Original Research

Comparison of Ovariectomy by Laparoscopic and Conventional Open Methods in Dogs

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Abstract

Ovariectomy (OVE) is a routine surgical procedure for sterilization in small animal practice. The study was carried out in 12 female dogs presented to College of Veterinary Science and Animal Husbandry, Aizawl, for elective sterilization were divided into group COVE and group LapOVE, with six animals each. Conventional open ovariectomy was implemented in group COVE while laparoscopic ovariectomy was done in group LapOVE. Blood samples were collected at regular intervals to estimate C-reactive protein (CRP), cortisol, aspartate amino transferase (AST) and blood glucose level. Significant variations were noticed in CRP, cortisol and AST between the groups. Significant changes were observed in serum glucose level within both groups during and after the time of surgery as compared to baseline. Findings of the present study suggest that laparoscopic ovariectomy causes less tissue damage, muscle trauma and post-operative pain than conventional open ovariectomy in female dogs.

Key words: Aspartate Amino Transferase, C-Reactive Protein, Glucose, Laparoscopic Ovariectomy, Neutering in Dogs, Serum Cortisol

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Introduction

Surgical sterilization or neutering of dogs and cats is one of the most frequently performed surgical techniques in veterinary practice (Stockner, 1991). Surgical sterilization can be accomplished by removing both the ovaries and uterus (ovariohysterectomy) or by removing the ovaries alone (ovariectomy) (Howe,

2006). From the animal welfare point of view, neutered animals obtain several clear benefits from the elective procedure. Neutered female dogs, in general, have been found to live longer than intact animals (Kraft, 1998). Neutering prevents or reduces the risk of development of mammary tumour, pyometra, the inconvenience of vaginal discharge and male attraction during estrus (Davidson *et al*., 2004). Standard of care for sterilization of female dogs in the United States has been ovariohysterectomy (OVH); ovariectomy (OVE) procedures have been routinely performed in some European countries for years (Goethem *et al.*, 2003; Gower and Meyhew, 2008).

It is well documented that conventional neutering procedures performed by celiotomy inflict pain and morbidity in dogs as a result of tissue trauma, organ manipulation, and inflammation (Hardie *et al.*, 1997). Also, surgical complications like haemorrhage from the ovarian vessels, anaesthesia accidents, tissue reaction to suture material leading to granulomas, wound infection, or delayed healing were reported (Burrow and Batchelor, 2005). Alternative surgical techniques are always needed to avoid these complications or at least some of them. One of these techniques is the Laparoscopic sterilization of female dog, which was first reported in 1985 (Wildt and Lawler, 1985). Laparoscopic techniques have become increasingly more important in veterinary medicine in the last 10 years. The present study was carried out to compare tissue damage, post-operative stress and pain following conventional open and laparoscopic methods of ovariectomy in female dogs.

Materials and Methods

The study was conducted at Teaching Veterinary Clinical Complex, Department of Veterinary Surgery and Radiology, College of Veterinary Sciences and Animal Husbandry, Aizawl on 12 adult female dogs, weighing 3.7 to 22.4 kg with the age range of 12 months to 60 months. The dogs were randomly divided into two equal groups. Food and water were withheld for 12 and 6 hours respectively prior to the surgery in all the animals. Routine clinical examinations were also carried out preoperatively. Urinary bladder was emptied by catheterization. Ceftriaxone (20 mg/kg body weight, IV; Intacef, Intas Biopharmaceuticals, Gujarat, India) was administrated as a preoperative pro-phylaxis at the time of inducing anesthesia. The anesthetic protocol used was same for all animals. Dogs were pre-anaesthetized with glycopyrrolate (0.01 mg/kg body weight IM; Pyrolate, Neon Laboratories Limited, Mumbai, India) and xylazine (0.5 mg/kg body weight IM; Xylaxine, Indian Immunologicals Ltd, Telangana, India). General anesthesia was induced with propofol (2–5 mg/kg body weight IV; Lipuro®, B. Braun India, Mumbai, India) and tracheal intubation was performed. Anaesthesia was maintained with isoflurane (Forane, Abbott India Ltd, Asecia Queenborough, U.K) combined in 100% oxygen via a semi-closed anaesthetic breathing system.

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Conventional Open Ovariectomy

Conventional method was performed in group COVE through a standard caudal ventral midline incision. Dogs were placed in dorsal recumbency and surgeon was positioned near the left abdominal region of the dog. A snook ovariectomy hook was used to gain exposure of each ovary by applying of traction on the suspensory ligament. Simple and transfixation ligatures were used both over the ovarian pedicle and at the location of proper ligament of ovary to close the uterine horn with the size 0 polyglactin 910. Ovaries were resected and the pedicle was checked for haemorrhage. The uterine horn was released into the abdomen. The abdominal incision was closed in a routine manner using size 0 polyglactin 910 for inner layers in simple continuous pattern and the 2-0 nylon for skin in horizontal mattress pattern.

Laparoscopic Ovariectomy

Laparoscopic ovariectomy was performed in group LapOVE. Dogs were placed in dorsal recumbency in Trendelenburg position in a 'V' positioner. Bilateral LapOVE was performed through an 11-mm port placed at the umbilicus and two 6-mm port placed on midline approximately 5 cm below the umbilicus and 2cm above the umbilicus respectively. Using veress needle technique, insufflation with carbon dioxide (CO_2) was provided via an automatic insufflator with pressure set at 12 mm Hg and with a flow rate of 1-2 L/min. Then the 11 mm primary trocar was inserted at the umbilicus, and a 30^o, 10-mm diameter laparoscope (Karl Storz GmbH & Co. KG, Germany) connected to a light source was introduced through this port. The other two 6 mm portals were inserted under laparoscopic visualization to prevent injury to abdominal organs. After operative port fixation, the dogs were tilted either to the right or left lateral recumbency to perform left or right LapOVE, respectively. The surgeon was positioned near the left abdominal region of the dog for right LapOVE and vice versa. The 5 mm bipolar electrocoagulation forceps was introduced and the ovarian pedicle, proper ligament and mesovarium were cauterized. Following ensuring haemostasis of the ovarian pedicle; the 5 mm laparoscopic scissor was inserted into abdomen to resect the ovary and the resected ovary was removed under laparoscopic visualization. After removing all ports, the portal sites were sutured in 2 simple interrupted layers using 0 polyglactin 910 for inner layers and 2-0 nylon for skin.

The blood samples (4ml) were collected from cephalic or saphenous veins, in dry clot-activator vials before administration of anaesthesia (base line), during surgery (immediately after removing the first ovary), after surgery, and then 4, 24, 48 and 72 hours after extubation. Serum was separated by centrifugation of collected blood at 4000rpm for 10 minutes and isolated sera were kept at -20^{0}C. Collected samples were used for analysis of Aspartate aminotransferase (AST, U/L), Glucose (GLU, mg/dl), and C - reactive protein (CRP, mg/L) using Fully Automated Serum Biochemical Analyser (Fuji Dri-Chem 4000i, Fujifilm, Japan). Serum cortisol (COR, ng/ml) was evaluated through ELISA method with Canine cortisol ELISA kit (CSB-

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E14303c, Cusabio, China). Statistical analysis was carried out by SPSS version 20 with two-way Analysis of Variance (ANOVA).

Results

Significantly decreased CRP value was observed in group LapOVE animals at 4 hour ($p \leq 0.05$), 24 hour and 48 hour ($p \leq 0.01$) post-operatively as compared to group COVE. Peak CRP (Mean±SD) level in group COVE and LapOVE biches was observed at 24 hour post-operatively and recorded as 36.03 ± 7.43 and 17.51 ± 4.59 mg/L respectively (Table 1).

Table 1: Mean ± SD values of CRP (mg/L) recorded at different time intervals in group COVE and LapOVE

Groups	BS	DS	AS	4 hr	24 hr	48 hr	72 hr	Significance
COVE	3.13 ± 0.98^{aA}	3.29 ± 0.97^{aA}	4.48 ± 1.02^{abA}	9.31 ± 3.71^{bA}	36.03 ± 7.43^{dA}	23.12 ± 5.09^{cA}	8.76 ± 6.61^{abA}	*
LapOVE	4 ± 0.80^{aA}	4.03 ± 0.84^{aA}	4.21 ± 0.92^{aA}	4.45 ± 0.89^{aB}	17.51 ± 4.59^{cB}	7.5 ± 3.08^{bB}	5.5 ± 2.42^{abA}	*
Significance	NS	NS	NS	*	**	**	NS	

** $p \leq 0.05$, ** $p \leq 0.01$, ^{NS}Non significant; Means bearing similar lowercase superscript in the same row and uppercase superscript in same column do not differ significantly.*

Significantly decreased ($p \leq 0.01$) cortisol value was observed in group LapOVE female dogs at the time of surgery (DS), after surgery (AS) and 4 hour post-operatively as compared to group COVE. Peak cortisol (Mean±SD) level in group COVE and LapOVE animals was observed at 4 hour post-operatively and recorded as 166.58 ± 16.35 and 110.59 ± 9.57 ng/ml respectively (Table 2).

Table 2: Mean ± SD values of Cortisol (ng/ml) recorded at different time intervals in group COVE and LapOVE

Groups	BS	DS	AS	4 h	24 h	48 h	72 h	Significance
COVE	61.87±7.44 cA	106.46±12.92 dA	136.47±11.83 eA	166.58±16.35 fA	59.15±22.83 bcA	43.46±12.10 abA	38.09±4.98 aA	*
LapOVE	60.02±8.26 bA	73.03±10.43 cB	92.98±11.25 dB	110.59±9.57 eB	58.86±8.07 abA	52.5±8.11 abA	42.33±5.31 aA	*
Significance	NS	**	**	**	NS	NS	NS	

** $p \leq 0.05$, ** $p \leq 0.01$, ^{NS}Non significant; Means bearing similar lowercase superscript in the same row and uppercase superscript in same column do not differ significantly.*

Significantly decreased ($p \leq 0.05$) AST activity was observed in group LapOVE female dogs at 24 hour post-operatively as compared to group COVE. Significantly increased ($p \leq 0.05$) AST activity was observed in group COVE animals at 24 and 48 hour post-operatively as compared to the baseline (BS) value (Table 3). Significantly increased ($p \leq 0.05$) glucose level was recorded in group COVE at the time of surgery (DS) and after surgery (AS), as compared to baseline (BS). Non-significantly increased ($p > 0.05$) glucose level was recorded in group LapOVE at the time of surgery (DS) and after surgery (AS), as compared to baseline (BS). Peak mean glucose level was observed at the period of after surgery (AS) in both the groups and gradually decreased to baseline value at 24 hour post-operatively (Table 4).

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Table 3: Mean ± SD values of AST (U/L) recorded at different time intervals in group COVE and LapOVE

Groups	BS	DS	AS	4 hr	24 hr	48 hr	72 hr	Significance
COVE	33±2.52^{aA}	30.33±2.87^{aA}	32.16±2.63^{aA}	35.33±8.59^{aA}	72.66±17.73^{bA}	64±20.72^{bA}	31.33±8.57^{aA}	*
LapOVE	36.83±10.87^{A}	30.16±10.08^{A}	29.5±11.13^{A}	34.83±11.28^{A}	44.83±11.00^{B}	44.33±11.00^{A}	34.66±9.50^{A}	NS
Significance	NS	NS	NS	NS	*	NS	NS	

**p≤0.05, ^{NS}Non significant; Means bearing similar lowercase superscript in the same row and uppercase superscript in same column do not differ significantly.*

Table 4: Mean ± SD values of serum glucose (mg/dL) recorded at different time intervals in groups COVE and LapOVE

Groups	BS	DS	AS	4 hr	24 hr	48 hr	72 hr	Significance
COVE	77.5±6.65^{a}	100.83±12.02^{bc}	114±37.92c	96±14.07^{abc}	82.83±10.38^{ab}	77.67±6.53^{a}	85.17±5.41^{ab}	*
LapOVE	82.5±17.97^{ab}	101.67±13.66^{b}	104.33±15.90^{b}	86.67±24.41^{ab}	76.67±18.35^{a}	78.67±12.91^{a}	85.81±12.93^{ab}	*

** p≤0.05; Means bearing similar lowercase superscript in the same row do not differ significantly.*

Discussion

Significantly increased CRP value was observed in group COVE animals at 4, 24 and 48 hours post-operatively as compared to group LapOVE. Ranganath and Kumar (2007) reported a significant elevation in C-reactive protein level at 24 hours to 48 hours post-operatively in dogs undergone conventional ovariohysterectomy as compared to laparoscopic group. Similar findings were also observed by Stedile *et al*. (2009) during laparoscopic and conventional splenectomy in dogs. In this study, peak mean CRP levels in both COVE and LapOVE were observed at 24 hour post-operatively. These findings were in accordance Caspi *et al.* (1987), Conner *et al.* (1988), Burton *et al.* (1994), Ranganath and Senthil (2006) and Haraguchi *et al.* (2017). Yamamoto *et al*. (1993) observed that the magnitude of increase in concentration of serum C-reactive protein was generally related to the intensity of the surgical trauma. Significantly increased CRP value observed in group COVE animals as compared to LapOVE could be due to greater tissue damage and inflammatory phenomenon occurred in group COVE animals associated with conventional ovariectomy procedures (Yamamoto *et al*., 1993; Conner *et al*., 1998; Grande *et al*., 2002; Rahr *et al*., 2006). Assay of cortisol concentration have been used as an indicator of stress and pain in dogs (Hansen *et al*., 1997; Devitt *et al*., 2005; Hancock *et al*., 2005) and in cats (Smith *et al*., 1996). Marcovich *et al.* (2001) observed that cortisol measurement was useful for assessment of intraoperative noxious stimuli in dogs. Agnati *et al.* (1991) and Tecot (2008) also reported a similar finding. Significantly increased serum cortisol level observed in group COVE animals as compared to group LapOVE was attributed to the increased surgical stress and pain occurred in group COVE female dogs associated with conventional ovariectomy procedures (Hansen *et al*., 1997; Devitt *et al.*, 2005; Hancock *et al.*, 2005; Ranganath and Kumar, 2007).

Significantly increased AST activity was observed in group COVE animals at 24 hour post-operatively as compared to group LapOVE animals. The present findings were similar with Ranganath and Kumar (2007) in dogs undergone traditional flank ovariohysterectomy as compared to laparoscopic method. Significantly

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increased AST activity was observed in group COVE animals at 24 and 48 hour post-operatively as compared to baseline value and non-significantly increased AST activity was observed in group LapOVE at same period of observations. Schmidt and Booker (1982) also reported significantly increased AST level up to 72 hours after conventional surgical procedures in dogs. According to Allison (2012) peaked AST value could be observed approximately 24–36 hours after acute muscle injury in animals with a half-life of 4 to 12 hours in dogs. Elevated AST activity without much variation in ALT value was observed during muscle damage in small animals (Sodikoff, 2001). Significantly elevated AST activity observed in group COVE animals as compared to LapOVE animals in this study might be due to the excess muscle trauma (Kaneko, 1980; Allison, 2012) happened in group COVE during conventional ovariectomy procedures.

Significantly increased glucose level was recorded in group COVE animals during and after the time of surgery as compared to baseline, whereas non-significantly increased glucose level was recorded in group LapOVE during and after the time of surgery as compared to baseline. Similar to the present findings, significantly increased glucose value during conventional ovariohysterectomy was reported by Devitt *et al.* (2005), Ranganath and Kumar (2007), Rafee *et al.* (2015) and Thanwardas (2017). Increased glucose concentration observed in this study might be attributed to the stress and pain response associated with surgery and anaesthesia, which induced the endogenous corticosteroid and catecholamine release (epinephrine and norepinephrine), which stimulated gluconeogensis and glycogenolyis and also caused a state of insulin resistance (Benjamin, 2001; Allison, 2012; Singh *et al*., 2013). Along with post-surgical stress, alpha-2 agonist was also reported to induce increased serum glucose by suppressing insulin and stimulating glucagon release (Brockman, 1981).

Conclusion

Findings of the present study suggest that laparoscopic ovariectomy inflicts less pain and stress when compared to conventional open method of ovariectomy. Laparoscopic ovariectomy could be recommended instead of conventional open ovariectomy in terms of pain and post-operative stress for elective sterilization in dogs.

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