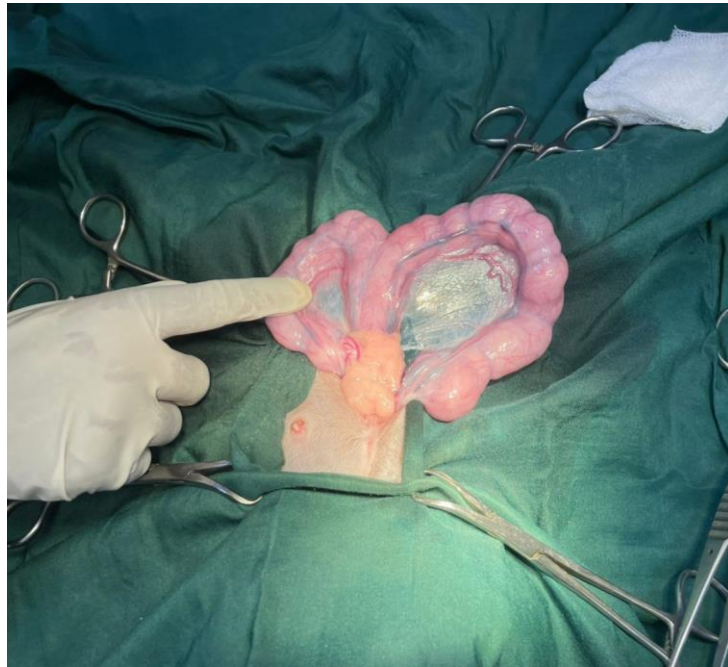


Figure 7: Expose uterus horn and ovary.

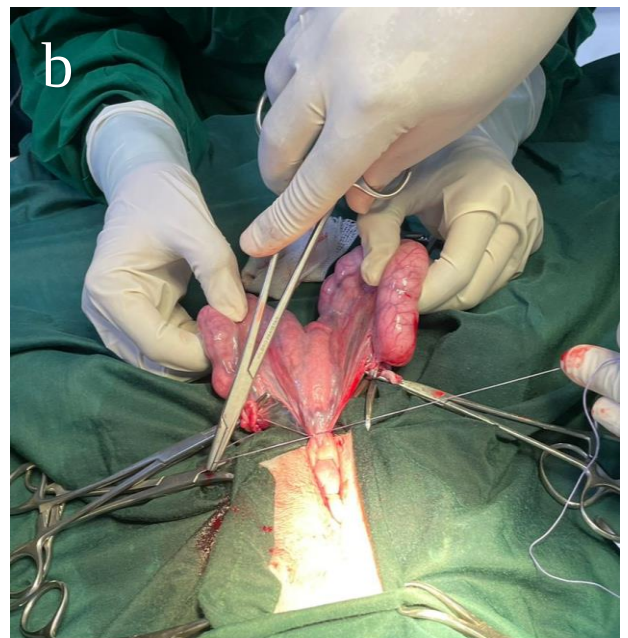
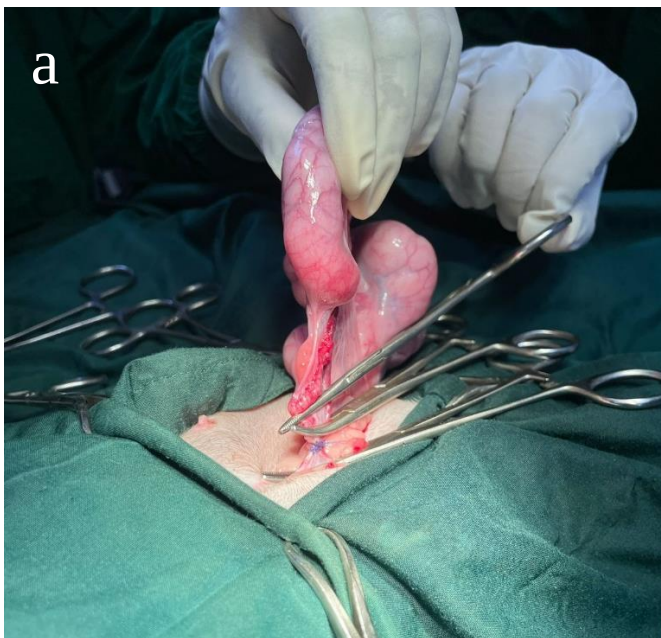


Figure 8: Removal of uterus and ovary (**a**: holding the ovary & **b**: ligation of uterus)

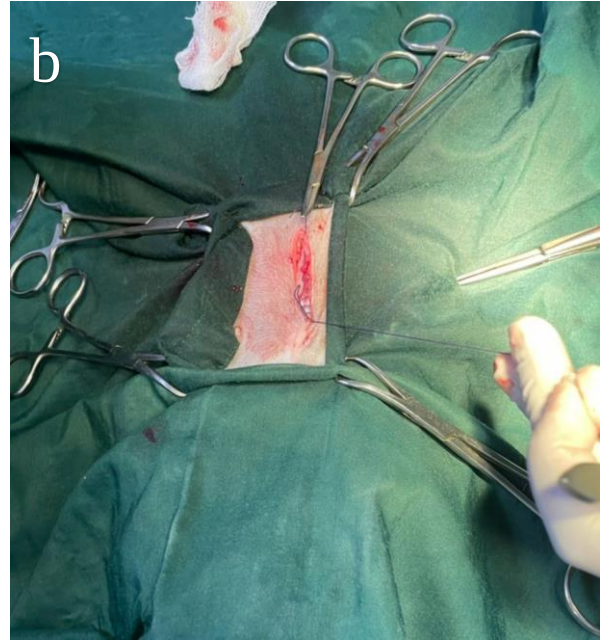


Figure 9: Different suture patterns on muscle and skin (a & b).

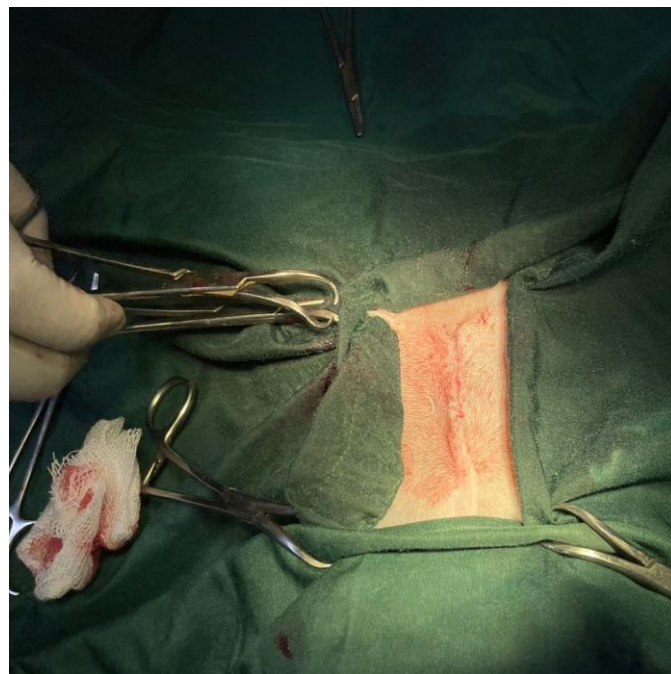


Figure 10: Finally closed muscle and skin.

2.4.6.2. Flank approach

The limbs were extended caudally while the cat was in left lateral recumbency, with the proper restraints in place. The abdominal musculature was dissected following the natural course of the muscle fibers after a 2.5 cm oblique incision was made on (2 cm caudally in the last ribs and 2 cm ventrally lumbar vertebrae) to the the left mid-flank area. Once inside the abdominal cavity, the uterus and left ovary were located and cautiously exteriorized. 2-0 chromic vicryl was used to double ligate the left ovarian pedicle, and a three-clamp method was used to help transect the pedicle. Following confirmation that there was no bleeding, the pedicle was returned to the abdominal cavity. On the right ovarian pedicle, the same technique was carried out. The uterine body was exteriorized after the excision of both ovaries. A circumferential (2-0) vicryl ligature. The skin was sutured with simple interrupted sutures made of nylon.



Figure 11: Cleaning, shaving the operating area and wearing draper to patient to avoid contamination.

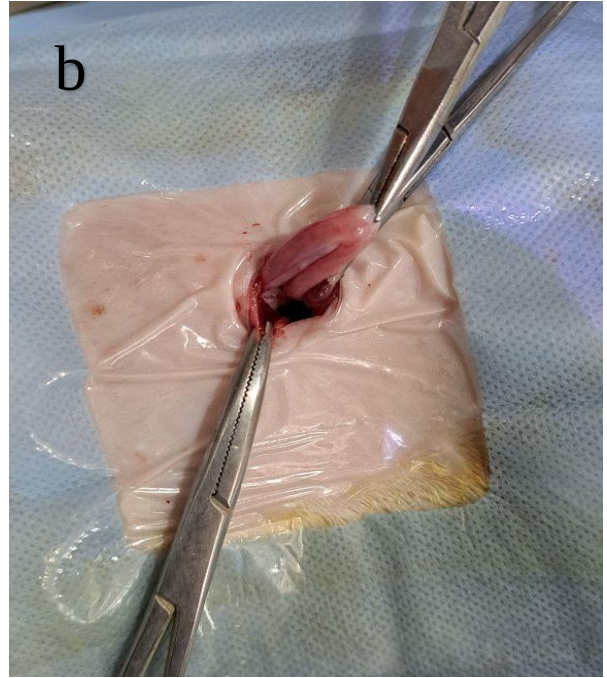
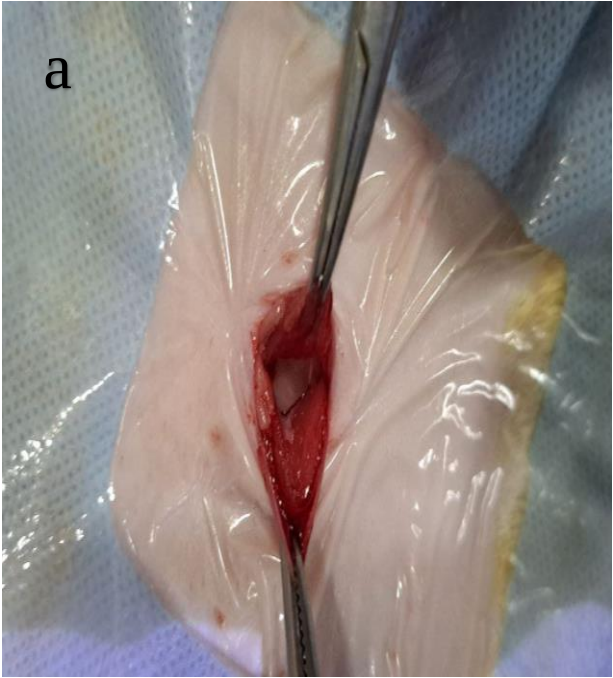


Figure 12: Incision in the operating site (a) and finding the left uterus horn (b).

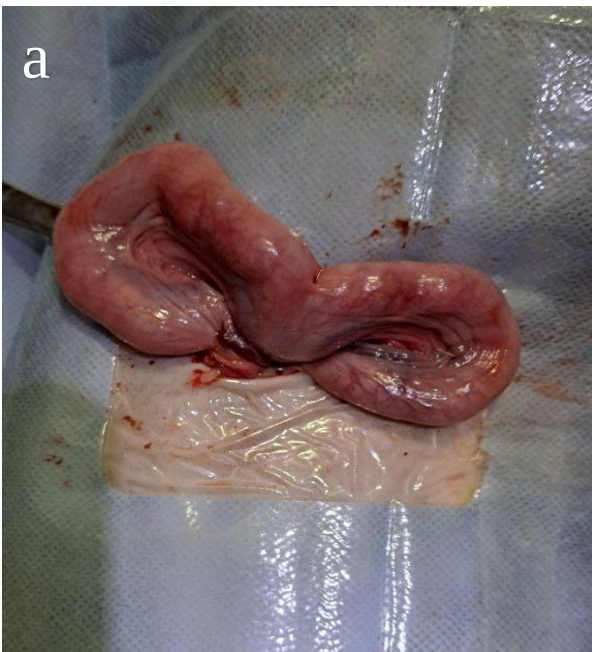


Figure 13: Expose the uterus horn, and ovary (a); remove them from the body (b).

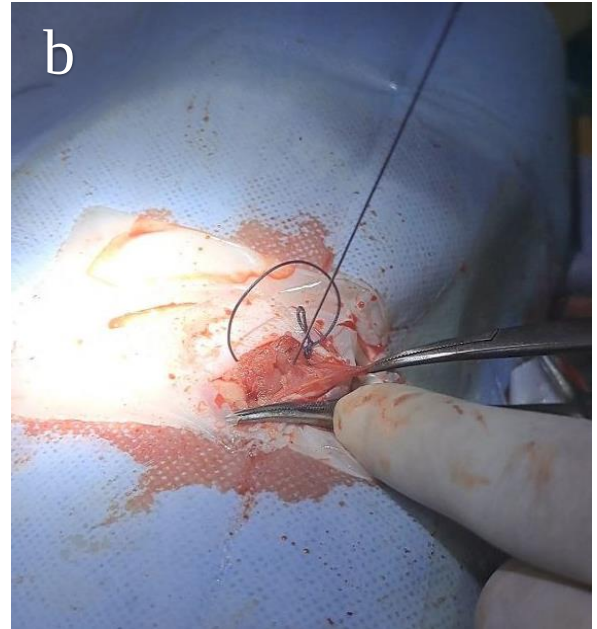
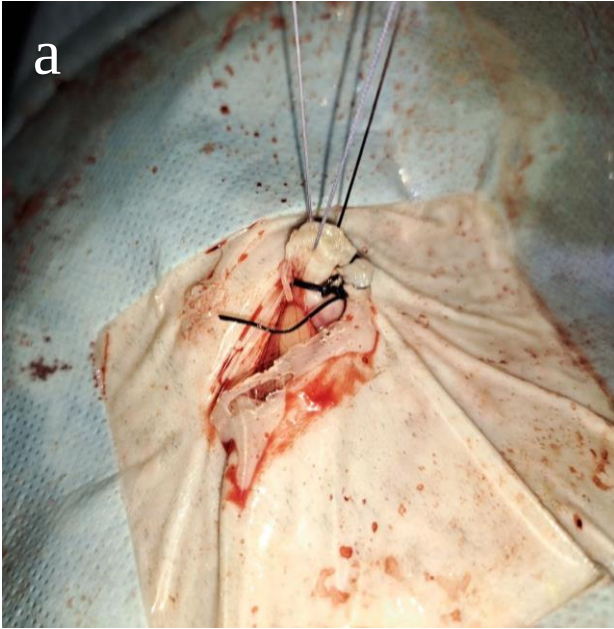


Figure 14: Stamping (bifurcation of uterus horn site) and different suture patterns on muscle (a & b)



Figure 15: Finally closed muscle and skin.

2.4.7. Post-Operative Care

Both cat was management and kept on injection following surgery. For the next seven days.

2.4.7.1. For midline approach surgery

The owner was directed to clean the surgical site and administer topical antibiotic ointment twice a day (Nebanol Plus ointment®, Square Pharmaceuticals, Bangladesh) that contained neomycin sulfate, bacitracin zinc, and polymyxin B sulfate. And systemic antibiotics provide (cefuroxime + clavulanic acid) at a dose of 12.5 mg/kg body weight, per oral (**PO**) twice a day (Tablet Cefaclav®, 125 mg). For five days, analgesic injection (0.5 mg/kg body weight of meloxicam and Melvet®, Acme Laboratories Ltd., Bangladesh) route: subcutaneous (**S/C**) was used to treat pain. For seven days, **I/M** administration of antihistaminic chlorpheniramine maleate (1 mg/kg body weight) (Injection Astavet®, Acme Laboratories Ltd., Bangladesh) was performed.

2.4.7.2. For flank approach surgery

Cleaning the surgery site and applying topical antibiotic ointment containing neomycin sulfate, bacitracin zinc, and polymyxin B sulfate twice a day (Nebanol Plus ointment®, Square Pharmaceuticals, Bangladesh) and antibiotics provide Ceftriaxone Sodium (Trade name: Injection Triject Vet®, SK+F Laboratories Ltd., Bangladesh) at a dose 50mg/ kg BW, route: **I/M**. For five days, analgesic injection flunixin meglumine (1.1 mg/kg body weight) Trade name: Fixin vet®, ACI Laboratories Ltd., Bangladesh) route: **S/C** was used to treat pain. For seven days, **I/M** administration of antihistaminic chlorpheniramine maleate (1 mg/kg body weight), route: **I/M** (Trade name: Injection Alar vet®, popular pharmaceuticals Ltd., Bangladesh) was performed.

2.5. histopathological procedure

Anesthesia and surgical procedures were performed as described. Routine OHE with removal of the uterine horns and ovaries. In cases of obvious pathological abnormalities (thickening of the uterine wall and/or filling of the uterus; n = six cats), the incision was extended, and the uterus and ovaries were removed completely. Surgically removed ovaries and uterine horn segments or uteri were examined macroscopically, and any abnormalities were noted. Directly thereafter, they were transferred into 10% neutral buffered formalin and stored for 48h at room temperature. Ovaries and uterine horn segments were cut longitudinally and transversally, 1 cm caudal to the horn tip. After dehydration in ethanol, tissues were embedded in paraffin wax. Sections (5µm thick) were cut from the tissue blocks with a microtome, subsequently mounted on coated slides, dried overnight at 37°C, and stained with hematoxylin and eosin for histological evaluation.

3. Result

3.1. Wound healing

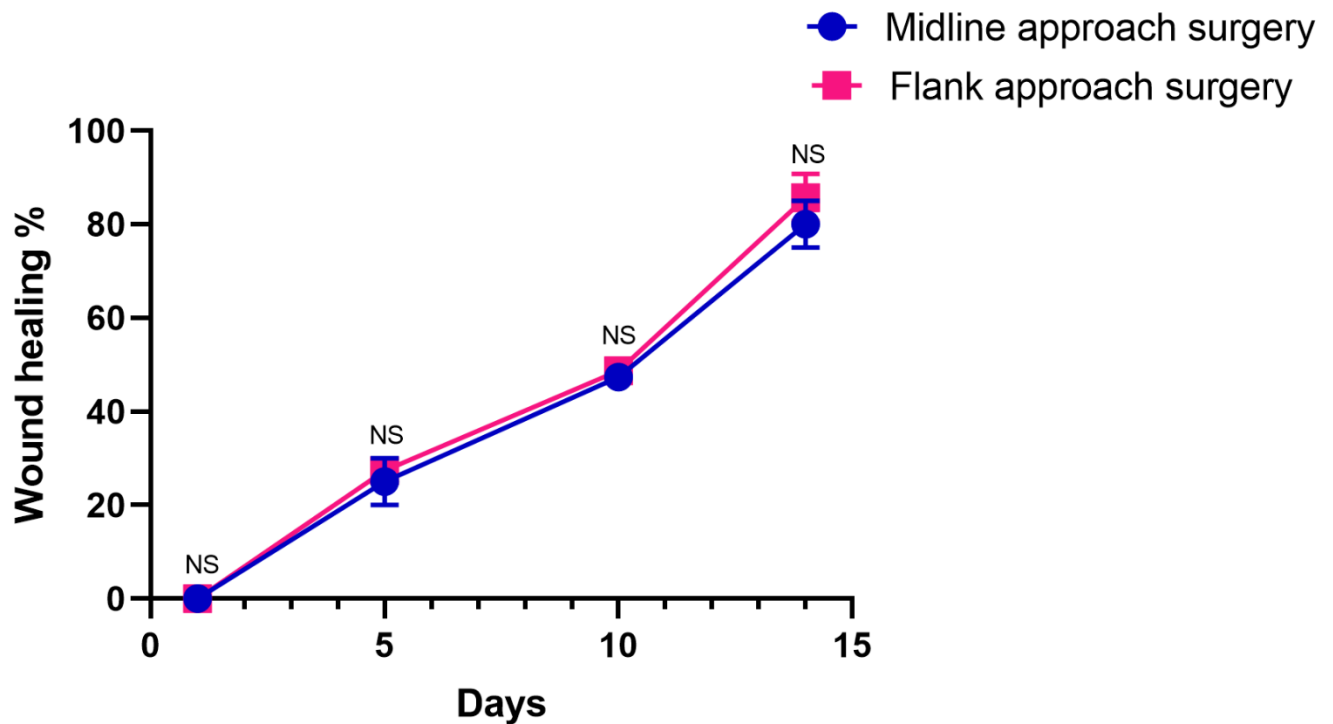


Figure 16: Comparison wound healing %, NS $P > 0.05$.

The figure shows compare the wound healing % over 15 days following two surgical approaches midline approach surgery and flank approach surgery. Both approaches start at 0% wound healing on day 0. By day 5, the healing progresses to approximately 20% for both groups and by day 10, it reaches around 40%, with no statistically significant difference (**NS**) between the two approaches at these time points. By day 15, wound healing has advanced to about 90% in both groups, still without any significant difference (**NS**) in healing rates. The two approaches are nearly identical, indicating that both methods result in similar wound healing progress over time. But we can see the figure wound healing slightly earlier in the case of flank approach surgery.

3.2 Histopathological findings

Histopathological examination of the section of the uterine wall showed the uterine wall turning attenuate. There was atrophy of both the endometrium and endometrial glands (Fig. 3). Shedding of the superficial epithelium of endometrium was severe. In contrast, the columnar cells of superficial epithelium of endometrium of normal uterus were intact (Fig. 4). Presence of hemorrhagic areas was also found in endometrium. Although no severe inflammation could be observed in histopathological examination, some areas were infiltrated by lymphocytes and neutrophils, indicating regional inflammation. These findings suggest the existence of purulent inflammation.

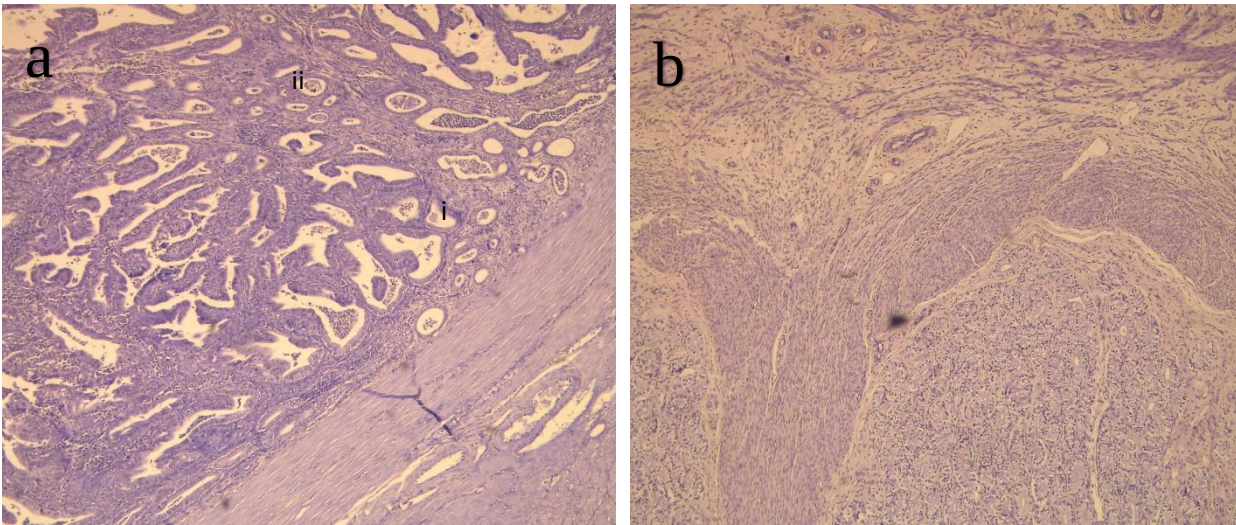


Figure 17: (a) Microscopic structure of endometrium of the queen with pyometra; shedding of epithelium and endometrial atrophy are obvious. (i) Neutrophil and (ii) Lymphocyte. (b) Microscopic structure of endometrium of the normal queen showing intact epithelium and glands (H & E; ×4)

The histopathological architecture of ovarian tissues from queens with pyometra was compared to that of normal queens. Microscopic examination of ovarian tissues from pyometra-affected queens revealed notable abnormalities, including the presence of cystic follicles and ovarian rifts, indicative of disrupted ovarian physiology potentially linked to systemic hormonal imbalances and inflammatory processes associated with pyometra. In contrast, ovarian tissues from normal queens displayed a typical histological structure, characterized by well-defined ovarian follicles and stroma without any pathological alterations, as visualized under Hematoxylin and Eosin (H & E) staining at $\times 4$ magnification. These findings underscore the impact of pyometra on ovarian morphology, highlighting the systemic effects of the condition on reproductive tissues.

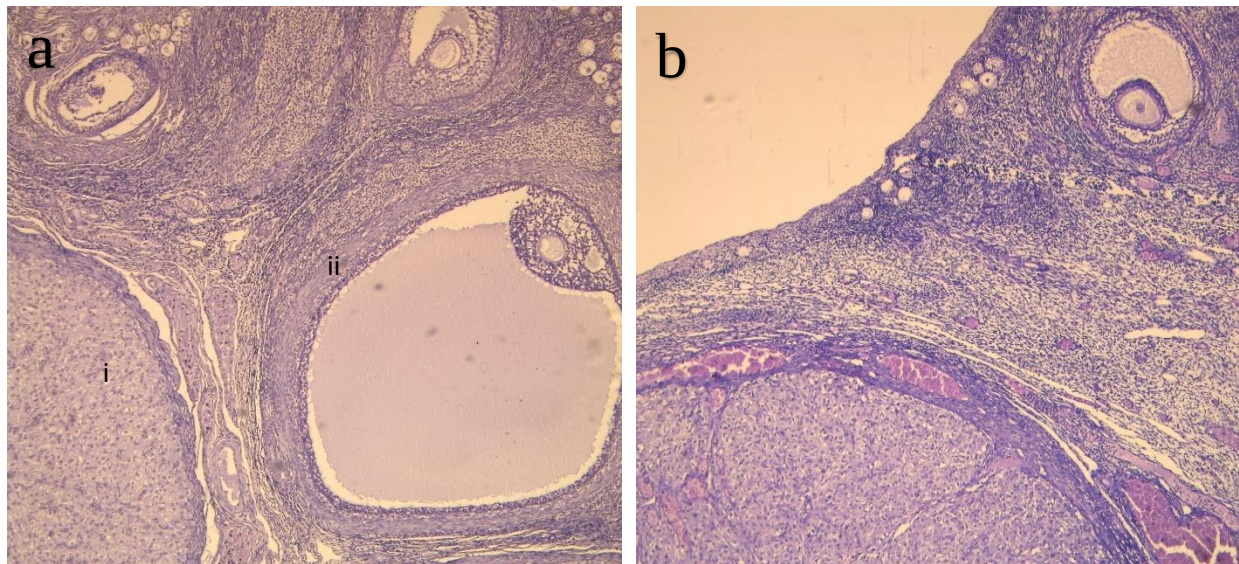


Figure 18: (a) Microscopic structure of ovary of the queen with pyometra; shedding of epithelium and endometrial atrophy are obvious. (i) Dead neutrophil containing pus, (ii) Proliferation of medulla. (b) Microscopic structure of the normal queen showing intact epithelium and glands (H & E; $\times 4$)

4. Discussion

In this study, surgical availability, wound healing, recovery, and post-operative outcomes are evaluated among the midline and flank methods for OHE in cats. The ovaries and uterus were successfully removed using both techniques; however, there were some noticeable variations in the surgery and recuperation experiences.

4.1. Surgical Access and Visibility

The midline technique provides a more accurate view of the reproductive organs, especially when there is severe uterine pathology such as pyometra or aberrant reproductive morphology. According to (Coe et al., 2006), the midline method is beneficial in complex instances that need improved internal structure imaging. This is in keeping with their earlier findings. Even though it's less intrusive, the flank method restricts access to the entire uterus and can make procedures more difficult if there are anomalies. The midline technique is therefore better in more complex situations.

4.2. Wound Healing

Although the wound healing times from the two methods were similar, there was little tendency for the flank approach to heal more quickly. Compared to the midline incision, which is vulnerable to the weight of the abdominal organs, the lateral incision may heal more quickly because it undergoes less mechanical stress and movement. Prior research has documented similar results, showing that flank incisions accelerated wound healing by lowering suture line tension (Davidson et al., 2004).

4.3. Post-Operative Recovery and Complications

Cats in the flank approach group recovered more quickly and experienced less discomfort than those in the midline group. The position of the incision, which avoids the main abdominal muscles, and the less invasiveness may be to blame for this. The benefits of the flank approach in nursing animals by preventing disruption of the mammary gland were noted by earlier research, such as (McGrath et al., 2004). However, our study expanded these findings to include non-lactating cats.

4.4. Clinical Implications

The choice of surgical technique should be influenced by the specific case. The midline approach is favored for complex surgeries requiring thorough visualization of the reproductive organs, such as in cases of severe pyometra or congenital abnormalities. On the other hand, the flank approach is beneficial for routine OHE, especially in patients with a higher risk of wound complications or those requiring faster recovery.

4.5 Histopathology findings

The results highlight the notable changes in ovarian and uterine histology linked to pyometra. Chronic inflammation is indicated by the abnormalities of the uterus, such as significant atrophy and epithelial shedding. Systemic hormonal imbalance because of pyometra is suggested by ovarian alterations, especially the appearance of cystic follicles and rifts.

5. Conclusions

This study underscores the critical role of histopathological evaluation in understanding the systemic effects of pyometra on feline reproductive organs. The findings revealed significant uterine abnormalities, including endometrial atrophy, epithelial shedding, and localized inflammation, as well as ovarian changes like cystic follicles, highlighting the extensive hormonal and inflammatory disruptions associated with the condition. These insights reinforce the necessity of timely surgical intervention to prevent further complications. Both the midline and flank approaches for OHE were effective, with comparable wound healing outcomes. The midline approach provided superior access to manage severe pathological changes, while the flank approach facilitated quicker recovery and minimized post-operative discomfort. By combining surgical expertise with detailed histopathological analysis, veterinarians can tailor their approach to the specific clinical needs of each patient. This study advocates for further research to expand our understanding of pyometra's histopathological impacts and optimize surgical practices in feline reproductive health care.

6. Limitation

- ❖ **Small Sample Size:** The study involved only two cats, limiting the ability to generalize the results to a larger population.
- ❖ **Lack of Long-Term Follow-Up:** The absence of long-term monitoring restricts understanding of post-operative complications or recurrence.
- ❖ **Surgical Skill Variability:** Differences in the surgeon's experience with each technique were not controlled, which could have impacted the outcomes

References

- Agudelo, C. F., Diseases, C., & Brno, P. S. (2012). *Cystic endometrial hyperplasia - pyometra complex in cats . A review A review*. March 2013, 37–41.
- Coe, R. J., Grint, N. J., Tivers, M. S., Hotston Moore, A., & Holt, P. E. (2006). Comparison of flank and midline approaches to the ovariohysterectomy of cats. *Veterinary Record*, 159(10), 309–313. <https://doi.org/10.1136/vr.159.10.309>
- Davidson, E. B., Moll, H. D., & Payton, M. E. (2004). Comparison of laparoscopic ovariohysterectomy and ovariohysterectomy in dogs. *Veterinary Surgery*, 33(1), 62–69. <https://doi.org/10.1111/j.1532-950X.2004.04003.x>
- Devitt, C. M., Cox, R. E., & Hailey, J. J. (2005). Duration, complications, stress, and pain of open ovariohysterectomy versus a simple method of laparoscopic-assisted ovariohysterectomy in dogs. *Journal of the American Veterinary Medical Association*, 227(6), 921–927. <https://doi.org/10.2460/javma.2005.227.921>
- Hagman, R. (2012). Clinical and Molecular Characteristics of Pyometra in Female Dogs. *Reproduction in Domestic Animals*, 47(SUPPL.6), 323–325. <https://doi.org/10.1111/rda.12031>
- Hollinshead, F., & Krekeler, N. (2016). *Pyometra in the queen To spay or not to spay ?* 21–33. <https://doi.org/10.1177/1098612X15623114>
- McGrath, H., Hardie, R. J., & Davis, E. (2004). Lateral flank approach for ovariohysterectomy in small animals. *Compendium on Continuing Education for the Practicing Veterinarian*, 26(12), 922–930.
- Oliveira, J. P., Mencalha, R., Sousa, C. A. dos S., Abidu-Figueiredo, M., & Jorge, S. da F. (2014). Pain assessment in cats undergoing ovariohysterectomy by midline or lateral celiotomy through use of a previously validated multidimensional composite pain scale. *Acta Cirurgica Brasileira*, 29(10), 633–638. <https://doi.org/10.1590/S0102-8650201400160002>
- Dong, W. yang, Jiang, C. yang, & Qian, C. zhong. (2013). Histopathological observations on the uterus and ovary of a cat with pyometra. *Pakistan Veterinary Journal*, 33(3), 395–397.

Biography

I am Md. Adnan Omar Alvi, son of Md.Easa and Rina Parvin. I have completed my Secondary School Certificate from BKSP public school, Zirani, Savar, Dhaka in 2015 and Higher Secondary School Certificate from Sristy collage of tangail, Tangail in 2017. I am an intern veterinarian at Chattogram Veterinary and Animal Sciences University, Bangladesh, under the Faculty of Veterinary Medicine. I want to use my skills and ingenuity for the benefit of the country, and I have a strong interest in veterinary medical research. In the future, I would like to work in the field of veterinary epidemiology and research.