COMPARISON OF CONVENTIONAL AND LAPAROSCOPIC OVARIOHYSTERECTOMY IN CANINE

V.T. Khanchandani[1], V.D. Aher[2] and G.S. Khandekar[3]
Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, Parbhani, Maharashtra Animal and Fisheries Sciences University, Nagpur-440 006, Maharashtra

Received on: 29.11.2017
Accepted on: 09.03.2018

ABSTRACT

The objective of this study was to compare conventional and laparoscopic ovariohysterectomy in canine. 12 healthy bitches were randomly divided into two groups viz. group A and group B, each group consisting of 6 cases. Group A bitches were operated by conventional method and Group B bitches were operated by laparoscopic method. All the physiological parameters, surgical parameters and haematobiochemical parameters were evaluated at various stages in both the groups. Although, rectal temperature showed no significant difference between the groups but the heart rate and respiratory rate showed a significant decrease in laparoscopic group. The duration of surgical time was found to be non-significantly lesser in group B and the length of incision was significantly smaller in group B with no postoperative complications. Thus, the present clinical study was suggestive that, laparoscopy causes less surgical stress to the animal when compared with conventional method.

***Key words*:** conventional, laparoscopic, ovariohysterectomy, canine

Introduction

Ovariohysterectomy i.e. surgical removal of ovaries with uterus (Fossum, 2013) is the most common surgical procedure performed in veterinary practice for sterilization in dogs (Bloomberg, 1996, Fox *et al*., 1998). In traditional ovariohysterectomy using ventral midline approach, the uterus and ovaries are double ligated, transected and abdomen is typically closed in three layers. Laparoscopic method of ovariohysterectomy is an alternative to traditional abdominal ovariohysterectomy in bitches, having several advantages (Davidson *et al.*, 2004). It causes less post-operative pain compared to conventional method of ovariohysterectomy in bitches (Devitt *et al.,* 2005). It involves minimal invasiveness with maximum visibility, shorter surgical time, decreased postoperative discomfort and pain, less incidence of infection, and uncomplicated healing with minimal scarring, which usually needs no postoperative care or regular dressing (Dutta *et al*., 2010, Gower and Mayhew, 2008, Mahalingam *et al*., 2009).

Materials and Methods

The present study was conducted on 12 healthy bitches randomly divided into two equal groups viz. group A ovariohysterectomy by conventional method and group B ovariohysterectomy by laparoscopic method. The bitches in both the groups were premedicated with acepromazine, butorphanol, glycopyrrolate @ 0.05 mg/kg, 0.2 mg/kg and 0.01 mg/kg body weight respectively combined in a single syringe. Anaesthesia was induced by propofol @ 4 mg/kg body weight intravenously to effect.

The bitches were subjected to routine clinical examination prior to the date of surgery. Abdominal palpation was carried out before induction of anaesthesia to detect any abnormality of uterus like tumour, enlargement (pyometra), pregnancy etc. They were fasted and withheld water for 12 hours before the induction of anaesthesia and adequate intravenous fluid was given. Urinary bladder was evacuated by applying adequate pressure on the lower abdomen at the site of bladder after pre-anaesthesia in group B for laparoscopic ovariohysterectomy. Ventral abdomen was shaved and prepared aseptically for ovariohysterectomy. Conventional method of ovariohysterectomy was done in standard procedure using ventral midline method. A 2-8 cm long incision was made on the midline behind the umbilicus with B.P. blade No. 22 attached with a B.P. handle No. 4. Skin, subcutaneous Conventional and laparoscopic ovariohysterectomy tissue, linea alba, falciform ligament and peritoneum were incised. After exteriorization of uterus and ovaries, proper ligation of ovarian pedicle and uterine body was done and severed. Peritoneums, muscles, subcutaneous and skin were sutured routinely.

Laparoscopic method of ovariohysterectomy was done in a standard procedure. A small nick incision was taken just lateral to the umbilicus for insertion of veress needle and then pneumoperitoneum was attained in a standard procedure (10 to 13 mm Hg) with CO2. A 12-mm cannula was accommodated at the same site of incision to insert a 10 mm straight forward operative telescope and one 5 mm and one 10mm were inserted laterally. Each suspensory ligament and ovarian vasculature and base of the uterine horn was grasped with forceps and cauterized with bipolar electrocautery and were severed. Both the ovaries and uterine horn was grasped and removed from the 10 mm lateral working port. The portal sites were closed routinely.

Sutures were removed around 10-12 days postoperatively in conventional group and 5-7 days postoperatively in laparoscopic group. All the bitches were monitored until recovery. Various physiological, surgical, haematological and biochemical parameters were studied and recorded at different time interval in our study. Statistical analysis was done by ANOVA and t-test using Microsoft excel.

Results and Discussion

Physiological parameters

The mean ± S.E. rectal temperature, heart rate and respiratory rate in group A and group B was recorded at different

[1]Research Scholar, Department of Veterinary Surgery and Radiology, COVAS, Parbhani, email id: kvijaya237@gmail.com; Professor and Head; [3]Associate Professor, Department of Veterinary Surgery and Radiology, BVC, Mumbai

time intervals during surgery in both the groups and are mentioned in table 1, 2, and 3, respectively. There was no significant difference between group A and group B. The mean heart rate and respiratory rate showed a significant decrease in group B than group A.

Surgical parameters

The mean duration of surgical time was 78.17± 6.52 and 70.83 ± 9.78 in group A and group B, respectively. No significant difference was observed in the duration of surgical time between group A and group B. The mean length of incision was 6.00 ± 0.43 and 3.07 ± 0.03 in group A and group B, respectively. The length of incision was significantly larger in group A than group B.

Haematological parameters

The mean ± S.E. HB, PCV, TEC, TLC and DLC are mentioned in Table 4, 5, 6, 7, 8, 9, 10, respectively. The mean haemoglobin, PCV, total erythrocyte count and differential leukocyte count levels showed no significant difference between the groups. A non-significant increase in the mean TLC in group B was observed when compared to group A.

Biochemical parameters

The mean ± S.E. SGOT, SGPT, ALP, BUN, creatinine, serum glucose and cortisol are described in Table 11, 12, 13, 14, 15, 16, 17, respectively. SGOT showed a non-significant rise in group A than group B, while ALP showed a non-significant increase in group B when compared to group A and SGPT showed a significant increase in group B than group A. No significant difference was found in serum creatinine in both the groups however, BUN showed a non-significant increase in group B than group A. Serum glucose showed a non-significant increase in group A than group B and serum cortisol showed a significant increase in group A than group B.

Laparoscopic method of ovariohysterectomy was a practical sterilization technique. It provides an excellent observation when cauterizing, and transecting the ovaries and uterine horns. It's simple to grasp and hold the ovaries and uterus securely with forceps during cauterization which prevents any slippage and misplacement. The significant decrease in the mean heart rate in group B was similar to the findings reported by Raibole (2012) who mentioned a decrease in heart rate in laparoscopic-assisted group of cryptorchidectomy than conventional group. A decrease in the mean heart rate in group B could be due to pressure on the diaphragm because of CO_2 insufflation in the abdomen (Raibole, 2012). A decrease in respiratory rate in group B is similar to the findings by Khandekar (2011) during laparoscopy in dogs. The decrease in the mean RR in laparoscopic group could be due to the pressure on the diagphram due to pneumoperitoneum. No significant difference was observed in the duration of surgical time between group A and group B. Similarly, no significant difference in the durations of laparoscopic assisted ovariohysterectomy and open ovariohysterectomy were observed by Devitt *et al*. (2005). Lee and Kim (2013) reported significantly shorter surgical time for laparoscopic group compared with open surgery group for ovariectomy in dogs. The differences between duration of surgical time in different studies might be influenced by Conventional and laparoscopic ovariohysterectomy surgeon's experiences, body condition score which is related to amount of fat around the ovarian pedicle, body weight, position of the patient and vessel sealing devices (Shariati *et al*., 2014). Although it might be dependent on various factors, the duration of surgical time in laparoscopic ovariohysterectomy was non-significantly shorter than conventional ovariohysterectomy. Holding true to its name as "key hole surgery" incisions in the laparoscopic procedure were found to be significantly smaller than that in conventional ovariohysterectomy. Similar findings were reported by Shariati *et al*. (2014) during two portal laparoscopy and open surgery for ovariectomy in dogs.

Haematological reports showed no significant differences in HB, PCV, TEC and DLC, but TLC showed a non-significant increase in laparoscopic group when compared to bitches of conventional group. Khandekar (2011) observed a mild increase in TLC during laparoscopy in dogs however, Laiju *et al*. (2011) observed a significant ($P<0.05$) decrease in TLC immediately after ovariohysterectomy, then increased 24 hours postoperatively in canine. An increase in group B might be because of penetrative injury during trocarization or little tissue damage during cauterization.

The SGOT findings in the present study were similar to Ranganath and Kumar (2007) who found a significant elevation ($P\leq0.05$) in the mean AST level in conventional ovariohysterectomy than laparoscopic ovariohysterectomy group in bitches. These elevated findings could be attributed to muscle trauma and tissue damage during surgical procedure (Gunay *et al*., 2011) and to excess muscle trauma during conventional method than laparoscopic method of ovariohysterectomy (Ranganath and Kumar, 2007). The increase in the mean SGPT in laparoscopic group could be due to pneumoperitoneum and pressure on liver during laparoscopic ovariohysterectomy or port placement in dogs. The findings in the present study in laparoscopic group were similar to the findings reported by Tiwari (2015) during laparoscopic ovariectomy and by Raibole (2012) during laparoscopic-assisted cryptorchidectomy. Statistical analysis showed a non-significant increase in group B when compared to group A. Similarly, Dutta *et al.* (2010) found a nonsignificant increase in ALP on the third day postoperative in different methods of laparoscopic sterilization in female dogs. The elevation in plasma ALP after laparoscopic surgery may be attributed to tissue injury as a result of ischemia/reperfusion-induced oxidative stress in the liver and kidney following CP (Dutta *et al.*, 2010). Some non-significant increase in blood urea nitrogen in bitches of group B was found when compared to group A. Raibole (2012) Conventional and laparoscopic ovariohysterectomy observed a significant increase in the mean BUN levels in the laparoscopic assisted group of cryptorchidectomy than conventional group. This increase in BUN might be due to reduced blood flow to kidneys leading to retention of nitrogenous substances in the blood after administration of propofol (Jena *et al*., 2014). No significant difference was seen in serum creatinine levels in both the groups. The non-significant increase in glucose level in conventional group was similar to the findings by Devitt *et al.* (2005) who mentioned a significant increase in blood glucose from preoperative concentrations at 1, 2, 4 and 6 hrs in open ovariohysterectomy and at 1 hour in laparoscopic-assisted ovariohysterectomy in dogs. The mean glucose level ranged

from 32 ± 8.12 to 95.50 ± 7.54 in conventional method of ovariohysterectomy and 28.00 ± 7.91 to 75.17 ± 8.16 in laparoscopic method of ovariohysterectomy in bitches. Hyperglycaemia recorded might be due to rise in adrenocortical hormones, release of catecholamines due to increased hepatic glucose production and decreased glucose utilization due to stress to surgery and anaesthesia (Singh *et al*., 2013). Significant increase in cortisol levels in bitches undergoing conventional method of ovariohysterectomy than laparoscopic method were similar to the findings by Thakur (2013) during traditional method of ovariohysterectomy when compared to laparoscopic-assisted method of ovariohysterectomy in dogs. Statistically, significant elevation (Pd" 0.05) in bitches sterilized by conventional method upto 4 hours after surgery compared to bitches sterilized by laparoscopic method was found by Ranganath and Kumar (2007). Significant rise in the serum cortisol level for longer period in conventional ovariohysterectomy bitches compared to laparoscopic ovariohysterectomy bitches suggested that the open surgical method of ovariohysterectomy in bitches was more stressful and painful than laparoscopic method (Ranganath and Kumar, 2007). Thus, the present study concluded that laparoscopic method of ovariohysterectomy was superior, minimally invasive and provided a quick recovery without any post-operative complications compared to conventional method of ovariohysterectomy.

Acknowledgement

The College of Veterinary and Animal Sciences, Parbhani and Bombay Veterinary College, Mumbai supported this study and provided the facilities available for the research work.

References

Bloomberg MS (1996) Surgical neutering and nonsurgical alternatives. *JAVMA* **208**(4). 517-519.

Davidson EB, Moll HD, and Payton ME (2004) Comparison of laparoscopic ovariohysterectomy and ovariohysterectomy in dogs. *Vet. Surg*. **33**: 62-69.

Devitt CM, Cox RE and Hailey JJ (2005) Duration, complications, stress and pain of open ovariohysterectomy versus a simple method of laparoscopic-assisted ovariohysterectomy in dogs. *J. Am. Vet. Med. Assoc.*

Table 1: Mean rectal temperature (^{0}F)

Operative stages	Group A	Group B	Overall
Pre-operative	102.02 ± 0.24	101.97 ± 0.23	101.99 ± 0.02
15min	101.17 ± 0.42	101.05 ± 0.37	101.11 ± 0.06
30min	100.13 ± 0.58	100.57 ± 0.42	100.35 ± 0.22
45min	99.75 ± 0.63	100.22 ± 0.43	99.98 ± 0.23
60min	99.15 ± 0.52	99.42 ± 0.37	99.28 ± 0.13
Postoperative	99.92 ± 0.52	100.32 ± 0.40	100.12 ± 0.20
Overall	100.36 ± 0.43	100.59 ± 0.35	

Table 2: Mean heart rate (beats/min)

Operative stages	Group A	Group B	Overall
Pre-operative	108.67 ± 8.92	106.17 ± 7.98	107.42 ± 1.25
15min	122.67 ± 5.72	120.83 ± 5.24	121.75 ± 0.92
30min	116.67 ± 6.32	113.67 ± 6.17	115.17 ± 1.50
45min	110.50 ± 6.18	109.00 ± 5.36	109.75 ± 0.75
60min	107.50 ± 5.94	106.50 ± 5.36	107.00 ± 0.50
Postoperative	117.17 ± 5.75	117.50 ± 5.15	117.33 ± 0.17
Overall	113.86 ± 2.42	112.28 ± 2.48	

Table 3: Mean respiration rate (breaths/min)

Operative stages	Group A	Group B	Overall
Pre-operative	42.67 ± 3.29	36.50 ± 2.60	39.58 ± 3.08
15min	35.17 ± 2.93	31.00 ± 2.48	33.08 ± 2.08
30min	31.67 ± 2.60	28.33 ± 2.46	30.00 ± 1.67
45min	28.17 ± 2.41	25.67 ± 2.86	26.92 ± 1.25
60min	24.83 ± 2.15	23.00 ± 2.37	23.92 ± 0.92
Postoperative	29.83 ± 1.11	30.50 ± 2.19	30.17 ± 0.33
Overall	32.06 ± 2.55	29.17 ± 1.91	

Table 4: Mean haemoglobin concentration (g/dl)

Operative stages	Group A	Group B	Overall
Pre-operative	13.77 ± 0.57	13.87 ± 0.65	13.82 ± 0.05
During operative	11.00 ± 0.71	11.47 ± 0.35	11.23 ± 0.23
Post-operative	12.80 ± 0.62	13.23 ± 0.46	13.02 ± 0.22
Overall	12.52 ± 0.81	12.86 ± 0.72	

Table 5: Mean packed cell volume (%)

Operative stages	Group A	Group B	Overall
Pre-operative	41.00 ± 2.18	42.00 ± 1.93	41.50 ± 0.50
During operative	35.33 ± 1.69	34.67 ± 2.11	35.00 ± 0.33
Post-operative	39.67 ± 2.03	39.67 ± 2.28	39.67 ± 0.00
Overall	38.67 ± 1.71	38.78 ± 2.16	

Table 6: Mean total erythrocyte count (10^6/cumm)

Operative stages	Group A	Group B	Overall
Pre-operative	6.51 ± 0.33	6.57 ± 0.29	6.54 ± 0.03
During operative	5.67 ± 0.35	5.69 ± 0.32	5.68 ± 0.01
Post-operative	6.04 ± 0.35	6.23 ± 0.35	6.13 ± 0.10
Overall	6.07 ± 0.24	6.16 ± 0.26	

Table 7: Mean total leukocyte count (10^3/cumm)

Operative stages	Group A	Group B	Overall
Pre-operative	11.83 ± 0.72	13.63 ± 0.97	12.73 ± 0.90
During operative	8.32 ± 0.74	9.47 ± 0.93	8.89 ± 0.58
Post-operative	13.86 ± 1.06	14.61 ± 0.96	14.23 ± 0.38
Overall	11.33 ± 1.62	12.57 ± 1.58	

Table 8: Mean neutrophil count

Operative stages	Group A	Group B	Overall
Pre-operative	59.83 ± 1.76	59.83 ± 0.87	59.83 ± 0
During operative	67.83 ± 2.18	71.17 ± 0.91	69.50 ± 1.67
Post-operative	65.00 ± 1.77	60.83 ± 1.72	61.42 ± 0.58
Overall	63.22 ± 2.39	63.94 ± 3.62	

Table 9: Mean lymphocyte count

Operative stages	Group A	Group B	Overall
Pre-operative	28.83 ± 1.64	29.83 ± 0.48	29.33 ± 0.50
During operative	21.67 ± 2.03	20.67 ± 0.80	21.17 ± 0.50
Post-operative	25.33 ± 2.39	27.33 ± 0.56	26.33 ± 1.00
Overall	25.28 ± 2.07	25.94 ± 2.74	

Table 10: Mean monocyte count

Operative stages	Group A	Group B	Overall
Pre-operative	7.17 ± 0.60	6.33 ± 0.42	6.75 ± 0.42
During operative	5.33 ± 0.42	5.00 ± 0.52	5.17 ± 0.17
Post-operative	7.17 ± 0.70	6.67 ± 0.92	6.92 ± 0.25
Overall	6.56 ± 0.61	6.00 ± 0.51	

Table 11: Mean serum glutamic oxaloacetate transaminase (SGOT/ AST) (IU/L)

Operative stages	Group A	Group B	Overall
Pre-operative	25.43 ± 14.86	25.65 ± 6.72	25.54 ± 0.11
During operative	32.06 ± 5.43	28.12 ± 2.64	30.09 ± 1.97
Post-operative	22.21 ± 5.07	20.54 ± 2.50	21.38 ± 0.83
Overall	26.57 ± 2.90	24.77 ± 2.23	

Table 12: Mean serum glutamic pyruvate transaminase (SGPT/ALT) (IU/L)

Operative stages	Group A	Group B	Overall
Pre-operative	14.35 ± 2.20	19.18 ± 4.45	16.77 ± 2.41
During operative	18.51 ± 2.53	28.64 ± 3.72	23.57 ± 5.06
Post-operative	13.35 ± 2.19	23.02 ± 3.29	18.19 ± 4.83
Overall	15.40 ± 1.58	23.61 ± 2.75	

Table 13: Mean alkaline phosphatase (IU/L)

Operative stages	Group A	Group B	Overall
Pre-operative	116.66 ± 11.62	112.70 ± 4.84	114.68 ± 1.98
During operative	120.78 ± 15.06	125.41 ± 5.62	123.10 ± 2.32
Post-operative	141.49 ± 9.62	152.19 ± 4.43	146.84 ± 5.35
Overall	126.31 ± 7.68	130.10 ± 11.64	

Table 14: Mean blood urea nitrogen (mg/dl)

Operative stages	Group A	Group B	Overall
Pre-operative	20.55 ± 2.92	21.51 ± 2.44	21.03 ± 0.48
During operative	21.86 ± 2.50	25.19 ± 1.84	23.77 ± 0.25
Post-operative	17.47 ± 1.55	22.50 ± 2.71	19.32 ± 1.02
Overall	20.79 ± 1.51	21.96 ± 1.09	

Table 15: Mean serum creatinine (mg/dl)

Operative stages	Group A	Group B	Overall
Pre-operative	0.91 ± 0.18	0.93 ± 0.20	0.92 ± 0.01
During operative	1.22 ± 0.17	1.25 ± 0.19	1.23 ± 0.01
Post-operative	0.95 ± 0.12	0.94 ± 0.17	0.94 ± 0.01
Overall	1.03 ± 0.10	1.04 ± 0.10	

Table 16: Mean serum glucose (mg/dl)

Operative stages	Group A	Group B	Overall
Pre-operative	73.42 ± 1.52	75.55 ± 2.76	74.49 ± 1.07
During operative	117.61 ± 4.10	111.99 ± 3.75	114.80 ± 2.81
Post-operative	89.13 ± 5.69	88.67 ± 3.79	88.90 ± 0.23
Overall	93.39 ± 12.93	92.07 ± 10.66	

Table 17: Mean serum cortisol (mcg/dl)

Operative stages	Group A	Group B	Overall
Pre-operative	3.58 ± 0.73	3.22 ± 0.64	3.40 ± 0.18
During operative	5.45 ± 0.79	4.67 ± 0.50	5.06 ± 0.39
Post-operative	3.43 ± 1.08	2.93 ± 0.94	3.18 ± 0.25
Overall	4.16 ± 0.65	3.16 ± 0.54	

227(6): 921-927.

Dutta A, Maiti SK, Ajith P and Kumar N (2010) Evaluation of different laparoscopic sterilization techniques in a canine birth control program (2010) *Turk. J. Vet. Anim. Sci.* **34**(4): 393-402.

Fox SM, Mellor DJ, Firth EC, Hodge H and Lawoko CRO (1994) Changes in plasma cortisol concentrations before, during .and after analgesia, anaesthesia and anaesthesia plus ovariohysterectomy in bitches. *Res.Vet. Sci.* **57**: 110-118.

Fox SM, Mellor DJ, Lawoko CRO, Hodge H and Firth EC (1998) Changes in plasma cortisol concentrations in bitches in response to different combinations of halothane and butorphanol, with or without ovariohysterectomy. *Res.Vet. Sci.* **65**: 125-133.

Fossum TW (2013) Small Animal Surgery, 4th ed., Elsevier, Missouri: 780.

Gower S, and Mayhew P (2008) Canine laparoscopic and laparoscopic-assisted ovariohysterectomy and ovariectomy. *Comp. Cont. Educ Vet*. **30**(8): 430-440.

Gunay A, Gunes N, and Gunay U (2011) Effect of ovariohysterectomy on lipid peroxidation and levels of some antioxidants and biochemical parameters in bitches. *Bull. Vet. Inst. Pulawy* **55**: 695-698.

Jena B, Das J, Nath I, Sardar KK, Sahoo A, Beura SS and Painuli A (2014) Clinical evaluation of total intravenous anaesthesia using xylazine or conventional and laparoscopic ovariohysterectomy dexmedetomidine with propofol in surgical management of canine management. *Vet. world.* **7**(9): 671-680.

Khandekar GS (2011) Laparoscopic Examination and Treatment of Abdominal disorders in Dogs and Pigs. Unpublished PhD. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Laiju MP, Devanand CB and Sarada AT (2011) Effect of surgical stress on physiological, haematological and biochemical parameters in elective canine ovariohysterectomy. *JIVA.* **9**(1): 25-27.

Lee JY and Kim MC (2013) Comparison of oxidative stress status in dogs undergoing laparoscopic and open ovariectomy. *J. Vet. Med. Sci.* **76**(2): 273-276.

Mahalingam A, Kumar N, Maiti SK, Sharma AK, Dimri U and Kataria M (2009) Laparoscopic sterilization vs. open method of sterilization in dogs: a comparison of two techniques. *Turk. J. Vet. Anim. Sci.* **33**(5): 427-436.

Raibole DP (2012) Comparative study of conventional method & laparoscopic assisted technique for cryptorchidectomy in dogs. Unpublished M.V.Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Ranganath L and Kumar SSS (2007) Comparative studies on changes in C-reactive protein, serum cortisol, blood glucose and aspartate amino transferase level following left flank method and laparoscopic methods of ovariohysterectomy in bitches. *Veterinarski Arhiv.* **77**(6): 523-529.

Shariati E, Bakhtiari J, Khalaj A and Naslaji AN (2014) Comparison between two portal laparoscopy and open surgery for ovariectomy in dogs. *Vet. Res. Forum.* **5**(3): 219-223.

Singh K, Mahajan SK, Sangwan V, Gopinathan A, Kumar A, Anand A and Saini NS (2013) BAG-Propofol-isofluorane Anesthesia in Orthopaedic Dog Patients. *Indian Vet. J.* 90 (5): 30-33.

Thakur DR (2013) Laparoscopic- assisted ovariohysterectomy versus traditional method of ovariohysterectomy in dogs under propofol- isoflurane anaesthesia. Unpublished M.V.Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Tiwari MK (2015) Comparative evaluation of butorphanol tartrate and propofol as constant rate infusion in laparoscopic ovariectomy in canine. Unpublished M.V.Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.