COMPARISON OF LAPAROSCOPIC METHOD OF ENDOSTAPLING AND ENDOLOOP SUTURING FOR OVARIOHYSTERECTOMY IN FEMALE DOGS

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By

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CERTIFICATE

This is to certify that the thesis entitled ***"Comparison of laparoscopic method of endostapling and endoloop suturing for ovariohysterectomy in female dogs"*** submitted by **Mr. Vishwanatha, B., ID No. MVHK 921** in partial fulfillment of the requirements for the award of **MASTER OF VETERINARY SCIENCE** in **VETERINARY SURGERY AND RADIOLOGY** of the Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar is a record of bonafide research work carried out by him during the period of his study in this University under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bangalore

June, 2011

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Dedicated to my beloved aunt-Mrs. Leelavathi

and

My mother-Jayamma

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LIST OF ABBREVIATIONS

%	Per cent
@	At
cm	Centimetre
°F	Degrees Fahrenheit
dL	Decilitre
IU/ L	International Units per Litre
Kg	Kilogram
mg	Milligrams
mg/dL	Milligrams per decilitre
mg/kg	Milligrams per kilogram
mmHg	Millimetres of mercury
min	Minute
v*iz.*	Namely

Introduction

I. INTRODUCTION

Ovariohysterectomy is a necessity for many of our domestic companion animals, aiding in population control, disease prophylaxis, therapeutics and behaviour modification (Stone *et al*., 1993). Routine reproductive sterilization of dogs is one of the most frequently performed surgical procedures in Veterinary practice (Mayhew and Brown, 2007). Inspite of different means and methods of sterilization adopted, surgical neutering remains the main stay of pet population control (Anderson, 1992, Olson and Johnston, 1993). Now a days non invasive or minimally invasive method of ovariohysterectomy is gaining importance in companion animals.

Laparoscopy is the visualization of the peritoneal cavity through the anterior abdominal cavity with the use of an endoscope or laparoscope (Gomel, 1974). Laparoscopic intervention for many abdominal surgeries has been considered as minimally invasive (Freeman, 1998) and also has potential preference for mass sterilization in animal birth control programmes (Chariar *et al*., 2005). Laparoscopy is an operative procedure designed for visual inspection of the abdominal cavity and its organs using a minimally invasive technique and has many applications including sterilization (Hamdane *et al.,* 2003). Laparoscopy has been used for a number of years as a method of visually obtaining biopsy specimens of abdominal organs. Veterinarians may start to use laparoscopy as a diagnostic and therapeutic tool in their practice (Gross *et al.,* 1993).

Laparoscopic sterilization has shown to be more effective and safe method than conventional surgery. Laparoscopy, by decreasing bowel handling and serosal drying reduces the severity and duration of post-operative illness. This together minimizes the

post-operative adhesion formation. In addition, the smaller, less painful wounds and accelerated post-operative recovery give additional advantages over conventional open surgery (Wildt and Lawler, 1985).

The open technique is commonly performed in Veterinary medicine, open procedures are often performed with small incisions, which decrease visualization and increase the risk of incomplete resection of ovarian tissue which in turn leads to ovarian remnant syndrome and increased risk of mammary cancer and pyometra (Wallace, 1991). Laparoscopic ovariohysterectomy has distinct advantages like less post-operative pain, lower risk of dehiscence; minimal post-operative wound complications and shortened hospitalization over the open abdominal ovariohysterectomy in female dogs (Davidson *et al.,* 2004). One of the advantages of laparoscopic technique is superior visualization, which may reduce the risk of incomplete ovary resection (Austin *et al.,* 2003).

Due to initial high cost of the equipment, procedural learning curve and increased duration of procedure compared to traditional surgical techniques, laparoscopy is avoided by some Veterinary surgeons (Remedios and Fergusen, 1996). For a laparoscopic surgeon, familiarization with instruments and hands on experience is necessary.

In view of the above facts, a study on laparoscopic ovariohysterectomy in female dogs was carried out with following objectives:

1. To standardize the laparoscopic method of sterilization in female dogs.
2. To compare and evaluate the two techniques of laparoscopic sterilization in female dogs.
3. To study and compare the effect of endostapling and endosuture method of laparoscopic ovariohysterectomy on physiological, hematological and biochemical parameters.

Review of Literature

II. REVIEW OF LITERATURE

Laparoscopy is a modality, which is designed for visual inspection and operative procedures of the abdominal cavity and its organs using a minimally invasive technique. It works on the principle of total internal reflection of light transmitted and captured through the glass fibers present in the scope. Laparoscopy has many applications in Veterinary practice, which includes sterilization in small pet animals and mares. Laparoscopy is also widely used in birds, Lab animals and Amphibians for determination of sex, affections of oral cavity and other diagnostic procedures.

2.1 History of Laparoscopy

In 1901, the first experimental laparoscopy was performed in Berlin by the German surgeon George Kelling, who used a cystoscope to peer into the abdomen of a dog after first insufflating it with air.

In 1910 Jacobeus coined the word ‘laparoscopy’ and performed first clinical laparoscopic surgery in human beings (Cali, 1980).

First clinical application of laparoscopy in dogs involved ovarian function studies in early 1960’s.

In 1977, Kurt Semm first time demonstrated endoloop suturing technique in laparoscopic surgery.

In 1979, Semm and co-workers introduced instrumentation that brought operative laparoscopy to its present state (Sanfilippo and Singh, 1996).

The first case of laparoscopic ovariectomy in a bitch was published in 1985 and in 1997 for ovariohysterectomy (Minami *et al.,* 1997).

In 1985, Wildt and Lawler described the laparoscopic sterilization of bitches by bipolar high frequency coagulation of salpinx (Valocky *et al.,* 1999).

Reich *et al.* (1989) performed first laparoscopic per vaginum assisted hysterectomy.

In 1993, Theile and co-workers described the laparoscopic ovariectomy in female dogs.

The first laparoscopic ovariohysterectomy in a bitch was carried out by Von Siegle *et al.,* 1994.

2.2 Laparoscopy in Animals

2.2.1 Dog

2.2.1.1 Diagnostic purpose

Wildt *et al.* (1977) opioned that laparoscopy was simple accurate and practical technique for observation of internal organ anatomy and function. Authors also used laparoscope for clinical evaluation of reproductive tract to diagnose and confirm the pyometra, early pregnancy in the queen cats and bitches.

Grauer *et al.* (1983) carried out laparoscopic guided renal biopsy in dogs and cats and observed that laparoscopic renal biopsy was advantageous over key hole technique, which resulted in higher quantity of diagnostic tissue in focal renal disease.

Bhusan (1996) carried out laparoscopic assisted pancreatic biopsy in dogs as a diagnostic aid during the studies on pancreatitis.

Spinella *et al.* (2006) carried out laparoscopic ultrasonography in dogs and reported that this method allowed core biopsy or needle aspiration from non-superficial lesion.

2.2.1.2 Therapeutic purpose

Silvaa *et al.* (1995) performed laparoscopic intrauterine insemination in bitches and reported that all animals were pregnant.

Robert *et al.* (1996) studied laparoscopic stapled gastropexy in dogs and observed no difference in amount of connective tissue deposition at adhesion site between laparoscopic stapled gastropexy and incisional gastropexy groups. The authors also stated that laparoscopic gastropexy technique might have application as minimally invasive procedure for gastropexy for dogs at risk for developing gastric dilatation and volvulus.

Rawling *et al.* (2002) removed urinary calculi in dogs by laparoscopic assisted cystopexy and reported that the technique was quick, easy to perform and not associated with urinary tract infection or abnormalities of urination.

Hewitt *et al.* (2004) performed laparoscopic assisted jejunostomy feeding tube implantation in dogs and reported that the technique should be considered as an option for dogs requiring enterostomy feeding but not requiring a celiotomy for other reason.

Brun *et al.* (2008) performed laparoscopic cystotomy for removal of urolith in dog and stated that the technique was appropriate and an alternative to conventional cystotomy for treatment of canine vesicle urolithiasis.

Collard and Viguier (2008) performed laparoscopic ovariohysterectomy in a dog with pyometra and stated that laparoscopic ovariohysterectomy was performed in order to decrease incision size and to limit risk of wound dehiscence, which is frequently associated with hypercorticism.

Mayhew (2009) described laparoscopic and laparoscopic assisted cryptorchidectomy in dogs and cats and concluded that laparoscopic examination of peritoneal cavity aided in the diagnosis of abdominal cryptorchidism and also allowed treatment using either a totally laparoscopic or a laparoscopic assisted technique.

Stedile *et al.* (2009) carried out laparoscopic versus open splenectomy in dogs and stated that laparoscopic technique was useful for splenectomy in dogs being advantageous in term of blood loss, surgical stress and extent surgical wound.

Fukushima *et al.* (2011) carried out laparoscopic intrauterine artificial insemination in six dogs and evaluated cadiorespiratory and blood gas alterations during laparoscopic surgery. Authors observed significant alterations were hypercapnia, hypoventilation, and respiratory acidosis.

2.2.2 Other species of animals

2.2.2.1 Diagnostic purpose

Magale *et al.* (1956) preformed laparoscopic examination of ovarian cycle in a cow and stated that it was useful method because of direct observation of ovary instead of palpation.

Sumar and Bravo (1991) reported the laparoscopic technique for *in situ* observation of the ovaries in Llamas and Alpacas.

Yarbrough *et al.* (1995) performed laparoscopic examination of abdominal organs in seven Llamas.

Srinivasan *et al.* (1999) reported that swine was an excellent model for many laparoscopic procedure as porcine anatomy was generally similar to human anatomy with some minor differences. Practice on porcine models could help to refine techniques and increase efficiency and skill.

Gaglio *et al.* (2000) carried out laparoscopic-guided liver biopsy in *Rheus macaques* and reported that laparoscopy guided liver biopsy provided excellent tissue specimen for analysis.

Chiesa *et al.* (2009) performed isobaric (gasless) laparoscopic procedure, using a single port, for obtaining serial kidney and liver biopsy samples from standing steers and concluded that the isobaric (gasless) single-port laparoscopic technique was feasible for kidney and liver biopsy on standing steers. The procedure can be performed in a reliable and efficient manner in the sedated standing bovine.

2.2.2.2 Therapeutic purpose

Gourleyet and Riese (1990) performed laparoscopic artificial insemination in sheep.

Fischer and Vachon (1992) performed laparoscopic cryptorchidectomy in horses and stated that laparoscopy offered excellent visualization of the structures of the inguinal ring and facilitated removal of the abdominally located testis.

Butt and Wilson (2003) performed laparoscopic colopexy in horses and reported that large colon displacement was responsible for at least 50 per cent of colic cases that needed surgical treatment.

Beck *et al*. (2003) performed endoloop assisted laparoscopic partial nephrectomy in twelve female Yucatan mini pigs and authors concluded that use of modification of endoloop allows more controlled pressure application in nephrectomy therefore it was safe and effective.

Kenneth *et al.* (2005) carried out laparoscopic abomasopexy in dairy cows for correction of left sided displacement of abomasum.

2.3 Laparoscopic sterilization

2.3.1 Dogs

Wildt *et al.* (1977) performed laparoscopic examination of internal organ and observed that ovary of bitch was completely encapsulated and concealed in a peritoneal

pouch, bursa ovarii which had a ventral slit like opening that prohibited direct laparoscopic examination of ovary.

Wildt and Lawler (1985) performed laparoscopic sterilization of bitch and queen by uterine horn occlusion using electrocoagulation or plastic clips. The authors reported that laparoscopically uterine horns and adjacent ovarian bursae were located easily and further stated that uterine horns in all prepubertal animals were less muscular and smaller in diameter than in adults.

Gallagher *et al.* (1992) carried out laparoscopic castration for canine cryptorchidism by ligating testicular artery and veins and vas deference using endoscopic ligating clips.

Uson *et al.* (1992) performed laparoscopic sterilization in bitches by resection and removal of ovary after application of endo-clips on both ends of ovary.

Thiele *et al.* (1993) carried out laparoscopic ovariectomy along with ovarian bursa, parts of suspensory ligament and ovarian ligament and opioned that laparoscopic sterilization was easy and simple to perform and advocated for mass sterilization.

Minami *et al.* (1997) performed laparoscopy assisted ovariohysterectomy in two dogs with pyometra by using ultrasonic scalpel and opioned that laparoscopic assisted ovariohysterectomy for pyometra may be superior to ordinary open ovariohysterectomy.

Okamato *et al.* (1998) performed laparoscopic ovariohysterectomy in bitches and queen.

Valocky *et al*. (1999) performed laparoscopic sterilization by creating mechanical occlusion of oviducts using endo-staples, electrocoagulation and endo-suture technique in bitches and reported that time required for laparoscopic ovariectomy by electrocoagulation was less than that of laparoscopic ovariectomy by endo-stapling and endo-suture techniques.

Brun *et al.* (2000) performed laparoscopic ovariohysterectomy in dogs and reported that laparoscopic surgery was a suitable technique to perform ovariohysterectomy.

Dharmaceelan *et al.* (2000) carried out a comparative evaluation of three different techniques of laparoscopic sterilization *viz.*, resection and removal of ovary after clip application, electrocautery of ovary and electrocautery and removal of ovary after clip application and reported that resection and removal of ovary after clip application was superior to other two techniques and observed that it could be better adapted for female dogs sterilization.

Ashwani *et al.* (2002) performed laparoscopic salphingo-oophorectomy using otoscope in pups and reported that prepubertal neutering using otoscope was simple procedure with short intra-operative duration, less painful, quick recovery, less hospitalization and least manipulation of viscera.

Austin *et al.* (2003) performed laparoscopic ovariohysterectomy in dogs using a harmonic scalpel and reported a reduction of risk of incomplete ovarian tissue resection.

Hamdane *et al.* (2003) carried out laparoscopic ovariectomy of dogs by endo-loop sutures and transacted by electrocautery and concluded that using of endoloop suture for laparoscopic ovariectomy was effective and safe.

Davidson *et al.* (2004) compared laparoscopic ovariohysterectomy with surgical method of ovariohysterectomy in dogs and reported that laparoscopic ovariohysterectomy was potentially safe surgical alternative to traditional ovariohysterectomy in dogs.

Devitt *et al.* (2005) compared laparoscopic ovariohysterectomy with open ovariohysterectomy based on duration of surgery, surgical complications, stress and pain due to surgery and found laparoscopic ovariohysterectomy was superior over open ovariohysterectomy in bitches.

Hancock *et al.* (2005) carried out laparoscopic ovariohysterectomy using harmonic scalpel and reported that the harmonic scalpel coagulated ovarian and uterine vessels completely with minimal collateral damage to surrounding tissue and it was safe alternative to ovariohysterectomy in dogs.

Malm *et al.* (2005) carried out comparative study on post-operative stress between laparoscopic ovariohysterectomy and conventional approach in bitches and stated that stress response was similar in both groups.

Van Nimwegen *et al.* (2005) compared Neodymium: Yttrium aluminium garnet (Nd:YAG) surgical laser and bipolar electrocoagulation (BEC) for laparoscopic ovariectomy (OVE) in dogs and stated that BEC reduced surgical time and intra-operative mesovarial bleeding compared with laser resection.

Bhakthiari *et al.* (2006) performed elective laparoscopic ovariohysterectomy in dogs and concluded that laparoscopic ovariohysterectomy is safe and could be performed in a reasonable time with minimal pain in dogs.

Mayhew and Brown (2007) compared three techniques for ovarian pedicle haemostasis during laparoscopic assisted ovariohysterectomy. The authors used extracorporeal modified Roeder knot, metal clips and bipolar vessel sealing for haemostasis and stated that bipolar vessel sealing shortens surgical time significantly and provided excellent haemostasis during laparoscopic assisted ovariohysterectomy.

Ranganath and Kumar (2007) compared C-reactive protein, serum cortisol, blood glucose and aspartate amino transferase level following left flank method and laparoscopic method of ovariohysterectomy in bitches and stated that level of C-reactive protein, blood glucose and aspartate amino transferase were significantly elevated in left flank method of ovariohysterectomy than laparoscopic method of ovariohysterectomy.

Van Nimwegen and Kirpensteijn (2007[b]) compared Nd: YAG surgical laser and Remorgida bipolar electrocautery forceps for canine laparoscopic ovariectomy and stated that Remorgida forceps could be inexpensive and decreased surgical time when compared with Nd: YAG laser ovariectomy.

Gower and Mayhew (2008) stated that laparoscopic ovariohysterectomy and ovariectomy procedure in dogs by ligating the uterine arteries using a bipolar vessel-sealing or laparoscopic clips and the uterine body was ligated with a pre-tied loop suture or extracorporeal sutures and conclude that laparoscopic ovariohysterectomy and

ovariectomy were associated with less postoperative pain and faster return to normal activity versus open sterilization methods.

Kumar *et al.* (2008) compared laparoscopic and conventional method of ovariohysterectomy in female dogs and stated that there was no significant difference in mean surgical time between laparoscopic and conventional method of ovariohysterectomy in female dogs.

Shirodkar *et al.* (2008) performed laparoscopic oophorectomy by electrocautery and endo-looping techniques and stated that both procedures were effective but endo-looping required additional precision and perfection.

Culp *et al.* (2009) compared laparoscopic and open method of ovariectomy in small dogs and concluded that laparoscopy was a safe method for ovariectomy and resulted in increased postoperative activity when compared with an open ovariectomy.

Dupre *et al.* (2009) performed laparoscopic ovariectomy in dogs and compared single portal and two portal accesses on the basis of surgical times and perioperative complication and concluded that single portal access of laparoscopic ovariectomy is safe and feasible and did not significantly increase total surgical time in comparison with two portal approaches.

Freeman *et al.* (2009) performed oophorectomy by natural orifice transluminal endoscopic surgery in dogs and stated that this method in dogs appears to be a reasonable alternative to traditional surgery.

Holey (2010) compared laparoscopic electrocoagulation and endostapling techniques of ovariohysterectomy in female dogs and concluded that electrocoagulation and endostapling provide adequate haemostasis and complete sealing of ovarian and uterine end.

Rivier *et al.* (2011) performed combined laparoscopic ovariectomy and laparoscopic-assisted gastropexy in dogs and concluded that combined laparoscopic ovariectomy and laparoscopic assisted gastropexy appears to be a successful and low morbidity alternative procedure to ovariectomy / ovariohysterectomy and gastropexy.

2.3.2 Other species of animals

Aguilar *et al.* (1997) carried out endoscopic ovariohysterectomy in two lions (*Panthera leo*) and stated that the technique was appropriate for the zoo lions even with pathological reproductive changes.

Boure *et al.* (1997) developed a technique of paralumbar fossa laparoscopic ovariectomy in horses with use of endoloop ligatures and concluded that paralumbar fossa laparoscopic ovariectomy in mares using endoloop ligatures and the 33-mm diameter trocar-cannula unit was effective technique for ovariectomy in horses.

Hason and Galuppo (1999) performed bilateral laparoscopic ovariectomy in standing mares by intracorporeal dissection and ligation of the ovarian pedicles and concluded that standing laparoscopic ovariectomy appears to eliminate many of the potential complications associated with traditional surgical methods for ovareictomy and avoids the risk of general anesthesia.

Carpenter *et al.* (2000) performed laparoscopic ovariectomy and ovariohysterectomy in llamas and alpacas.

Kolata (2002) performed laparoscopic ovariohysterectomy and hysterectomy on African lions using ultracision harmonic scalpel.

Delling *et al.* (2004) carried out hand assisted laparoscopic ovariohysterectomy in the mare and stated that hand assisted laparoscopic ovariohysterectomy technique represented a minimally invasive and technically feasible alternative for conventional ovariohysterectomy.

Bleul *et al.* (2005) performed bilateral ovreictomy in eight cows and concluded that bilateral laparoscopic ovariectomy via left flank approach in standing cows was feasible.

Van Hoogmoed and Galuppo (2005) performed laparoscopic ovareictomy using the Endo-GIA staples and concluded that use of Endo-GIA stapling device was an easy and an efficient method of ovariectomy and minimal ovarian manipulation was required to apply the stapler.

Van Nimwegen and Kirpensteijn (2007[a]) performed laparoscopic ovareictomy in cats using Nd:YAG laser and a bipolar electrocoagulation.

Aziz *et al*. (2008) performed bilateral ovareictomy in six female donkeys.

Smith and Mair (2008) carried out unilateral and bilateral laparoscopic ovariectomy of mares by electrocautery.

Al Badrany (2009) performed laparoscopic ovariectomy in rabbit by resection and removal of ovary after clip application, electrocautery of the ovary and ligation of the ovary by silk.

2.4 Laparoscopic procedure

2.4.1 Selection and preparation of animals

Wildt *et al.* (1977) selected dogs weighing 4.5 to 32 kg between six weeks to nine years of age group for laparoscopic observation of internal organs.

Wildt and Lawler (1985) employed bitches aged 3 to 43 month and queen cats aged 3 to 38 months for laparoscopic uterine horn occlusion.

Thiele *et al.* (1993) advised the owner to fast the dogs 12 hours before surgery with no restriction to water for laparoscopic oophorectomy in bitches.

Valocky *et al.* (1999) performed laparoscopic ovariectomy by withholding food for twenty four hours and water for six hours.

Dharmaceelan *et al.* (2000) performed laparoscopic ovariectomy by withholding food for twenty four hours and water for six hours. Pre-operatively enema and bladder catheterization were done to evacuate the bowel contents and urine respectively.

Austin *et al.* (2003) selected female dogs with mean body weight of 17.7 kg (range 10 – 26 kg) aged 5 months to 5 years for laparoscopic ovariohysterectomy.

Davidson *et al.* (2004) selected female dogs weighing in the range of 10 to 38 kg (mean 17.9 kg), aged 4 to 36 months (mean 10.5 months) for laparoscopic ovariohysterectomy. The authors stated that all the dogs were vaccinated and tested negative for heart worm and intestinal parasite infestation prior to surgery.

Hancock *et al.* (2005) selected 16 intact Beagle female dogs ranging body weight 10 to 12 kg for laparoscopic ovariohysterectomy.

Ranganath and Kumar (2007) selected 12 healthy female dogs ranging in body weight 12 to 18 kg and 1 to 2 years of age for comparative study of left flank method and laparoscopic method of ovariohysterectomy.

Mayhew and Brown (2007) selected female dogs more than 8 kg body weight for laparoscopic assisted ovariohysterectomy.

Freeman *et al*. (2009) selected 10 healthy dogs weighing 20.5 kg to 28.2 kg for oophorectomy by natural orifice transluminal endoscopic surgery.

Holey (2010) selected 12 healthy dogs weighing 12 kg to 15 kg and 8 months to 2 years for comparative study of laparoscopic electrocoagulation and endostapling techniques of ovariohysterectomy in female dogs.

2.4.2 Anaesthetic protocol for surgery

Haitjema and Cullen (2001) premedicated the dogs with Acepromazine 0.05 mg/kg body weight intramuscularly, induction with Thiopentone 10 mg/kg body weight intravenously and anesthesia was maintained with Sevoflurane in oxygen.

Mutoh *et al.* (2002) studied the effects of meditomedine-midazolam, midazolam-butorphanol, or acepromazine-butorphanol as premedicants for mask induction of anaesthesia with sevoflurane in dogs. They concluded that in dogs, use of premedicants provides smoother and better quality of mask induction with sevoflurane.

Duke *et al.,* (2006) premedicated the dogs with Acepromazine maleate @ 0.05 mg/kg body weight and Glyccopyrrolate @ 0.01 mg/kg body weight intramuscularly. Anesthesia was induced with Thiopental intravenously and maintained with Sevoflurane.

Jadon *et al.* (2008) comparatively evaluated isoflurane and sevoflurane anaesthesia in puppies. All the pups were subjected to the intramuscular administration of atropine sulphate 0.06 mg/kg body weight and diazepam 2 mg/kg body weight intravenously. The anaesthesia was maintained for 30-40 minutes at 2.5% sevoflurane. Authors concluded that anaesthesia with sevoflurane was better than isoflurane in young puppies. It may be used with mask without any difficulty and has least deleterious effects on body systems and provides more cardiac stability.

Basha (2010) comparatively evaluated isoflurane and sevoflurane for ovariohsterectomy in female dogs. They premedicated the dogs with atropine sulfate 0.04 mg/kg body weight intramuscularly and diazepam 1 mg/kg body weight intravenously and anesthesia was induced and maintained with sevoflurane.

2.4.3 Instrumentation and operative procedure

Wildt *et al.* (1977) used three sizes of laparoscope *viz*., 2.7, 5 and 10 mm in animals and reported that the 5 mm laparoscope was versatile and provided better visualization.

Wilson and Ferguson (1984) sterilized the laparoscopic instruments using a solution containing 25% ethyl alcohol, 25% sterile distilled water and 50% poloxamar iodine complex equivalent to 1% titrable iodine.

Johns (1991) used equipments and instruments such as high flow insufflators, a video camera and monitor system, endoscopic sutures, bipolar cautery instruments, several pairs of functional laparoscopic scissor, a suction irrigation system, a unipolar cutting instruments or laser and blunt hollow dissecting forceps for laparoscopic oophorectomy in women.

Sumar and Bravo (1991) sterilized all laparoscopic instruments in 70% alcohol that contain chlorhexidine.

Driscoll *et al*. (1982) evaluated the uterus tissue reaction in rabbits using absorbable and nonabsorbable microsutures (nylon and coated polyglactin 910) and reported that after 35–70 days there was a lesser tissue reaction in absorbable sutures.

Remedios *et al.* (1992) reported that total time (min) taken for laparoscopic ovariohysterectomy was 127.1±26.4 (mean ± sd) and open ovariohysterectomy was

43.8 ± 14.6 in female dogs.

Uson *et al.* (1992) used 10 mm telescope and other instruments such as scissors, grasping forceps, endo-clips and a clip applicator to perform ovariectomy in female dogs.

Chiu *et al.* (1993) reported that the use of nitrous oxide had limitation during laparoscopic surgery as electrocautery could not be used with insufflation of gases that support combustion.

Gross *et al.* (1993) measured the effects of abdominal insufflations with nitrous oxide on cardio-respiratory values and stated that cardio-respiratory changes associated with laparoscopy, although significant are minimal and did not preclude its use if insufflation pressure did not exceed 20 mmHg.

Mullet *et al.* (1993) stated that because of more solubility of CO_2 gas used for insufflation the risk of fatal gas embolism was reduced but increased CO_2 content in blood was noticed. Authors also stated that controlled ventilation was therefore necessary to avoid high arterial CO_2 concentration in animals with anaesthesia induced respiratory depression.

Thiele *et al.* (1993) carried out laparoscopic ovariectomy in female dogs and maintained intra-abdominal pressure between 8 and 15 mmHg with flow rate of 1 to 3 litres per min of CO_2 for laparoscopic stapled gastropexy in dogs. Authors used three 10 mm trocars on each side of flank with a 10 mm telescope.

Saravanan (1996) and Dharmaceelan *et al.* (2000) sterilized the laparoscopic instruments in closed formalin chamber for period of 24 hours were further soaked in 1.5% solution of chlorhexidine solution for 30 minute prior to use and were rinsed with sterile water and wiped dry with sterile gauze.

Tanya *et al.* (1996) observed mild but no significant cardiopulmonary changes during insufflations with CO_2 gas pressure of 15 mmHg in healthy, normovolumic, adequately ventilated dogs. The authors also reported that mild hemodynamic changes were due to mechanical process of insufflating the abdomen. The authors preferred arterial blood gas analysis for critical patient and capnogram for medium sized dog without cardiopulmonary disease to monitor hypercarbia.

Minami *et al.* (1997) used a 10/12 mm camera port with a blunt visual trocar, 10 mm laparoscope with a 3 CCD video camera and a light source for laparoscopic assisted ovariohysterectomy in dogs with pyometra. The authors used three other 10/12 mm ports. Authors maintained pneumoperitoneum with CO_2 at 10 $mmHg/cm^2$ pressure by an inflation device.

Valocky *et al.* (1999) used veress needle, a set of trocar and canulas in the range of 0.5 to 1.5 cm rigid metal probe, endo-pean forceps, endo-scissor, titanium clips and endo-stapler and extra corporal orsilon technique with non traumatic units and adapter for laparoscopic sterilization by three different techniques in female dogs.

Dharmaceelan *et al.* (2000) performed laparoscopic ovariectomy by maintaining intra-abdominal pressure of 15 mmHg using CO_2 at the flow rate of 4 litres per min

before trocarization and 2 litres per min after trocarization for laparoscopic ovariectomy. Authors used 3 six mm trocars and one 11 mm trocar for each side of flank for laparoscopic ovariectomy in female dogs. Other instruments used were 5 mm forward oblique laparoscope, grasping forceps, clip applicator, titanium endo-clips, scissors and electrocautery unit and CO_2 insufflators.

Kumar *et al.* (2007) insuflated the abdomen with CO_2 to an intra-abdominal pressure of 12 mmHg for dogs weighing 12 to 14 kg and 14 mmHg for dogs weighing 15-18 kg body weight. Authors used 10 mm trocar for median port at umbilicus and two 5 mm paramedian trocar approximately 5 cm caudolateral to median port on either side.

Mayhew and Brown (2007) performed laparoscopic assisted ovariohysterectomy in female dogs by maintaining abdominal pressure 10-15 mmHg with CO_2. The authors also used 5 mm 0^0, 29 cm laparoscope and instrument ports of 6 mm.

Ranganath and Kumar (2007) performed laparoscopic ovariohysterectomy by positioning dogs in dorsal recumbency with elevated pelvis (30^0) and all limbs were secured separately and ribcage was supported by sand bags. The authors used 12-14 mmHg CO_2 for insufflations of abdomen.

Shirodkar *et al.* (2008) used three 5 mm peri-umbilical midline ports for laparoscopic oophorectomy in dogs. Authors used heavy grasper, Maryland forceps, laparoscopic scissor, monopolar electrocautery for electro-coagulation of ovarian vessels.

Gower and Mayhew (2008) stated that the essential instrumentation for laparoscopic ovariohysterectomy included a laparoscope video imaging system,

mechanical gas insufflators and light source, trocar cannula assemblies and various laparoscopic forceps and an adjustable surgical table capable of tilting laterally.

Holey (2010) performed laparoscopic ovariohysterectomy by maintaining intra-abdominal pressure of 12 mmHg using CO_2 at the flow rate of 4 litres per min before trocarization and 2 litres per min after trocarization for laparoscopic ovariohysterectomy. Authors used two 5 mm trocars and one 10 mm trocar for laparoscopic ovariohysterectomy in female dogs. Other instruments used were 5 mm forward oblique laparoscope, grasping forceps, clip applicator, titanium endo-clips, scissors and electrocautery unit and CO_2 insufflators.

Rivier *et al.* (2011) used one median portal (10 mm) at the umbilicus and two lateral portals (5 mm and 10 mm), one on each side of the mammary glands and the abdomen was insufflated with CO_2 (6 L/min) to an intra-abdominal pressure of 8 to 12 mmHg. A 10-mm zero degree telescope was inserted in the umbilical portal. The two other cannulas were inserted under endoscopic guidance.

2.5 Patient evaluation

2.5.1 Clinical parameters

Hancock *et al.* (2005) performed ovariohysterectomy by harmonic scalpel assisted laparoscopic and stated that difference in temperature, heart rate and respiratory rate might have been falsely affected and directly attributed to the excitement of dog-human interaction.

Shirodkar *et al.* (2008) studied physiological parameter *viz*., rectal temperature, pulse rate, respiratory rate after laparoscopic oophorectomy and found significant decrease during post-operative assessment.

Holey (2010) compared laparoscopic electrocoagulation and endostapling techniques of ovariohysterectomy in female dogs and stated that there was a non significant variation in temperature, heart rate and respiratory rate.

2.5.2 Hematobiochemical parameters

Schmidt and Booker (1982) reported significant elevation in total leukocyte count, serum cortisol and aspartate amino transferase level up to 72 hours following ovariohysterectomy in bitches.

Muir and Hubbel (1991) stated that the decrease in erythrocyte count after induction of anaesthesia was due to relaxation of splenic capsule leading to pooling of erythrocytes in the spleen of dogs.

Millis *et al.* (1992) studied post-operative haematological profiles of dogs undergoing ovariohysterectomy and stated that post-operative leukocyte differential counts were typical of stress leukograms, and were characterized by leukocytosis, neutrophillia, lymphopenia and eosinopenia. Mild decrease in packed cell volume, red blood cell count and haemoglobin concentration were consistent with minor blood loss during surgery or fluid retention and haemodilution post-operatively. Authors concluded that celiotomy and routine ovariohysterectomy in healthy dogs did not alter haematological profiles 24 hours after surgery.

Dharmaceelan *et al.* (2000) reported significant reduction in red blood cell count during surgery and post-operative day, with no significant difference in packed cell volume, haemoglobin, neutrophil, lymphocyte, eosinophil, basophil and monocyte between pre and post-operative levels.

Austin *et al.* (2003) reported that the difference between pre and post-operative creatine kinase which underwent laparoscopic ovariohysterectomy and stated that creatine kinase was not predictable indicator of surgical stress.

Shirodkar *et al.* (2008) reported fluctuation in total erythrocyte count, haemoglobin concentration, packed cell volume and erythrocyte sedimentation rate during immediate post-operative evaluation.

Holey (2010) reported that there was a non significant variation in haematological and biochemical parameters and a statistically non-significant decreased in total erythrocyte and might be due to the reason of minimum blood loss during the surgical procedure in both groups.

2.6 Advantage and limitations of laparoscopy

Wildt and Lawler (1985) stated that sterilization of pets by laparoscopic techniques required a large initial capital investment, and brief training for proper use of equipment.

Cushieri (1991) listed the advantages of laparoscopic surgery in human beings viz., reduced tissue trauma, less postoperative pain, better cosmetic results, and quicker return to normal function and shorter hospitalization time.

Palmer (1993) stated that ovariectomy in horse by laparoscopy provided improved visibility, secured haemostasis with minimal surgical morbidity, decreased post-operative discomfort and rapid healing.

Thiele *et al.* (1993) stated that the advantages of laparoscopic sterilization in bitches were absence of large abdominal incision, reduction in post-operative wound pain and rapid normalization of general well being after surgery.

Ragle and Schneider (1995) observed that laparoscopic surgical methods have been associated with decreased patient morbidity, greater patient satisfaction and improved intra-operative observation and manipulation of viscera in horses.

Valocky *et al.* (1999) stated that advantage of laparoscopy was an immediate possibility of recording on video system, compact disc or phonograph. The author also reported that laparoscope provided an authentic panoramic picture of cavity observed.

Richter (2001) reported that failure to complete a procedure was always a possibility with laparoscopy, the clinician should not be afraid to convert the procedure to an open laparotomy if necessary. Author also stated that higher the experience, complication will be rare.

Austin *et al.* (2003) stated that superior visualization was provided by the ability of laparoscopic camera to get close to structure and magnify the image to the desired level.

Davidson *et al.* (2004) stated that disadvantages of laparoscopic ovariohysterectomy were requirement of more than one surgeon, patient size limitation and equipment cost.

Devitt *et al.* (2005) and Hancock *et al.*, (2005) stated that laparoscopic assisted ovariohysterectomy caused less pain and surgical stress compared with open ovariohysterectomy in female dogs.

Rivier *et al.* (2011) stated that the laparoscopic procedure were advantages over open laparatomy by low morbidity and low risk of suture dehiscence.

2.7 Complication of laparoscopy

Peterson and Behrman (1971) reported that exploratory laparotomy required in five patients to identify and control bleeding during laparoscopic sterilization. Authors also reported that bleeding occurred during electro-cutting as the cut was beyond the coagulated area and there was also a gastric perforation due to wrong trocarization.

Beverly and Anson (1987) reported fatal air embolism due to inadvertent penetration of veress needle into spleen during insufflations with nitrogen gas in a dog.

Nord (1992) stated that common complication encountered during human laparoscopic surgery was hypercapnia, decreased cardiac output, emphysema, gas emboli, bowel perforation and haemorrhage and coagulation injury.

Hardie *et al.* (1996) reported spleenic puncture, stomach perforation and residual subcutaneous emphysema as the complications encountered after laparoscopic stapled

gastropexy in dogs. Authors also suggested that improper placement of cannula could result in damage to internal organs with immediate problems such as haemorrhage or delayed problem such as peritonitis from a perforated hollow organs.

Freeman and Handrickson (1998) stated that use of endoscopic loop sutures increase the surgical cost and the risk for intraoperative complications, including trauma to friable adipose tissue, tearing of the vascular pedicle and accidental ligation of ureter.

Brun *et al.* (2000) performed laparoscopic ovariohysterectomy in dogs and stated that the most common intra-operative complication was haemorrhage with one death and one animal required shifting to exploratory celiotomy.

Materials and Methods

III. MATERIALS AND METHODS

3.1 Selection of Animals

Twelve healthy female dogs presented to Department of Surgery and Radiology, Veterinary College Hospital, Hebbal, Bangalore, for ovariohysterectomy above 6 months of age and body weight which ranged from 12 to 18 kg were included for this study. All the female dogs were subjected to clinical examination and hematobiochemical tests to assess their fitness for the surgery. Only female dogs found fit with normal body parameters were selected for surgery. All selected female dogs were housed in hygienic kennels and dewormed seven days before surgery.

Selected female dogs were randomly divided into two groups *viz*., six dogs each of Group A and Group B.

Group A - Six female dogs were subjected for ovariohysterectomy by laparoscopic endo-stapling method under Sevoflurane anesthesia.

Group B - Six female dogs were subjected for ovariohysterectomy by laparoscopic endo-suturing method under Sevoflurane anesthesia.

3.2 Instrumentation

i. Pneumoperitoneum needle (Veress needle) of 10 cm length with spring-mounted blunt inner cannula (Plate 1).

ii. Laparoscopic trocar and cannula (Plate 2).

a) One trocarless threaded cannula with multifunctional valve and insufflations stopcock of 6 mm diameter and 8.5 cm working length (Plate 2 a).

b) Trocars with pyramidal tip of 5 mm diameter and 8.5 cm working length along with cannula, multifunctional valve and insufflations stop cock (Plate 2 b).

c) One trocar with pyramidal tip of 10 mm diameter and 10.5 cm working length along with cannula, multifunctional valve and insufflations stop cock (Plate 2c).

iii. Telescope: Forward oblique telescope (30°) of 5 mm diameter and 29cm of working length incorporated with fiber optic transmission (Plate 3).

iv. One dissecting and grasping forceps: 5 mm in diameter and 36 cm length with insulation (Plate 4 a).

v. One Grasping forceps: Jaws with 2×4 teeth and 5 mm in diameter and 36 cm length with insulation (Plate 4 b).

vi. One curved, serrated scissors: 5 mm in diameter and 36 cm length with insulation (Plate 5 a).

vii. One bipolar coagulating forceps: 5 mm in diameter and 33 cm length with insulation (Plate 5 b).

viii. Endostapler: 10 mm in diameter and 33 cm length (Plate 6).

ix. Endo-staple: medium large size made of titanium (Plate 7).

x. One Laproscopic needle holder: 5 mm in diameter and 33 cm in length with ratchet, jaws curved left, for use with suture material size 1-0 and 7-0 (Plate 8 a).

xi. One Endoloop push rod: 5mm in diameter cannula with push rod for pre-tied endo-loop application (Plate 8 b).

xii. Electronic Carbon dioxide endoflator: Unit is electronically equipped to monitor, maintain and control a constant preset intra-abdominal pressure. This is capable of delivering gas flow of up to 0 to 20 litres per minute. It contains digital indicators for patient intra-abdominal pressure up to 0 to 30 mmHg (Plate 9).

xiii. Electrocoagulation unit: Consist of a main cord, silicon rubber patient plate, pedal foot switch, connecting cords and two control switches with bipolar maximum output of 125 watts for coagulation (Plate 10).

xiv. Light source: Cold light fountain halogen 250 twin lamps of 250 watts with fibre optic cable of 3.5 mm diameter and 180 cm of length were used (Plate 11).

xv. Veterinary Video Camera III: consist of integrated digital fiberscope filters, connecting cable, C- mount lens and vet-c mount camera head (Plate 12).

xvi. Documentation unit: Consist of Karl Storz AIDA^{TM} control with DVD/CD writer, frame grabber board, slot bracket, Karl Storz AIDA^{TM} 2.0 software, Karl Storz USB stick, inter base Desktop, connecting cable, S-video connecting cable and main cord (Plate 13).

3.3 Sterilization of instruments

All the laparoscopic instruments used were cleaned with 10% ethyl alcohol and kept in closed formalin chamber (Plate 14) with formaldehyde tablets for a period of 24 hours and just prior to use the instruments were rinsed in sterile water and wiped dry with

Plate 1. Pneumoperitoneum needle (Veress needle)

Plate 2. a) Trocarless threaded 6 mm cannula

b) Two 5 mm trocar and cannula

c) 10 mm trocar and cannula

Plate 3. Forward oblique telescope (30°)

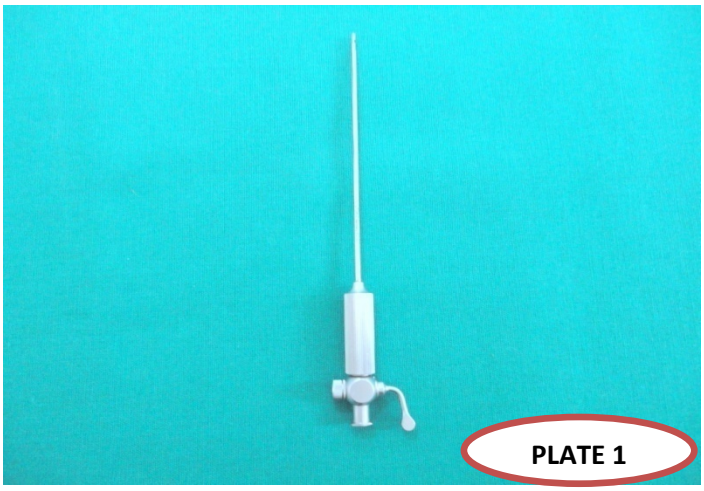
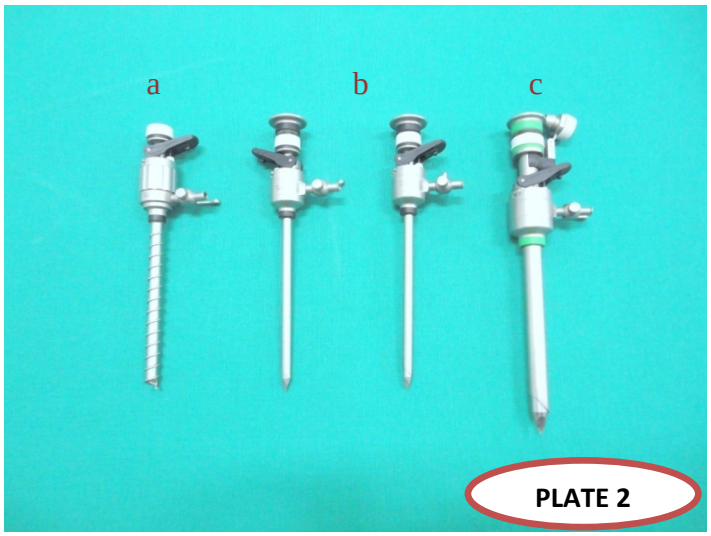


PLATE 1


a
b
c
PLATE 2

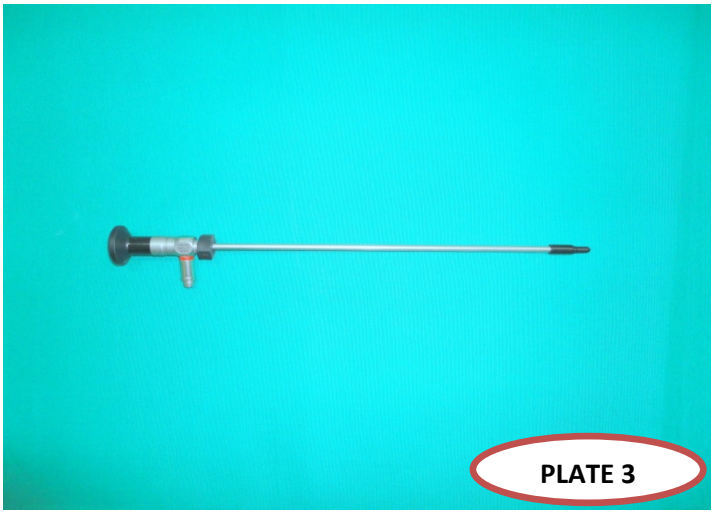


PLATE 3

Plate 4. a) Dissecting forceps

b) Grasping forceps

Plate 5. a) Curved, serrated scissors

b) Bipolar coagulating forceps

Plate 6. Endostapler

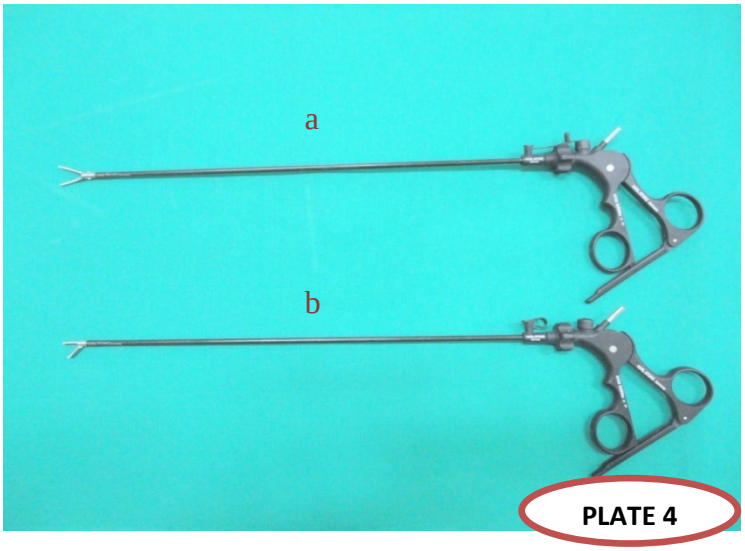

a
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PLATE 4

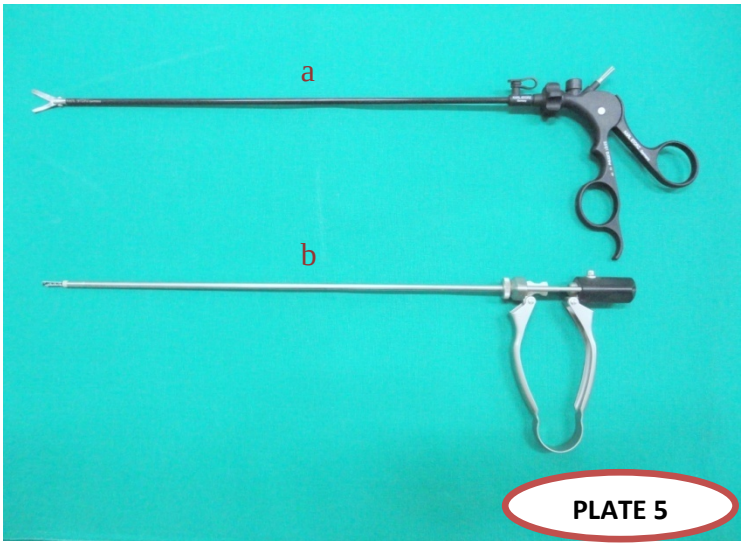
a
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PLATE 5

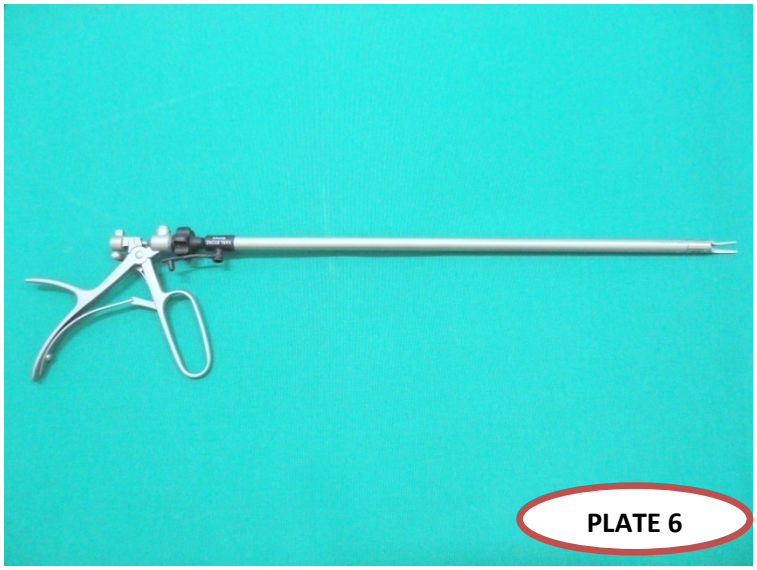


PLATE 6

Plate 7. Titanium Endo-staple

Plate 8. a) Laproscopic needle holder

b) Endoloop push rod

Plate 9. Electronic Carbon dioxide endoflator

Plate 10. Electrocoagulation unit

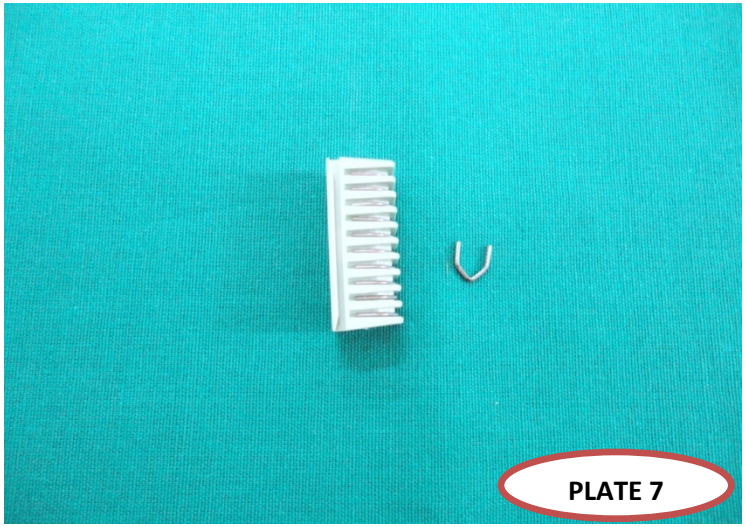


PLATE 7

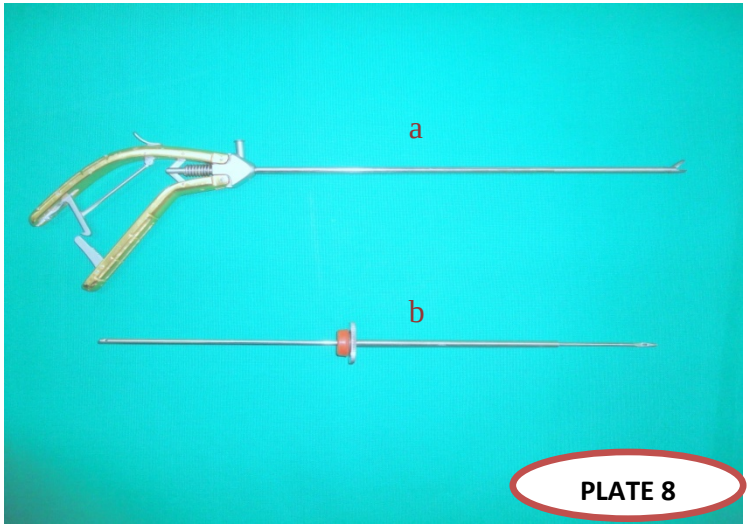


PLATE 8

PLATE 9

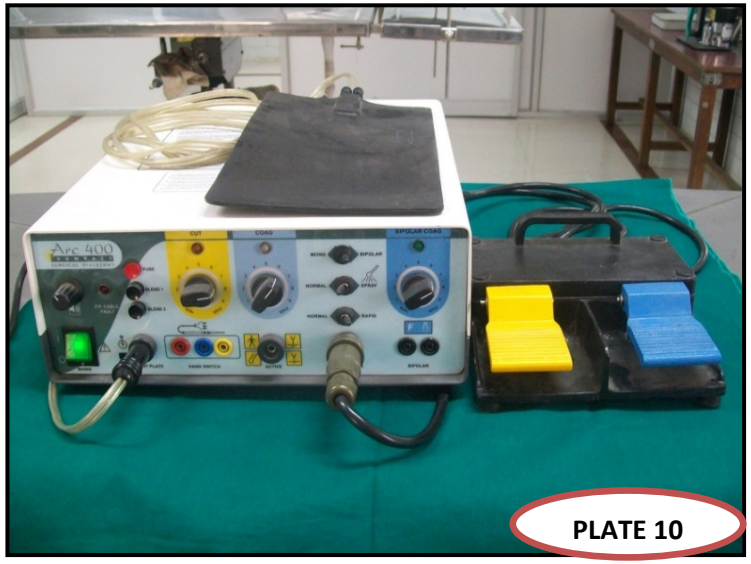


PLATE 10

Plate 11. Light source

Plate 12. Veterinary Video Camera III

Plate 13. Documentation unit

Plate 14. Closed formalin chamber

PLATE 11

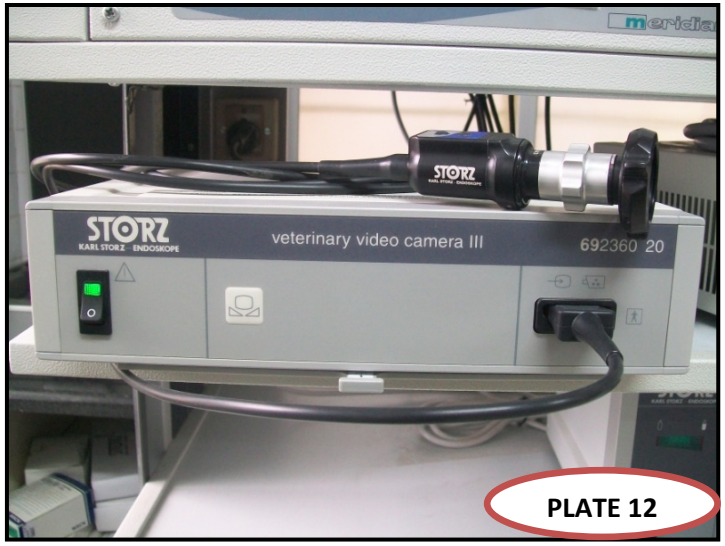


PLATE 12

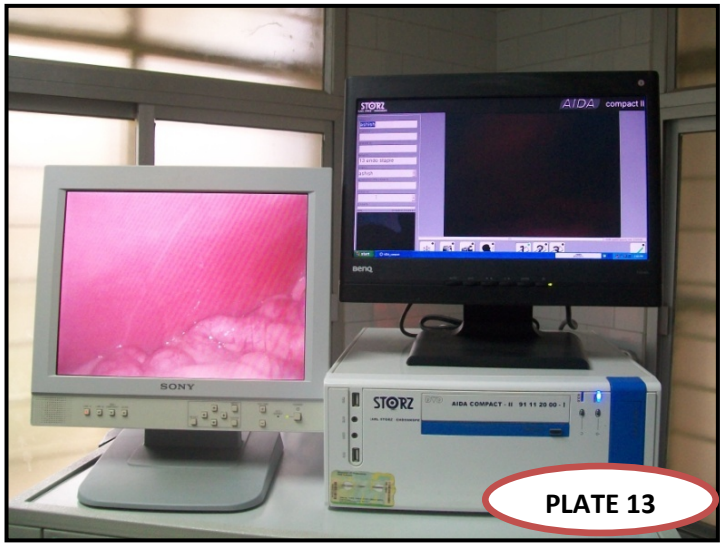


PLATE 13

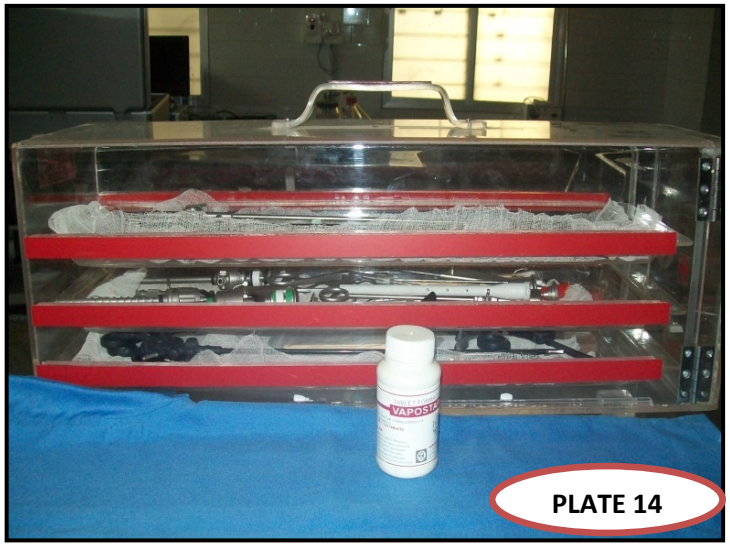


PLATE 14

sterile gauze. All general surgical instruments used were sterilized by autoclave at 121° C, 15lbs psi for 15 minutes.

3.4 Procedure

3.4.1 Preparation of animal and surgical site

All the female dogs were restricted solid food for 12 hours and water for four hours before the surgery. Warm soap water enema was administered two hours before to surgery.

Urinary bladder was emptied by catheterization just prior to induction of anaesthesia. For both groups, ventral abdomen (from xiphoid to os pubis) was prepared for aseptic laparoscopic surgery.

3.4.2 Anaesthetic protocol

All the dogs of both the group were premedicated with atropine sulphate (Atropine sulphate® injection IP. (0.6mg/ml), Harson Laboratories, Akota, Baroda - 20) 0.04 mg/kg body weight subcutaneously and Diazepam (Calmpose® Injection IP (10mg/2ml), Ranbaxy Laboratories Limited, Nihalgarh, H.P-25) 1mg/kg body weight intravenously. After 20 minutes, general anesthesia was induced and maintained by Sevoflurane (Sevorane® Inhalation anesthetic, Abbot India Ltd, Mumbai).

3.4.3 Positioning and placement of ports

All the dogs in both the group were positioned in dorsal recumbency with elevated hind quarters (30°) (Plate 17). All the limbs were secured separately and ribcage

was supported by sand bags. All the dogs were anesthetised with sevoflurane anesthesia by mask induction and later intubated with endotracheal tube which was connected to the Sevoflurane anesthesia (Plates 15 & 16). A small slit was made at umbilicus and subcutaneous tissue was separated bluntly. A spring loaded pneumoperitoneum needle was inserted into the abdomen followed by insufflation using carbon dioxide gas to an intra-abdominal pressure of 12 mmHg for dogs weighing 12-18 kg (Plate 18 & 19).

Immediately after establishment of pneumoperitoneum to a 12 mmHg intra-abdominal pressure, veress needle was removed. Median port was made by introducing 5 mm trocar at umbilicus into the abdomen directing trocar tip dorsally to avoid injury to visceral organs. The tube from carbon dioxide endoflator was connected to median port, trocar was removed. Telescope (5 mm, 30°) was inserted into the median port, abdominal wall and visceral organ were inspected for any puncture or bleeding. Two more paramedian ports were made approximately five cm caudo-lateral to median port on either side by inserting one 5 mm and one10 mm trocar which were used as instrumental port (Plates 20 a, b & c). In Group B animals, another median port was made eight centimeters from first median port by inserting 5 mm trocar which was used as instrumental port (Plates 21 a, b, c & d).

3.4.5 Laparoscopic ovariohysterectomy by endostapling method

Visceral organs (Plate 22) were manipulated by alligator and grasping forceps. To locate left ovary, animal was slightly turned towards right side and vice versa for right ovary by manipulating the angle of the operating table. Ovarian bursa was easily located

Plate 15. Induction of sevoflurane anaesthesia

Plate 16. Endotracheal intubation

Plate 17. Positioning of the animal in dorsal recumbency with elevated pelvis (30^0)

Plate 18. Insertion of Veress needle

Plate 19. Insufflation of abdomen with carbon dioxide

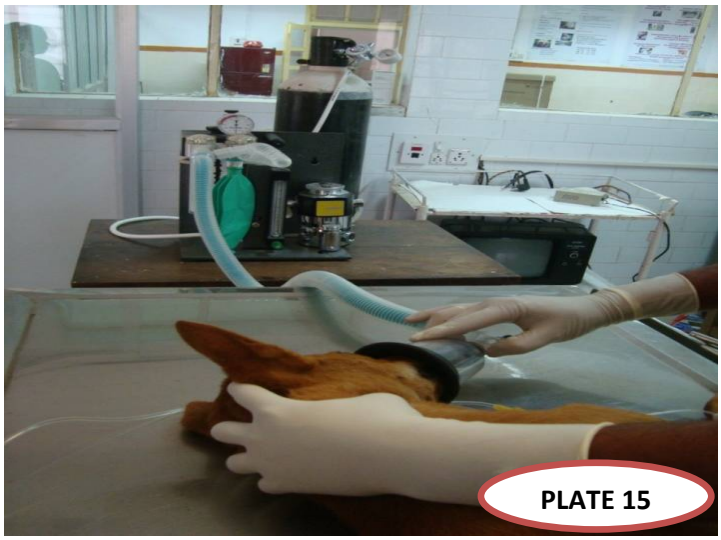


PLATE 15

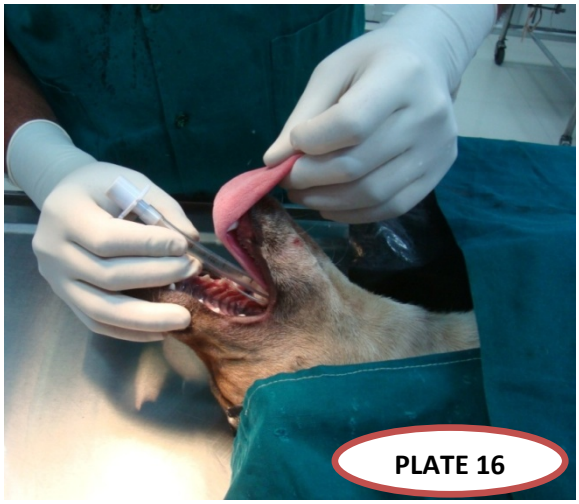


PLATE 16

PLATE 17

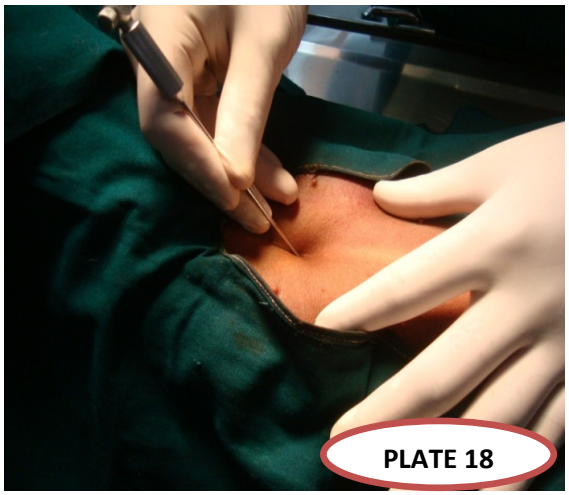


PLATE 18

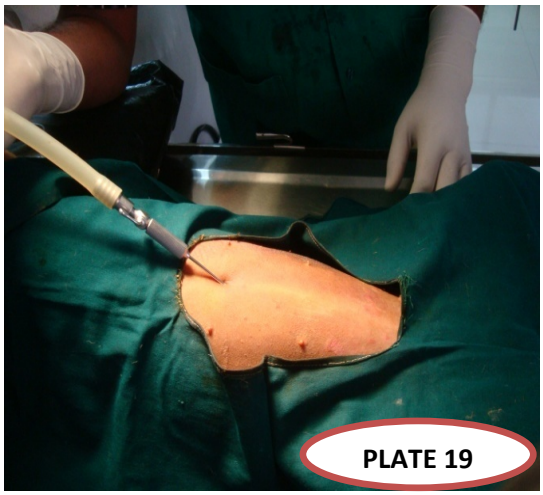


PLATE 19

Plate 20. Group A: Insertion of trocars, one median (a) and two paramedian port with telescope and grasping forceps (b & c).

Plate 21. Group B: Insertion of trocar at umbilicus (a), two paramedian port with telescope and grasping forceps (b & c) and one port 8cms from umbilicus (d).

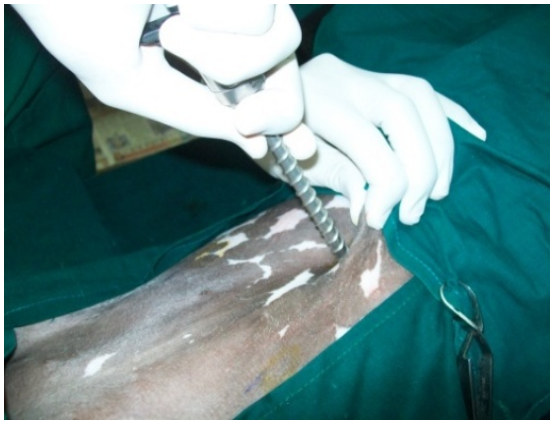


PLATE 20 a

PLATE 21 a

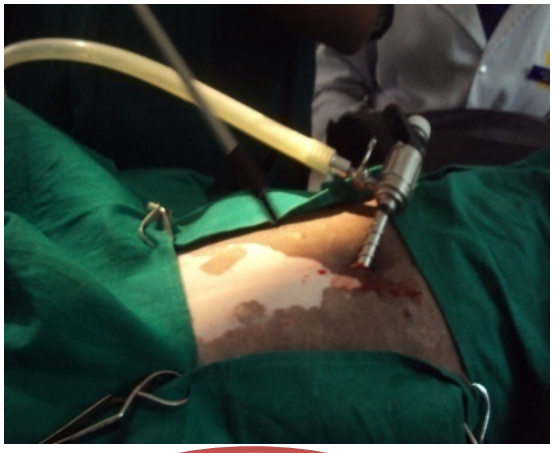


PLATE 20 b

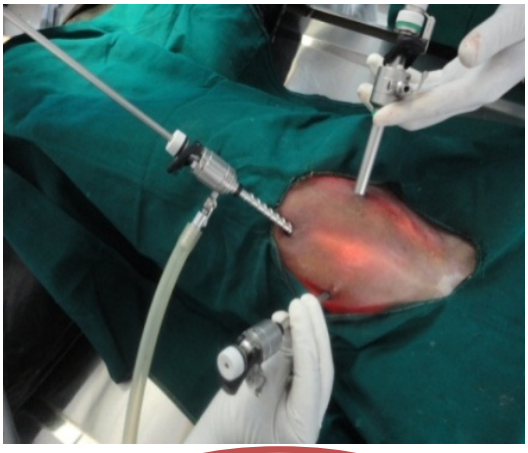


PLATE 21 b

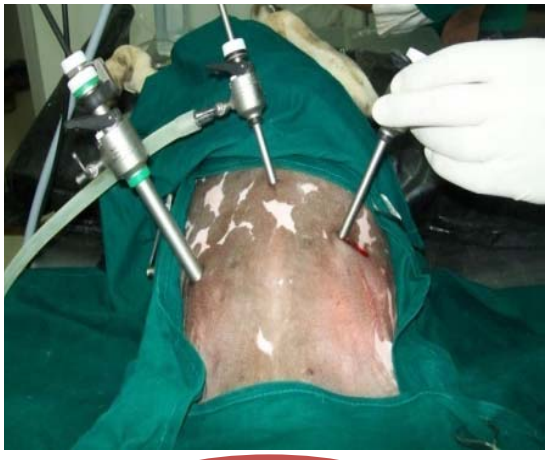


PLATE 20 c

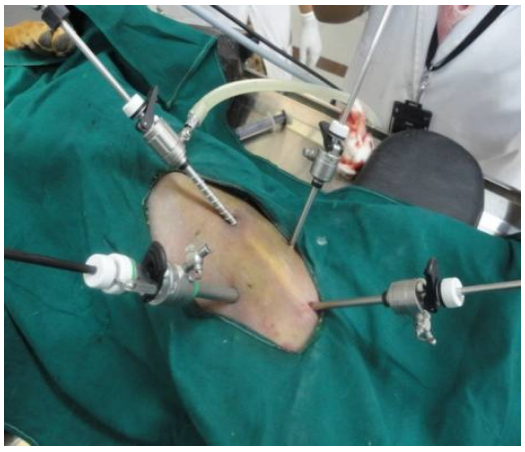


PLATE 21 c

just caudal to the kidney (Plate 23). In some cases ovaries were traced from uterine body end, slowly moving towards uterine horn and ovarian bursa.

Ovarian pedicle was located and two rows of staples were applied (Plate 24) by endo-stapler followed by cutting using laparoscopic scissor in between two staples (Plate 25). Care was taken to avoid damage to the kidney. The opposite side ovarian pedicle was also cut as described above. The uterine horns and body were separated from broad ligament by mild traction using grasping forceps and laparoscopic scissor.

Uterine arteries and the uterine body just cranial to cervix were stapled by two rows of staples (Plate 26) followed by cutting using laparoscopic scissors (Plate 27). The entire genital tract was held using grasping forceps and removed through 10 mm port (Plate 34). Slit wound was approximated by single simple interrupted suture using nonabsorbable suture monofilament polyamide number 0.

3.4.6. Laparoscopic ovariohysterectomy by endosuturing method

Visceral organs were manipulated by dissecting and grasping forceps. To locate left ovary, animal was slightly turned towards right side and vice versa for right ovary by manipulating the angle of the operating table. Ovarian bursa was easily located just caudal to the kidney. In some cases ovaries were traced from uterine body end, slowly moving towards uterine horn and ovarian bursa.

Ovarian pedicle was located and meso-ovarian was cauterized by bipolar electrocautery (Plate 28), three ligatures were made using polyglactin 910 No. 1-0 below the left ovary by intracorporeal knot technique (Plate 29 a & b) followed by cutting using

Plate 22. Visualization of abdominal viscera

Plate 23. Grasping of ovarian bursa

Plate 24. Application of endo-staple at ovarian pedicle (Group A)

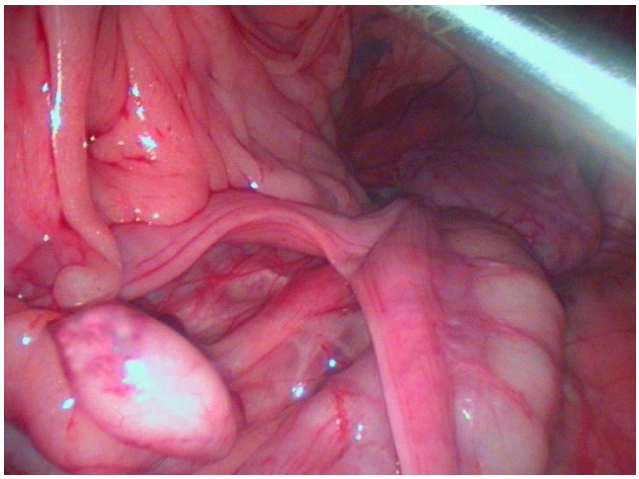


PLATE 22

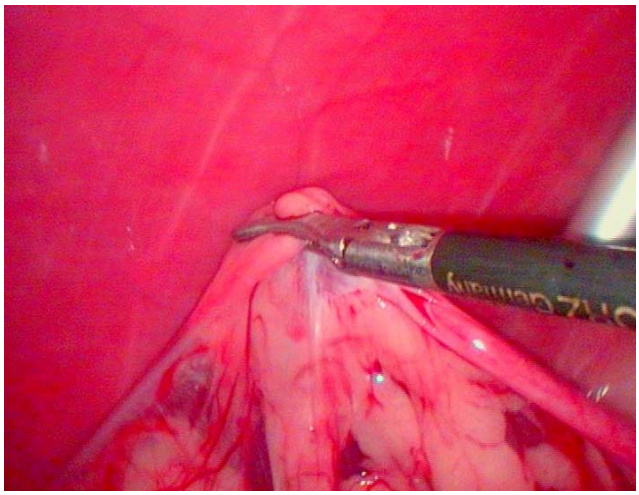


PLATE 23

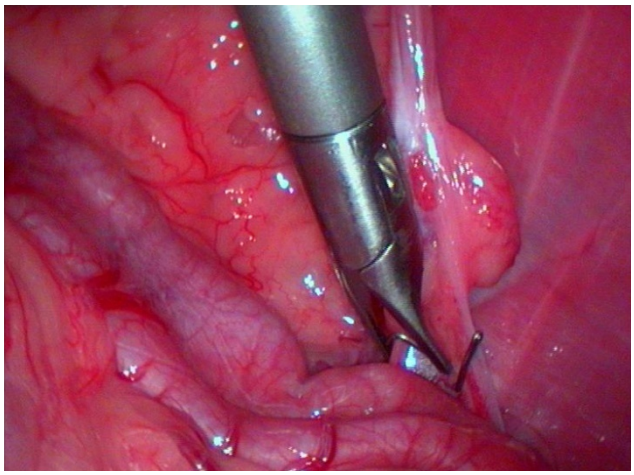


PLATE 24

Plate 25. Cutting of ovarian pedicle in between two staples (Group A)

Plate 26. Application of staples at cervical end of uterus (Group A)

Plate 27. Cervical end after cutting (Group A)

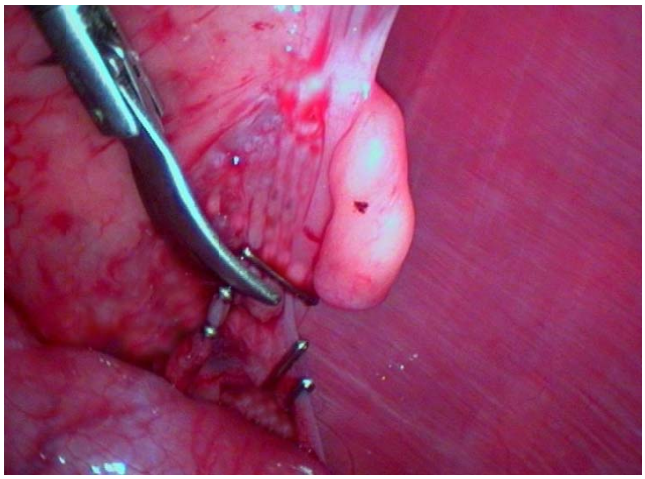


PLATE 25

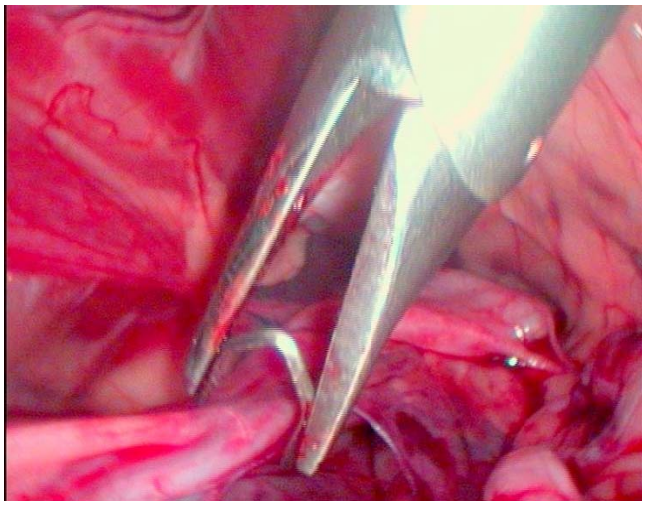


PLATE 26

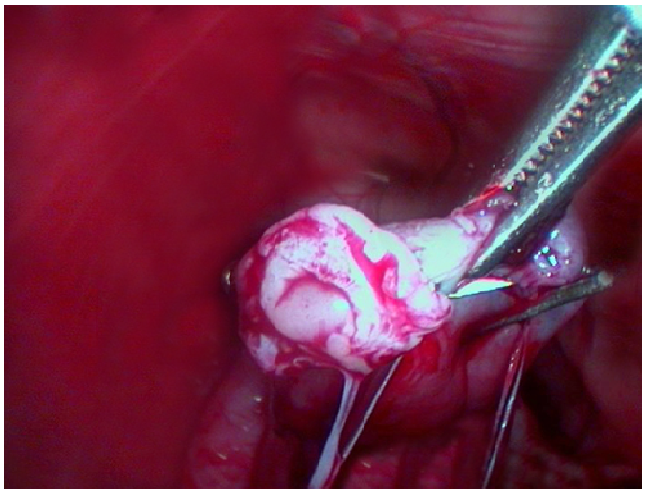


PLATE 27

Plate 28. Cauterization of broad ligament (Group B)

Plate 29. Making a loop (a) and ligation of ovarian end (b) (Group B)

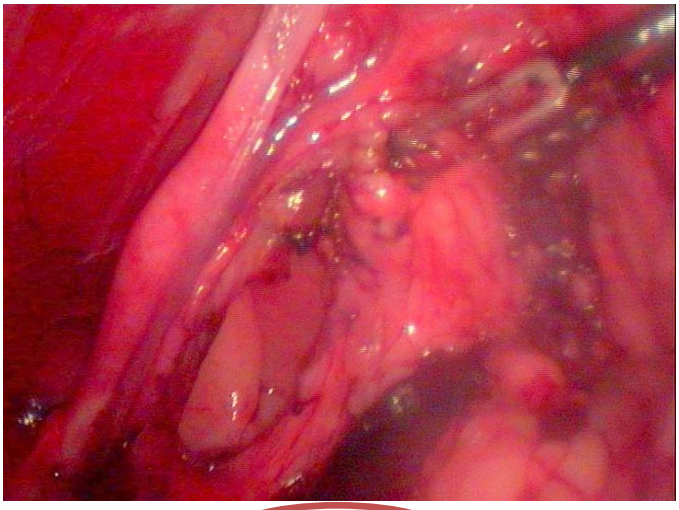


PLATE 28

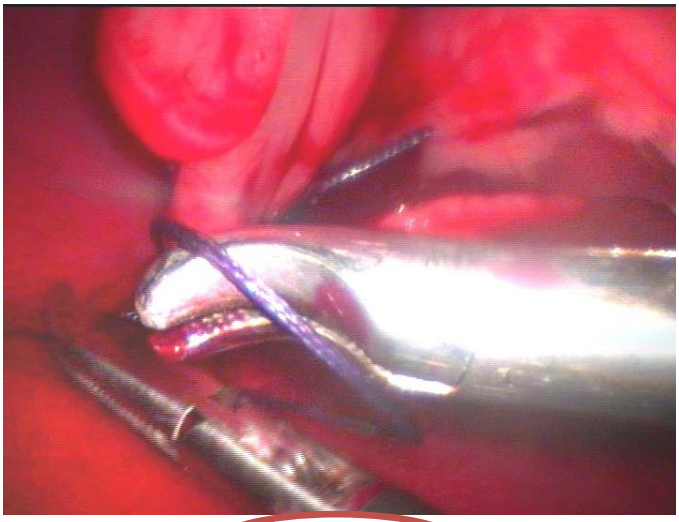


PLATE 29 a

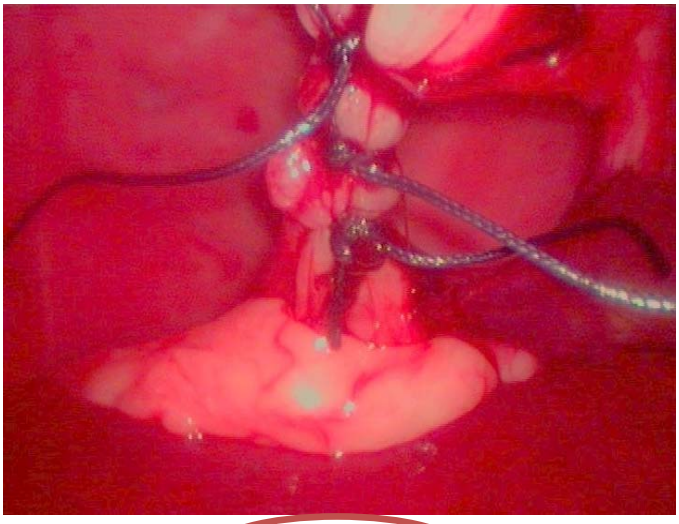


PLATE 29 b

laparoscopic scissor in between the ligatures (Plate 30). Care was taken to avoid damage to the kidney. The opposite side ovarian pedicle was also cut as described above.

Uterine arteries and the uterine body just cranial to cervix were ligated (Plate 31) by making three ligatures, using polyglactin 910, No. 1-0 by intracorporeal knot technique, followed by cutting using laparoscopic scissors (Plate 32). The entire genital tract was held using grasping forceps and removed through 10 mm port (Plate 34). Slit wound was approximated by single simple interrupted suture using nonabsorbable suture monofilament polyamide No. 1-0.

Post-operatively Ceftriaxone sodium (Intacef® inj, 500 mg vial, Intas Pharmaceticals Ltd., Ahamedabad – 380009) was administered at the dose rate of 20 mg/kg body weight, twice daily to all female dogs for three days along with regular wound dressing with povidone iodine.

3.5 Parameters studied

3.5.1 Clinical investigation

Rectal temperature ($^{\circ}$F), heart rate (per min) and respiratory rate (per min) were recorded before surgery, 24, 48, 72 hours and 7^{th} day after surgery in all the female dogs of group A and B.

3.5.2 Haematological investigation

Haemoglobin (g%), Total erythrocyte count (10^6/cmm), Total leukocyte count (10^3/cmm) and Differential leukocyte count (%) were estimated by standard methods (Benjamin, 1998) by collecting 2ml of blood from cephalic vein in EDTA vial

Plate 30. Cutting of ovarian end in between two ligations (Group B)

Plate 31. Ligation of cervical end of uterus (Group B)

Plate 32. Cutting of cervical end in between two ligations (Group B)

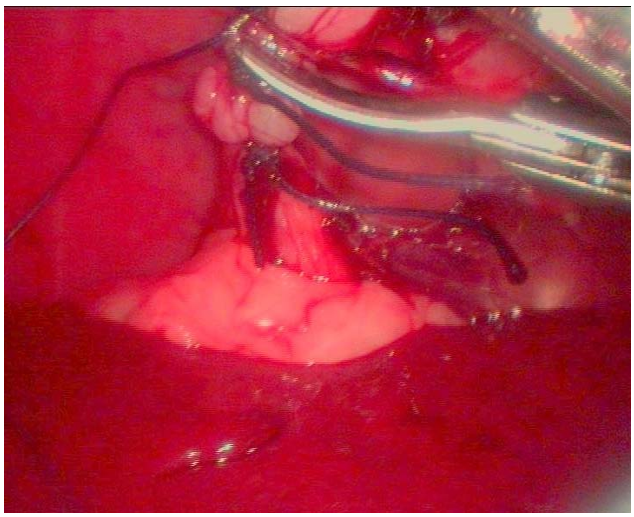


PLATE 30

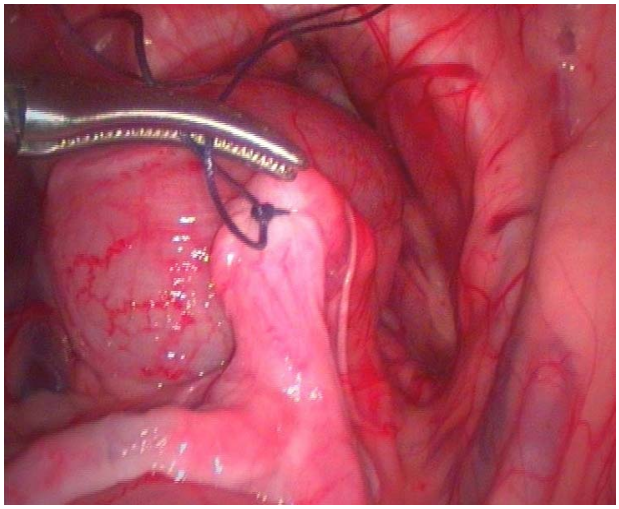


PLATE 31

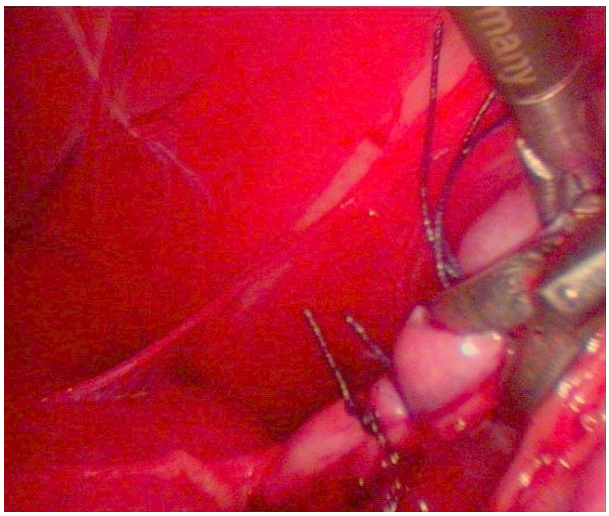


PLATE 32

Plate 33. Cervical end after cutting (Group B)

Plate 34. Removal of entire organ through 10 mm port

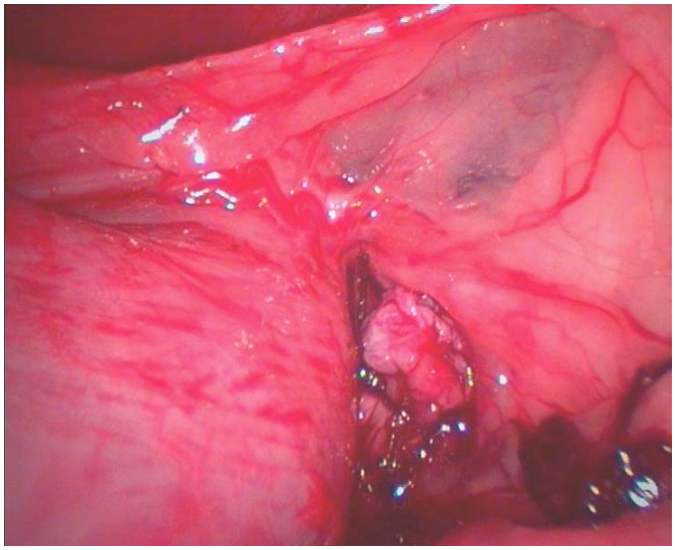


PLATE 33

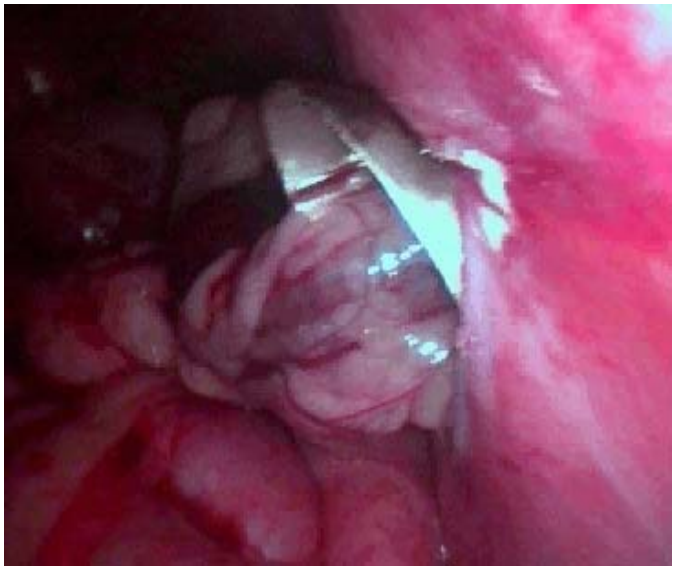


PLATE 34

at 0, 24, 48, 72 hours and 7th day after surgery. Haematological parameters were analysed on the same day of collection.

3.5.3 Biochemical investigation

Blood samples were collected and serum was separated at 0, 24, 48, 72 hours and 7th day after surgery, for estimation of serum alanine amino transferase (IU/L), serum aspartate amino transferase (IU/L) and serum creatinine (mg/dL) by standard method (Henry, 1979), using ARTOS biochemical analyzer (M/s. Swemed diagnostic, Bangalore) using respective diagnostic kit as per the manufacturer's instruction.

All the results of clinical, haematological and biochemical studies were statistically analyzed by unpaired t-test, using computer based statistical programme Graph pad prism, and interpreted as per the procedure described by Snedecor and Cochran (1996) to arrive at conclusion.

Results

IV. RESULTS

The present study was undertaken on twelve healthy female dogs presented to Department of Surgery and Radiology, Veterinary College Hospital, Hebbal, Bangalore, for ovariohysterectomy and the results of the study are presented under the following headings.

4.1 Selection, preparation and positioning of animals

Twelve healthy dogs aged above six months and ranging in body weight from 12 to 18 kg were selected for the present study. All the dogs were subjected to clinical examination and hematobiochemical test to assess their fitness for surgery. The selected dogs were randomly divided into two groups.

Restriction of solid food for 12 hours and water intake for four hours before surgery was appropriate in all 12 female dogs. Administration of soap water enema two hours prior to surgery and catheterization of urinary bladder just prior to anaesthetic administration facilitated good visualization and easy manipulation of visceral organs.

Dorsal recumbency with elevated pelvis (30˚) along with tilting of animal towards right while manipulating the left ovary and vice versa provided good visualization of ovaries and eased ovariohysterectomy.

4.2 Sterilization of instruments

Laparoscopic instruments were cleaned with 10 % ethyl alcohol and kept in closed formalin chamber with formaldehyde tablets for a period of 24 hours and rinsing

the instruments and wiping them dry with sterile gauze was adequate to prevent local and systemic infection in dogs of both the group.

4.3 Premedication and anaesthesia

Premedication was done with atropine sulphate at a dose rate of 0.04 mg/kg body weight sub-cutaneously and diazepam @ 1 mg/kg body weight intravenously. After 20 minutes, general anaesthesia was induced and maintained with sevoflurane. Administration of atropine sulphate reduced salivary secretion. Pre-anaesthesia with diazepam provided good sedation. Induction of anaesthesia was smooth and uneventful. No intra-operative anaesthetic complications were noticed in any of the cases. All the dogs also had a smooth recovery from the anaesthesia. The anaesthetic protocol followed was satisfactory for the surgical intervention.

4.4 Intra-abdominal pressure

12 mmHg intra-abdominal pressure for insufflation of intra-abdominal cavity in female dogs weighing 12-18 Kg body weight provided better visualization of abdominal organs and easy manipulation of laparoscopic instruments inside the abdominal cavity.

4.5 Surgical site

Three portal sites (one median port 5 mm, two paramedian one 10 mm and other 5 mm ports) of Group A and four port site (two median ports 5 mm, two paramedian ports one 10 mm and other 5 mm ports) in Group B were adequate to visualize, access and remove the ovaries and uterus in all the female dogs.

4.6 Haemostasis

In Group A, medium large size endo-staple made of titanium provided appropriate occlusion of vessel lumen and haemostasis.

In Group B, endo-sutures of intracorporeal knot using polyglactin-910 provided appropriate occlusion of vessel lumen and haemostasis.

4.7 Duration of procedures

The mean time (mins) taken for surgical procedure (from skin incision to skin suturing) in Group A and Group B were 56.00 ± 1.93 and 96.10 ± 3.54 respectively. There was a statistically significant ($p < 0.05$) difference in duration of surgical procedure between Group A and Group B (Fig. 1).

4.8 Intra-operative complication

No surgical complications were noticed in any of the dogs of Group A during surgery but slippage of knot at the cervical end was observed in one dog in Group B animals during surgery and it was religated with pre-tied endoloop suture.

4.9 Post-operative care and observation

Post-operatively Ceftriaxone sodium was administered at the dose rate of 20 mg/kg body weight, twice daily to all dogs for three days along with regular wound dressing with povidone iodine. The cutaneous wound healed within 7 days. Animals of both groups recovered uneventfully (Plates 35 & 36).

Plate 35. Group A: Closure of portal sites (a), Wound healing on 3rd day (b) and Wound healing on 7th day (c)

Plate 36. Group B: Closure of portal sites (a), Wound healing on 3rd day (b) and Wound healing on 7th day (c)

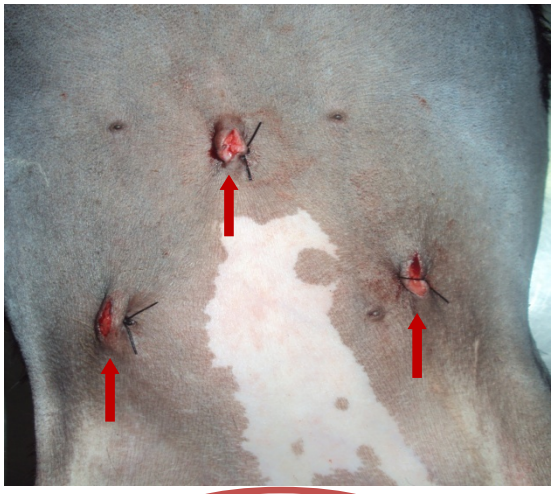


PLATE 35 a

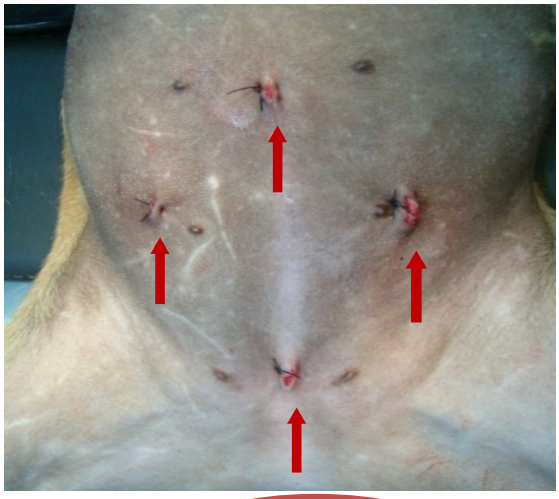


PLATE 36 a

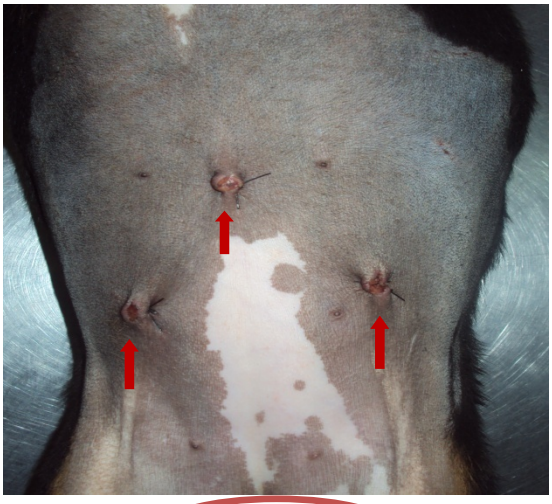


PLATE 35 b

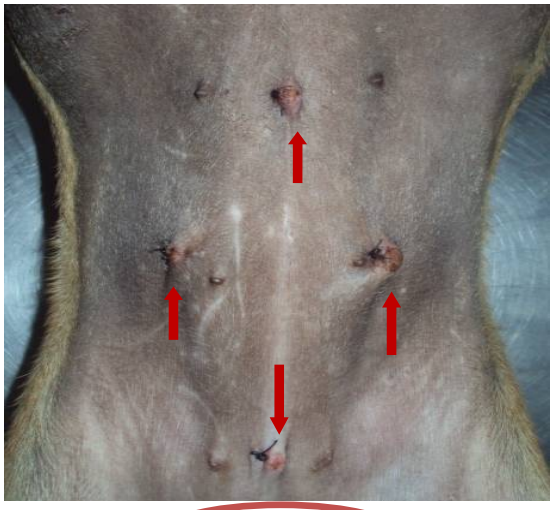


PLATE 36 b

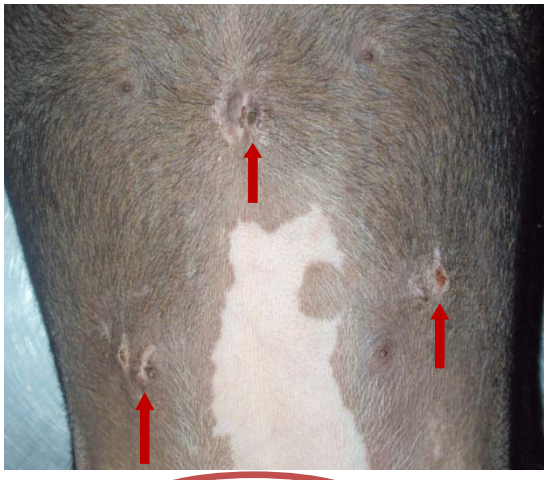


PLATE 35 c

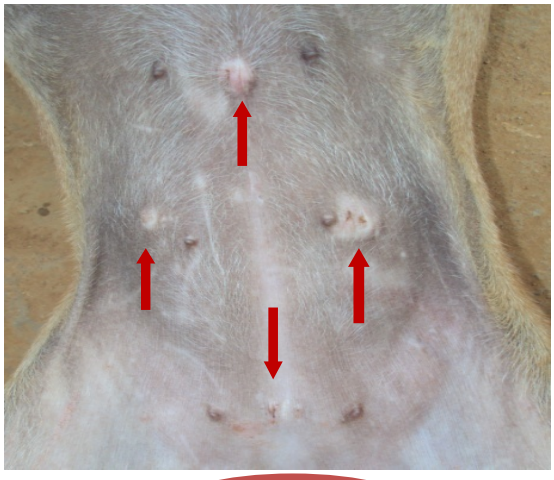


PLATE 36 c

An uneventful recovery of all animals indirectly entitled about the safety of both the ovariohysterectomy procedures. The laparoscopic wound healed completely by day seven. During seven post-operative days, the female dogs resumed the normal activity without any complication. It was observed that strict aseptic surgery, optimum antibiotics in addition to close care and monitoring of the patient during post-operative period might have contributed significantly towards well being of the dogs.

4.10 PARAMETERS

4.10.1 Clinical evaluation

4.10.1.1 Rectal temperature (°F)

In Group A, pre-operative rectal temperature (mean ± SE) was 101.00 ± 0.08 and post-operatively temperature ranged from 100.98 ± 0.14 to 102.56 ± 0.08.

In Group B, the mean value of pre-operative rectal temperature was 100.80 ± 0.21; post-operatively it ranged from 100.88 ± 0.20 to 102.55 ± 0.04 (Table 1, Fig. 2).

Further, within the Group and between the groups the changes in mean values of rectal temperature were statistically non-significant ($p > 0.05$).

4.10.1.2 Respiratory rate (breath per min)

In Group A, pre-operative respiratory rate (mean ± SE) was 21.16 ± 0.54. Post-operatively it ranged from 22.50 ± 0.99 to 24.66 ± 0.42 and the values were within the normal range.

In Group B, the mean value of the pre-operative respiratory rate was 22.50 ± 0.42 and post-operatively it ranged from 22.00 ± 0.36 to 24.50 ± 0.22 and the values were in the normal range (Table 1, Fig. 3).

The variations in the mean values of respiratory rate within the Group and between the groups were statistically non-significant ($p > 0.05$).

4.10.1.3 Heart rate (beats per min)

In Group A, pre-operative heart rate (mean ± SE) was 98.33 ± 0.61. Post-operatively it ranged from 97.66 ± 0.33 to 104.00 ± 1.63 and the values were within the normal range.

In Group B, the mean value of the pre-operative heart rate was 98.33 ± 0.54 and post-operatively it ranged from 97.33 ± 0.84 to 103.00 ± 0.68 and the values were in the normal range (Table 1, Fig. 4).

The variations in the mean values of heart rate within the Group and between the groups were statistically non-significant ($p > 0.05$).

4.10.2 Haematological parameters

4.10.2.1 Haemoglobin (g %)

In Group A, the mean value of pre-operative haemoglobin level was 11.66 ± 0.21 and post-operatively it ranged from 10.33 ± 0.21 to 12.33 ± 0.33 however the values were within the normal range.

TABLE 1: Mean ± SE values of Rectal temperature, Respiratory rate and Heart rate in dogs of Group A and B.

TIME INTERVAL	TEMPERATURE (°F)		RESPIRATORY RATE (per min)		HEART RATE (beats/per min)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	101.00 ± 0.08	100.80 ± 0.21	21.16 ± 0.54	22.50 ± 0.42	98.33 ± 0.61	98.33 ± 0.54
24 H	102.56 ± 0.08	102.55 ± 0.04	24.66 ± 0.42	24.50 ± 0.22	104.00 ± 1.63	103.00 ± 0.68
48 H	101.56 ± 0.09	101.86 ± 0.08	22.66 ± 0.33	22.16 ± 0.30	100.00 ± 0.73	99.33 ± 0.66
72 H	101.03 ± 0.09	101.45 ± 0.10	22.50 ± 0.99	22.00 ± 0.36	98.66 ± 0.98	97.33 ± 0.84
7^{th} Day	100.98 ± 0.14	100.88 ± 0.20	23.83 ± 0.30	22.33 ± 0.49	97.66 ± 0.33	99.33 ± 0.42

Figure 1: Duration of procedure (min) in dogs of Group A and B.

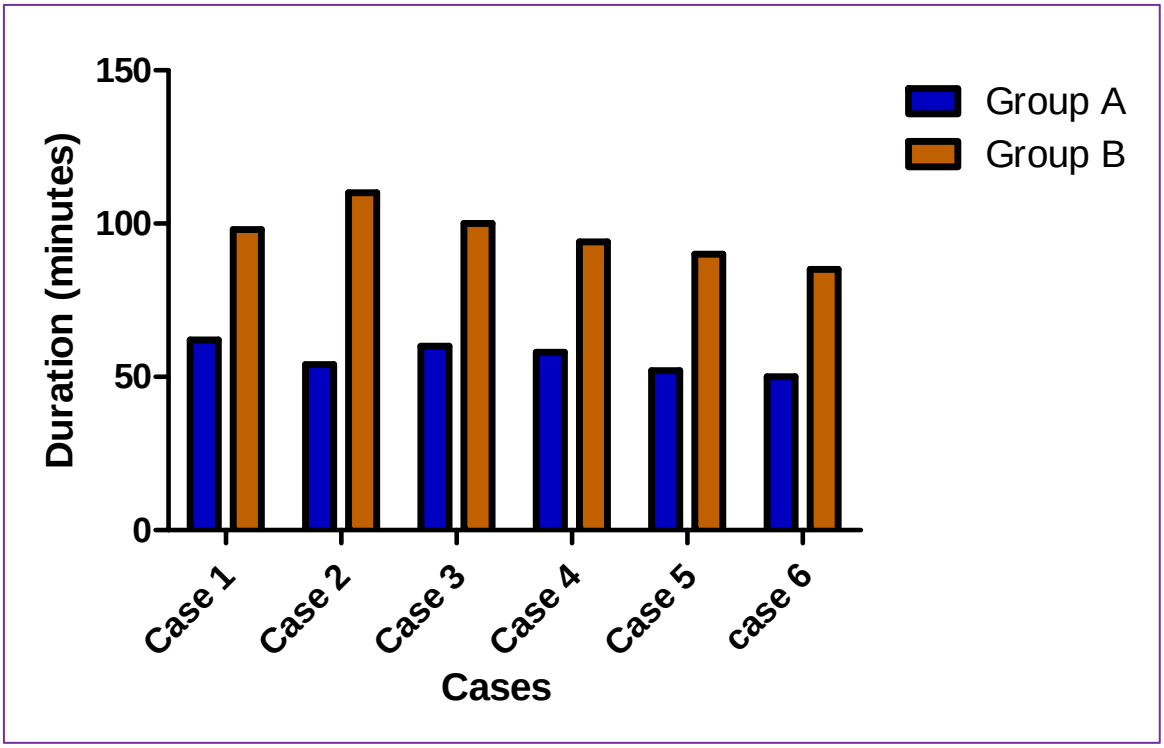


Figure2: Mean ± SE values of Rectal Temperature (˚F) in dogs of Group A and B.

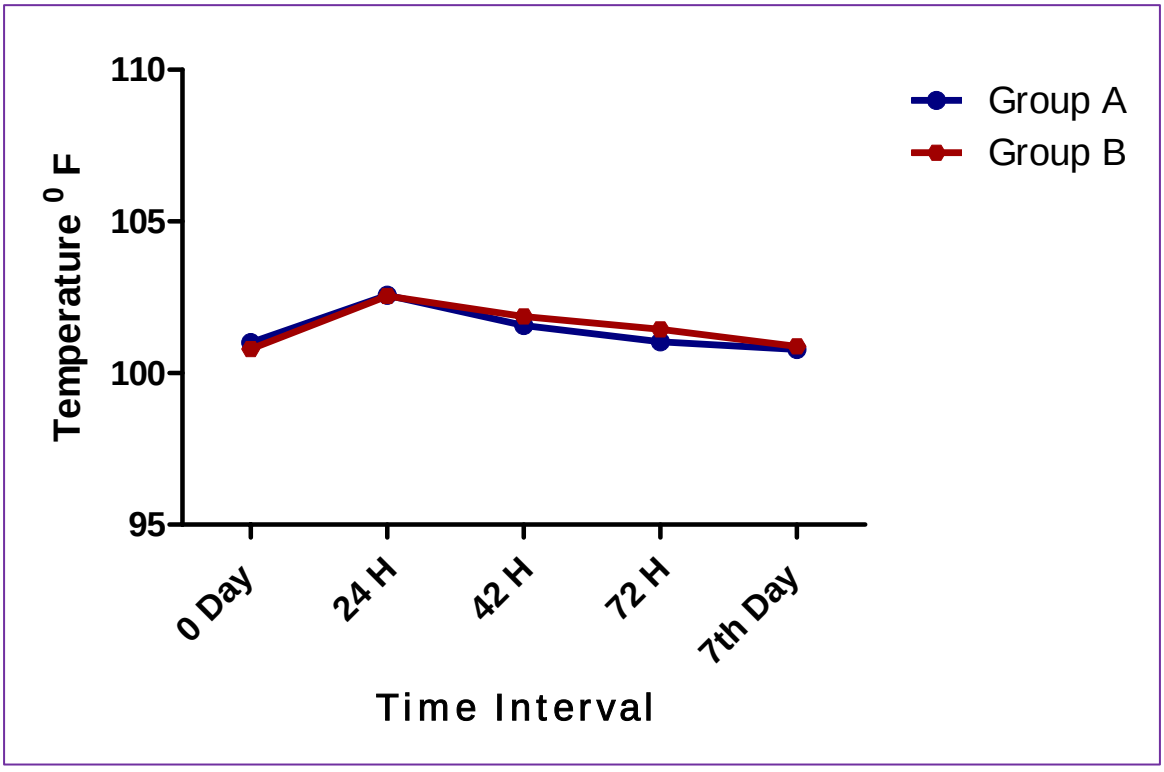


Figure 3: Mean ± SE values of Respiratory rate in dogs of Group A and B.

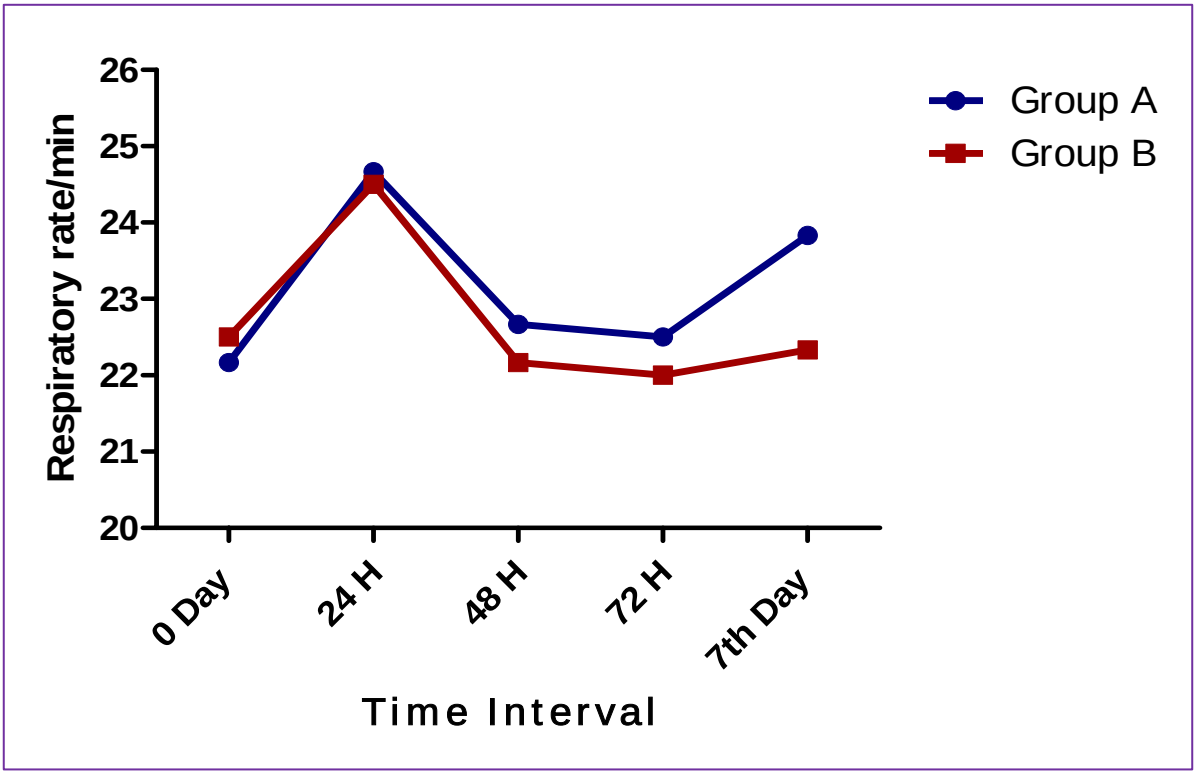
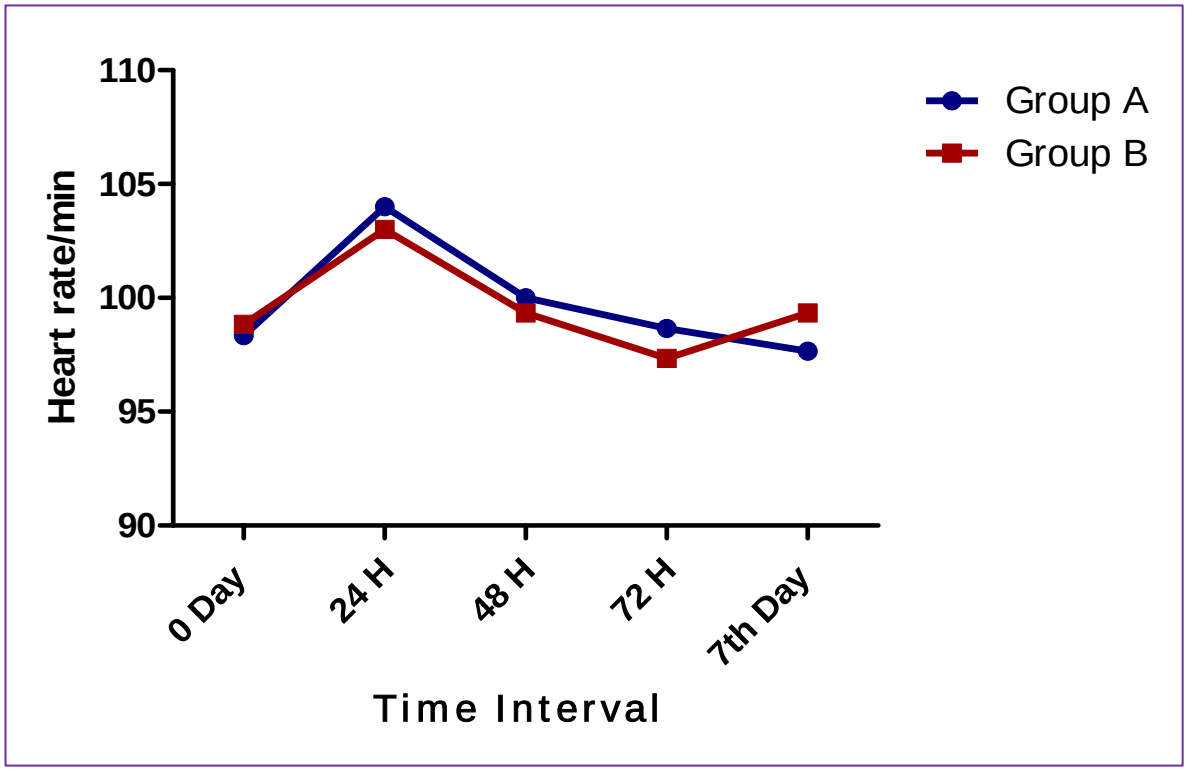


Figure 4: Mean ± SE values of Heart rate in dogs of Group A and B.



In Group B, the mean value of pre-operative haemoglobin level was 11.50 ± 0.34 and post-operatively it ranged from 11.00 ± 0.36 g % to 11.83 ± 0.47**,** however the values were within the normal range (Table 2, Fig. 5).

The variations in the mean values of haemoglobin within the groups and between the groups were statistically non significant ($p > 0.05$).

4.10.2.2 Total erythrocyte count (10^6 Cells/mm^3)

In Group A, the mean value of pre-operative total erythrocyte count level was 7.08 ± 0.04 and post-operatively it ranged from 6.98 ± 0.01 to 7.26 ± 0.11, however the values were within the normal range.

In Group B, the mean value of pre-operative total erythrocyte count level was 7.10 ± 0.03 and post-operatively it ranged from 6.88 ± 0.03 to 7.21 ± 0.08; however the values were within the normal range (Table 2, Fig 6).

The variations in the mean values of total erythrocyte count within the groups and between the groups were statistically non-significant ($p > 0.05$).

4.10.2.3 Total leukocyte count (10^3 Cells/mm)

In Group A, the mean value of pre-operative total leukocyte count level was 12.16 ± 0.09 and post-operatively it ranged from 12.06 ± 0.07 to 13.95 ± 0.27, however the values lie within the normal range.

TABLE 2: Mean ± SE values of Haemoglobin, Total erythrocyte count and Total leukocyte count in dogs of Group A and B.

TIME INTERVAL	HAEMOGLOBIN (g %)		TOTAL ERYTHROCYTE COUNT (10^6 Cells/mm^3)		TOTAL LEUKOCYTE COUNT (10^3 Cells/mm)	
	Group A	**Group B**	**Group A**	**Group B**	**Group A**	**Group B**
0 Day	11.66 ± 0.21	11.50 ± 0.34	7.08 ± 0.04	7.10 ± 0.03	12.16 ± 0.09	11.95 ± 0.09
24 H	10.33 ± 0.21	11.00 ± 0.36	7.26 ± 0.11	6.88 ± 0.03	13.95 ± 0.27	13.95 ± 0.27
48 H	12.33 ± 0.33	11.83 ± 0.47	7.10 ± 0.03	7.20 ± 0.05	12.70 ± 0.06	13.30 ± 0.18
72 H	12.16 ± 0.30	11.50 ± 0.61	7.03 ± 0.03	7.21 ± 0.08	12.46 ± 0.07	12.76 ± 0.20
7^{th} Day	11.83 ± 0.16	11.16 ± 0.40	6.98 ± 0.01	7.16 ± 0.12	12.06 ± 0.07	12.50 ± 0.21

Figure 5: Mean ± SE values of Haemoglobin in dogs of Group A and B.

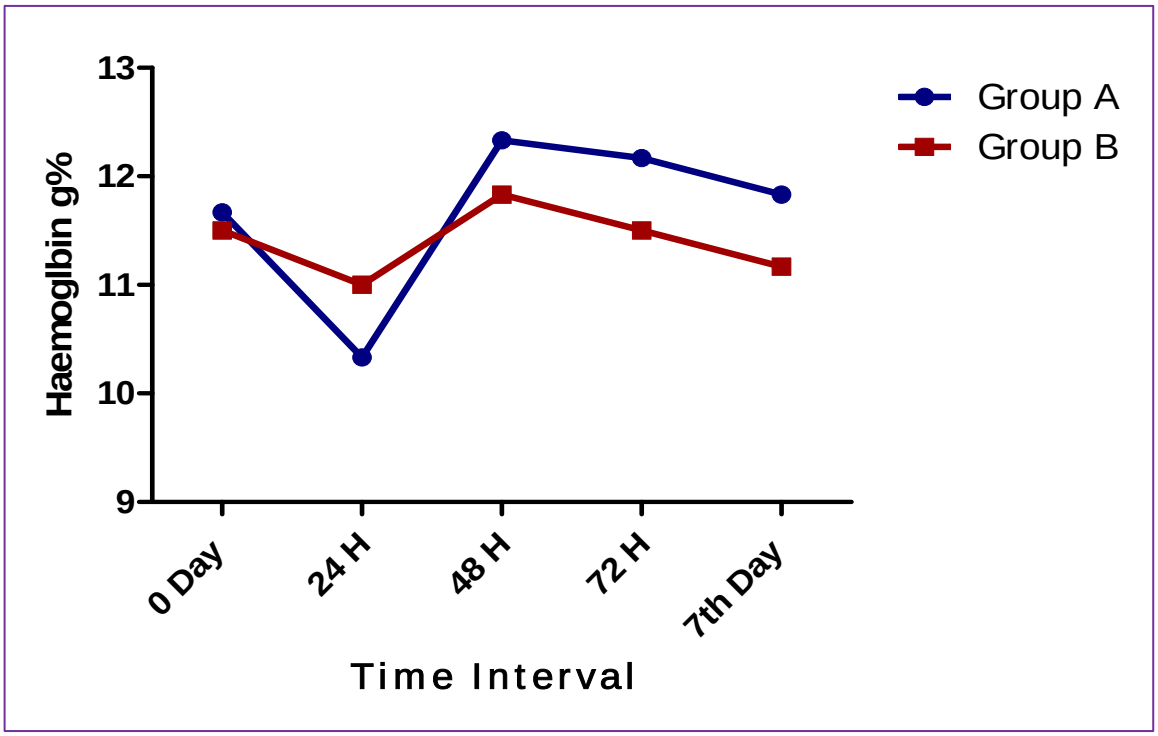
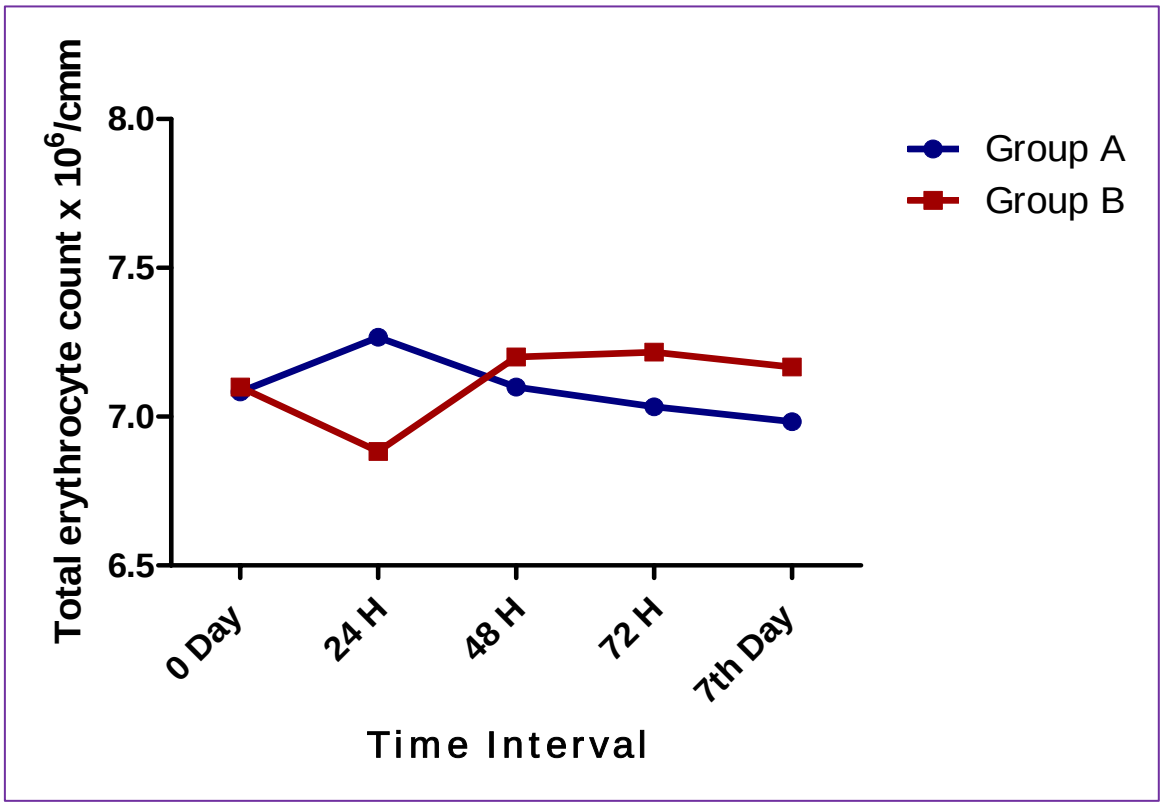


Figure 6: Mean ± SE values of Total erythrocyte count and in dogs of Group A and B.



In Group B, the mean value of pre-operative total leukocyte count level was 11.95 ± 0.09 and post-operatively it ranged from 12.50 ± 0.21 to 13.95 ± 0.27, however the values lie within the normal range (Table 2, Fig 7).

The variations in the mean values of total leukocyte count within the groups and between the groups were statistically non significant ($p > 0.05$).

4.10.2.4 Differential leukocyte count

4.10.2.4.1 Neutrophil (%)

In Group A, the pre-operative percentage value of neutrophils count was 71.00 ± 0.57 (mean ± SE). The mean values of neutrophil per cent post-operatively varied from 71.50 ± 0.42 to 77.66 ± 0.42 and the values were within the normal range.

In Group B, the pre-operative mean value of neutrophils percentage was 70.50 ± 0.42. Post-operatively the mean values of neutrophil percentage varied from 70.83 ± 0.60 to 78.16 ± 0.30 (Table 3, Fig. 8).

Further, within the group and between the groups, the variations in the mean values of neutrophils percentage were statistically non-significant ($p > 0.05$).

4.10.2.4.2 Lymphocyte (%)

In Group A, the pre-operative percentage value of lymphocyte count was 26.83 ±0.54 (mean ± SE). The mean values of lymphocyte percentage post-operatively ranged from 20.16 ± 0.47 to 26.66 ± 0.49 and the values were within the normal range.

TABLE 3: Mean ± SE values of Neutrophil, Lymphocyte and Eosinophil in dogs of Group A and B.

TIME INTERVAL	NEUTROPHIL (%)		LYMPHOCYTE (%)		EOSINOPHIL (%)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	71.00 ± 0.57	70.50 ± 0.42	26.83 ±0.54	27.00 ± 0.51	1.16 ± 0.16	1.50 ± 0.22
24 H	77.66 ± 0.42	78.16 ± 0.30	20.16 ± 0.47	19.00 ± 0.36	1.00 ± 0.25	1.33 ± 0.21
48 H	74.50 ± 0.56	74.50 ± 0.42	23.16 ± 0.47	23.66 ± 0.49	1.00 ± 0.00	0.66 ± 0.21
72 H	72.66 ± 0.21	72.66 ± 0.66	25.00 ± 0.25	25.33 ± 0.66	1.33 ± 0.21	0.83 ± 0.16
7^{th} Day	71.50 ± 0.42	70.83 ± 0.60	26.66 ± 0.49	26.66 ± 0.61	1.00 ± 0.00	1.16 ± 0.16

Figure 7: Mean ± SE values of Total leukocyte count in dogs of Group A and B.

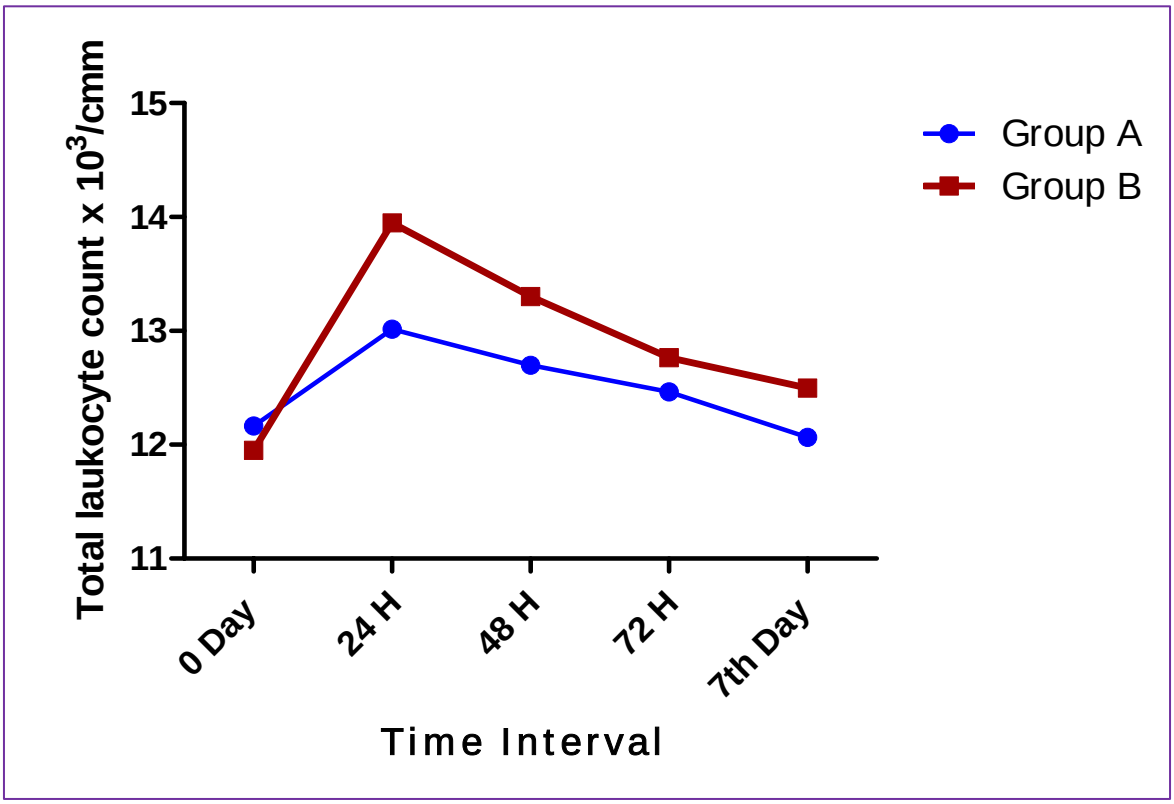
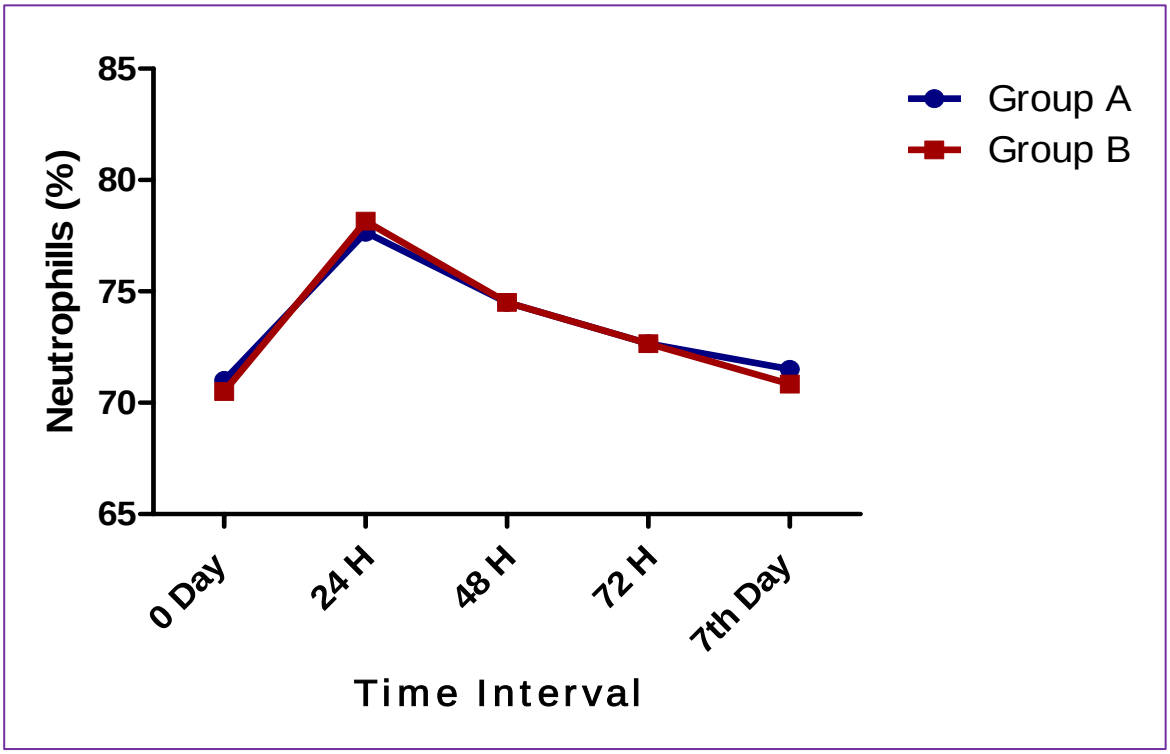


Figure 8: Mean ± SE values of Neutrophils in dogs of Group A and B.



In Group B, the pre-operative mean value of lymphocyte per cent was 27.00 ± 0.51. Post-operatively the mean values of lymphocyte percentage ranged from 19.00 ± 0.36 to 26.66 ± 0.61 (Table 3, Fig. 9).

Further, within the group and between the groups, the variations in the mean values of lymphocyte percentage were statistically non-significant ($p > 0.05$).

4.10.2.4.3 Eosinophil (%)

In Group A, the pre-operative percentage value of eosinophil count was 1.16 ± 0.16 (mean ± SE). The mean values of eosinophil percentage post-operatively ranged from 1.00 ± 0.00 to 1.33 ± 0.21 and the values were within the normal range.

In Group B, the pre-operative mean value of eosinophil percentage was 1.50 ± 0.22. Post-operatively the mean values of eosinophil per cent ranged from 0.66 ± 0.21 to 1.33 ± 0.21 (Table 3, Fig. 10).

Further, within the group and between the groups, the variations in the mean values of eosinophil per cent were statistically non-significant ($p > 0.05$).

4.10.2.4.4 Monocyte (%)

In Group A, the pre-operative percentage value of monocyte count was 1.00 ± 0.00 (mean ± SE). The mean values of monocyte percentage post-operatively ranged from 1.00 ± 0.00 to 1.33 ± 0.21 and the variations were within the normal range.

Figure 9: Mean ± SE values of Lymphocyte in dogs of Group A and B.

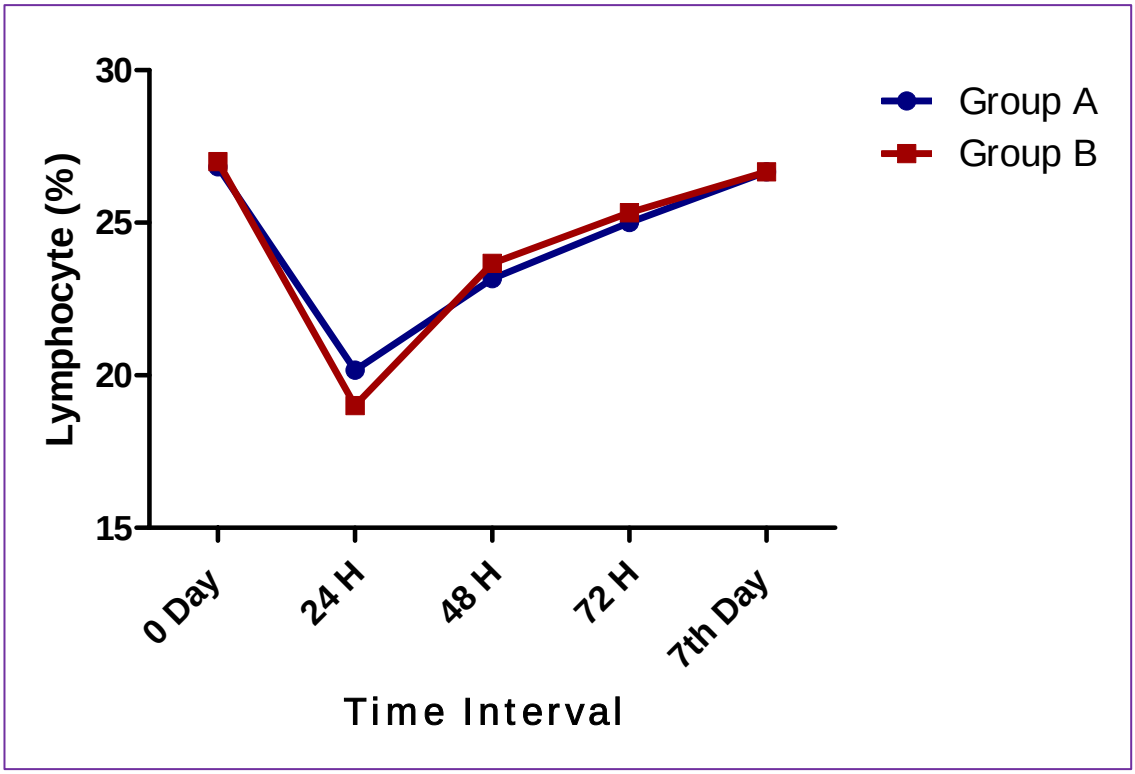
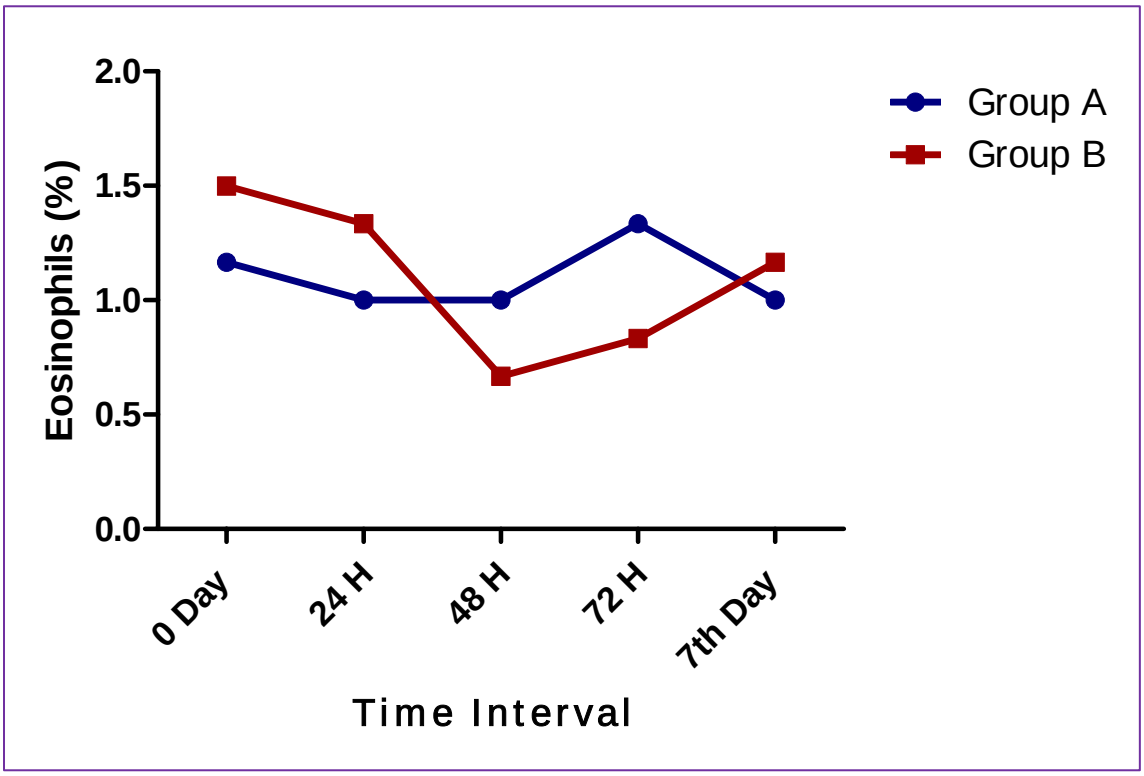


Figure 10: Mean ± SE values of Eosinophil in dogs of Group A and B.



In Group B, the pre operative mean value of monocyte percentage was 1.00 ± 0.00. Post-operatively the mean values of monocyte percentage ranged from 1.00 ± 0.00 to 1.50 ± 0.22 (Table 4, Fig. 11).

Further, within the group and between the groups, the changes in the mean values of monocyte percentage were statistically non-significant ($p > 0.05$).

4.10.2.4.5 Basophil (%)

In Group A, the pre-operative percentage value of basophil count was 0.00 ± 0.00 (mean ± SE). The mean values of basophil per cent post-operatively ranged from 0.00 ± 0.00 to 0.00 ± 0.00 and the variations were within the normal range.

In Group B, the pre-operative mean value of basophil percent was 0.00 ± 0.00. Post-operatively the mean values of basophil per cent ranged from 0.00 ± 0.00 to 0.00 ± 0.00 (Table 4).

Further, within the group and between the groups, the changes in the mean values of basophil per cent were statistically non-significant ($p > 0.05$).

4.10.3 Biochemical parameters

4.10.3.1 Serum alanine aminotransferase (IU/L)

In Group A, the mean value of pre-operative serum alanine aminotransferase level was 30.66 ± 0.42. The mean values of post-operative serum alanine aminotransferase ranged from 30.33 ± 0.33 to 32.66 ± 0.33 and the values were within the normal range.

TABLE 4: Mean ± SE values of Monocyte and Basophil in dogs of Group A and B

TIME INTERVAL	MONOCYTE (%)		BASOPHIL (%)	
	Group A	Group B	Group A	Group B
0 Day	1.00 ± 0.00	1.00 ± 0.00	00.00 ± 00.00	00.00 ± 00.00
24 H	1.16 ± 0.16	1.50 ± 0.22	00.00 ± 00.00	00.00 ± 00.00
48 H	1.33 ± 0.21	1.16 ± 0.16	00.00 ± 00.00	00.00 ± 00.00
72 H	1.00 ± 0.25	1.16 ± 0.16	00.00 ± 00.00	00.0 ± 00.00
7th Day	1.00 ± 0.00	1.00 ± 0.00	00.00 ± 00.00	00.00 ± 00.00

In Group B, the mean value of pre-operative serum alanine aminotransferase level was 29.83 ± 0.60 and post-operatively the mean serum alanine aminotransferase level ranged from 28.66 ± 0.33 to 31.66 ± 0.76 (Table 5, Fig. 12).

Further, between the groups the variations in the mean values of serum alanine aminotransferase level was statistically non-significant ($p > 0.05$).

4.10.3.2 Serum aspartate aminotransferase (IU/L)

In Group A, the mean value of pre-operative serum aspartate aminotransferase level was 34.16 ± 0.30. The mean values of post-operative serum aspartate aminotransferase ranged from 32.50 ± 0.50 to 38.00 ± 0.51 and the values were within the normal range.

In Group B, the mean value of pre-operative serum aspartate aminotransferase level was 33.66 ± 0.49 and post-operatively the mean serum aspartate aminotransferase levels ranged from 33.33 ± 0.84 to 37.33 ± 0.49 (Table 5, Fig. 13).

Further, within the group and between the groups the variations in the mean values of serum aspartate aminotransferase level was statistically non-significant ($p > 0.05$).

4.10.3.3 Serum creatinine (mg/dl)

In Group A, the mean value of pre-operative serum creatinine level was 0.41 ± 0.00. The mean values of post-operative serum creatinine ranged from 0.41 ± 0.00 to 0.47 ± 0.00 and the values were within the normal range.

TABLE 5: Mean ± SE values of serum Alanine amino transferase, serum Aspartate amino transferase and serum Creatinine in dogs of Group A and B.

TIME INTERVAL	ALANINE AMINO TRANSFERASE (IU/L)		ASPARTATE AMINO TRANSFERASE (IU/L)		CREATININE (mg/dL)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	30.66 ± 0.42	29.83 ± 0.60	34.16 ± 0.30	33.66 ± 0.49	0.41 ± 0.00	0.44 ± 0.00
24 H	32.66 ± 0.33	31.66 ± 0.76	38.00 ± 0.51	37.33 ± 0.49	0.47 ± 0.00	0.49 ± 0.00
48 H	30.83 ± 0.47	29.83 ± 0.60	34.66 ± 0.80	35.16 ± 0.47	0.44 ± 0.01	0.46 ± 0.00
72 H	30.50 ± 0.42	28.66 ± 0.71	33.83 ± 0.60	33.50 ± 0.56	0.41 ± 0.00	0.44 ± 0.00
7^{th} Day	30.33 ± 0.33	28.66 ± 0.33	32.50 ± 0.50	33.33 ± 0.84	0.41 ± 0.00	0.43 ± 0.00

Figure 11: Mean ± SE values of Monocyte in dogs of Group A and B

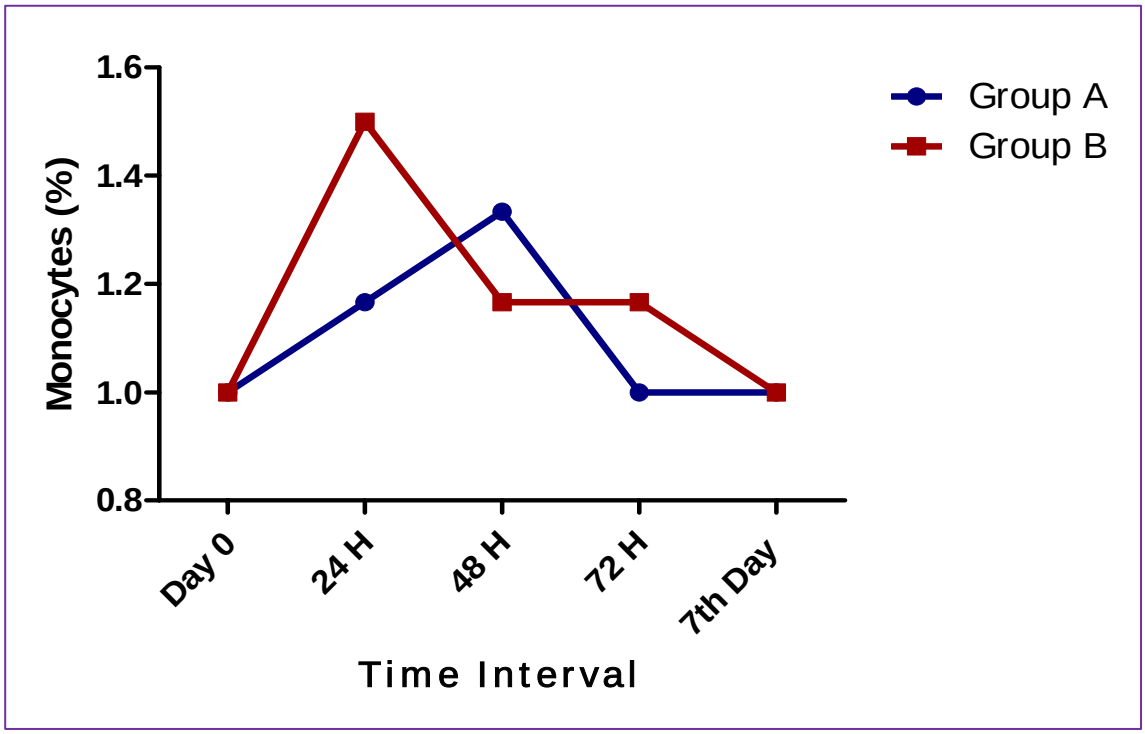
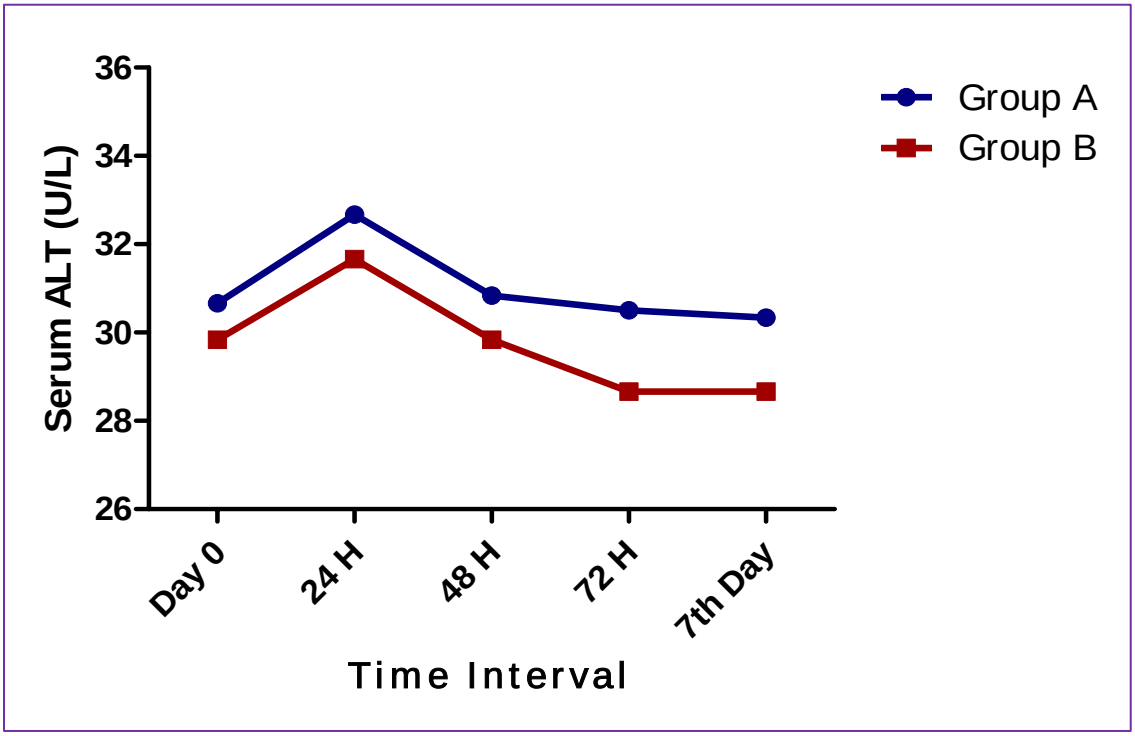


Figure 12: Mean ± SE values of serum Alanine amino transferase in dogs of Group A and B



In Group B, the mean value of pre-operative serum creatinine level was 0.44 ± 0.00 and post-operatively the mean serum creatinine level ranged from 0.43 ± 0.00 to 0.49 ± 0.00 (Table 5, Fig. 14).

Further, between the groups the variations in the mean values of serum creatinine level was statistically non-significant ($p > 0.05$).

Figure 13: Mean ± SE values of serum Aspartate amino transferase in dogs of Group A and B.

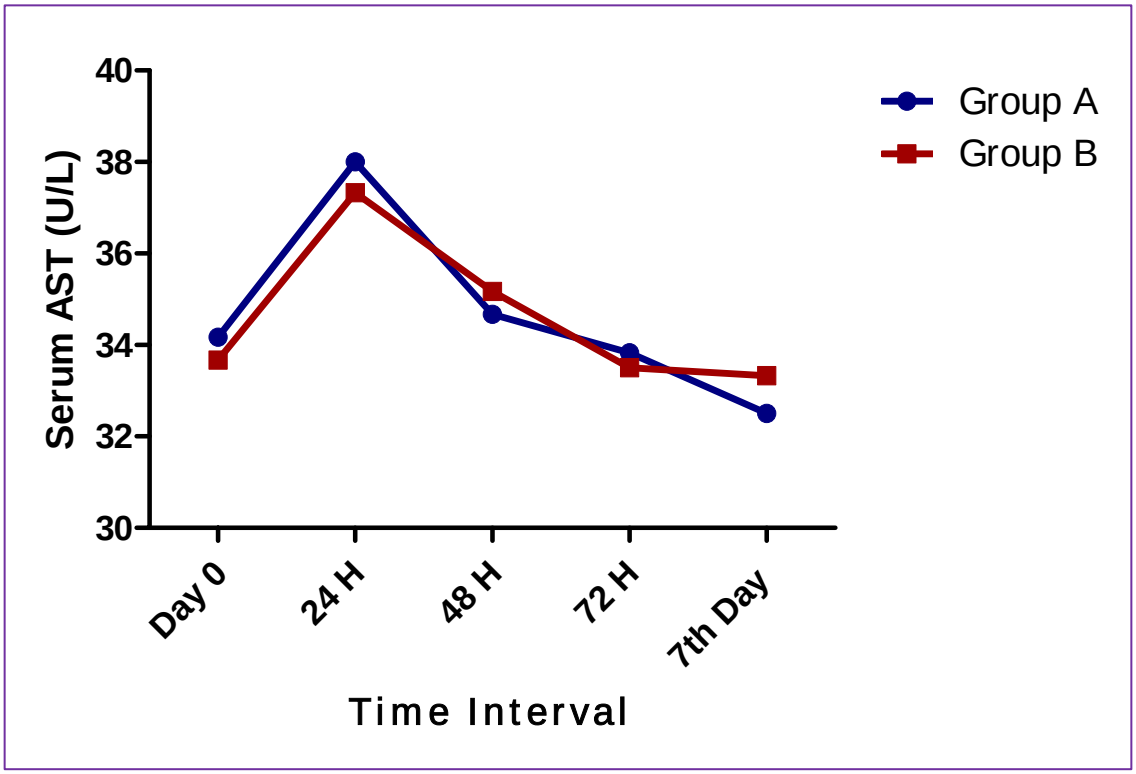
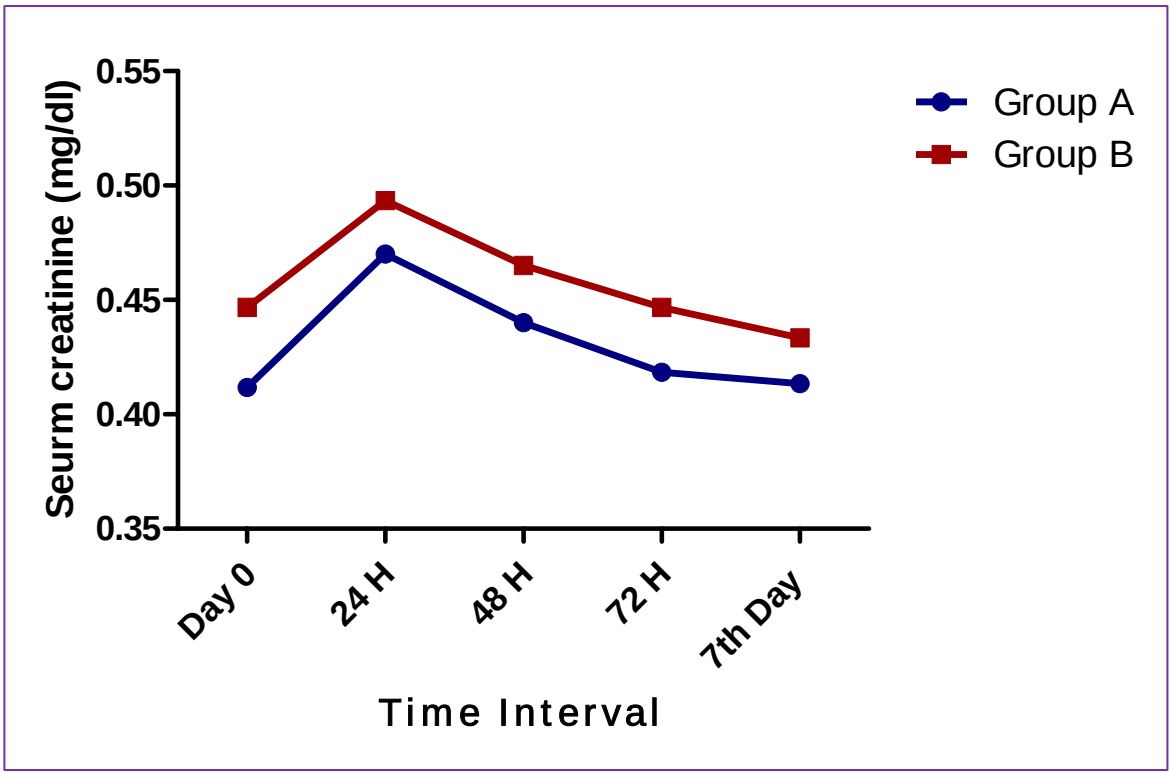


Figure 14: Mean ± SE values of serum Creatinine (mg/dL) in dogs of Group A and B.



Discussion

V. DISCUSSION

Ovariohysterectomy is the most common surgical procedure performed in veterinary practice for sterilization of female dogs. The present study was carried out to compare and evaluate the laparoscopic endo-stapling and endo-loop suturing method of ovariohysterectomy in female dogs.

5.1 Preparation and positioning of animals

Restriction of solid food for 12 hours and water for 4 hours gave satisfactory results. Thiele *et al.* (1993) advised 12 hours fasting with no restriction to water before the surgery, Dharmaceelan *et al.* (2000) performed laparoscopic ovariectomy by withholding food for 24 hours, water for 6 hours and Holey (2010) performed laparoscopic ovariohysterectomy by withholding food for 12 hours and water for 4 hours. Vomition, defecation was not noticed in any of the dogs during induction of anaesthesia or during surgery or recovery from anaesthesia. In the present study fasting and withholding of water was appropriate for complete surgical procedure.

Administration of soap water enema two hours prior to surgery and catheterization of urinary bladder just prior to anaesthesia prevented urination and defecation during administration of anaesthesia or during surgery. It also provided better visualization, access and manipulation of ovaries, uterus and associated structures and also avoided any injury to visceral organs. Similar method was earlier advocated by Dharmaceelan *et al.* (2000), Kumar *et al.* (2007) and Holey (2010).

Both Group A and B dogs were positioned in dorsal recumbency with elevated pelvis (30°) which facilitated sliding of viscera cranially and provided better visualization of genital tract and easy manipulation of laparoscopic instruments. During surgery, the dogs were tilted to the left and right to facilitate visualization of respective ovarian pedicles which was also described by Brun *et al.* (2000) and Gower and Mayhew (2008), while Reiver *et al.* (2011) adopted a similar position for combined laparoscopic ovariectomy and gastropexy in female dogs.

5.2 Sterilization of instruments

Laparoscopic instruments and telescope were sterilized in a closed formalin chamber with formaldehyde tablets for a period of 24 hours and were rinsed in sterile water and wiped dry with sterile gauze which was adequate to prevent local and systemic infection. All general surgical instruments used were sterilized in an autoclave at 121°C, 15 lbs psi for 15 min which was adequate. Holey (2010) earlier followed a similar procedure for sterilization of laparoscopic instruments, while Dharmaceelan *et al.* (2000) sterilized telescope and operating instruments in closed formalin vaporizer chamber for period of 24 hours and soaked the instruments in chlorhexidine for 30 min before use and were rinsed with sterile water and wiped dry with sterile gauze. Sumar and Bravo (1991) sterilized all laparoscopic instruments in 70% alcohol that contained chlorhexidine solution.

5.3 Premedication and anaesthesia

Pre-medication of female dogs with atropine sulphate at a dose rate of 0.04 mg/kg subcutaneously and diazepam at 1 mg/kg body weight intravenously was found to be

satisfactory. The administration of atropine sulphate reduced the salivary secretions, pre-anaesthesia with diazepam provided good sedative effects along with good muscle relaxation. Anaesthesia with sevoflurane inhalant anaesthesia provided good anaesthesia. The induction and maintenance of anaesthesia was satisfactory and also the recovery was smooth and satisfactory. Similar results were recorded by Basha (2010), while Jadon *et al.* (2008) recorded similar procedure at a different dose rate.

5.4 Intra-abdominal pressure

Pneumoperitoneum with 12 mmHg intra abdominal pressure in female dogs weighing 12 to 18 kg body weight provided enough space for manipulation of laparoscopic instruments, with no complications of subcutaneous emphysema or effect on cardiopulmonary system during postoperative days. The results are similar to the findings of Minami *et al.* (1997), Dharmaceelan *et al.* (2000), Hamdane *et al*. (2003), Davidson *et al.* (2004), Ranganath and Kumar (2007), Culp *et al.* (2009), Holey (2010) and Rivier *et al*. (2011). These authors reported pneumoperitoneum varying from 8 to 15 mmHg intra abdominal pressure for laparoscopic procedure in dogs.

5.5 Surgical site

Median port was made by introducing 5 mm trocar at umbilicus and two more paramedian ports were made approximately 5 cm caudolateral to median port on both sides by inserting one 5 mm and one 10 mm trocar in Group A is in accordance to the findings of Austin *et al.* (2003), Ranganath and Kumar (2007), Holey (2010) and Rivier *et al*. (2011), while in Group B another port was made approximately 8 cm from the umbilical port. This port placement were convenient to access and removal of ovaries and

uterus in all dogs, similar technique was reported by Brun *et al.* (2000) and Davidson *et al.* (2004) who used four ports for laparoscopic ovariohysterectomy in female dogs. While Culp *et al.* (2009) used midline two portal techniques for the laparoscopic ovariectomy.

5.6 Haemostasis

In Group A, haemostasis of ovarian and uterine end was achieved by placement of medium large size endo-staples made up of titanium. Titanium clips provided adequate haemostasis and complete sealing of ovarian and cervical end of uterus with no intra-operative and post-operative complications. Similar technique was followed by Holey (2010), while Valocky *et al.* (1999) preferred endo- staples for laparoscopic ovariectomy in female dogs. Dharmaceelan *et al.* (2000) performed laparoscopic ovariectomy by using titanium endo-clips for haemostasis and studied the histopathology of the clip applied sites of uterine horn and observed normal endometrial glands and indicated that there was no appreciable foreign body reaction against the titanium endoclips.

In Group B haemostasis of ovarian and uterine end was achieved by endo-sutures of intracorporeal knot technique using polyglactin-910 No. 1-0. Endo-sutures provided adequate haemostasis and complete sealing of ovarian and cervical end of uterus. Polyglactin 910 was nonpyrogenic, nonantigenic and induce minimal tissue reaction during resorption was recorded by Guyuron and Vaughan, (1996). Several authors used endo sutures in their studies *viz.*, Valocky *et al*. (1999) used modified endo-sutures for ovariectomy in two bitches, Hamdane *et al.* (2003) performed laparoscopic ovariectomy by endoloop ligatures of intracorporeal sutures, while Davidson *et al.* (2004) used 4-0

surgical wire ligatures to ligate the ovarian and cervical end to perform laparoscopic ovariohysterectomy and Shirodkar *et al.* (2008) performed laparoscopic oopherectomy by endo-loop suture using No. 1 black braided silk.

5.7 Duration of procedures

The mean time taken for surgical procedure in Group A and B was 56.00 ± 1.93 and 96.10 ± 3.54 respectively. The duration of procedure was longer in Group B compared to Group A. This increase in mean surgical time (min) was statistically significant. In endo-loop suturing technique surgical time was extended because of extra time taken for insertion of fourth trocar and lack of perfection in making endo-loop suturing. Similar observation was made by Shirodkar *et al.* (2008). The surgical time should be minimized in laparoscopic surgery by familiarization of laparoscopic instruments (Wildt and Lawler, 1985).

Valocky *et al.* (1999) reported that time required for laparoscopic ovariectomy by endo-stapling was less than that of endo-loop suture method. Similarly Shirodkar *et al.* (2008) reported that time needed for application of endo-loop ligature was slightly high as compared to the time needed for electrocoagulation. Holey (2010) reported that time needed for endostapling was slightly high compared to eletrocoagulation in laparoscopic ovariohysterectomy in dogs.

5.8 Intra-operative complication

In the present study there was no surgical complication noticed in any of the dogs of Group A. Similar findings were reported by Holey (2010) but Mayhew and Brown

(2007) noticed haemorrhage around the field where pedicle was sharply sectioned between staples.

In Group B, during intraoperative procedure slippage of knot at the cervical end was observed in one dog and immediately it was corrected with pre-tied endoloop suture. Hamdane *et al.* (2003) observed no hemorrhage following laparoscopic ovariectomy by endoloop suturing. Shirodkar *et al*. (2008) observed minor oozing of blood in endo-loop suturing technique of laparoscopic ovareiectomy.

The other complications of intraoperative procedures were recorded by various authors include, Hardie *et al.* (1996) reported that improper placement of cannula could result in damage to internal organs. Brun *et al.* (2000) reported that the most common intra-operative complication was haemorrhage with one death and one animal required shifting to exploratory celiotomy to control haemorrhage during laparoscopic ovariohysterectomy. Dharmaceelan *et al.* (2000) reported accidental electrocautery of a small portion of peritoneum in three dogs during laparoscopic ovariectomy. Austin *et al.* (2003) reported increased post operative swelling of the right paramedian port incision due to herniation of omentum through the abdominal wall. In the present study no such complications were observed.

5.9 Post-operative care and observation

Ceftriaxone sodium at a dose rate of 20 mg/kg was administered twice daily post-operative for three days. Administration of ceftriaxone helped in preventing post-operative infection (Rebuelto *et al.* 2002). Regular wound dressing with povidine iodine kept the area clean and also prevented infections.

An uneventful recovery of all animals indirectly entitled about the safety of both the ovariohysterectomy procedures. The laparoscopic wound healed completely by day seven. During post-operative seven days, the female dogs resumed the normal activity without any complication. It was observed that strict aseptic surgery, optimum antibiotics, in addition to close care and monitoring of the patient during post-operative period might have contributed significantly towards well being of the dogs.

5.10 PARAMETERS

5.10.1 Physiological parameters

5.10.1.1 Rectal temperature ($^{\circ}$F)

There was statistically no significant variation in rectal temperature noticed post-operatively in both the groups after laparoscopic ovariohysterectomy. Similar changes in temperature were noticed earlier by Hancock *et al.* (2005) and Holey (2010). While Shirodkar *et al.* (2008) observed significant decrease in rectal temperature during operative procedure and they thought it could be due to additive effect of peri-operative fasting and anesthesia and resumed to normalcy by 6^{th} post operative hour.

5.10.1.2 Respiratory rate (per min)

There was statistically non-significant variation in respiratory rate noticed post-operatively in both the groups which was also reported by Hancock *et al.* (2005) and Holey (2010). While Shirodkar *et al.* (2008) observed significant decrease in respiratory rate during operative procedure and they thought it could be due to the additive effect of

peri-operative fasting and anesthesia and resumed to normalcy by 6th post operative hour. The present study did not affect respiratory rate in all the animals.

5.10.1.3 Heart rate (beats/per min)

There was statistically non-significant variation in the heart rate after surgery in both the groups. Holey (2010) noticed similar changes in heart rate after laparoscopic ovariohysterectomy. While Tanya *et al.* (1996) noticed increased heart rate and decreased stroke volume during insufflations and 30 minutes after desufflation of carbon dioxide gas. Hancock *et al.* (2005) also suggested that differences in heart rate and respiratory rate may have been directly attributable to excitement due to dog-human interaction. The present study did not affect heart rate in all the animals.

5.10.2 Haematological parameter

5.10.2.1 Haemoglobin (g %)

The fluctuation in haemoglobin observed was within normal range and were statistically non-significant. This might be due to the reason of minimum blood loss during the surgical procedure in both groups. Dharmaceelan *et al.* (2000) also found non-significant change in haemoglobin level following laparoscopic ovariectomy in female dogs. Shirodkar *et al.* (2008) observed decrease in hemoglobin concentration during immediate post-operative evaluation and they thought it could be due to splenic engorgement during anesthesia and bleeding during the procedure.

5.10.2.2 Total erythrocyte count (10^6/cmm)

A statistically non-significant decrease in total erythrocyte count was noticed and the variations were within the normal range. This might be due to minimal blood loss during the surgical procedure in both the groups. Dharmaceelan *et al.* (2000) and Shirodkar *et al.* (2008) found significant decrease in the total erythrocyte count during the immediate post-operative evaluation following laparoscopic ovariectomy in female dogs and they thought it could be due to the increased pooling of blood in the spleen after induction of anaesthesia with thiopentone.

5.10.2.3 Total leukocyte count (10^3 Cells/mm)

There was statistically non-significant elevation observed in total leukocyte count in first 24 hrs and the elevation was within the normal range. Coles (1986) stated that the degree of leukocytosis in response to trauma or infection depends on the severity of infection or inflammation. Dharmaceelan *et al.* (2000) reported significant increase in total leukocyte count on first post-operative day and stated that it could be due to surgical stress and tissue damage. Shirodkar *et al.* (2008) found acute rise in the total leukocyte count following laparoscopic ovariectomy in female dogs up to 12 hour post-operatively and they concluded that it could be due to acute inflammatory changes following surgery.

5.10.2.4 Differential leukocyte count

5.10.2.4.1 Neutrophil (%)

A statistically non-significant increase in neutrophils up to 48 hours was noticed during the present study in both groups which was within normal range. This could be

due to response of body to tissue manipulation and inflammation (Benjamin, 1998). These observations collaborate with the opinion of Venugopalan (2005) who suggested that during the first 24 hours of inflammation following tissue damage, neutrophils predominates other cells. Dharmaceelan *et al.* (2000) reported no significant change in neutrophil count after laparoscopic ovariectomy.

5.10.2.4.2 Lymphocyte (%)

There was statistically non-significant decrease in lymphocyte up to 48 hours post-operatively in both groups and was within normal range. The lymphocyte count recorded an initial fall after the laparoscopic intervention, followed by a compensatory reverse trend with granulocyte per cent. Similar observations were also noticed by Dharmaceelan *et al.* (2000), Shirodkar *et al.* (2008), and Holey (2010).

5.10.2.4.3 Eosinophil (%)

A statistically non-significant variation was observed in both groups and the variations were within the normal range. Dharmaceelan *et al.* (2000) and Holey (2010) reported non-significant change in eosinophil count after laparoscopic ovariectomy.

5.10.2.4.4 Monocyte (%)

There was a statistically non-significant change in monocytes in both groups and the variation was within normal range. The monocytes per cent remained almost steady and mild changes did not reveal any definite pattern between the animals of two groups. As the monocyte being the 2^{nd} line of cellular defence, its role during early acute

inflammation may not be vital (Sastry, 2004). These observations were in accordance with Dharmaceelan *et al.* (2000) and Holey (2010).

5.10.3 Biochemical parameters

5.10.3.1 Serum alanine amino transferase (IU/L)

Statistically non-significant variations were seen in alanine amino transferase levels and in the present study all the values were within normal range. These findings suggest that either anesthesia or the procedure in this study had an influence on the liver function. Similar observations were also noticed by Kumar (2006) and Holey (2010). Al-Badrany *et al.* (2009) observed significant elevation in alanine amino transferase immediately after pneumoperitoneum and it returned back to normal within 24 hours.

5.10.3.2 Serum aspartate amino transferase (IU/L)

Statistically non-significant variations were seen in aspartate amino transferase levels and in the present study all the values were within the normal range. This may be related to less muscular damage. Schmidt and Booker (1982) reported significant increase in aspartate amino transferase level between 4 hours to72 hours after the operation and suggested this may be due to muscle cell damage and values were higher, if muscle damage was greater. Al-Badrany *et al.* (2009) observed significant elevation in serum aspartate amino transferase due to anesthetic drug and pneumoperitoneum and receded back to normal at 24 hours.

5.10.3.3 Serum creatinine (mg/dl)

There was statistically non-significant change in serum creatinine level during the present study. The variation in the serum creatinine values were within the normal range. These studies suggest that either the anesthesia or surgical procedure in the present study had any influence on the kidney function. These observations are in accordance with Kumar *et al*. (2008) and Holey (2010).

Summary

VI. SUMMARY

The present study was carried out for comparison of laparoscopic endostapling and endoloop suturing methods of ovariohysterectomy in 12 clinical cases of dogs weighing 12-18 kg which were randomly divided into Group A and B.

Premedication with atropine sulphate and diazepam followed by induction and maintenance of general anaesthesia with sevoflurane was satisfactory in all dogs of Group A and B.

In laparoscopic endostapling method of ovariohysterectomy one 5 mm median and two paramedian (one 5 mm and other 10 mm) ports, in laparoscopic endoloop suturing method of ovariohysterectomy additional port along with three ports provided easy access, good visualization and easy manipulation of instruments. 12 mmHg intra-abdominal pressure with carbon dioxide provided enough space for manipulation of laparoscopic instruments, good visualization of visceral organ with no complications.

In Group A, placement of medium large size titanium endo-staples provided adequate haemostasis of ovarian end and complete sealing of cervical end of uterus while in Group B, endosutures with intracorporeal knot technique using polyglactin- 910 No 1-0 provided adequate haemostasis of ovarian end and complete sealing of cervical end of uterus.

There was a significant difference in mean surgical time between the Group A and B dogs. Surgical procedure time required for Group B was longer compared to Group A.

There was no significant variation in rectal temperature, respiratory rate and heart rate in both the groups.

The haematological parameters viz., haemoglobin, total erythrocyte count, total leukocyte count and differential leukocytes count revealed no significant variation in both the group of dogs.

There was no significant variation in alanine amino transeferase, aspartate amino transferase and serum creatinine levels in all the dogs of Group A and B.

On the basis of the observations and the evaluations made during the present study, it could be deciphered that laparoscopic endostapling method of ovariohysterectomy procedure remained free of complications and was well tolerated by the animals but laparoscopic endoloop suturing method of ovariohysterectomy took more time in insertion of additional port (Four ports in Group B) in comparison to procedure of trocarization in animals of Group A and chances of insecure knot was more in Group B. Application of endostaples was easy, whereas endoloop suturing was complex and somewhat cumbersome in making the knots. The early and uneventful recovery could be attributed to minimal invasive nature of laparoscopic surgery.

In conclusion, the laparoscopic ovariohysterectomy in dogs using endostapling may be preferred over endo-loop suturing for wider clinical use and the procedure of endostapling may be improved by reducing the number of staples and procedure of endoloop suturing may be improved by familiarization of the technique.

Bibliography

VII. BIBLIOGRAPHY

AGUILAR, R. F., MIKOTA, S. K., SMITH, J., MUNSON, L., FREEMAN, L. and KOLATA, R., 1997. Endoscopic ovariohysterectomy in two lions (*Panthera leo)*. *J. Zoo Wild Med.,* **28**: 290-297.

AL-BADRANY, M. S., 2009. Laparoscopic ovariectomy in rabbits. *Irq. J. Vet. Sci.*, **23**: 51-55.

ANDERSON, D. G., 1992. The control of pet overpopulation. *Vet. Tech.,* **13**: 119-128.

ASHWANI, K., ARUP, K. D. and AMRESHKUMAR., 2002. Laparoscopic salpingo-oophorectomy using otoscope in pups. *Indian Vet. J.,* **79**: 506-507.

AUSTIN, B., HAMILTON, S. M., BROADSTONE, R. V. and MARTIN, R. A., 2003. Laparoscopic ovariohysterectomy in nine dogs. *J. Am. Anim. Hosp. Assoc.*, **39:** 391-396.

AZIZ, D. M., AL-BADRANY, M. S. and TAHA, M. B., 2008. Laparoscopic ovariectomy in standing donkeys by using a new instrument. *Anim. Reprod. Sci.*, **107:**107-14.

BASHA, A., 2010. A comparative study on isoflurane and sevoflurane anaesthesia in dogs. M.V.Sc. thesis, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, India.

BECK, S. D., LIFSHITZ, D. A., CHENG, L., LINGEMAN, J. E and SHALHAV, A. L., 2003. Endoloop assisted laparoscopic partial nephrectomy. *J. Urol.* **170:** 690

BENJAMIN, M. M., 1998. Leukocyte and their responses. *In:* Outline of Veterinary Clinical Pathology. *Edn. 3rd.*, Kalyani publishers, New Delhi, *pp* 76-92.

BEVERLY, A. G. and ANSON, L. W., 1987. Fatal air embolism during anaesthesia for laparoscopy in dog. *J. Am. Vet. Med. Assoc.*, **190**: 552-554.

BHAKTHIARI, J., MOKARAM, S., KHALAJ, A., SHARIFI, D and TAVAKOLI A., 2006. Clinical evaluation of elective laparoscopic ovariohysterectomy in dogs. *Irani J. of Vet. Surg*. **1:** 15-21.

BHUSAN B., 1996. Clinical and laboratory diagnosis of pancreatitis in canines. M.V.Sc. thesis, TamilnaduVeterinary and Animal Sciences University, Chennai, India.

BLEUL, U., HOLLENSTEIN, K. and KAHN, W., 2005. Laparoscopic ovariectomy in standing cows. *Anim. Reprod. Sci.*, **90:**193-200.

BOURE, L., MARCOUX, M. and LAVERTY, S., 1997. Paralumbar fossa laparoscopic ovareictomy in horses with use of endoloop ligature. *Vet. Surg*., **26:** 478-483.

BRUN, M. V., SILVA, F., BECK, C., MARIANO, M. B., and MELLO, J. R. B., 2000. Laparoscopic ovariohysterectomy in canine. *Braz. J. Vet. Res. Ani. Sci.*, **37**: 480-485.

BRUN, M. V., OLIVEIRA, S. T., MESSINA, S. A., STEDILE, R. and OLIVEIRA, R. P., 2008. Laparoscopic cystotomy for urolith removal in dogs: three case reports. *Arq. Bras. Med. Vet. Zootech.*, **60**: 103-108.

BUTT, T. D. and WILSON, D. C., 2003. Laparoscopic colopexy in a horse. *Can. Vet. J.*, **44**: 586-588.

CALI, R. W., 1980. Laparoscopy. *Surg. Clin. North Am.*, **60**: 407-425.

CARPENTER, E. M., HENDRICKSON, D. A. and ANDERSON, D. E., 2000. Laparoscopic ovariectomy and ovariohysterectomy in llamas and alpacas. *Vet. Clin. North Am. Equine Pract.***16:** 363-375.

CHARIAR, V. M., SHIRODKAR, D. N. and KHARE, Y., 2005. Minimally invasive technique cuts costs in veterinary surgery. *J. Minimal Access. Surg*. **1:** 84-85

CHIESA, O. A., VON BREDOW, J., LI, H. and SMITH, M., 2009. Isobaric (gasless) laparoscopic liver and kidney biopsy in standing steers. *Canad. J. Vet. Res*., **73:** 42–48

CHIU, P. I., GIN, T. and OH, T. E., 1993. Anaestheia for laparoscopic general surgery. *Anaesth. Instens. Care.*, **21**: 163-171.

COLES, E. H., 1986. Leukocyte. *In*: Veterinary Clinical Pathology. *Edn. 4th*., W. B. Saunders Co. Philadelphia, *pp* 57-61.

COLLARD, F. and VIGUIER, E., 2008. A pyometra managed by laparoscopic ovariohysterectomy in a dog. *Revue Med. Vet.*, **159**: 624-627.

CULP, W. T. N., MATHEW, P. D. and BROWN, D. C., 2009. The effect of laparoscopic versus open ovariectomy on postsurgical activity in small dogs. *Vet. Surg.*, **38**: 811-817.

CUSHIERI, A., 1991. Minimal access surgery and the feature of international laparoscopic surgery. *Am. J. Surg.*, **161**: 1404-1407.

DAVIDSON, E. B., MOLL, H. D. and MARK, E. P., 2004. Comparison of laparoscopic ovariohysterectomy and ovariohysterectomy in dogs. *Vet. Rec.*, **33**: 62-69.

DELLING, U., HOWARD, R. D., PLEASANT, R. S. and LANZ, O. T., 2004. Hand-assisted laparoscopic ovariohysterectomy in the mare. *Vet. Surg.*, **33**: 487-494.

DEVITT, C. M., COX, R. E. and HAILEY, J. J., 2005. Duration, complication, stress and pain of open ovariohysterectomy versus a simple method of laparoscopic assisted ovariohysterectomy in dogs. *J. Am. Vet. Med. Assoc.*, **227**: 921-927.

DHARMACEELAN, S., GANESH, T. N. and ARCHIBLAD, D. W. P., 2000. Laparoscopic sterilization in bitches: comparison of three techniques. *Indian J. Vet. Surg.*, **21**: 65-68.

DRISCOLL, G. L., BAIRD, P. J., MERKELBACH, P. J. and SMITH, D. H., (1982). Synthetic absorbable and nonabsorbable microsutures: a histological comparison. *Clin. Reprod. Fertil.,* pp 151–156.

DUKE, T., CAULKETT, N. A., and TATARYN, J. M., 2006. The effect of nitrous oxide on halothane, isofurane and sevoflurane requirements in ventilated dogs undergoing ovariohysterectomy. *Vet. Anaesth. and Analg*., **33:** 343-350.

DUPRE, G., FIORBIANCO, V., SKALICKY, M., GULTIKEN, N., SERHATAY, S., and FINDIK, M., 2009. Laparoscopic ovariectomy in dogs: comparison between single portal and two-portal access. *Vet. Surg.,* **38**: 818-824.

FISCHER, A. T. and VACHON, A. M., 1992. Laparoscopic cryptorchidectomy in horses. *J. Am. Vet. Med. Assoc.* **201:** 1705-1708

FREEMAN, L. J., 1998. Principles of Endosurgery. Veterinary Endosurgery. St. Louis Mosby. pp 15-17.

FREEMAN, L. J. and HENDRICKSON, D. A., 1998. Minimally invasive surgery of the reproductive system. Veterinary Endosurgery. St. Louis Mosby. pp 205-217

FREEMAN, L. J., RAHAMANI, E. Y., SHERMA, S., CHIOREAN, M. V., SELZER, D. J., CONSTABLE, P. D. and SNYDER, P. W., 2009. Oophorectomy by natural orifice transluminal endoscopic surgery: feasibility study in dogs. *Gastrointestinal Endo.*, **69**: 1321-1332.

FUKUSHIMA, F.B., MALM, C., ANDRADE, M. E. J., OLIVEIRA, H. P., MELO, E. G., CALDEIRA, F. M. C., GHELLER, V. A., PALHARES, M. S., MACEDO, S. P., FIGUEIREDO, M. S. and SILVA, M. X., 2011. Cardiorespiratory and blood gas alterations during laparoscopic surgery for intra-uterine artificial insemination in dogs. *Can .Vet. J.* **52:**77–79

GAGLIO, P. J., BASKIN, R. J., BLANCHARD, J., CHENG, S., DUNNE, B., DAVIDSON, J., LIU, H. and DASE, S., 2000. Partial hepatectomy and laparoscopic–guided liver biopsy in rhesus macaques (*Macaca mulatta):* novel approach for study of liver regeneration. *Comp. Med.,* **50**: 363-368.

GALLAGHER, L. A., FREEMAN, L. J., TRENKA-BENTHIN, S. and STOLOFF, D. R., 1992. Laparoscopic castration for canine cryptorchidism. *Poster Session Abst. ACVS, 27th Annual Meeting, Florida, pp* 411.

GOMEL, V., 1974. Laparoscopy. *CMA journal,* **111:** 167-169.

GOURLEYET, D. D. and RIESE, R. M., 1990. Laparoscopic artificial insemination in sheep. *Vet. Clin. North Am.: Food Anim. Pract.,* **6**: 615-633.

GOWER, S. and MAYHEW, P., 2008. Canine laparoscopic and laparoscopic assisted ovariohysterectomy and ovariectomy. *Surgical Views.,* 430-440.

GRAUER, G. F., TWEDT, D. C. and MERO, K. N., 1983. Evaluation of laparoscopy for obtaining renal biopsy specimens from dogs and cats. *J. Am. Vet Med. Assoc.*, **183**: 667-679.

GROSS, M. E., JONES, B. D., BERGSTRESSER, D. R. and ROSENBAUER R. R., 1993. Effects of abdominal insufflation with nitrous oxide on cardio-respiratory measurements in spontaneously breathing Isoflurane - anaesthetised dogs. *Am. J. Vet. Res.,* **54**: 1352-1358.

GUYURON, B. and VAUGHAN, C., 1996. Comparison of Polydioxanone and Polyglactin 910 in Intradermal Repair. *Plast. Reconstr. Surg.*, **98:** 817–820.

HAITJEMA, H. and CULLEN, L.K., 2001. Clinical experience with sevoflurane in dogs. *Aust. Vet. J.*, **79**: 339-34.

HAMDANE, A., ADAMIAK, Z. and BRZESKI, W., 2003. Laparoscopic ovariectomy of dogs by endoloop suture. *Indian Vet. J.,* **80**: 766-768.

HANCOCK, R. B., LANZ, I., WALDRON, D. R., DUNCAN, R. B., BROADSTONE, R. V. and HENDRIX, P. K., 2005. Comparison of postoperative pain after ovariohysterectomy by harmonic scalpel assisted laparoscopy compared with median celiotomy and ligation in dogs. *Vet. Surg.*, **34**: 273-282.

HASON, C. A and GALUPPO, L. D., 1999. Bilateral laparoscopic ovariectomy in standing mares: 22 cases. *Vet. Surg.* **28:** 106-112.

HARDIE, R. J., FLANDERS, J. A., SCHMIDT, P., CREDILLE, K. M. PEDRICK, J. P. and SHORT, C. E., 1996. Biochemical and histological evaluation of laparoscopic staple gastropexy technique in dogs. *Vet. Surg.*, **25**: 127-133.

HENRY, J. B., 1979. *In:* Clinical Diagnosis and Management by Laboratory Methods. *Edn. 16th.*, W. B. Saunders Co., Philadelphia, *pp* 130.

HEWITT, S. A., BRISSON, B. A., SINCLAIR, M. D., FOSTER, R. A. and SWAYNE, S. L., 2004. Evaluation of laparoscopic assisted placement of jejunostomy feeding tubes in dogs. *J. Am. Vet. Med. Assoc.*, **225**: 65-67.

HOLEY, S. A., 2010. Comparison of Laparoscopic electro-coagulation and endo-stapling techniques of ovariohysterectomy in female dogs. M.V.Sc. thesis, Karnataka Veterinary, Animal and Fisheries Science University, Bidar, India.

JADON, N.S., KUMAR, S., KANDPAL, M., SHARMA, V.K. and THATHOO, A.K., 2008 Comparative evaluation of isoflurane and sevoflurane anaesthesia in puppies. *Indian J. Vet. Surg.*, **29**:110-111.

JOHNS, A., 1991. Laparoscopic oophorectomy/oophorocystectomy. *Clin. Obst. Gynaecol.*, **34**: 460-466.

KENNETH, D. N., DAVID, E. A. and FENNANDO, S., 2005. Laparoscopic abomasopexy for correction of left sided displacement of the abomasum in dairy cows. *J. Am. Vet. Med. Assoc.*, **227**: 1142-1147.

KOLATA, R. J., 2002. Laparoscopic ovariohysterectomy and hysterectomy on African lions (*Panthera leo)* using the ultracision (r) harmonic scalpel (r). *J. Zoo Wildlife Med.*, **33**: 280-282.

KUMAR, S. S. S., 2006. Comparison of surgical and laparoscopic method of sterilization in bitches. M.V.Sc. thesis, Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar, India.

KUMAR, S. S. S., RANGANATH, L., DEVARAJ, M. and NAGARAJA, R., 2008. Comparison of conventional and laparoscopic methods of ovariohysterectomy in bitches. *Indian Vet. J.,* **85**: 268-269.

KUMAR, S. S. S., RANGANATH, L., VASANTH, M. S. and VIJAYRAGHAVAN, R., 2007. Laparoscopic ovariohysterectomy in bitches. *Indian J. Vet. Surg.*, **28**: 110-112.

MAGALE, F., FINCHER, M. G. and MCENTEE, K., 1956. Peritoneoscopy in the cow. Visualisation of the ovaries, oviduct and uterine horns. *Cornell Vet.,* **46**: 109-121.

MALM, C., SAVASSI, R. P. R., GHELLER, V. A., OLIVEIRA, H. P., LAMOUNIER, A. R. and FOLTYNEK, V., 2005. Ovario-hysterectomia: estudo experimental comparative entre as abordagens laparoscopica e aberta na especie canina- III. Estresse pela analise do cortisol plasmatico. *Arquivo-Brasileiro-de-Medicina-Veterinaria-e-Zootecnia.*, **57**: 584-590.

MAYHEW, P. D. and BROWN, D. C., 2007. Comparison of three techniques for ovarian pedicle haemostasis during laparoscopic-assisted ovariohysterectomy. *Vet. Surg.*, **36**: 541-547.

MAYHEW, P., 2009. Laparoscopic and laparoscopic-assisted cryptorchidectomy in dogs and cats. *Surgical Views.,* 274-281.

MILLIS, D. L., HAUPTMAN, J. G. and RICHTER, M., 1992. Pre-operative and post-operative haemostatic profiles of dogs undergoing ovariohysterectomy. *Cornell Vet.*, **82**: 465-470.

MINAMI, S., OKAMOTO, Y., EGUCHI, H. and KATO, K., 1997. Successful laparoscopy assisted ovariohysterectomy in two dogs with pyometra. *J. Vet. Med. Sci.*, **59**: 845-847.

MUIR, W. W. and HUBBEL, J. A. E., 1991. Specific intravenous anaesthetic drugs. *In:* Handbook of Veterinary Anaesthesia. *Edn. 1st*., Jaypee Brothers, New Delhi, *pp* 74-86.

MULLET, C. V., VIALE, C. P., and SAGNARD, P. E., 1993. Pulmonary CO_2 elimination during surgical procedure using intra or extra periotineal CO_2 insufflation. *Anaesth. Analog.*, **76**: 622-626.

MUTOH, T., NISHIMURA, R. and SASAKI, N., 2002. Effects of meditomedine-midazolam, midazolam-butorphanol, or acepromazine-butorphanol as premedicants for mask induction of anaesthesia with sevoflurane in dogs. *Am. J. Vet. Res.*, **63**:1022-1028

NORD, H. J., 1992. Complication of laparoscopy. *Endoscopy*, **24**: 693-700.

OKAMATO, Y., MINAMI, S., KATO, K. and MATSUHASHI, A., 1998. Laparoscopic assisted ovariohysterectomy in dogs and cats. *J. Jap. Med. Assoc.*, **51**: 91-94.

OLSON, P. N. and JOHNSTON, S. D., 1993. New developments in small animal population control. *J. Am. Vet. Med. Assoc.*, **202**: 904-909.

PALMER, S. E., 1993. Standing laparoscopic laser technique for ovariectomy in five mares. *J. Am. Vet. Med. Assoc.*, **203**: 242-250.

PETERSON, E. P. AND BEHRMAN, S. J., 1971. Laparoscopic tubal sterilization. *Am. J. Obst. Gynaecol.*, **10**: 24-29.

RAGLE, C. A. and SCHNEIDER, R. K., 1995. Ventral abdominal approach for laparoscopic ovariectomy in horses. *Vet. Surg.*, **24**: 492-497.

RANGANATH, L. and KUMAR, S. S. S., 2007. Comparative studies on changes in C-reactive protein, serum cortisol, blood glucose and aspartate amino transferase level following left flank method and laparoscopic method of ovariohysterectomy in bitches. *Veterinarski Arhiv.,* **77**: 523-529.

RAWLING, C. A., HOWERTH, E. W., MAHAFFEY, M. B., FOUTZ, T. L., BEMENT, S. and CANALIS, C., 2002. Laparoscopic assisted cystopexy in dogs. *Am. J. Vet. Res.,* **63**: 1226-1231.

REBUELTO, M., ALBARELLOS, G., AMBROS, L., KREIL, V., MONTOYA, L., BONAFINE, R., OTERO, P. and HALLU, R., 2002. Pharmacokinetics of ceftrixone administered by the intravenous, intramuscular or subcutaneous routes to dogs. *J. Vet. Pharmacol. Therap.,* **25**: 73:76.

REICH, H., DE CAPRIO, J., and MCGLYNN, F., 1989. Laparoscopic hysterectomy. *J. Gynaecol. Surg.,* **5**: 213-216.

REMEDIOS, A. M. and FERGUSEN, J., 1996. Minimally invasive surgery: laparoscopy and thoracoscopy in animals. *Comp. Cont. Edu.* **18**: 51-57.

REMEDIOS, A. M., FERGUSON, J. F., WALKER, D. D. and WALSH, P. J., 1992. Laparoscopic versus open ovariohysterectomy in dogs: A comparison of postoperative pain and morbidity. *Poster Session Abst. ACVS, 27th Annual Meeting, pp* 425.

RICHTER, K. P., 2001. Laparoscopy in dogs and cats. *Vet. Clin. North Am. Small Anim. Pract.,* **31**: 707-727.

RIVIER, P., FURNEAUX, R. and VIGUIER, E., 2011. Combined laparoscopic ovariectomy and laparoscopic-assisted gastropexy in dogs susceptible to gastric dilatation-volvulus. *Can. Vet. J.,* **52:**62–66.

ROBERT, J. H., JAMES, A. F., PETER, S., KELLY, M. C., TOI, P. P. and CHARLES, E. S., 1996. Biomechanical and histological evaluation of a laparoscopic stapled gastropexy technique in dogs. *Vet. Surg.*, **25**: 127-133.

SANFILIPPO, S. J. and SINGH, M., 1996. Contemporary operative laparoscopy. *In:* Reproduction Endocrinology, *Edn. 3rd.*, Lippincot Raven. Publisher, Philadelphia, *pp* 2064-2090.

SARAVANAN, D., 1996. Laparoscopic study of normal and superovulated ovaries in crossbreed cows. M.V.Sc. thesis, Tamilnadu Veterinary and Animal Sciences University, Chennai, India.

SASTRY, G. A., 2004. Inflammation. *In:* Veterinary Pathology. *Edn. 7th.*, CBS Publishers and Distributors, New Delhi, *pp* 55-56.

SCHMIDT, R. E. and BOOKER, J. L., 1982. Effects of different surgical stresses on haematological and blood chemistry values in dogs. *J. Am. Anim. Hosp. Assoc*., **18**: 758-762.

SHIRODKAR, K., CHARIAR, V. M., TANK, P. H., MANKAD, M. Y. and PAITHANPAGARE, Y. M., 2008. Laparoscopic oophorectomy in bitches. *Indian J. Vet. Surg.*, **29**: 11-13.

SILVAA, L. D. M., ONCLINA, K., SNAPSB, F. and VERSTEGENA, J., 1995. Laparoscopic intrauterine insemination in the bitch. *Theriogenol.*, **43**: 615-623.

SMITH, L. J. and MAIR, T. S., 2008. Unilateral and bilateral laparoscopic ovariectomy of mares by electrocautery. *Vet. Rec.*, **163**: 297-300.

SNEDECOR, C. W. and COCHRAN, W. G., 1996. *In*: Statistical Analysis. *Edn.* 8th ., Oxford and IBH publishing co. New Delhi, *pp* 335-345.

SPINELLA, G., VALENTINI, S., SPADARI, A. and FEDRIGO, M., 2006. Laparoscopic ultrasonography in six dogs. *Vet. Rad. & US.*, **47**: 283-286.

SRINIVASAN, A., TRUS, T. L., CONARD, A. J. and SCARBROUGH, T. J., 1999. Common laparoscopic procedures in swine: a review. *J. Invest. Surg.*, **12**: 5-14.

STEDILE, R., BECK, C. A. C., SCHIOCHET, F., FERREIRA, M. P., OLIVEIRA, S. T., MARTENS, F. B., TESSARI, J. P., BERNADES, S. B. L., OLIVEIRA, C. S., SANTOS, A. P., MELLO, F. P. S., ALIEVI, M. M. and MUCCILLO, M. S., 2009. Laparoscopic versus open splenectomy in dogs. *Pesq. Vet. Bras.*, **29**: 653-660.

STONE, E. A., CANTRELL, C. G. and SHARP, N. J. H., 1993. Ovary and uterus. *In*: Textbook of Small Animal Surgery. *Edt*. Slatter, D. *Edn*. *3rd* ., Philadelphia, WB Saunders, *pp* 1293-1307.

SUMAR, J. and BRAVO, P. W., 1991. In situ observation of the ovaries of Llamas and Alpacas by use of a laparoscopic technique. *J. Am. Vet. Med. Assoc.*, **199**: 1159-1160.

TANYA, D., STEINCHER, B. L. and REMEDIOS, A. M., 1996. Cardiopulmonary effects of using carbon dioxide for laparoscopic surgery in dogs. *Vet. Surg.*, **25**: 77-82.

THIELE, S., KELCH, G. and GERLACK, K., 1993. Castration of the bitch by means of laparoscopic ovariectomy. *Kleintierpraxis*, **38**: 463-466.

USON, P. J., TEFEDO, V., VIVES, M. A., EZGUERRA, L. J. and USON, J. L. M., 1992. Therapeutique laparoscopique L'ovariectomie et al ligature des cornes utrines chez la chienn. *Rec. Met. Vet.*, **168**: 237-241.

VALOCKY, I., PAISS, S. and MARACEK, I., 1999. Methods of laparoscopic sterilization of bitches. *Vet. Med. Czech.*, **44**: 269-273.

VAN HOOGMOED, L. M and GALUPPO, L. D., 2005. Laparoscopic ovariectomy using the Endo-GIA stapling device and catch pouches and evaluation of analgesic efficacy of epidural morphine sulphate in 10 mares. *Vet. Surg.*, **34:** 646-650.

VAN NIMWEGEN, S. A. and KIRPENSTEIJN, J., 2007[a]. Laparoscopic ovariectomy in cats: comparison of laser and bipolar electrocoagulation. *J. Feline Med. Surg.*, **9:**397-403.

VAN NIMWEGEN, S. A. and KIRPENSTEIJN, J., 2007[b]. Comparison of Nd: YAG surgical laser and Remorgida bipolar electrosurgery forceps for canine laparoscopic ovariectomy. *Vet. Surg.*, **36**: 533-540.

VAN NIMWEGEN, S. A., VAN SWOL, C. F. P. and KIRPENSTEIJN, J., 2005. Neodymium: Yttrium aluminium garnet surgical laser versus bipolar electrocoagulation for laparoscopic ovariectomy in dogs. *Vet. Surg.*, **34**: 353-357.

VENUGOPALAN, A., 2005. Inflammation. *In:* Essentials of Veterinary Surgery. *Edn. 8th.*, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi. *pp* 91.

VON SIEGLE, H., BOHM, R., FERGUSON, J., FRIEDRICH, M. and LOSERT, U. M., 1994. Laparoskopische ovariohysterektomie bei einem. *Hund. Wien. Tierarztl. Mschr.*, **81**: 149-152.

WALLACE., M. S., 1991. The ovarian remnant syndrome in the bitch and queen. *Vet. Clin. North Am. Small Anim. Pract.* **21:** 501-507.

WILDT, D. E. and LAWLER, D. F., 1985. Laparoscopic sterilization of bitch and queen by uterine horn occlusion. *Am. J. Vet. Res.*, **46**: 864-869.

WILDT, D. E., GAIL, M. K. and STEPHAN, W. J. S., 1977. Laparoscopy for direct observation of internal organs of the domestic cat and dog. *Am. J. Vet. Res.*, **38**: 1429-1432.

WILSON, A. D. and FERGUSON, J. G., 1984. Use of flexible fiber optic laparoscope as a aid in cattle. *Can. Vet. J.*, **25**: 229-234.

YARBROUGH, T. B., SYNDER, J. R. and HARMON, F. A., 1995. Laparoscopic anatomy of Llama abdomen. *Vet. Surg.*, **24**: 244-249.

Abstract

VIII. ABSTRACT

The present study was conducted to compare and evaluate the laparoscopic method of endostapling and endoloop suturing for ovariohysterectomy in female dogs. There were no significant variations observed in physiological (rectal temperature, heart rate and pulse rate), haematological (Hb, TLC, TEC, DLC) and biochemical parameters (creatinine, AST, ALT). Surgical time required for Group B was significantly more compared to Group A due to insertion of extra port and application of secure knot. There were no surgical complications in any of the dogs of Group A but slippage of knot was observed in one dog of Group B. The post-operative early and uneventful recovery could be attributed to minimal invasive nature of laparoscopic surgery. On the basis of the observations and the evaluations during the present study, it was concluded that the laparoscopic ovariohysterectomy in dogs using endostapling may be preferred over endoloop suturing for wider clinical use.