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Evaluation of clinical outcomes following conventional right flank and laparoscopic ovariectomy in female dogs

Vilas, D.[1†], Mahendra Tanwar[2], Sakar Palecha[2], K. Kachwaha[3], M.L. Sharma[4] and P. Bishnoi[5]

Rajasthan University of Veterinary and Animal Sciences, Bikaner- 334 001 (Rajasthan)

[1]MVSc Scholar, [2]Assistant Professor, [3]Instructor, [4]PhD Scholar and [5]Professor and Head, Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, Bikaner

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A study was conducted on 12 female dogs to compare the outcomes of conventional and laparoscopic ovariectomy techniques. The animals were randomly divided into two equal groups: group A underwent conventional right flank ovariectomy, while group B underwent laparoscopic ovariectomy using a three-port technique. All procedures were performed under a standardized anaesthetic protocol. No significant differences were observed in vital parameters such as heart rate, respiratory rate, and rectal temperature between the groups. In both groups, no significant changes were seen in blood glucose levels pre- and postoperatively. Postoperative serum cortisol levels and pain scores increased non-significantly in both groups; however, group A consistently demonstrated higher cortisol concentrations and pain scores than group B. The duration of surgery was significantly (P<0.05) shorter in group A (65.50±6.11 min) compared to group B (105.30±8.42 min). Complications such as haemorrhage, difficulty in ovarian resection, and wound dehiscence were recorded in both groups. Although laparoscopic ovariectomy was more time consuming, it was associated with reduced postoperative discomfort, indicating a potential welfare advantage over the conventional approach.

Key words: *Dog, Laparoscopic ovariectomy, Pain, Right flank ovariectomy*

Surgical sterilization is a widely accepted method for population control and management of reproductive health in female dogs. Among the various techniques available, ovariohysterectomy (OVH) remains the most commonly practiced procedure and it can be performed using different surgical approaches/techniques, including the conventional midline or right flank ovariohysterectomy, early-age gonadectomy, ovariectomy, and laparoscopic-assisted methods (Stone, 2003). Ovariectomy alone has been recognized as an effective alternative to traditional OVH for elective sterilization in female dogs and cats. This technique offers several advantages, such as a smaller incision, enhanced visualization of the ovarian pedicle, reduced surgical trauma, and a lower incidence of postoperative complications (DeTora *et al.*, 2011). Despite its widespread use, conventional open surgical approaches are still associated with a range of potential postoperative complications, including intra-abdominal haemorrhage, ovarian remnant syndrome, stump pyometra, fistulous draining tracts, inadvertent ureteral ligation, and estrogen-responsive urinary incontinence (Stone, 2003).

In recent years, minimally invasive surgical techniques, such as laparoscopic ovariectomy, have gained prominence due to their advantages in reducing perioperative morbidity. Laparoscopic procedures are associated with reduced tissue trauma, less postoperative pain, faster recovery, and lower complication rates when compared to traditional open surgery (Monnet *et al.*, 2003). The present study was therefore aimed to clinically compare standard right flank ovariectomy and laparoscopic ovariectomy in terms of intra- and postoperative complications, surgical time, and physiological responses in female dogs.

Materials and Methods

The study was conducted on 12 clinically healthy, non-pregnant female dogs of varying ages, breeds and body weights, presented for elective ovariectomy. The animals showing signs of oestrus or pregnancy based on clinical examination and transabdominal ultrasonography were excluded from the study. The selected animals were randomly assigned into two groups (n=6 each); group A underwent right flank ovariectomy and group B underwent laparoscopic ovariectomy.

In animals of group A, standard soft tissue surgical instruments were utilized and they were sterilized by autoclaving. Group B procedures employed KARL STORZ laparoscopic equipment, including a 30° telescope, Veress needle, spiral cannulae (5-6 mm), bipolar and Kelly grasping forceps, endoscopic scissors, a camera control unit, light source (LED Nova 150), Endoflator, electrocautery unit (Shalya Sigma), and associated accessories. Laparoscopic instruments were sterilized by immersion in 2.4% glutaraldehyde solution (CIDEX) for 10 hr at room temperature, followed by sterile saline rinsing and drying.

Preoperatively, feed and water were withheld from the animals for 16 hr and 8 hr, respectively. The surgical site was aseptically prepared by scrubbing

*Correspondence; E-mail: drvilasdvet@gmail.com

with chlorhexidine, followed by application of povidone-iodine solution. Preoperative medication included atropine SO_4 (0.04 mg/kg body wt) and xylazine HCl (1 mg/kg body wt) administered intramuscularly. General anaesthesia was induced with ketamine (5 mg/kg body wt, i.v.) and maintained using 1.5-2.5% isoflurane delivered via an endotracheal tube.

In group A, the animals were positioned in left lateral recumbency. A 2.5 cm dorso-ventral skin incision was made caudal to the midpoint between the last rib and iliac crest, avoiding superficial blood vessels. Subcutaneous tissue was dissected to expose the abdominal musculature. The oblique muscle layers were separated via grid technique and the peritoneal cavity was accessed. The ovary or uterine horn were identified, exteriorized, and the ovarian pedicle along with the utero-tubal junction was ligated and transected. The contralateral ovary was similarly accessed and removed. The abdominal wall was closed in two layers with polyglactin 910 (Vicryl®) No. 1 suture using simple interrupted pattern, and the skin was sutured with silk No. 1.

In group B, the animals were positioned in dorsal recumbency with a 15°-20° Trendelenburg tilt. A small skin incision cranial to the umbilicus was made for Veress needle insertion. Proper placement in the peritoneal cavity was confirmed via the hanging drop test using sterile normal saline. Pneumoperitoneum was established with CO, insufflation to a pressure of 10-12 mmHg using a mechanical insufflator. A 6 mm trocar and cannula were inserted at the same site for a 5 mm, 30° laparoscope. Two additional 5 mm working ports were placed caudolaterally to the camera port, creating a triangulated layout for instrument manipulation. The ovarian pedicles and utero-tubal junctions were cauterized with bipolar electrocautery and transected with laparoscopic scissors. Ovaries were retrieved through the lateral port (Fig. 1). Upon completion, pneumoperitoneum was evacuated by gentle abdominal compression, and port sites were closed in two layers with interrupted sutures using Vicryl® No. 0 and silk No. 1. The duration of surgery and intraoperative complications if any were noted.

Fig. 1: Retrieval of the ovary following resection- group B.

Postoperatively, meloxicam (0.25 mg/kg body wt, OD) and amoxicillin-sulbactam (12 mg/kg body wt, BID) were administered intramuscularly for 3 and 5 days, respectively. Daily wound care was done until suture removal by 10-12 days. Different physiological parameters including rectal temperature (RT), heart rate (HR), and respiratory rate (RR), and blood glucose and serum cortisol levels were recorded pre- and 24 hr postoperatively. Postoperative pain was assessed 24 hr after surgery using the University of Melbourne Pain Scale (UMPS), which incorporated physiological, behavioural, and clinical parameters (Afshar *et al.*, 2017). Different postoperative complications were also recorded in animals of both groups.

The data on different physiological and biochemical parameters were statistically analysed using paired t test and one way analysis of variance.

Results and Discussion

The age, body weight, and breed of the animals included in the study are summarized in table 1. The mean age and body weight of animals in group A were 24±6.33 months and 14.33±1.61/ kg, respectively. In group B, the mean age and body weight were 36.67±5.97 months and 23.5±4.02/ kg, respectively.

All animals in group A were non-descript (ND), whereas in group B, three animals were ND and the remaining were of German shepherd, Golden Retriever, and Labrador Retriever breeds. Variations in body weight among animals corresponded to differences in age and breed.

Table 1. Signalment details including approximate age, body weight, and breed of animals in groups A and B.

	Group A			Group B		
Case No.	Age (m)	Weight (kg)	Breed	Age (m)	Weight (kg)	Breed
1	11	11	ND	10	9	ND
2	36	16	ND	30	19	ND
3	10	12	ND	42	28	Labrador Retriever
4	42	20	ND	48	35	German shepherd
5	9	10	ND	42	18	ND
6	36	17	ND	48	32	Golden Retriever
Mean ±SE	24 ±6.33	14.33 ±1.61		36.67 ±5.97	23.5 ±4.02	

In the present study, no significant differences were observed between pre- and postoperative physiological parameters, aligning with previous findings. Bakhtiari *et al.* (2006) reported that HR, RR, and RT remained within normal ranges following elective laparoscopic ovariohysterectomy in dogs, with only transient, non-significant increases resolving within 48 hr. Similarly, Hancock *et al.* (2005) found no significant differences in physiological variables between the dogs which underwent laparoscopic and conventional spaying, emphasizing that such parameters might be unreliable indicators of pain due to confounding factors like human interaction. Afshar *et al.* (2017) also reported stable RT and RR, though a significant postoperative decrease in HR, suggesting that physiological changes may be more indicative of anxiety or fear than pain. Maticic *et al.* (2010) documented stable cardiovascular and respiratory parameters following orthopaedic procedures, with only transient postoperative hyperthermia. Dutta *et al.* (2010) reported no significant alterations in physiological values after various laparoscopic sterilization techniques, further questioning the sensitivity of these measures for pain detection. Gauthier *et al.* (2013) reinforced this view, demonstrating that postoperative pain in cats was better reflected by behavioural changes and localized sensitivity than by physiological indicators.

Table 2. Mean heart rate (beats/minute), respiratory rate (breaths/minute) and rectal temperature (°F) in animals of groups A and B during the preoperative and postoperative periods

Parameter		Group A	Group B
Heart rate	Preoperative	124.66±6.88	118±5.24
(beats/min)	Postoperative	131.33±6.88	119.33±5.69
Respiratory	Preoperative	43.83±2.5	46.5±3.77
rate (breaths/min)	Postoperative	46.33±1.76	43.83±3.20
Rectal	Preoperative	101.71 ± 0.37	102.63 ± 0.35
Temperature (°F)	Postoperative	101.93 ± 0.26	102.36 ± 0.19

Differences were non-significant (P/ >/ 0.05)

The mean duration of surgery for animals in group A was 65.5±6.11 min, while in group B it was 105.3±8.42 min, suggesting that the duration of surgery was significantly (P/ </ 0.05) longer in group B as compared to group A. Several studies have compared surgical durations between laparoscopic and open ovariectomy techniques, with mixed findings. Gauthier *et al.* (2013) reported longer mean surgical times for laparoscopic ovariectomy (41±6 min) compared to right flank ovariectomy (24±9 min) in cats, attributing the difference to the inexperience of assisting veterinary students. Similarly, Van Goethem *et al.* (2003) documented a mean duration of 40 min for laparoscopic ovariectomy in dogs using bipolar electrocoagulation, while conventional procedures required more time in obese animals due to the need for larger incisions. Coisman *et al.* (2014) and Culp *et al.* (2009) also observed longer operative times for laparoscopic approaches, though Coisman *et al.* (2014) noted the difference was not statistically significant. In contrast, Cassata *et al.* (2016) reported longer surgical times for mid-flank laparotomy, likely due to the difficulty of blindly grasping the ovaries. Whereas Freeman *et al.* (2010) found no significant difference in operative durations between laparoscopic and open techniques. These discrepancies highlight the impact of various factors, including surgical approach, operator experience and patient condition. In the present study, the longer mean surgical time observed in the laparoscopic group may be attributed to the inclusion of obese and older dogs, as increased body condition and repeated oestrous cycles are known to prolong surgical procedures (Van Goethem *et al.*, 2003).

In group A, intraoperative complications in most cases included capillary bleeding from the right flank incision site while approaching the peritoneal cavity, which was easily controlled using haemostasis with artery forceps. Exteriorization of the left ovary was time-consuming and more difficult in obese animals, with a higher incidence of bleeding from the ovarian pedicle noted in these cases. Manipulation of the left ovarian pedicle often required a deeper plane of anaesthesia for successful handling. In group B, in obese and multiparous animals, difficulties were encountered in grasping the ovarian pedicle. This was likely due to excessive fat deposition around the ovarian pedicle, resulting in minimal mesovarial bleeding. Loss of ovaries into the abdominal cavity via the accessory portal site occurred in two cases at the end of the procedure. In one animal, sudden regurgitation of bile-like fluid was observed, attributed to increased intra-abdominal pressure secondary to elevated CO_2 levels. Mild haemorrhage from the accessory portal site was observed in most cases, primarily following incision extension during ovary retrieval.

Postoperatively, most animals of group A exhibited loud vocalization during recovery from anaesthesia. Surgical wound dehiscence was observed in three cases between days 5 and 6 postoperatively. Additionally, mild erythema with discharge was noted in two cases. These complications were managed through re-suturing and appropriate wound care. In the majority of cases in group B, surgical wound dehiscence was observed at the lateral working portal site around the 3rd/4th postoperative day, particularly at the site used for ovary retrieval. However, re-suturing was not done and simple antiseptic dressing was followed for wound management.

Complications have been reported by several researchers after laparoscopic ovariectomy. Dupre *et al.* (2009) described minimal, self-limiting splenic bleeding during trocar insertion, while Van Goethem *et al.* (2003) noted minor wound complications, such as swelling, erythema, discharge, and dehiscence, following laparoscopic ovariectomy, highlighting the potential benefit of reduced surgical time in minimizing infection risk. Similarly, Austin *et al.* (2003) reported postoperative swelling, herniation, and seroma formation at lateral flank incisions, attributed to longer incisions and thinner skin. Devitt *et al.* (2005) observed inadequate anaesthetic depth during digital ovarian pedicle manipulation in open, but not laparoscopic ovariohysterectomies. Minor wound swelling and discharge were also documented by van Nimwegen *et al.* (2005) after laparoscopic procedures. Case *et al.* (2011) reported self-limiting splenic puncture and subcutaneous emphysema associated with both single- and three-port laparoscopy. Ohlund *et al.* (2011) observed minor haemorrhage from the ovarian pedicle and a postoperative wound infection. In contrast, Culp *et al.* (2009) and Cassata *et al.* (2016) reported minimal complications using harmonic scalpel techniques, with only minor mesovarian bleeding and no significant surgical or anaesthetic issues. Likewise, Swaffield *et al.* (2020) noted mild, self-resolving erythema and discharge at the suture site by postoperative day three in cats undergoing flank ovariectomy. Overall, the findings of the present and earlier studies indicate that while neither laparoscopic nor open surgical approaches are devoid of complications, most postoperative events are minor, self-limiting, and effectively managed with appropriate perioperative care.

Table 3. Mean blood glucose (mg/dL) and serum cortisol (µg/dL) levels in animals of Groups A and B

Parameter		Group A	Group B
blood glucose (mg/dL)	Preoperative	95.166±5.48	95.33±10.43
	Postoperative	95.33±3.45	84.33±7.78
serum cortisol (µg/dL)	Preoperative	1.55±0.43	2.02±0.5
	Postoperative	4.21±0.95*	3.43±0.53

*Significantly different (P<0.05) within group A and from group B

The mean blood glucose levels of animals in groups A and B during the pre and postoperative periods are presented in table 3. No significant differences were observed between the preoperative and postoperative blood glucose levels in group A (P/ >/ 0.05). Although a postoperative decrease in mean blood glucose was noted in group B as compared to its preoperative value, this difference was not statistically significant. Hancock *et al.* (2005), Stedile *et al.* (2009) and Freeman *et al.* (2010) reported no significant differences in blood glucose concentrations between dogs undergoing laparoscopic and conventional procedures. In contrast, Devitt *et al.* (2005) observed a significant postoperative increase in glucose levels lasting 6 hr after conventional ovariohysterectomy, compared to a transient one-hour elevation in laparoscopic cases. Similarly, Ranganath and Kumar (2007) reported significantly higher glucose levels in dogs undergoing conventional spaying than in those undergoing laparoscopic procedures during the immediate postoperative period. These findings suggest that while transient elevations in glucose may occur, blood glucose alone is an inconsistent and unreliable marker for evaluating surgical stress in dogs undergoing ovariectomy.

Animals of both groups exhibited an increase in serum cortisol levels postoperatively compared to their respective preoperative values. However, this increase was significant (P/ </ 0.05) in group A. Additionally, the postoperative cortisol levels in group A were significantly higher (P/ </ 0.05) than in group B. The findings are consistent with those of Freeman *et al.* (2010), who have reported significantly elevated serum cortisol levels postoperatively in dogs undergoing transluminal endoscopic spaying, attributing the increase to elevated intra-abdominal pressure from pneumoperitoneum and prolonged operative times. Similarly, Smith *et al.* (1999) found higher cortisol levels in cats undergoing longer-duration ovariohysterectomies, suggesting a correlation between surgical duration and stress response. In contrast, Sherin *et al.* (2019) reported significantly lower cortisol levels in dogs undergoing laparoscopic ovariectomy as compared to conventional procedures, attributed to reduced surgical stress with minimally invasive techniques. While Stedile *et al.* (2009) found no significant differences in cortisol levels between laparoscopic and open splenectomy groups, concluding that cortisol level may not reliably reflect surgical stress. Devitt *et al.* (2005) observed marked cortisol elevations in dogs undergoing conventional ovariohysterectomy, with relatively stable levels following laparoscopic procedures. Naitoh *et al.* (2002) demonstrated that cortisol levels returned to baseline within 8 hr after laparoscopic pancreatectomy, while remaining elevated in open surgery groups. Ranganath and Kumar (2007) associated the heightened cortisol response with the longer duration of conventional ovariohysterectomy, a finding echoed by Hancock *et al.* (2005), who observed normalization of cortisol levels by 6 hr post-surgery in conventional cases. In the present study, the higher postoperative cortisol concentrations observed in the right flank ovariectomy group suggest a greater physiological stress response compared to the laparoscopic group, and support the growing body of evidence that laparoscopic surgery induces a reduced stress response compared to traditional open techniques.

The mean postoperative pain score in group A was 4.5±0.61, while in group B it was 3.16±0.79, however, the difference was not statistically significant (P/ >/ 0.05). Relatively higher pain scores observed in the right flank ovariectomy group is consistent with findings by Hancock *et al*. (2005) and Devitt *et al.* (2005), who have reported increased pain scores in dogs undergoing conventional ovariohysterectomy compared to laparoscopic technique. In contrast, Coisman *et al*. (2014) found no significant differences in pain scores between the cats undergoing laparoscopic and open ovariectomy. The lack of statistically significant differences in pain scores between groups in the present study may indicate comparable postoperative discomfort. In the right flank group, pain may result from stretching or tearing of the suspensory ligament from the peritoneum, while in the laparoscopic group, discomfort could be attributed to prolonged intra-abdominal CO_2 insufflation, potentially causing phrenic nerve stretching, peritoneal acidosis, and tissue desiccation (Coisman *et al*., 2014).

The present study indicated that physiological parameters such as heart rate, temperature, and respiratory rate, remained within normal postoperative ranges, and were inadequate as sole indicators of pain or surgical stress. Despite the absence of statistical significance, consistently higher pain scores and elevated cortisol levels in the right flank ovariectomy group suggested a relatively greater physiological stress response compared to laparoscopic procedure. Laparoscopic ovariectomy was associated with fewer complications and a more favourable postoperative profile, reinforcing its value as a minimally invasive alternative. Nevertheless, operative duration and clinical outcomes may be influenced by factors such as patient condition and surgical expertise.

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