COMPARISON OF SINGLE INCISION LAPAROSCOPIC SURGERY (SILS) WITH TWO PORT TECHNIQUE FOR LAPAROSCOPIC OVARIECTOMY IN DOG

THESIS

Submitted in partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

VETERINARY SURGERY AND RADIOLOGY

BY

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Appendix-B

DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled **"COMPARISON OF SINGLE INCISION LAPAROSCOPIC SURGERY (SILS) WITH TWO PORT TECHNIQUE FOR LAPAROSCOPIC OVARIECTOMY IN DOG"** or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/publication of any University or scientific organization. The sources of the materials used and all assistance received during the course of any investigation have been duly acknowledged.

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Appendix-C (I)

DECLARATION OF ADVISORY COMMITTEE

Anturkar Kaustubh Vishnupanth has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled **"COMPARISON OF SINGLE INCISION LAPAROSCOPIC SURGERY (SILS) WITH TWO PORT TECHNIQUE FOR LAPAROSCOPIC OVARIECTOMY IN DOG"** submitted by him is the result of research work is sufficient to warrant its presentation to the examination in the subject of Veterinary Surgery and Radiology for the award of Master of Veterinary Science (M. V. Sc.) degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

We also certify that the thesis or part thereof has not been previously submitted by him for a degree of any other University.

Date:

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I)	Dr. D. U. Lokhande	Professor, Department of Veterinary Surgery and Radiology	
II)	Dr. G. S. Khandekar	Professor, Department of Veterinary Surgery and Radiology	
III)	Dr. S. D. Tripathi	Assistant Professor, Department of Veterinary Surgery and Radiology	
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CERTIFICATE

This is to certify that the thesis entitled **"COMPARISON OF SINGLE INCISION LAPAROSCOPIC SURGERY (SILS) WITH TWO PORT TECHNIQUE FOR LAPAROSCOPIC OVARIECTOMY IN DOG"** submitted by Mr. **Anturkar Kaustubh Vishnupanth** of the Maharashtra Animal Sciences University, Nagpur, in partial fulfillment of the requirement for the degree of Master of Veterinary Science has been approved by the Student's Advisory Committee after examination in collaboration with the External Examiner.

Name & Signature of External Examiner

Signature & Seal of HOD

Signature of Guide/Advisor

ADVISORY COMMITTEE

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Date:
Place: Mumbai

Kaustubh V Anturkar

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LIST OF ABREVIATIONS

Abbreviations	Full Form
°	Degree
%	Percent
±	Plus or minus
µl	Microliter
° F	Degree Fahrenheit
ALP	Alkaline Phosphatase
ALT	Alanine aminotransferase
ASA	American Society of Anaesthesiologists
AST	Aspartate Aminotransferase.
BMR	Body Metabolic Rate
BSDPHA	Bai Sakarbai Dinshaw Petit Hospital for Animals
BUN	Blood Urea Nitrogen
BW	Body Weight
CD	Critical Difference
cm	Centimeter
CO_2	Carbon Dioxide
ETO	Ethylene oxide
Fig.	Figure
GmbH	Gesellschaft mit beschränkter Haftung
Hb	Haemoglobin
IU/L	International Units per Litre
lapOVE	Laparoscopic Ovariectomy
LESS	Laparoendoscopic Single Site
LOVH	Laparoscopic ovariohysterectomy
mcg/dl	Microgram per deciliter
mg/dl	Milligram/deciliter
mg/kg	milligram per kilogram
mm	Millimetre
mm Hg	Millimetre of mercury
MPAS	Multiple Portal Access
ND	Non-Descript
No.	Number
NOTES	Natural Orifice Transluminal Endoscopic Surgery
NS	Non-Significant
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
PCV	Packed Cell Volume
RKVY	Rashtriya Krishi Vikas Yojana
SE	Standard Error
SGPT	Serum Glutamyl Pyruvate Transaminase
SILAIS	Single Incision Laparoscopic assisted Intestinal Surgery
SILS	Single Incision Laparoscopic Surgery
SITRACC	Single Trocar Access Cholecystectomy
SPAGO	Single Portal Access Gastropexy and Ovariectomy

SPAS	Single Portal Access
TEC	Total Erythrocyte Count
TLC	Total Leucocyte Count
TVCC	Teaching Veterinary Clinical Complex
UMPS	University of Melbourne Pain Score
USP	United States Pharmacopoeia
YAG	Yttrium Aluminium Garnet

1. INTRODUCTION

Pet animals like cat and dog are now a part and parcel of the modern Indian family. This is more so in metropolitan cities. This has also brought an increased awareness in pet animal parents regarding the modern and latest treatment options available. It is not uncommon for veterinarians nowadays to come across owners who have made a detailed study of the modern surgical technique and treatment options available. However, the duty of the veterinarian who is treating the pet becomes of prime importance because not only he/she has to treat the animal but also to be true to the expectations of the modern pet owner. Minimally invasive surgery has now become a handy option available for veterinary surgeons in fulfilling their expectations

Numerous studies have proven that laparoscopic surgeries reduce hospitalization time and improve the surgical outcome when compared with open abdominal surgeries. The development of veterinary laparoscopy for one of the most common procedures in veterinary practice such as elective laparoscopic ovariectomy and vasectomy (Manassero *et al.*, 2018), has made rapid strides from the time of the year 1985 when Wildt and Lawler demonstrated first laparoscopic sterilization in a bitch. Minimally invasive surgeries are the future of veterinary medicine. The studies which have been carried out by surgeons for laparoscopic ovariectomies reported very few perioperative complications, reduced post-operative pain, decrease in surgical stress and increased post-operative activity of patient (Phypers 2017).

Besides reduced hospital stay and recovery laparoscopic surgeries are preferred for other valid reason such as excellent visibility of genitourinary tract which includes ovarian vessels and other visceral organs. Laparoscopy offers great visibility of organs, position their blood supply and surrounding tissues.

Laparoscopic ovariectomy was initially practiced with a three port technique, although the procedure produces less morbidity than conventional open spays but still require several incisions for port placement. Every incision that is made carries a risk of complications, damage to intrabdominal organs, bleeding, more pain, possible complications like herniation due to intrabdominal pressure and has an impact on cosmetic appearance. The need of reducing number of complications in three port technique kick started the development of the technique collectively known as Single Incision Laparoscopic Surgery.

SILS was derived from a technique, which was developed first for scar less surgery called NOTES (Natural Orifice Transluminal Endoscopic Surgery). This technique involves use of natural orifices such as umbilicus. Incision is made on umbilicus and port is placed and operated. Thus the surgical scar is present at umbilicus and is rarely visible, However NOTES did not gain much popularity. It remains as a research technique and a few number of cases only has been recorded. The failure of NOTES seems to have stimulated SILS as a very eminent and doable technique with minimal invasion and rendering same scarless effect (Rao *et al.*, 2011).

One of the major reported complication noted in veterinary laparoscopy is the injury to the abdominal organs due to blind veress needle insertion. Numerous authors and research workers have worked on single port technique. However it hampered the movement and ergonomics to perform major surgeries. In this situation SILS uses only one single incision of 2-3 cms which is made on linea-Alba for placement of the port. Once the incision is made the port is inserted in the abdominal cavity from the opening. The method is simple, safe and causes minimum damage as compared to 2 or 3 port technique. The port can be placed with least handling as the material is foam so doesn’t cause trauma to the surrounding tissues. Single site also reduces the chance of port site infections, hernia and other complications which are observed in conventional laparoscopy.

A normal SILS device has 4 channels which allows insertion of instruments in range of 5-15mm diameter. This consists of instruments such as 5 mm handpieces, telescopes 5-12mm diameter, stapling devices 10-12mm diameter, bipolar cautery or ultrasonic dissectors of 10-12mm diameter. All of these instruments can be introduced simultaneously through a 2-3 cm abdominal access. One of the four channels is designed like a tube having a plug and valve at one end which is used for insufflation. (Huhn 2016).

Mumbai veterinary college has a fully equipped, state of the art laparoscopy unit developed under RKVY scheme. The unit regularly carries out laparoscopic procedures such as laparoscopic ovariohysterectomy and ovariectomy, laparoscopic cryptorchidectomy, vasectomy, lap-assisted cystotomy, lap-assisted gastrotomy and gastropexy and laparoscopic gastric plication for obese dogs. As many cases are reported to BSDPH and TVCC for voluntary laparoscopic ovariectomy and ovariohysterectomy this study entitled “Comparison of Single incision laparoscopic surgery (SILS) with two port technique for laparoscopic ovariectomy in dog” was undertaken with following objectives.

1. To evaluate the Single incision laparoscopic surgery technique in comparison with two port technique for laparoscopic ovariectomy in dogs.
2. To study the complications of Single incision and double incision laparoscopic surgery in dogs.
3. To evaluate haematobiochemical changes in dogs undergoing single incision lapOVE and two port lapOVE.

2. REVIEW OF LITERATURE

The present clinical study entitled "Comparison of Single Incision Laparoscopic Surgery (SILS) with two port technique for Laparoscopic Ovariectomy in Dog" was conducted on 12 healthy dogs divided in two groups.

Review of literature has been described below as:

2.1: Review of literature for laparoscopic ovariectomy

2.2: Review of literature for two port laparoscopic ovariectomy

2.3: Review of literature for Single Incision Laparoscopy and SILS port

2.4: Review of literature on Anaesthesia for laparoscopy

2.1: Review of literature for laparoscopic ovariectomy and ovariohysterectomy

Wildt and Lawler (1985) reported first successful canine laparoscopic sterilization techniques. They concluded that laparoscopic ovariectomy was a safe and faster alternative method to conventional ovariohysterectomy. Further they opined that because of its minimal invasiveness it could be performed on young and prepubertal animals as a practical means of sterilizing dogs on a mass basis.

Siegl *et al.* (1994) performed laparoscopic ovariohysterectomy in a bitch in supine position with the head tilted at 30 degrees. Pneumoperitoneum was created with CO_2 at pressure of 12 mmHg. They recorded that duration of surgery was 60 minutes with quick postoperative recovery because of minimal abdominal trauma.

Minami *et al.* (1997) first reported laparoscopic assisted ovariohysterectomy for pyometra in a female dog. The hemostasis was achieved with an ultrasonic scalpel and hemoclips. They recorded that levels of serum Interleukin-6 and C- reactive protein were found to be lesser as compared to conventional ovariohysterectomy.

Remedios *et al.* (1997) studied laparoscopic versus conventional ovariohysterectomy in bitches and reported less post-operative pain and morbidity in bitches. Further they evaluated the hematological parameters, incision size, pain score and stress associated with the procedure by evaluating of plasma cortisol. They concluded that the laparoscopic procedure was practice/technique dependent and major complications could arise because of operator's errors.

Okamoto *et al.* (1998) performed laparoscopic ovariohysterectomy in three cats and four dogs. Two trocars with cannulae were inserted at lateral sides of the abdomen and one just cranial to the pubis. Ovaries were cauterized and resected. Extraction of ovaries and uterus was done from the caudal cannula. The uterine body was ligated and resected in routine manner. The authors reported no complications during and after the procedure, postoperatively.

Valocky *et al*. (1999) compared laparoscopy for sterilization of bitches by three ways viz; a) occluding the oviducts after using an endostapler, b) oviduct occlusion by electro cautery with the help of endo-coagulator and c) using a modified endo suture technique for ovariectomy. They observed the effectiveness of the methods, complications and difficulties involved and concluded that smaller incisions contributed to lesser post-operative pain and improved postoperative recovery. Further they also opined that laparoscopic sterilization was safe in older animals too.

Wakankar *et al.* (1999) studied the efficacy of laparoscopic ovariohysterectomy in 8 female dogs by two or three port method with a 10mm telescope and observed that laparoscopic ovariohysterectomy was safer with minimum complications than conventional ovariohysterectomy.

Dharmaceelan *et al.* (2000) compared three different techniques for laparoscopic sterilization i.e. removal and resection of ovaries after clip application, electro cauterizing the ovaries and a combination of electrocoagulation and clip application for removing the ovaries in 18 healthy female dogs. They opined that the ovaries and associated structures were well visualized without any intraoperative or postoperative complications. They concluded that clip application method was better than the other two methods with a shorter duration of surgery than in electrocoagulation method (42.83 ± 1.40 minutes).

Brun *et al.* (2000) conducted a study on 24 healthy female canines for laparoscopic ovariohysterectomies under general anesthesia. They noticed that laparoscopic ovariohysterectomy was successful in 23 dogs, while in one dog conversion to open surgery was needed. They stated that the technique proved to be adequate and enabled performance of laparoscopic ovariohysterectomy in healthy animals. However, they advised in events of intraoperative hemorrhages surgeon should be ready for conversion to open surgery.

Austin *et al.* (2003) studied laparoscopic ovariohysterectomy on 9 healthy female dogs by using a harmonic scalpel. In the study they compared pre-operative and post-operative creatine kinase values with respect to surgical time, incision size and blood loss. They reported no co-relatation in preoperative and postoperative creatine kinase values with duration of the surgery, incision length or amount of blood loss.

Davidson *et al.* (2004) performed laparoscopic assisted ovariohysterectomy by ligating the uterus and the ovaries with surgical wire (4-0) in 16 dogs and a conventional ovariohysterectomy in 18 dogs. The dogs were assessed for subjective and objective pain scores at different intervals of time. Further they evaluated the surgical time and complications that occurred. They a reported mean surgery time of 120minutes for laparoscopic assisted ovariohysterectomy when compared to 69 minutes in conventional method with lesser postoperative pain score in LOVH group. They observed complications like postoperative fever and anorexia, minor vaginal bleeding and pedicle haemorrhage in dogs operated with laparoscopic ovariohysterectomy.

Bleul *et al.* (2005) evaluated laparoscopic ovariectomy method for development of an optimal surgical technique. The procedure was performed on 8 standing cattle. A bilateral flank approach was used in 2 cows and in 6 cows left flank approach was used. The camera port was placed at the ventral angle of left paralumbar fossa 10 centimeter cranio-ventral to the tuber coxae, the two ports for the instruments which were placed approximately 20 and 30 centimeters ventral to the tuber coxae. They noticed that left flank approach was feasible for bilateral laparoscopic ovariectomy in standing cows.

Chariar *et al.* (2005) reported in that laparoscopic ovariohysterectomy is better than conventional way of spaying with no distention of uterus following ovariectomy and uterine electrodessication. They also stated that laparoscopic sterilization becomes very economic when performed on a large scale for stray dog population control.

Van Nimwegen *et al.* (2005) evaluated neodymium yttrium aluminium garnet (YAG) laser and bipolar electro coagulation for laparoscopic sterilization procedures in dogs. They reported that the use of laser resulted in increased incidence of ovarian bleeding which caused a two minute delay in transecting the ovary as compared to the bipolar electrocoagulation. They concluded that the use of bipolar electrocautery reduced intra operative time and intraoperative bleeding as compared to laser resection.

Devitt *et al.* (2005) studied the duration, complication, stress and pain in open ovariohysterectomy versus laparoscopic assisted ovariohysterectomy. They reported that laparoscopic assisted ovariohysterectomy caused less pain, less surgical stress and lesser recovery time than traditional ovariohysterectomy.

Van Goethem *et al.* (2006) suggested that canine ovariectomy could potentially replace ovariohysterectomy as procedure of choice for regular neutering of healthy female dogs. They noticed that ovariohysterectomy took more time, and was associated with increased morbidity i.e. longer incision, increased trauma to the abdominal organs as compared to ovariectomy. They stated that there was no significant difference in between the two techniques with reference to urogenital problems like endometritis or pyometra and urinary incontinence.

Mayhew and Brown (2007) studied the efficacy of three techniques for haemostasis for ovariectomy in dogs and studied the surgical time for each procedure. They reported median surgical time of 75 minutes in suture group, 53.5 minutes in clip application group and 35.5 minutes in vessel sealing group. They observed that the three methods of hemostasis i.e. suture, clip and vessel sealing were found to be safe for pedicle ligation. They further noticed that use of a vessel sealer resulted in reduced surgical time and provided excellent haemostasis for ovariectomy.

Kumar *et al.* (2007) studied laparoscopic ovariectomy in nine bitches with two paramedian (5mm) ports and one median (10mm) port. They stated that use of CO_2 for abdominal insufflation at 12-14mm Hg pressure and use of bipolar electrocautery for hemostasis was adequate for the laparoscopic procedures and satisfactory wound healing was seen by fifth postoperative day.

Shirodkar *et al.* (2008) performed laparoscopic ovariectomy in female dogs with two methods viz., use of electrocautery and endo-looping technique for pedicle ligation. They observed uneventful recovery with faster healing without any complications in electrocoagulation method. They preferred electrocoagulation since it had more advantages over endo-looping method.

Collins (2008) evaluated laparoscopic and traditional ovariohysterectomy in female dogs under general anaesthesia and reported that in laparoscopic ovariectomy surgical time was shorter, incision size was smaller and there was less trauma to the abdominal wall than the traditional ovariohysterectomy.

Gower and Mayhew (2008) described laparoscopic ovariohysterectomy and ovariectomy surgeries in bitches. They stated that the laparoscopic procedures were less painful, reduced hospitalization time and had faster recovery as compared to open procedures.

Friedrich *et al.* (2009) performed laparoscopic OVH for pyometra in a brown bear by laparoscopic ovariohysterectomy in trendelenburg position and total 4 ports were placed to access the abdominal cavity. They reported that visualization could be maintained by moving animal laterally as and when needed. A harmonic scalpel and ultrasonic generator was used for hemostasis. They reported a surgical time of 51 minutes and stated that the procedure can be safely performed in healthy as well as old animals.

Alves *et al.* (2009) evaluated creatine kinase and aspartate aminotransferase (AST) after laparoscopic and traditional ovariectomy in queens. They concluded that procedures performed by video laparoscopy caused less trauma to the abdominal muscles as compared to the conventional methods and the postoperative recovery time was lesser than the traditional method.

Bendale (2010) studied the use of xylazine–ketamine-halothane for laparoscopic ovariectomy in dogs. He observed that xylazine-ketamine-(2.5%)

halothane anaesthesia was a safe and effective combination for induction and maintenance of anaesthesia for laparoscopic ovariectomy. He further stated that laparoscopic ovariectomy could be performed as a day care surgery allowing faster recovery and reducing the cost of post-operative management.

Dutta *et al*. (2010) evaluated different techniques of laparoscopic sterilization under ketamine- xylazine anaesthesia in 60 mongrel dogs. The animals were randomly divided in to three groups. In group A bilateral laparoscopic oophorectomy was performed, in group B laparoscopic ovariohysterectomy by endocliping or electrocautery was done and In group C laparoscopic ovariohysterectomy with electrocautery only was performed. They recorded parameters like surgical time, physiological parameters and biochemical parameter and reported that surgical time in group A (25 ± 3.46) was significantly lower than the group B (50.83 ± 5.30) and C (47.17 ± 4.13) with a significant decrease in the physiological parameters and a non-significant increase was noted in the biochemical parameters. They opined that all the three techniques were feasible and safe for laparoscopic sterilization but endoclipping and electrocautery showed effective hemostasis in group A and group B.

Khandekar (2011) conducted laparoscopic ovariectomies in 6 bitches, after placing the dogs in trendlenburg position using a bipolar electrocoagulation technique. He reported surgical time of 30 minutes for the removal of the ovaries. And found that the technique was safe with minimum complications.

Al-Badrany *et al*. (2012) studied laparoscopic ovariohysterectomies in 8 bitches under xylazine - ketamine anaesthesia protocol. The pneumoperitoneum was attained by insufflation of CO_2 at a pressure of 12 mm hg. Hemostasis was managed by electrocoagulation and titanium clips. They observed that there were no intraoperative complications or postoperative complications even after 30 days from the surgery. The mean surgical time for the procedure was 35 minutes and they suggested that LOVH could be an alternative to traditional ovariohysterectomy.

Thakur (2013) studied a comparison of lap-assisted ovariohysterectomy and traditional method of ovariohystectomy in 12 dogs. The author concluded that lap-assisted method for ovariohysterectomy was more comfortable and the anaesthetic protocol used were suitable for performing ovariohysterectomy by both methods.

Tripathi (2017) found that the three port technique was a safe and easy method for laparoscopic ovariectomy in dogs.

Salvekar (2017) compared laparoscopic ovariectomy and laparoscopic ovariohysterectomy in 12 dogs. She reported that the mean surgical time for laparoscopic ovariectomy was 71.16± 3.08 minutes and for laparoscopic ovariohysterectomy was 60.66 ± 5.60 minutes. They concluded that both the techniques were feasible and safe for patients and the surgical time could be reduced with experience of the surgeon.

2.2: Review of literature for two port laparoscopic ovariectomy

Devitt *et al.* (2005) studied the postoperative pain, duration of surgery and complications of surgery in open ovariohysterectomy compared to laparoscopic assisted ovariohysterectomy in bitches. They opined that laparoscopic-assisted ovariohysterectomy was less complicated than laparoscopic ovariohysterectomy because of the use of two ports, less instrumentation and use of extracorporeal suture techniques. They concluded that the time required for completion of the procedure, anaesthetic complications and post-op surgical complications were found similar in both the techniques.

Dupre *et al.* (2009) studied the complication rates and surgical time of single port and two port laparoscopic ovariectomy by using a bipolar sealer and divider device in dogs. They observed that no significant difference was found in the mean surgical time between the single port and two port technique. They stated that factors that affected the surgical time, included ovarian ligament fat scores, ovarian bleeding, body condition scores and the surgeon's expertise. However, they reported complications from both the groups such as splenic trauma and bleeding from the ovaries. They further concluded that the single port laparoscopic ovariectomy using a vessel sealer and divider was found to be feasible and did not increase the total surgical time as compared to the two portal access.

Culp *et al.* (2009) undertook a two port technique for laparoscopic ovariectomy to evaluate complications, surgical time and post-operative activity using an accelerometer tagged to the collar of the dogs undergoing conventional and laparoscopic ovariectomy. They concluded that the procedures were performed within a surgical time and without any postoperative complications. They observed increased post-operative activity in dogs operated by laparoscopy as compared to open technique.

Kim *et al.* (2011) performed laparoscopic ovariectomy in 17 cats using a single port technique. A 12 millimeter umbilical port was placed, the ovarian structures were cauterized and transected with bipolar electrocoagulation forceps. They reported minimal blood loss and mean surgical time of 23. 7 minutes ± 5.5 without any intraoperative and postoperative complications.

Kulkarni (2012) conducted comparative study on laparoscopic ovariectomy with single port vs two port access under propofol and isoflurane anaesthesia in 12 female dogs and concluded that both the methods were suitable for LapOVE in dogs, however single port access reduced the number of incision.

2.3: Review of literature for Single Incision Laparoscopy and SILS port:

Duron *et al*. (2011) studied cholecystectomy by single incision laparoscopic surgery (SILS) using a SILS™ port in 55 human patients and evaluated the surgical time, technique, conversion rate and post-operative complications. They concluded that an improvement in the operating room time was observed at the time of the study and reported no post-operative complications like port site hernias, infections or small bowel obstruction. The authors mentioned that single skin and single fascial incision would prove superior and could replace techniques using multiple fascial incisions.

Rao *et al.* (2010) stated that single incision laparoscopic surgery was a very new modality which helped in reducing the scars of standard laparoscopic surgery. Based on their research they stated that conventional laparoscopic procedures are carried out by placing 3-4 or more ports which caused reduced cosmesis, more pain and increased risk of complications due to port site infection and hernias. They further concluded that SILS could be a stepping stone towards truly scarless intervention.

Cusati *et al.* (2011) conducted a study in which 4 laparoscopic surgeons performed multiple laparoscopic procedures in a porcine model by using three different types of ports including SILS™ port. They concluded that all the tested ports allowed the performance of the procedure. However, challenges in handling the ports continue to exist and continuous improvement in design was necessary.

Meyer (2012) studied the use of single port access technique (SITRACC®) for partial or total nephrectomy in pigs with reference to time taken for the procedure, time to insert SITRACC®, loss of blood and complications observed during procedures. Ten pigs of equal weight were distributed in two groups i.e. group A total right nephrectomy and group B partial left nephrectomy. They studied the time taken for insertion of the port and loss of intravascular blood volume post-surgery and reported the surgical time to be varying from 15-43 mins and that the use intracorporeal suture caused an expressive blood loss.

They concluded that partial and total nephrectomy by use of single port access was feasible and safe in pigs.

Khalaj *et al.* (2012) conducted a study to compare SILS with three portal laparoscopic splenectomy in 18 mongrel dogs. Dogs were placed in dorsal recumbency with head titled down at 30 degree angle in right lateral position. A 5mm TriPort was inserted through a small incision using a trocar. A harmonic scalpel was used for cutting and sealing the splenic vessels and adhesions. In dogs operated by traditional three port technique, ports were placed at the umbilicus and cranial and caudal to the umbilicus 3cm apart in a straight line. They concluded that SILS was a more feasible, faster and a safer alternative than traditional method and also has advantages in relation to surgical time and surgical wound healing.

Runge *et al.* (2012) described laparoscopic entry technique for single port access (SPA) for canine ovariectomy in 6 intact female dogs. A 2 cm ventral midline incision was made and a 5 mm blunt laparoscopic trocar was used to enter into the abdomen and two additional 5 mm trocars were inserted from the same incision and ovariectomies were performed. They observed that SPA technique reduced the average surgical time with less postoperative complications. However, they noted that the instruments and camera interfered with each other. Since the cannulae were in close proximity to each other.

Manasssero *et al.* (2012) studied the use of a novel technique of single incision laparoscopy for ovariectomy using SILS™ port (Covidien) in 40 dogs. They compared single incision laparoscopic ovariectomy with trans-abdominal tension suture in first 20 dogs and without tension suture in next 20 dogs. A small 2cm incision was made and the port was placed by folding the lower ridge with the use of doyen clamps. Ovaries were visualised, grasped and cauterized. They reported that in 4 cases where trans-abdominal tension suture was used to transfix ovaries, minor mesovarium bleeding was observed. While, no bleeding was observed in group B. They reported that the time to perform an ovarian resection remained unchanged with or without suspension suture.

Coisman *et al.* (2013) in their study on the decontamination and sterilisation of a disposable port used for single incision laparoscopy. They stated that the standard processes of decontamination and sterilization of a port intended for a single use were effective for elimination of inoculated bacteria and that the port may be reused for laparoscopic procedures.

Case and Ellison (2013) performed single incision lap-assisted intestinal surgery (SILAIS) in 7 dogs and 1 cat. The study was undertaken to describe the clinical findings and short term outcome. The animals were secured in dorsal recumbency and port was placed. The stomach duodenum and the jejunum were explored intracorporeally to locate the cause. All intestinal procedures were carried out extracorporeally but omentalization of the affected part was attempted intracorporeally. They reported that SILAIS was successful in all the cases except 1 dog with a median surgical time of 120 minutes. They opined that SILS™ port SILAIS was feasible and appeared to be effective in selected cases of dogs and cats.

Emerson *et al*. (2013) conducted single incision multicannulated laparoscopic ovariectomy in two tigers (*Panthera tigris*). The tigers were positioned on dorsal recumbency and sites were prepared asceptically. The ports were placed through small 20mm incision was made in the skin. Ovarian pedicles were located, elevated with the help of laparoscopic forcep and were sealed with a bipolar ligation device. Both the ovaries were retrieved with a 10mm specimen retrieval bag. They reported that SILS method offered certain advantages over conventional laparoscopic ovariectomies. However, they reported instrument interference due to straight instruments. They further concluded that laparoscopic ovariectomy using a SILS™ port was performed safely and in reasonable amount of time.

Runge *et al.* (2013) described a technique of single port access for gastropexy and Ovariectomy (SPAGO) using a SILS™ port in 18 female dogs. Bilateral ovariectomy was performed by using articulating forceps, a vessel sealing device and a 30° telescope. The lap-assisted gastropexy was performed after ovariectomy by grasping the antrum of the stomach with a 10mm DuVall forceps and suturing the mucosal layer of antrum to the transverse abdominis muscle. They reported that using angulating instruments with a 30° telescope increased the triangulation and improved working space intra abdominally. They concluded that single port access gastropexy and ovariectomy was a feasible technique for sterilisation in female dogs and prophylactic gastropexy.

Fransson (2014) described the use of SILS port in veterinary laparoscopic surgeries. They observed that the major disadvantage of SILS access techniques was the close clustering of the instrument causing clashing and a fulcrum effect which lead to crossing of the instruments at the level of body wall which resulted in the right hand instrument functioning on the left side and vice a versa.

Runge *et al.* (2014) developed an operative technique for **s**ingle port laparoscopic cryptorchidectomy (SPLC) in cats and dogs. The intra-abdominal testicles were located, grasped and elevated for effective visualisation of the vascular pedicle. The pedicle was sealed with a bipolar vessel sealing device and testicles were taken out after removal of the SILS port. They reported that single port laparoscopic cryptorchidectomy could be combined with other elective laparoscopic procedures in a wide range of dogs and cats. They further concluded that the technique provided less invasive alternative to open and multiport techniques with a better recovery time.

Gonzalez- Gasch *et al.* (2015) compared single port access technique with multiple access technique for elective laparoscopic procedures in 98 dogs. They compared the duration of surgery, complications involved and the frequency of conversion to open surgeries for elective procedures. Procedures like gastropexy and ovariectomies were performed by single port access (SPAS) and multiple port access (MPAS). They reported that only 12 out of 98 dogs had intraoperative complications out of which 9 were minor and 3 were major, which were later converted into open surgeries. They reported that, overall that there were less complications as with reduced time of surgery in single port technique.

Sanchez *et al.* (2015) performed laparoscopic ovariohysterectomy using SILS™ port in nine dogs. They observed clashing of the hand instruments and reduced triangulation as the main limitation for this technique. However, a combination of articulated and straight instruments improved the triangulation and dissection capability. They concluded that ovariohysterectomy could be performed with a single portal access with less abdominal trauma, good cosmetic results and less complications during intraoperative and postoperative period.

Wallace *et al.* (2015) described single incision laparoscopic assisted (using a SILS port) technique for ovariohysterectomy in seven dogs as a treatment of hydrometra and pyometra. The ovarian pedicles were sealed and divided by a vessel sealing device. The body of the uterus was exteriorized and was ligated with suture material. They concluded that single incision laparoscopic assisted technique for cases of pyometra was feasible depending upon the case selection and experience of single incision laparoscopy.

Tapia-Araya *et al.* (2015) studied laparoendoscopic single site (LESS) (group I) and three portal access (group II) technique for laparoscopic ovariectomy in 10 dogs. They reported a mean surgical time of 36.6 ± 3.5min in Group I and 32.0 ± 3.0 min in group II with no perioperative complications and faster recovery. They observed that the longer surgical time in group I was due to limited triangulation leading to restricted range of motion causing interference between instruments and scope. They further stated that the use of articulated instruments increased the triangulation and range of motion improving manoeuvrability in procedures. They concluded that LESS-OVE was feasible and safe in bitches. However, it requires more skill than conventional laparoscopy and thus increases the surgical time.

2.4. Review of literature on anaesthesia for laparoscopy:

Hall and Chamber (1987) reported that induction of anaesthesia continuous infusion of propofol was safe and smooth with fast recovery in healthy dogs.

Short and Bufalari (1999) observed good quality of induction of anaesthesia with propofol and smooth recovery in non premedicated dogs. They concluded that the use of opioids, sedatives and analgesics along with propofol enhanced the muscle relaxation and analgesia. They stated that propofol (6-7mg/kg BW) can be used in different surgeries, including laparoscopy.

Dharmaceelan *et al*. (2000) premedicated dogs undergoing laparoscopic ovariectomy with atropine sulphate (0.04mg/kg BW) SC and triflupromazine hydrochloride (1mg/kg BW) IV and induction and maintenance of anaesthesia with 2.5% thiopentone sodium (25mg/kg BW) IV and reported excellent to good quality of anaesthesia with no anaesthetic complications.

Martin *et al.* (2001) reported that propofol (5mg/kg BW) IV anaesthesia was found to be safe for dogs undergoing laparoscopic surgeries. They observed changes in the cardiovascular parameters during induction, but the recovery was rapid and uncomplicated. They further concluded that rapid administration of propofol led to apnoea whereas slow administration showed inadequate induction of anaesthesia.

Brzeski *et al.* (2002) studied the effect of pneumoperitoneum (12mm Hg) induced by insufflation with CO_2 in two groups for laparoscopy in dogs premedicated with atropine (0.04mg/kg BW) SC and medeothymidine (40mcg/kg

BW) IM. In group I inhalant anaesthetic with a mixture of oxygen and Isoflurane (1-3%) in a closed circuit system was used and in group II intravenous anaesthesia with thiopental sodium (14mg/kg BW) was given. The changes in the biochemical and haematological indices were observed. They concluded that the general anaesthesia and pneumoperitoneum produced in dogs in both the groups had no negative effect on the health of the patients can be effectively used in laparoscopy.

Austin *et al.* (2003) performed laparoscopic ovariohysterectomy in bitches premedicated with acepromazine (0.1mg/kg BW) IM and induced with propofol (4mg/kg BW) IV along with maintenance of anaesthesia with on Isoflurane (2.5%). They stated that the anaesthetic combination used was safe and adequate for laparoscopic ovariohysterectomy in dogs.

Senthil (2006) studied the conventional and laparoscopic method for ovariohysterectomy in dogs premedicated with diazepam (0.5mg/kg BW) IV and induced and maintained on thiopentone sodium (2.5%) at a dose rate of 25mg/kg. He concluded that this anaesthetic combination used for laparoscopic ovariohysterectomy was adequate and offered good muscle relaxation.

Runge *et al.* (2012) used a combination of propofol (4.5mg/lb) IV and isoflurane (2.5%) anaesthesia for single portal access gastropexy (SPAGO) in 18 dogs with satisfactory anaesthesia and no anaesthetic complications.

Falgunan (2014) reported excellent muscle relaxation during laparoscopic tubectomy by endoclip and electrocautery in Bonnet Macaques under midazolam and butorphanol (0.1mg/kg BW) and xylazine(0.5mg/kg) IM and ketamine(10mg/kg BW) IM and maintained on Isoflurane (0.5%).

Singh (2014) evaluated lap-assisted gastropexy and belt loop gastropexy in 10 dogs preanesthetized with butorphanol (0.3mg/kg BW) IV, induced with propofol (5mg/kg BW) IV and maintained on isoflurane USP (2%). She recorded physiological parameters like temperature HR, RR and haematological parameters like Hb, PCV, TEC, SGPT, SGOT serum BUN and serum creatinine and reported that the combination of butorphanol-propofol-isoflurane produced optimum duration and good quality anaesthesia with excellent degree of muscle relaxation. However, she also noted a significant drop in the physiological and haematological parameters.

Datir (2018) studied the efficacy of two different anaesthetic protocols for thoracic examination in 12 dogs. The dogs were preanaesthetized with acepromazine (0.04 mg/kg BW) IM and anaesthesia was induced by propofol (5mg/kg BW) IV and maintained on isoflurane USP 2.5% in group I while in group II the dogs were induced with ketamine (7mg/kg BW) IV and maintained on isoflurane USP 2.5%. He reported good quality of induction of anaesthesia and excellent degree of muscle relaxation with fast recovery. However, he also reported a very significant drop in the physiological parameters and haematological parameters.

Leclerc *et al.* (2018) performed laparoscopic ovariectomy with single port access device in seven african lionesses under premedication with butorphanol (0.3mg/kg BW) IM, midazolam (0.2mg/kg BW) IM and dexmedetomidine (50 mcg/kg BW) IM combination and induction with propofol. They concluded that the anaesthesia used was satisfactory and provided good quality of relaxation of uterus and ovaries with faster and smooth recovery.

Khanchandani (2017) compared conventional and laparoscopic ovariohysterectomy in dogs premedicated with acepromazine (0.05mg/kg BW), butorphanol (0.2mg/kg BW) and glycopyrrolate (0.01mg/kg) combined in a single syringe and administered intravenously along with propofol (4mg/kg BW) IV and maintained on isoflurane anaesthesia (2.5%). She reported good to excellent quality of anaesthesia in both the groups with quick and smooth recovery. She concluded that the combination of acepromazine-butorphanol-glycopyrrolate along with propofol and isolfurane anaesthesia was safe and suitable for laparoscopic procedures.

Vishwasrao (2019) evaluated the effects of preanaesthetic administration of acepromazine (0.02mg/kg BW) IV – butorphanol (0.2mg /kg BW) IV versus midazolam (0.2mg/kg BW) IV – buprenorphine (0.02mg/kg BW) IV in conjunction with propofol and isoflurane anaesthesia in dogs undergoing laparoscopic surgeries. She studied physiological, preanesthetic, anaesthetic and hematobiochemical parameters and reported better relaxation and smooth recovery in acepromazine and butorphanol group. She concluded that acepromazine – butorphanol combination was more effective than midazolam-buprenorphine in conjunction with propofol-isoflurane anaesthesia.

Gulvady (2019) studied total laparoscopic gastropexy in dogs preanaesthetized with acepromazine (0.02mg/kg BW) IV – butorphanol (0.2mg /kg BW) induced with propofol (4mg/kg BW) IV and maintained on isoflurane (2%). She reported excellent muscle relaxation and smooth recovery with the anaesthetic combination used. She concluded that the depth of anaesthesia and muscle relaxation was adequate for performing laparoscopic procedures.

3. MATERIALS AND METHODS

The present clinical study on **"Comparison of Single Incision Laparoscopic Surgery (SILS) with two port technique for Laparoscopic Ovariectomy in Dog"** was undertaken in 12 dogs presented for elective laparoscopic ovariectomy at the Department of Surgery and Radiology, Mumbai Veterinary College as well as to the outpatient department of the college and Bai Sakarbai Dinshaw Petit Hospital for animals, Parel, Mumbai.

All the cases were randomly divided into two groups i.e. group I and group II. 6 cases in each group respectively. In group I laparoscopic ovariectomy was performed with Single incision laparoscopic technique (SILS™ port) and in group II the cases were operated by traditional two port laparoscopy technique.

3.1 Preparation of the dogs

All dogs enrolled in the study were apparently healthy and physiologically stable for undergoing the procedure. All the animals were clinically examined for temperature, heart rate, respiratory rate along with, chest auscultation and abdominal palpation to detect any abnormality of the uterus like tumour, pyometra, or pregnancy. Dogs were fasted for 12 hours and water was withheld for 8 hours prior to induction of anaesthesia. Blood was collected after placing an intravenous catheter in cephalic vein (Plate 1) of the forelimb 24 hours prior to surgery for haemato-biochemical analysis.

Table 3.1 Details of, breed, approximate age and weight of the dogs in group I.

Case No	Breed	Age (year)	Weight (kgs)
1.	Boxer	1year	30kgs
2.	Bully Kutta	1.5 years	25kgs
3.	Labrador	1.2years	23 kgs
4.	Cocker spaniel	3 years	18 kgs
5.	Indie	1.2 years	17kgs
6.	Golden Retriever	1.5years	21kgs

Table 3.2 Details of, breed, approximate age and weight of the dogs in group II.

Case No	Breed	Age (year)	Weight (kgs)
1.	Boxer	3 years	27kgs
2.	Labrador	1.2 years	23kgs
3.	Labrador	4 years	33kgs
4.	Golden Retriver	1.5years	25kgs
5.	Indie	1.2years	20kgs
6.	Golden Retriver	3 years	22kgs

3.2 Pre-anaesthesia and induction of anaesthesia

In both the groups, atropine sulphate[1] (0.04 mg/kg BW) (Plate 2A) and dexamethasone[2] (0.025 mg/kg BW) (Plate 2B) was administered subcutaneously 20 minutes prior to surgery. Amoxicillin sodium and sulbactum[3] (20 mg/kg BW) (Plate 3) as preoperative antibiotic was administered intravenously. The dogs were sedated with butorphanol tartarate[4] (0.2 mg/kg BW) (Plate No.4) and midazolam[5] (0.2 mg/kg BW) (Plate No.5) intravenously and the urinary bladder was evacuated manually. The surgical site was prepared by trimming the hair from xiphoid to pubis and upto the inguinal folds on lateral side. The site was then scrubbed with savlon[6] (chlorhexidine gluconate 1%) and betadine scrub[7] (Plate 6 A and B) multiple times. In both the groups anaesthesia was induced with Propofol[8] (4 mg/kg BW) (Plate 7) intravenously. The total calculated dose of propofol was administered at a slow rate over a period of one minute (Plate 8).

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[1] Atropine Sulphate – Morvel laboratories Ltd. Mehsana. (Plate 2A).
[2] Dexamethasone sodium (Dexona) – Zydus animal health care. (Plate 2B).
[3] Amoxicillin sodium IP and Sulbactum sodium USP (Amoxirum® Forte 300mg), Virbac Animal HealthIndia Pvt Ltd. (Plate 3).
[4] Butorphanol Tartarate Injection USP (Butrum-2), Aristo Pharmaceuticals Pvt. Ltd. (Plate 4).
[5] Midazolam Injection USP (Mezolam 1mg/ml) Neon laboratories, Palghar. (Plate 5).
[6] Savlon (chlorhexidine gluconate 1%) 200ml bottle, Alliance formulations, Solan, Himachal Pradesh. (Plate 6A).
[7] Povidone Iodine cleansing solution USP 7.5% w/v (Betadine surgical scrub 7.5%), Win Medicare Pvt. Ltd (Plate 6B).
[8] Propofol Injection IP (1% w/v) (NEOROF). Neon Laboratories Pvt. Ltd. (Plate 7).

After complete induction of anaesthesia, animals were intubated with different sizes of endotracheal tube (Plate 9) depending upon the body weight of the animal under the guidance of a laryngoscope (Plate 10). The cuff of endotracheal the tube was inflated with atmospheric air by a 5ml syringe and then the tube was connected to anaesthetic machine[10] (Plate 11).

3.3 Maintenance of anaesthesia

In both groups anaesthesia was maintained with Isoflurane USP[9] (2%) (Plate 12) along with oxygen at a flow rate of 1200 ml/min and the rebreathing bag at 2/3rd of its capacity with the semi-closed pop off valve near the patient for escape of expiratory gases.

3.4 Laparoscopic ovariectomy by SILS and Two port

3.4.1 Laparoscopic instruments used in SILS technique-

1. SILS™ flexible port with (2) 5mm cannulae , 5mm cannula with Luer lock valve Covidien, Norwalk, Connecticut, USA (Plate 13 and 14)
2. Hopkins straight forward telescope 0^0, diameter 5 mm, length 29 cm, autoclavable, fiber optic light transmission in corporate (Plate 15)
3. Clickline Kelly grasping and dissecting forcep (Plate 16).
4. Clickline laparoscopic scissor (Plate 17).
5. Grasping laparoscopic forcep (Plate 18).
6. Take-apart bipolar grasping forcep (Plate 19)
7. Telecam SL II – Camera Control Unit (Plate 21 A) and Telecam I – Camera Head with 2 freely programmable camera head buttons, color system PAL, with integrated parfocal zoom and fiber optic light source cable (Plate 20 A and 20 B)

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[9]Isoflurane USP, Raman and Weil Pvt. Ltd. Daman. (Plate No. 12)
[10] Isoflurane Vaporizer VP 300 (Plate No. 11)

8. Karlz storz cold light fountain Xenon Nova 300 (Plate No. 21 B)
9. Electronic CO_2 endoflator SCB with sterilisable silicon tubing, sterile filter, 5 kg CO_2 cylinder with regulator. (Plate 21 C)
10. Electro-cautery Unit (Plate 22)
11. AIDA (Advanced Image and Data Archiving System)- documentation system (Plate 21 D)

Surgical Instruments used:

1. Needle holder (Plate 23 A).
2. Scalpel handle no 4, scalpel blade no. 11 (Plate 23 B).
3. Straight artery forceps (Plate 23 C).
4. Toothed tissue forceps (Plate 23 D).
5. Thumb forceps (Plate 23 E).
6. Straight Mayo scissors (Plate 23 F).
7. Allis forceps (Plate 24 A)
8. Doyens clamp (Plate 24 B).
9. Vicryl 0 (Plate 25).
10. Ethilon 0 (Plate 26).

3.4.2 Laparoscopic instruments used in two port laparoscopic ovariectomy

1. Ternamian endo tip cannula, size 5 mm, consisting of multifunctional valve, cannula with thread, with rotational insufflation stopcock and reducer. (Plate 27).
2. Ternamian endo tip cannula, size 5 mm (Plate 28)
3. A Veress pneumoperitoneum needle with total working length 10 cm and spring-loaded blunt stylet and Luer-lock (Plate 29).
4. Hopkins straight forward telescope 0^0 , diameter 5 mm, length 29 cm, autoclavable, fiber optic light transmission in corporate (Plate 15).

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[11] Vicryl 0 Ethicon, Johnson & Johnson Pvt. Ltd., Aurangabad (Plate 25)
[12] Ethilon 0 Ethicon, Johnson & Johnson Pvt. Ltd., Aurangabad (Plate 26)

5. Clickline Kelly grasping and dissecting forcep (Plate 16).
6. Clickline laparoscopic scissor (Plate 17).
7. Grasping laparoscopic forcep (Plate 18).
8. Take-apart bipolar grasping forcep (Plate 19).
9. Telecam SL II – Camera Control Unit (Plate 21A) and Telecam I – Camera Head with 2 freely programmable camera head buttons, color system PAL, with integrated par focal zoom) and fiber optic light source cable (Plate 20 A and 20 B).
10. Karlz storz cold light fountain Xenon Nova 300 (Plate 21 B).
11. Electronic CO_2 endoflator SCB with sterilisable silicon tubing, sterile filter, 5 kg CO_2 cylinder with regulator. (Plate 21 C).
12. Electro-cautery Unit (Plate 22).
13. AIDA (Advanced Image and Data Archiving System) - documentation system (Plate 21 D).

3.4.3 Sterilization of SILS™ port and cannulae;

SILS™ is a flexible port with (two) 5mm cannulae and is made up of heat sensitive biomaterials like foam and plastic. After every use the port was cleaned with distilled water and then put into a mix solution of Hydrogen peroxide[13] (Plate 30) 50ml (3%) + Betadine[14] 10ml (1%) (Plate 49A) + 10ml Savlon[6] (1%) + 20ml of Korsolex[15] solution (Plate No. 31). The ports were treated in the solution for 10 minutes and were sterilized by Ethylene oxide (ETO) sterilisation in a commercial facility. All the laparoscopic hand instruments were cleaned with distilled water and then immersed completely in Korsolex[15] (2% glutaraldehyde solution) for 4 hours in a tub long enough to hold all the instruments. Finally all the instruments were rinsed with sterile water and dried completely with sterile gauze piece immediately after and prior to the laparoscopic procedure.

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[13] Hydrogen Peroxide Solution 6% (w/v), 450ml bottle, Hansa Chemical Works, Mumbai (Plate 30).
[14] Povidone- iodine solution IP 10% w/v (Betadine solution), Win-Medicare Pvt. Ltd., New Delhi (Plate 80 A).
[15] Korsolex, 500 ml bottle, Raman and Weil Pvt. Ltd., Daman, India. (Plate 31).

3.4.4 Sterilization of Laparoscopic instruments

Laparoscopic instruments were cleaned with distilled water and then immersed in Korsolex[15] (2% Glutaraldehyde solution) for 4 hours in a tub long enough to hold all the instruments. Further they were rinsed with sterile water and dried, whereas the Veress needle and ternamian cannulas were autoclaved along with the general surgical instruments.

3.4.5 Single incision laparoscopic ovariectomy by SILS™ port -

After induction of anaesthesia and intubation, the dogs were placed in dorsal recumbency in trendelenberg position (Plate 32) and the patients head opposite to the monitor. The area was clipped and prepared for surgery after putting a full size drape. The surgeon and assistant surgeon stood on the same side. The sides were changed while operating the other ovary. A single skin incision of approximately 3 cm was made just caudal to the umbilicus and extended to the level of the peritoneum (Plate 33). Muscular margins of the incised linea-alba were grasped and everted with Allis forceps (Plate 34 and 35).The SILS™ Port device was folded at the level of the lower ridge with the use of Doyen clamp (Plate 36) and was then inserted into the peritoneal cavity under direct vision. Only half of the device was introduced, making sure that the lower ridge was completely inside the abdomen. Then, it was released from the Doyen forcep and allis forceps were removed (Plate 37). Thereafter, three laparoscopic 5-mm cannulae were introduced through the access channels of the multi trocar device at the 3 o'clock, 6 o'clock and 10 o'clock positions. Pneumoperitoneum (Plate 38) was established with an electronic CO_2 insufflator (12 mm Hg with a flow rate of 1 l/m) (Plate 39) attached to the appropriate cannula of the multiport device. The three cannulae were oriented in a triangular pattern by placing a 5 mm 0° laparoscope 29 cm in length (Laparoscope HOPKINS straight forward telescope, Karl Storz GMBH, Germany) into the 3 o'clock trocar. A routine exploratory laparoscopy (Plate 40) was performed using a 5 mm zero-degree telescope. Dogs were put in a 10°

Trendelenburg position and the operating table was tilted at about 20° on either the left side or right side (Plate 41) to ease exposure of the left and right ovary, respectively. The left ovary was located (Plate 42) after tilting the table on right side and grasped with grasper (Plate 43). The ovarian suspensory ligaments and vessels were cauterised with bipolar cautery forceps (Plate 44 and 45). The cauterised part of the ovary was transected (Plate 46) and (Plate 47). The right ovary was operated in a similar manner (Plate No. 48-53). Both the ovaries were removed out of the body through the portal incision. Immediately after removal, each ovary was examined to ensure its complete removal (Plate 54) before termination of the procedure. The insufflation was stopped, the port was removed and CO_2 was evacuated from the body by manual expression.

3.4.6 Two port laparoscopic ovariectomy-

After induction of anaesthesia and intubation, the dogs were placed in dorsal recumbency in trendelenberg position (Plate 56). The area was clipped and prepared for surgery after putting a full size drape. The surgeon stood on the right side the animal while the assistant surgeon was on left side. A nick incision was taken on the midline 2 cm lateral to the umbilicus for insertion of veress needle (Plate 57).Hanging drop test was performed to ensure proper positioning of veress needle (Plate 58). Pneumoperitoneum was established by insufflating CO_2 (12 mm Hg) with a Verres needle (Plate 59) and an electronic insufflator. A small 1-2 cms incision was made just below the umbilicus for insertion of a 5 mm endotip cannula (Plate 60) which was used to insert a 5mm 0^o Telescope (Plate 61) was inserted through the cannula and a routine exploratory laparoscopy was performed where whole abdominal cavity was checked for any injury. The second port was placed just diagonally left (in some cases right) to the camera port under the guidance of telescope (Plate 62 and 63). The operating table was lowered down on the head side of the animal to facilitate visualisation of the abdominal viscera and identification of the left ovariouterine complex. The left ovary was grasped (Plate 64) with a grasper from accessory port and brought to the abdominal wall which allowed percutaneous advancement of a trans-abdominal suspension suture (Plate

65) Vicryl 0[10] with a tapering needle to expose the ovarian pedicle. The needle was advanced through the body wall, visible laparoscopically. The needle was directed through the ovariouterine complex encircling the bunch of tissue (Plate 66) and directed out of the abdominal wall. Both the ends of the suture materials were clamped with an artery forceps (Plate 67) and was pulled by the assistant to maintain tension and visualise the ovarian vasculature. The ovarian suspensory ligament, ovarian vessels and uterine horn were cauterized with a bipolar cautery forceps (Plate 68, 69 and 70). The cauterised part of the ovary was transected (Plate 71) and (Plate 72). The right ovary was operated in similar manner (Plate 73-76). Both the ovaries were removed out of the body from the same port (Plate 77). Immediately after removal, each ovary was examined to ensure its complete removal (Plate No.79) before termination of the procedure. Insufflation was stopped, both the ports were removed and the CO_2 was evacuated from the body by manual expression.

3.4.7 Termination of the procedure

Once both of the ovaries were taken out, both the pedicles were checked for any signs of bleeding. The hand instruments, telescope the three cannulae, and the port were removed after evacuation of the carbon dioxide from the abdomen. Incision line was sutured with simple interrupted sutures with Vicryl 0[10] (Plate 24). While suturing of the abdominal incision, the isoflurane concentration was reduced to 1 per cent and after skin sutures, it was reduced to 0.5 per cent. The skin incision was sutured by two cross mattress sutures (Plate 55) with Ethilon 0[11] (Plate 25), where as in group II the skin incision was sutured by cross mattress sutures (Plate 78) using Ethilon 0[11]. After the completion of surgical procedure the vaporizer dial setting was switched off, and the rebreathing bag was emptied and free oxygen was flushed through the circuit. Oxygen was given to the dog till reappearance of the swallowing and the gag reflex. The patient was then extubated after deflating the bulb of the endotracheal tube. Injection of buprenorphine[16] (0.02 mg/kg BW) was given intravenously for post-operative analgesia.

[16] Buprenorphine Hydrochloride, Neon laboratories Pvt. Ltd. Palghar.

3.5 Post-operative care and follow-up

The surgical wounds were dressed with Betadine[14] solution and Burncool ointment[15] daily. Parentral administration of antibiotics Injection Amoxicillin and sulbactum[3] @ (12.5mg/kg BW q24h intravenously) was done for 7 days. Injection Meloxicam[17] was administered @ (0.1mg/kg BW q24h) subcutaneously for the next 3 days. Injection Buprenorphine[16] was administered (0.02 mg/kg BW q12h) subcutaneously twice daily for 5 days. The wound healing was monitored regularly. The sutures were removed on the 10th day post-surgery post operatively in group I and group II

3.6 Parameters studied

The following parameters were studied

3.6.1 <u>Surgical parameters</u>

a. Surgical time required

1. SILS™ port technique for ovariectomy: Time recorded in minutes from the incision on mid ventral abdomen for port placement to the complete removal of both the ovaries and removal of the port.

2. Two port technique for ovariectomy: Time recorded in minutes from veress needle insertion to deflation after complete removal of ovaries.

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[14] Povidone- iodine solution IP 10% w/v (Betadine solution), Win-Medicare Pvt. Ltd., New Delhi
[15] Siver sulphadiazine cream IP (Burn Cool), Super Formulations Pvt. Ltd., Ujjain.
[17] Meloxicam Injection IP 5mg/ml (Melonex® Inj), Intas Pharmaceuticals Ltd.

b. Muscle relaxation of abdominal muscles

The degree of muscle relaxation was graded based on the progressive decline of muscle tone as indicated by relaxation of the abdominal muscles during insufflation of the abdomen, ease of veress needle and trocar insertion. The degree of muscle relaxation was graded as follows:

Table 3.2 Grading of the degree of muscle relaxation.

Muscle Relaxation	Grade
Excellent	++++
Good	+++
Fair	++
Poor	+

c. Muscle relaxation of uterus and ligament.

The relaxation of uterus and ovarian ligament was evaluated in all 12 cases by grasping the uterine horn for checking the flaccidity and relaxation of the horn and the ovarian ligament.

d. Ease of approach.

Ease of approach with respect to the positioning of the animal, the triangulation, position of the surgeon and assistant surgeon and placement of monitor was studied in both of the groups.

e. Port Placement

Port placement in both the techniques was evaluated by ease of performing laparoscopic ovariectomy and by time taken for completion of the procedure.

f. Pain score

Post-operative pain was measured using the University of Melbourne Pain Scores (UMPS) after complete evaluation by the same evaluator at 24, and 48 hours after surgery. Each case was evaluated in the morning on the day of evaluation before administration of analgesics. The same evaluator was assigned for all cases. The UMPS is given in Table 3.3 and 3.4.

Table 3.3 University of Melbourne Pain Score (UMPS) scale

BIOLOGICAL VARIABLES		
No.	Description	Scale
1.	Dilated pupil	2
	Normal pupil	0
2	Percentage of increase in cardiac frequency	
	<20%	0
	>20%	1
	>50%	2
	>100%	4
3.	Salivation	2
	No salivation	0
BEHAVIORAL VARIABLES		
4.	Response to Palpation	
	No changes	0
	Reaction to touch	2
	Reaction before being touched	3
5.	Motor Activity	
	Resting , sleeping	0
	Semiconscious	0
	Awake	1
	Restless, moving around	3
	Eating	0

6.	Mental state	
	Submissive	0
	Sociable	1
	Cautious	2
	Aggressive	3
7.	Posture	
	Protects the affected area (foetal position)	2
	Lateral position	0
	Prone position	1
	Sitting or standing	1
	Moving	1
	Abnormal posture	2
8.	Vocalization	
	Does not vocalize	0
	Vocalizes when touched	2
	Intermittent vocalization	2
	Continuous Vocalization	3

Based on the UMPS scale, the grading of the Pain scale was done as**;**

Table 3.4 Grading of the Pain scale

0	Absence of Pain
1-8	Light pain
9-15	Moderate Pain
>15	Severe Pain

3.6.2. Intra-operative or postoperative complications

Intraoperative and postoperative complications during the surgery were recorded.

3.6.3 Physiological parameters :-

a) Rectal temperature (°F) – Rectal temperature was recorded in all dogs by inserting a thermometer in the rectum before, during and after recovery from anaesthesia in both the techniques.

b) Heart rate (Beats/min)_– Heart rate of all dogs was recorded before, 30 minutes during and after the surgery in both techniques (group I and group II).

c) Respiratory rate (Breaths/min) - Respiratory rate was recorded for all the dogs before induction of anaesthesia, 30 minutes during anaesthesia and after recovery from anaesthesia.

d) Pulse rate (Beats/min) - Pulse rate was recorded for all the dogs before, 30 minutes during and after the surgical procedure in both the groups.

3.6.4. Hematobiological parameters

Blood samples were collected in sterile vial from cephalic vein, before anaesthesia and at 24 hours after the completion of the laparoscopic surgical procedure.

Complete blood count:

The following hematological parameters were estimated using fully automatic analyser Celltac α Nihon Kohden;

a. Hemoglobin (%) (Hb).
b. Total erythrocyte count (TEC) (million/mm^3).
c. Total leukocyte count (TLC) (thousands/ mm^3).
d. Packed cell volume (PCV) (%)
e. Cortisol (mcg/dl)

Liver function tests:

The following serum parameters were estimated using fully automatic analyser EM 200 Erber Mannheim;

a. Aspartate Aminotransferase (AST), IU/L

b. Alanine Aminotransferase (ALT),IU/L

c. Alkaline Phosphatase (ALP) IU/L

Kidney function tests:

a. Blood Urea Nitrogen.(BUN), mg/dl

b. Serum Creatinine (mg/dl)

3.7 Statistical analysis

The data generated during the study was analysed following standard procedure. (Snedecor and Cochran, 1994).

4. RESULTS AND DISCUSSION

The present clinical study entitled **"Comparison of Single Incision Laparoscopic Surgery (SILS) with two port technique for Laparoscopic Ovariectomy in Dog"** was undertaken with the objective of comparing SILS™ port technique with two port technique for laparoscopic ovariectomy in bitches.

This clinical study was conducted on 12 clinically healthy dogs presented to the Department of Surgery & Radiology, Mumbai Veterinary College for an elective laparoscopic ovariectomy. The dogs were randomly divided into two groups viz., group I and group II.

The dogs in group I were operated for laparoscopic ovariectomy by Single incision laparoscopic technique by SILS™ port, while the dogs in group II were operated by using two port technique for laparoscopic ovariectomy.

The results of the study recorded with respect to physiological, surgical and haemato-biochemical parameters were recorded and discussed appropriately.

4.1 Preparation of the Animals

The preparation of patient with respect to nil by mouth, with holding water and surgical site preparation was found to be adequate in both the groups with no peri, intra and post-operative complication noted in the present study.

Table no. 4.1.The mean age and body weight of the dogs in group I.

Case No.	Breed	Age (years)	Weight (kgs)
1.	Boxer	1.00	30.00
2.	Bully Kutta	1.50	25.00
3.	Labrador	1.20	23.00
4.	Cocker Spaniel	3.00	18.00
5.	Indie	1.20	17.00
6.	Golden retriever	1.50	21.00
Mean ± S.E		1.566 ± 0.72	22.33 ± 4.80

Table no. 4.2.The mean age and body weight of the dogs in group II.

Case No.	Breed	Age (years)	Weight (kgs)
1.	Boxer	3.00	27.00
2.	Labrador	1.20	23.00
3.	Labrador	4.00	33.00
4.	Golden Retriever	1.50	25.00
5.	Indie	1.20	20.00
6.	Golden Retriever	3.00	22.00
Mean ± S.E		2.31 ± 0.48	26.66 ± 7.00

The dogs presented in the study were client owned with 1 Golden retriever in group I and 2 Golden retrievers in group II. Similarly 1 boxer female in each groups and 1 Labrador in group I and 2 Labradors in group II. The average age of dogs in group I was 1.566 ± 0.72 and weight 22.33 ± 4.80 respectively. In group II the average age of the dogs was 2.31 ± 0.48 and weight was 26.66 ± 7.00 respectively.

4.2 Pre-anaesthesia and induction of anaesthesia

The pre-anaesthetic protocol of administration of atropine sulphate (0.04 mg/kg BW) subcutaneously and dexamethasone sodium (0.025 mg/kg BW) subcutaneously followed by sedation with butorphanol tartrate (0.2 mg/kg BW) and midazolam (0.2 mg/kg BW) intravenously and induction of anaesthesia with propofol (4 mg/kg BW) intravenously was found to be adequate with no intraoperative anaesthetic complication noted in any of the dogs in both the groups.. Overall quality of induction of anaesthesia was excellent in both groups except one dog in (case 5) group II. Similar type of observations were noted by Kulkarni (2012) and Thakur (2013) for laparoscopic ovariectomies in dogs. Leclerc *et al.* (2018) suggested that combination of Butorphanol –Midazolam-

Propofol and Isoflurane provided sufficient relaxation of uterus and ovarian ligaments for laparoscopic ovariectomy in lionesses.

4.3 Maintenance of anaesthesia

In both groups maintenance of anaesthesia was carried out with Isoflurane USP (2%) along with oxygen at flow rate of 1200 ml/min and the rebreathing bag at $2/3^{rd}$ of its capacity with partially open pop off valve near the patient for escape of expiratory gases. In this study isoflurane anaesthesia provided excellent degree of muscle relaxation and fast post anaesthetic recovery in both the groups. Brezski *et al*. (2002) observed that dogs maintained on isoflurane as a maintenance anaesthetic showed excellent muscle relaxation and rapid recovery from anaesthesia. Auer *et al.* (1978) also observed fast and smooth post anaesthetic recovery in ponies maintained on Isoflurane anaesthesia. Similar observations have also been reported by Khandekar (2011), Kulkarni (2012), Thakur (2013) and Gulvady (2019) for laparoscopic procedures in dogs.

4.4. Laparoscopic ovariectomy procedure

4.4.1 Single incision laparoscopic ovariectomy by SILS™ port –

A routine exploratory laparoscopy was performed. Dogs were kept in a 10° Trendelenburg position and the operating table was tilted at about 20° on either the right or the left side to ease exposure of the left and right ovary, respectively. Ovariectomy was performed and both the ovaries were removed after cauterising the broad ligament, proper ligament and ovarian vessels. Insufflation was stopped, the port was removed, and the CO_2 was evacuated from the body by manual expression. The abdominal musculature was sutured with simple interrupted pattern by absorbable suture material (Vicryl 0) and skin was sutured with cross mattress with non-absorbable suture material (Ethilon 0).

In this study it was noticed that the triangulation of the port was limited, which provoked clashing and restricted movement of the laparoscopic hand instruments and telescope inside the abdominal cavity during performing the procedure. Similar type of interference and fulcrum effect by SILS™ Port in different kind of laparoscopic surgeries was also reported by Fransson (2014).

According observations by Manassero et al. (2012) use of articulated instruments could improve the triangulation whereas, flexibility and cylindrical shape of device can facilitate bending of the port and tilting the operating table in the same direction could resolve the triangulation limitations. Dupre *et al*. (2009) opined that personal skills along with experience in laparoscopic procedures could influence the ability to perform single incision laparoscopic surgery.

Tapia-Araya *et al.* (2015) observed that SILS™ port laparoscopic ovariectomy technique was feasible, safe in healthy bitches whereas, as per their observations this is skill demanding technique, surgical time required was more than traditional laparoscopic ovariectomy and faster recovery as compared to three portal access.

In the present study it was noticed that SILS™ port technique minimizes the risk of internal organ injury because the insertion of port is done under direct visualization. No injuries to the abdominal organs like spleen, liver, stomach was noted in group I. However the incision size is more than normal incision taken for two port or three port technique. The standard straight laparoscopic hand instruments used for SILS™ port technique were found feasible and suitable for laparoscopic ovariectomy.

4.4.2 Two port laparoscopic ovariectomy –

A routine exploratory laparoscopy was performed where whole abdominal cavity was examined. The second port was placed just diagonally left (in some cases right) to the camera port under the guidance of telescope. The left ovary was grasped with a grasper from accessory port and brought to the abdominal wall which allowed percutaneous advancement of a trans-abdominal suspension suture (Vicryl 0) with a tapering needle to expose the ovarian pedicle. The needle was advanced through the body wall, under the guidance of telescope. The needle was directed through the ovariouterine complex encircling the bunch of tissue and directed out of the abdominal wall. During this procedure it was noticed that handling of the needle plays a crucial role in encircling the ovariouterine tissues. A constant tension was maintained by the assistant to ensure visibility of the ovarian vasculature. The ovarian suspensory ligament and ovarian blood supply was cauterized with a bipolar cautery forceps. The cauterised part was transected and ovary was separated. Similar procedure was performed for resection of the right ovary. Both the ovaries were removed out of the body from the same port. The portal sites were closed with simple interrupted sutures by absorbable suture material (Vicryl 0) and skin was sutured with cross mattress with non-absorbable suture material (Ethilon 0)

In the present study it was noted that grasping the ovary of the opposite side of the port was difficult because of interference produced by clashing of the instruments. This particular problem was solved by slow and coordinated movements of the instruments.

The important finding noticed in this technique was trans-abdominal fixation of ovary to the abdominal wall kept persistent tension, which provoked safe and easy cauterisation of ovary. It was also noticed that in few cases it led to minor bleeding of the mesovarium (Plate 83 and 84) but there was no major complications of haemorrhage observed. Further, additional trauma to the abdominal wall while passing of the needle for suspension suture was also noticed (Plate 82)

In the present study, in case 2, 3 and 5 injury to the spleen was observed while inserting veress needle (Plate 85, 86 and 87). Major disadvantage of this technique was increased risk of abdominal viscera damage due to veress needle insertion as per observations by Tapia- Araya *et al*. (2015). Dupre et al (2009) also reported similar disadvantages in dogs undergoing two portal laparoscopic ovariectomy. Similar type of complications in laparoscopic ovariectomy were also reported by Gonzalez-Gasch *et al*. (2015)

In the present study, it was observed that the technique facilitated quick cauterization of ovaries which resulted in the reduction of surgical time. Further time required for completion of the procedure was much less than single port technique, but postoperative recovery period and pain was more than single port.

4.5 Parameters studied

4.5.1 Surgical parameters:

(1) Surgical time

The surgical time recorded in minutes in group I and group II is given in table 4.3 and presented graphically in fig. 1 and 2.

Table no. 4.3. Surgical time (in minutes) for group I and group II.

Case No.	Group I	Group II
1.	45.00	45.00
2.	43.00	43.00
3.	40.00	40.00
4.	45.00	39.00
5.	43.00	37.00
6.	46.00	40.00
Mean ± S.E.	43.66 ± 0.88	40.66 ± 1.17

Two sample test for surgical time.

Group	Mean ± SE	T stat	T crit (0.05)
Group I	43.66 ± 0.88	2.04	2.22
Group II	40.66 ± 1.17		

The treatments were found non-significant.

The time required for completion of the surgery in group I and group II was 43.66 ± 0.88 minutes and 40.66 ± 1.17 minutes. Non-significant difference in the surgical time was found between the groups. However, the surgical time required in group I was quite more than group II. This could be attributed to the time required for placement of the port and difficulty in handling of instrument intracorporally.

Tapia-Araya *et al.* (2015) opined that single incision laparoscopy was a skill demanding technique and thus increases the surgical time they reported a mean surgical time of 36.6 ± 3.5 min for completion of laparoscopic ovariectomy by SILS™ port. Similarly, Dupre *et al.* (2009) compared time required for single port and two port laparoscopic procedure and recorded a non-significant difference in the surgical time between both the techniques. Khandekar (2011) reported 30 minutes of time to perform two port laparoscopic ovariectomy in dogs. Similar type of findings were also reported by Devitt *et al.* (2005)

Time required for completion of the procedure in SILS™ port technique in this study was more than the two-port technique, it could be because of the skill and experience of the operator in laparoscopic surgery.

(2) <u>Muscle relaxation of abdominal muscles</u>

Table no. 4.4. Quality of Muscle relaxation for group I and group II.

Case No	Scale	
	Group I	Group II
1.	Excellent	Excellent
2.	Good	Good
3.	Excellent	Good
4.	Excellent	Excellent
5.	Good	Good
6.	Excellent	Excellent

In both the groups all the dogs under this study exhibited good to excellent quality of muscle relaxation. No sign of discomfort was observed during insufflation of the abdominal cavity and insertion of trocar or handling the ovaries in both the groups.

Kulkarni (2012) also reported good to excellent quality of muscle relaxation during laparoscopic ovariectomy under propofol and Isoflurane anaesthesia in dogs. Leclerc *et al.* (2018) reported that combination of butorphanol–midazolam-propofol and isoflurane provided sufficient relaxation of uterus and ovarian ligaments for laparoscopic ovariectomy in lionesses. Similar findings have been reported by Lokhande (2008), Tatelu (2009), Nadkarni (2014), Singh (2014), Tripathi (2017) and Gulvady (2019) while performing different type of laparoscopic procedures under propofol and Isoflurane anaesthesia in dogs.

(3) Muscle relaxation of uterus and ligament

In both the groups good to excellent quality of muscle relaxation and relaxation of ovarian ligaments was observed. However, 1 dog (case no. 5) from group I and 2 dogs (case no.4 and no.5) from group II showed less relaxation of ovarian ligaments. In most cases uterus was flaccid, and dogs did not exhibited sign of pain during handling and cauterization of the ovarian pedicle. Good to excellent quality of ovarian ligaments relaxation in this study could be due to the cumulative effect of the use of balanced anaesthetic protocol. Kumari (2015) also observed excellent relaxation of uterine ligaments in dogs premedicated with midazolam and induced with propofol.

Manassero *et al.* (2012) observed easily accessible ovaries during laparoscopic ovariectomy due to good quality relaxation of ovarian ligaments in dogs premedicated with midazolam, induced with propofol and maintained on Isoflurane. Tiwari (2015) reported similar findings with butorphanol propofol and isoflurane anaesthesia in dogs undergoing laparoscopic ovariectomy.

In this study it was noticed that a combination of butorphanol, midazolam propofol and maintenance with isoflurane produced adequate muscle and ovarian ligaments relaxation for laparoscopic ovariectomy.

(4) Ease of approach

The animals were positioned in dorsal recumbancy in trendelenburg position for laparoscopic ovariectomy with the head facing opposite to the monitor. In group I port triangulation was limited so that there was restricted range of movement for instrument handling leading to interference of the instruments and clashing in the initial stages. However, if the same procedure was done in a slow-coordinated fashion this problem was eliminated in the later stages. Also tilting the patient 20° degrees on either side for grasping of the respective ovaries minimises these drawbacks. The SILS™ port used in this study was flexible, flexibility of port aided in correcting the triangulation.

Tapia- Araya *et al*. (2015) reported similar observations and recommended the use of articulated instrument for laparoscopic procedures in SILS™ port technique. While Manassero *et al*. (2012) noticed that SILS™ port could be effective with standard instruments also as the port is flexible and could be bent in all directions to compensate triangulation limitations during laparoscopic surgeries. In group II while operating the ovary opposite to the second port placed similar type of clashing was seen between the telescope and the grasping forceps. The interference was dependent on the side of the port place and side of the ovary.

(5) <u>Port placement</u>

In group I port placement was done by making a 2-3 cms incision below umbilicus and after incinsing the linea-alba SILS port was placed. Three 5mm cannulae were inserted. The cannula at 10 o'clock position was used as a camera port whereas cannulas placed at 3o'clock and 6o'clock position were used for insertion of graspers and electrocautery. Placement of the instruments so close resulted into limited triangulation and interference between instruments. This was corrected by, slow and co-ordinated movements along with bending the port and changing the sites of instruments from time to time. Similar observations were noted by Dupre *et al*. (2009) and Manassero *et al*. (2012).

In group II a small incision just below the umbilicus was made for insertion of veress needle and the abdomen was insufflated. Once pneumoperitoneum was established a 5mm ternamian endotip cannula was inserted into the abdominal cavity. This port was used as a camera port. A second port was placed on either on right or left abdominal quadrant. A transabdominal suspension suture was passed to transfix the ovary to the abdominal wall. Placement of port facilitated cauterization of the ovaries resulting into reduced surgical time. Gower and Mayhew (2008) found the two-port technique suitable for performing laparoscopic ovariectomy in dogs.

(6) Pain score

The pain scoring as per the University of Melbourne Pain Scale (UMPS) was carried out 24 hours and 48 hours after surgery for each case and is given in the table no. 4.5, 4.6 and presented graphically in fig. 3 and 4.

Table no. 4.5. Pain score in the dogs as per UMPS for group I

Case No.	24 hrs after surgery	48hrs after surgery
1	8.00	5.00
2	6.00	4.00
3	9.00	4.00
4	5.00	3.00
5	8.00	3.00
6	8.00	3.00
Mean ± S.E	7.33 ± 0.61	3.66 ± 0.33

Table no. 4.6. Pain score in the dogs as per UMPS for group II

Case No.	24 hrs after surgery	48hrs after surgery
1	9.00	5.00
2	10.00	7.00
3	12.00	8.00
4	10.00	3.00
5	11.00	5.00
6	13.00	3.00
Mean ± S.E	10.83 ± 0.60	5.16 ± 0.83

Pain score for group I and II

Group		Mean ± SE	T stat	T crit (0.05)
Group I	After 24hrs	7.33 ± 0.61	5.9	2.57
	After 48 hrs	3.66 ± 0.33		
Group II	After 24 hrs	10.83 ± 0.60	5.37	
	After 48 hrs	5.16 ± 0.33		

Treatments found Significant at 1% and 5% level of significance

The mean pain scale of cases in group I after 24 hours of the surgery was 7.53 ± 0.61. The mean pain scale of cases in group II after 24 hours of surgery 10.83 ± 0.60 which was significantly higher than the group I. This could be attributed to the trauma caused by second port placement in group II. Tapia-Araya *et al*. (2015) observed less postoperative pain and faster recovery in patient's undergoing surgery by SILS technique. Similar observations were also recorded by Dupre *et al.* (2009) and Fransson (2014).

However, a decrease in the pain scores was observed 48 hours after surgery. The combined effect of an opioid (buprenorphine) and NSAID (meloxicam) could be the reason for reducing post-operative pain in this study. Mathews *et al*. (2000) studied safety and efficacy of meloxicam in dogs undergoing abdominal surgeries and concluded that administration of meloxicam was safe and effective method for postoperative pain management. Similar observations were also recorded by Epstein *et al.* (2015) Hellyer *et al.* (2007) opined that administration of an opioid as a pre-emptive analgesia was more beneficial for pain management in dogs.

4.6.2 Intraoperative and Post-operative complications

In group I minimal intraoperative complications such as minor bleeding from the mesovarium during the procedure was observed bleeding was arrested by cauterising the blood vessels with the help of bipolar cautery. However, in group II inadvertent injury to the spleen was noted. This could be because of the blind insertion of the veress needle so as to create pneumoperitoneum. The bleeding was identified after telescope insertion and thereafter the cauterisation of the bleeding was done with bipolar cautery. No cases required conversion into an open surgery in both groups. Intravenous styptics was also administered in these cases.

Gonzalez-Gasch *et al.* (2015) also reported that splenic puncture was the most common complication during the learning phase of laparoscopy but did not require conversion to open abdominal surgery. Similar observations were also reported in dogs by Runge *et al.* (2013) and Khalaj *et al.* (2012).

No major post-operative complications were noted in either group. Complication like surgical wound infection was observed in case no.5 of group I and case no.2 from group II. This complication was resolved by applying an E-collar to the dog and antiseptic ointment application at the wound site.

4.6.3 Physiological parameters

(a) Rectal Temperature (^{0}F)

The rectal temperature (^{0}F) recorded before surgery, during surgery (at 30 minutes) and after surgery in each case of group I and group II is given in table no. 4.7 and 4.8 represented graphically in fig. 5 and 6.

Table no. 4.7. Rectal temperature (^{0}F) at various time intervals in group I

Case No.	Before surgery	30 mins During surgery	After surgery
1.	101.2	99.4	100.5
2.	100.6	97.6	101.1
3.	102.1	98.5	100.4
4.	101.2	98.9	100.8
5.	102.5	99.2	101.2
6.	101.5	99.3	101.5
Mean ± S.E	101.51 ± 0.27	98.81 ± 0.27	100.91 ± 0.17

Table no. 4.8. Rectal temperature (^{0}F) at various time intervals in group II.

Case No.	Before surgery	30 mins During surgery	After surgery
1.	100.4	98.8	100.1
2.	99.8	98.2	100.8
3.	101	99.8	100.1
4.	102.6	98.2	101.4
5.	100.2	98.6	101.2
6.	100.1	99.5	101.3
Mean ± S.E	100.68 ± 0.41	98.85 ± 0.27	100.81 ± 0.24

Anova table for Rectal Temperature in group I

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	24.120	12.06	32507	0.00
Error	15	5.565	0.371	-	-
Total	17	-	-	-	-

Anova table for Rectal Temperature before, during and after surgery in group I

	Mean ± S.E	Critical difference t (0.05)
Before	101.51 ±0.27 [a]	0.749
During	98.81 ± 0.27[b]	
After	100.91 ± 0.17[a]	

Treatments found Significant at 1% and 5% level of significance

Anova Table for Rectal Temperature in group II

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	14.493	7.247	11.826	0.001
Error	15	9.192	0.613	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Rectal Temperature before, during and after surgery group II

	Mean ± S.E	Critical difference t (0.05)
Before	100.68 ±0.41 [a]	0.963
During	98.85 ± 0.27[b]	
After	100.81 ± 0.24[a]	

Mean should be read column wise. Mean with different superscript vary significantly.

The mean rectal temperature before, at 30 minutes during surgery and at 24 hours after surgery in group I was 101.51 ±0.27 ^{0}F, 98.81 ± 0.27 ^{0}F and 100.91 ± 0.17 ^{0}F whereas, the mean rectal temperature before, at 30 minutes during surgery and at 24 hours after surgery in group II was 100.68 ± 0.41 ^{0}F, 98.85 ± 0.27 ^{0}F and 100.81 ± 0.24 ^{0}F.

Significant drop in rectal temperature at 30 minutes during surgery was noted in both the groups. The decrease in rectal temperature could be the result of the anaesthetic drugs used for the surgery. Thakur (2013) noticed decreased rectal temperature during laparoscopic ovariectomy surgery in dogs under propofol isoflurane anaesthesia. Propofol being an anaesthetic cause a decrease in BMR, a suppression of the thermoregulatory centre and vasodilation. Vasodilatation caused by propofol leads to a decrease in the systemic blood pressure, as well as a dose-related decrease in myocardial contractibility.

Hypothermia due to propofol administration has also been reported by Duke (1995), Ikeda *et al.* (1999) and Hayashi *et al*. (1994) Similar decrease in the body temperature with propofol-isoflurane anaesthesia in dogs has been reported by Datir (2018), Singh (2014), Kulkarni (2012), Thakur (2013), Gulvady (2019).

(b) Heart Rate (beats/minute)

The heart rate (beats/minute) recorded before surgery, at 30 minutes during surgery and at 24 hours after the surgery in each case of group I and group II is given in table no. 4.9, 4.10 and presented graphically in fig. 7 and 8.

Table no. 4.9. Heart rate (beats/minute) at various time intervals in group I.

Case No.	Before surgery	30 minutes During surgery	After surgery
1.	100	85	95
2.	115	83	110
3.	95	53	106
4.	105	50	107
5.	95	82	98
6.	98	69	120
Mean ± S.E	101.33 ± 3.12	70.33 ± 6.39	106 ± 3.64

Table no. 4.10. Heart rate (beats/minute) at various time intervals group II.

Case No.	Before surgery	30 minutes During surgery	After surgery
1.	109	75	102
2.	110	77	105
3.	105	69	106
4.	94	87	112
5.	102	82	108
6.	95	81	102
Mean ± S.E	102.5 ± 2.78	78.5 ± 2.55	105.83 ± 1.55

Anova table for Heart rate before, during and after surgery group I

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	4509.77	2254.88	17.629	0.00
Error	15	1918..66	127.911	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Heart rate before, during and after surgery in group I

	Mean ± S.E	Critical difference t (0.05)
Before	101.33 ± 3.12[a]	13.91
During	70.33 ± 6.39[b]	
After	106 ± 3.64[a]	

Mean should be read column wise. Mean with different superscript vary significantly

Anova table for Heart rate before, during and after surgery group II

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	2668.44	1334.22	39.880	0.00
Error	15	501.83	33.456	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Heart rate before, during and after surgery in group II

	Mean ± S.E	Critical difference t (0.05)
Before	102.5± 2.78[a]	7.116
During	78.5± 2.55[b]	
After	105.83 ± 1.55[a]	

The mean heart rate before, during and after surgery in group I was 101.33 ± 3.12, 70.33 ± 6.39 and 106 ± 3.64 beats/min respectively. The mean heart rate before, during and after surgery in group II was 102.5 ± 2.78, 78.5± 2.55 and 105.83 ± 1.55 beats/min respectively.

A significant bradycardia was observed at 30 minutes of the procedure in both the groups; however, the heart rate came back to normal after the completion of surgical procedure. Kellihan *et al*. (2015) reported a decrease in heart rate after administration of butorphanol in dogs. Similar findings were also reported by Guzel e*t al.* (2013) after administration of midazolam in dogs.

In cases 3 and 4 of Group I, the heart rate decreased up to 53 beats/min and 50 beats/min. Following which the depth of anaesthesia was reduced by decreasing the concentration of isoflurane. The reduction in the heart rate after induction with propofol have been also reported by Kulkarni (2012), Thakur (2013), Nadkarni (2014) and Singh (2014). Insufflation of pneumoperitoneum with CO_2 could be the reason for bradycardia as per the observation by Brzeski *et al.* (2002) Similar findings were also recorded by Dutta *et al.* (2010) and Gulvady (2019).

(c) Pulse Rate (beats/minute)

The pulse rate (beats/min) recorded before surgery, at 30 minutes during surgery and after the surgery is given in the table no. 4.11, 4.12 and presented graphically in fig. 9 and 10.

Table no. 4.11. Pulse rate (beats/min) at different time intervals in group I

Case No.	Before Surgery	30 minutes during surgery	After Surgery
1.	100	85	97
2.	115	85	110
3.	95	53	106
4.	105	50	110
5.	97	85	98
6.	98	69	120
Mean ± S.E	101.6 ± 3.00	71.16 ± 6.72	106.83 ± 3.50

Table no. 4.12. Pulse rate (beats/min) at different time intervals in group II.

Case No.	Before Surgery	30 minutes during surgery	After Surgery
1.	109	75	102
2.	110	77	105
3.	105	69	106
4.	94	87	112
5.	102	82	108
6.	95	81	102
Mean ± S.E	102.5 ± 2.78	78.55 ± 2.55	105.83 ± 1.55

Anova table for Pulse rate before, during and after surgery group I

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	4458.00	2229.55	16.74	0.00
Error	15	1997.00	133.13	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Pulse rate before, during and after surgery in group I

	Mean ± S.E	Critical difference t (0.05)
Before	101.66 ± 3.00[a]	14.19
During	71.16± 6.72[b]	
After	106.83± 3.50[a]	

Mean should be read column wise. Mean with different superscript vary significantly

Anova table for Pulse rate before, during and after surgery group II

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	2668.44	1334 .2	39.88	0.00
Error	15	501.83	33.45	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Pulse rate before, during and after surgery in group II

	Mean ± S.E	Critical difference t (0.05)
Before	102.5± 2.78[a]	7.116
During	78.5± 2.55[b]	
After	105.83± 1.55[a]	

In group I the mean pulse rate recorded before, at 30 minutes during surgery and after surgery was 101.6 ± 3.00, 71.16 ± 6.72 and 106.83± 3.50 beats/min respectively. The mean pulse rate recorded before, at 30 minutes during surgery and after surgery 102.5± 2.78, 78.5± 2.55 and 105.83±1.55 beats/min respectively in group II

A significant decrease in the pulse rate was noted during the surgical procedure between and within the groups. Monterio *et al*. (2008) stated that the decrease in the pulse rate could be attributed to the effect of opioid analgesics as they cause reduction in the pulse rate due to increase in the vagal tone. This decrease in pulse rate was similar to the bradycardic effects caused by butorphanol and propofol in this study.

Datir (2018) observed bradycardia in dogs administered acepromazine, propofol and Isoflurane anaesthesia during thoracoscopy. Singh (2014) and Nadkarni (2014) have also reported similar findings.

(d) Respiratory Rate (breaths/minute) -

The respiratory rate recorded before surgery, at 30 minutes during surgery and after the surgery is given in the table no. 4.13, 4.14 and presented graphically in fig. 11 and 12.

Table no. 4.13. Respiratory rate (breaths/min) at different time interval in group I.

Case No.	Before surgery	30 minutes During Surgery	After Surgery
1.	22	17	27
2.	16	14	25
3.	25	18	24
4.	20	17	21
5.	19	16	23
6.	21	18	22
Mean ± S.E	20.5 ± 1.23	16.66 ± 0.61	23.66 ± 0.88

Table no. 4.14. Respiratory rate (breaths/min) at different time intervals in group II.

Case No.	Before surgery	30 minutes During surgery	After Surgery
1.	24	18	25
2.	18	16	28
3.	21	16	23
4.	28	19	25
5.	27	15	24
6.	24	17	21
Mean ± S.E	23.66 ± 1.52	16.83 ± 0.60	24.33 ± 0.95

Anova table for Respiratory rate before, during and after surgery group I

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	147.44	73.22	13.794	0.00
Error	15	80.167	5.344	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Respiratory rate before, during and after surgery in group I

	Mean ± S.E	Critical difference t (0.05)
Before	20.5 ± 1.23[a]	2.84
During	16.66± 0.61[b]	
After	23.66 ±0.88[a]	

Mean should be read column wise. Mean with different superscript vary significantly

Anova table for Respiratory rate before, during and after surgery group II

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	Fcal	Fprob
Treatments	2	206.77	103.38	14.426	0.00
Error	15	107.500	7.167	-	-
Total	17	-	-	-	-

Treatments found Significant at 1% and 5% level of significance

Anova table for Respiratory rate before, during and after surgery in group II

	Mean ± S.E	Critical difference t (0.05)
Before	23.66± 1.52[a]	3.29
During	16.83± 0.60[b]	
After	24.33± 0.95[a]	

Mean should be read column wise. Mean with different superscript vary significantly

In group I mean respiratory rate before, at 30 minutes during surgery and at 24 hours after surgery was 20.5 ± 1.23, 16.66 ± 0.61 and 23.66 ± 0.88 breaths/ minute, while in Group II mean respiratory rate before, at 30 minutes during surgery and at 24 hours after surgery were 23.66± 1.52, 16.83 ± 0.60 and 24.33 ± 0.95 breaths/minute respectively. A significant decrease in the respiratory rate was noticed at in both the groups at 30 minutes during the procedure which could be due to the cumulative effect of the preanesthetic like butorphanol and anaesthetic agent propofol, which both have cardiopulmonary depression effects. Kojima *et al*. (2002). Kulkarni (2012) and Thakur (2013) also observed a decrease in the respiratory rate in dogs induced with propofol for laparoscopic ovariectomy and ovariohysterectomy. Propofol directly acts on the central respiratory centre and ventilator response which result into decrease in respiration. Devitt *et al.* (2005) Nadkarni (2014) and Gulvady (2019) have also reported similar findings in dogs.

4.6.4 <u>Haematological parameters</u>

(a) Hemoglobin (Hb) (gm %)

The haemoglobin (gm%) recorded before and 24 hours after the laparoscopic procedure in the dogs is given in table no. 4.15, 4.16 and presented graphically in fig. 13 and 14.

Table no. 4.15. Haemoglobin (gm %) levels before and after surgery in group I

Case No.	Before surgery	After surgery
1.	18.1	16.3
2.	18.9	18.1
3.	18	15.9
4.	15.8	15.3
5.	15.1	15.9
6.	12.4	14.7
Mean ± S.E.	16.38 ± 0.99	16.03 ± 0.47

Table no. 4.16. Haemoglobin (gm %) levels before and after surgery in group II

Case No.	Before surgery	After surgery
1.	18	17
2.	17	16.4
3.	16.7	16.2
4.	14.2	15.3
5.	18.5	16.5
6.	14.8	16.8
Mean ± S.E.	16.53 ± 0.70	16.36 ± 0.24

Paired t-Test for group I

Before	After	tstat	tcrit(0.05)
16.38 ± 0.99	16.03 ± 0.47	0.95	2.57

*p ≤0.05 non-significant

Paired t-Test for group II

Before	After	tstat	tcrit(0.05)
16.53 ± 0.70	16.36 ± 0.24	1.08	2.57

*p ≤0.05 non-significant

In group I the mean haemoglobin levels before and after surgery was 16.38 ± 0.99 and 16.03 ± 0.47. The mean haemoglobin levels before and after surgery in group II was 16.53 ± 0.70 and 16.36 ± 0.24.

Non-significant decrease in the levels of haemoglobin was observed within the groups however, the values were within normal physiological limits. Similar Non-significant decrease in the levels of haemoglobin were recorded in dogs under propofol anaesthesia by Skarda and Muir. (1994) and Khan *et al.* (2006)

The decrease in the haemoglobin values could be attributed to the splenic pooling of RBCs. Similar findings were reported by Dharmaceelan *et al.* (2000), Shirodkar (2008), Bendale (2010), Khandekar (2011) and Tatelu (2009) during laparoscopic surgeries in dogs.

(b) Total erythrocyte count (TEC) (million/mm^3)

The total erythrocyte count (million/mm^3) recorded before and 24 hours after the laparoscopic surgery is given in table no. 4.17 and 4.18 and presented graphically in fig. 15 and 16.

Table no. 4.17. Total erythrocyte count (million/mm^3) before and after surgery in group I

Case No.	Before	After
1.	7.2	6.5
2.	8.04	7.8
3.	7.53	7.2
4.	5.69	6.5
5.	6.69	6.9
6.	7.86	6.03
Mean ± S.E.	7.16 ± 0.35	6.82 ± 0.25

Table no. 4.18. Total erythrocyte count (million/mm^3) before and after surgery in group II

Case No.	Before	After
1.	7.86	7.32
2.	7.61	7.2
3.	7.2	7
4.	6.06	6.4
5.	8.09	7.3
6.	6.85	7.2
Mean ± S.E.	7.27 ± 0.30	7.07 ± 0.14

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
7.16 ± 0.35	6.82 ± 0.25	0.95	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
7.27 ± 0.30	7.07 ± 0.14	1.08	2.57

*p≤ 0.05 Non-significant

In group I, the mean total erythrocyte count (million/mm^3) before and after surgery was 7.16 ± 0.35 and 6.82 ± 0.25 respectively, While in group II, the mean total erythrocyte count before and after surgery was 7.27 ± 0.30 and 7.07 ± 0.14 respectively.

Non-significant decrease in the total erythrocyte count after procedure was observed within the groups. However the erythrocyte count remained within normal physiological limits. This could be attributed to splenic dilatation leading to the pooling of erythrocytes under propofol anaesthesia. Similar findings were also reported by Dharmaceelan *et al.* (2000) Tatelu (2009) and Kumari (2015) in dogs under midazolam and propofol anaesthesia.

(c) Total leukocyte count (TLC) (thousands/mm^3)

The total leukocyte count (thousands/mm^3) recorded before and 24 hours after the laparoscopic procedure is given in the table no. 4.19, 4.20 and presented graphically in fig. 17 and 18.

Table no. 4.19. Total leukocyte count (thousands/mm^3) before and after surgery in group I

Case No.	Before	After
1.	12.6	13
2.	12.1	13.5
3.	15.8	13.7
4.	9.1	10
5.	13.5	14.8
6.	11.1	10.8
Mean ± S.E.	12.36 ± 0.92	12.63 ± 0.75

Table no. 4.20. Total leukocyte count (thousands/mm^3) before and after surgery in group II

Case No.	Before	After
1.	11.1	12.7
2.	10.6	10.9
3.	13	14.5
4.	9.2	11.5
5.	11.3	12.4
6.	14	12
Mean ± S.E.	11.53 ± 0.70	12.33 ± 0.50

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
12.36± 0.92	12.63 ± 0.75	0.49	2.57

*p≤ 0.05 Non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
11.53 ± 0.70	12.33 ± 0.50	1.28	2.57

*p≤ 0.05 Non-significant

The mean total leukocyte count (thousand/mm^3) before surgery and anaesthesia in group I was 12.36 ± 0.92 and after the procedure was 12.63 ± 0.75

In group II the mean total leukocyte count before surgery and anaesthesia was 11.53 ± 0.70 and after the procedure was 12.33 ± 0.50.

A non-significant increase in the total leukocyte count (TLC) was observed within the groups. The increase in total leukocyte count values could be attributed to the stress, and tissue damage caused due to the port placement and cauterization of the ovaries (Brzeski *et al.* (2002). However, Dharmaceelan *et al.* (2000) reported a significant increase in the Total leukocyte count values 12-24 hours after surgery in dogs undergoing for laparoscopic procedures. Similar findings have been reported by Khandekar (2011) and Tatelu (2009).

(d) Packed cell volume (PCV) (%)

The packed cell volume (%) recorded before and 24 hours after the laparoscopic procedure is given in the table no. 4.21, 4.22 and presented graphically in fig. 19 and 20.

Table no. 4.21. Packed cell volume (%) before and after surgery in group I

Case No.	Before	After
1.	55	45
2.	56.3	52
3.	52.2	47.9
4.	37.9	42
5.	46	44.5
6.	53.8	45.7
Mean ± S.E.	50.2 ± 2.86	46.18 ± 1.39

Table no. 4.22. Packed cell volume (%) before and after surgery in group II

Case No.	Before	After
1.	53.8	52
2.	55.3	49.7
3.	50.1	52
4.	45.8	55
5.	58.7	49.01
6.	51.09	44.2
Mean ± S.E.	52.46 ± 1.83	50.31 ± 1.49

Paired T test in group I

Before	After	tstat	tcrit(0.05)
50.2 ± 2.86	46.18 ± 1.39	1.96	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
52.46 ± 1.83	50.31 ± 1.49	0.76	2.57

*p≤ 0.05 Non-significant

The mean packed cell volume (gram %) before surgery and anaesthesia in group I was 50.02 ±2.86 and after surgery was 46.18 ± 1.39. While in Group II was 52.46 ± 1.83 and after surgery was 50.31 ± 1.49 respectively

Non-significant decrease in the packed cell volume was observed after surgery within the groups. The decrease in the packed cell volume could be attributed to the haemodilution caused by fluid therapy leading to fluid shift into intravascular compartment (Skarda and Muir, 1994) Similar non-significant decrease in the packed cell volume in dogs under propofol anaesthesia was also recorded by Shirodkar (2008) Kinjavadekar *et al.* (2015), Singh (2014), Bendale (2010), Khandekar (2011), Nadkarni (2014) and Gulvady (2019) during laparoscopic surgeries in dogs.

(e) Cortisol (mcg/dl)

The Cortisol values (mcg/dl) recorded before and 24 hours after surgical procedure in group I and group II given in the table 4.23, 4.24 and presented graphically in fig. 21 and 22.

Table no. 4.23. Cortisol (mcg/dl) before and after surgery in group I

Case No.	Before	After
1.	6.5	6.4
2.	6.8	7.1
3.	4.5	5
4.	5.4	5.8
5.	6.2	5.8
6.	5.3	5.5
Mean ± S.E.	5.78 ± 0.35	5.93 ± 0.29

Table no. 4.24. Cortisol (mcg/dl) before and after surgery in group II

Case No.	Before	After
1.	6.3	6.6
2.	7.8	8.2
3.	4.3	5.2
4.	5.2	5.6
5.	3.5	3
6.	4.1	4.6
Mean ± S.E.	5.2 ± 0.65	5.5 ± 0.72

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
5.78 ± 0.35	5.93 ± 0.29	1.083	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
5.2 ± 0.65	5.5 ± 0.72	1.77	2.57

*p≤ 0.05 Non-significant

The mean cortisol level in group I before and after surgery was 5.2 ± 0.65 mcg/dl and 5.93 ± 0.29 mcg/dl respectively. While in group II, the mean cortisol level before and after the surgery was 5.2 ± 0.65 mcg/dl and 5.5 ± 0.72 mcg/dl**.**

Non-significant increase in the serum cortisol value was observed within the groups after the procedure. However, the values were within the normal limits. The findings in this study were similar to the findings of Thakur (2013) during traditional method of ovariohysterectomy as compared to laparoscopic-assisted method of ovariohysterectomy in dogs.

Tiwari (2015) also observed a non-significant increase in the serum cortisol values in dogs undergoing laparoscopic ovariectomy followed by a significant decrease post-operatively. Similar findings were reported by Fox et al. (1994) and Devitt et al. (2005) in dogs undergoing surgery.

4.6.7 Haemato-biochemical tests

4.6.7.1 Liver function tests:

(a) Aspartate aminotransferase (AST),(IU/L)

The aspartate aminotransferase (IU/L) levels recorded before and 24 hours after the laparoscopic surgical procedure is given in the table no. 4.25 and 4.26 and presented graphically in Fig. 23 and 24.

Table no. 4.25. Aspartate Aminotransferase (IU/L) before and after surgery group I.

Case No.	Before	After
1.	47.74	41
2.	29	35
3.	24.75	29.6
4.	29	34
5.	25	33
6.	51	45
Mean ± S.E.	34.41 ± 4.80	36.26 ± 2.31

Table no. 4.26. Aspartate Aminotransferase (IU/L) before and after surgery group II

Case No.	Before	After
1.	42	44
2.	42.43	45
3.	40	35
4.	38	40
5.	39	43
6.	37	39
Mean ± S.E.	39.73 ± 0.88	41 ± 1.52

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
34.41 ± 4.80	36.26 ± 2.31	0.70	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
39.73 ± 0.88	41 ± 1.5	0.97	2.57

*p≤ 0.05 Non-significant

The mean aspartate aminotransferase (IU/l) values in group I before surgery were 34.41 ± 4.80 and after surgery were found to be 36.26 ± 2.3. While in group II the mean aspartate aminotransferase values before and after surgery was 39.73 ± 0.88 and 41 ± 1.5 respectively.

Non-significant increase was noticed within the groups. However, the values were within normal physiological limits. Similarly, Khandekar (2011) and Raibole (2012) also reported a similar observation in dogs. However, Gulvady (2019) reported a non-significant decrease in the values of Aspartate aminotransferase post laparoscopic gastropexy under propofol Isoflurane anaesthesia in dogs.

b) Alanine aminotransferase (ALT), (IU/L)

The Alanine aminotransferase (IU/L) levels recorded before and 24 hours after the surgical procedure is given in the table no. 4.27 and 4.28 and presented graphically in fig. 25 and 26.

Table no. 4.27. Alanine aminotransferase (IU/L) before and after surgery in group I

Case No.	Before	After
1.	49	53
2.	41	42.5
3.	45.97	47
4.	42.8	40
5.	42	44
6.	54	54
Mean ± S.E.	45.79 ± 2.03	46.33 ± 2.20

Table no. 4.28. Alanine aminotransferase (IU/L) before and after surgery in group II

Case No.	Before	After
1.	66	68
2.	51.27	53.5
3.	40	38
4.	44	46.2
5.	57	58.5
6.	41	41
Mean ± S.E.	49.87 ± 4.17	50.86 ± 4.63

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
45.79 ± 2.03	46.33 ± 2.20	0.68	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
49.87 ± 4.17	50.86 ± 4.63	1.43	2.57

*p ≤0.05 non-significant

The mean serum alanine aminotransferase values (IU/L) in group I before and after surgery were 45.79 ± 2.03 and 46.33 ± 2.20 respectively. While the mean serum alanine aminotransferase values in group II, were 49.87 ± 4.17 and 50.86 ± 4.63 IU/L before and after surgery. Non-significant increase in alanine aminotransferase values were observed in within the groups. However, values in this study were within the normal physiological limits. Stedile *et al.* (2009) also reported non-significant increase in the levels of alanine aminotransferase during laparoscopic procedures in dogs. As per his opinion, it could be due to the decrease in hepatic blood flow and compressive effect of pneumoperitoneum on the liver. Similar observations of elevated values of serum glutamic pyruvate transaminase in dogs undergoing laparoscopic procedure were also recorded by Raibole (2012), Khandekar (2011) and Gulvady (2019).

c) Alkaline Phosphatase (ALP) (IU/L)

The alkaline phosphatase (IU/L) levels recorded before and 24 hours after the laparoscopic surgical procedure is given in the table no. 4.29, 4.30 and presented graphically in fig. 27 and 28.

Table no. 4.29. Alkaline phosphatase (IU/L) values before and after surgery in group I

Case No.	Before	After
1.	90	93.7
2.	65	68.3
3.	42.29	47
4.	87	89.6
5.	76	80
6.	75	69
Mean ± S.E.	72.5 ± 7.08	74.6 ± 6.95

Table no. 4.30. Alkaline phosphatase (IU/L) values before and after surgery in group II

Case No.	Before	After
1.	62.8	64
2.	46.71	49.2
3.	82.92	84.8
4.	45	49
5.	55	53
6.	60	63
Mean ± S.E.	58.73 ± 5.62	60.5 ± 5.55

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
72.54 ±7.08	74.6 ± 6.95	1.25	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
58.7 ± 5.62	60.5 ± 5.55	2.07	2.57

*p≤ 0.05 Non-significant

The mean alkaline phosphatase values before and after surgery in group I were 72.54 ±7.08 and 74.6 ± 6.95. While the mean alkaline phosphatase values before surgery and after the surgery were 58.7 ± 5.62 and 60.5 ± 5.55 in group II respectively.

A non-significant increase in the alkaline phosphatase value was observed in within the groups. The elevation in the values could be because of the compressive pressure of the pneumoperitoneum on the liver and thus reduced blood flow in the portal vein Stedile *et al.* (2009). Gulvady (2019) reported non-significant increase in the serum alkaline phosphatase values in dogs it could be effect of handling of organs like liver and stomach during laparoscopic gastropexy. Similar observations have been reported by and Raibole (2012) and Khandekar (2011).

4.6.7.2 Kidney function tests:

(a) Blood Urea Nitrogen (BUN) (mg/dl)

The Blood Urea Nitrogen levels (mg/dl) recorded before and 24 hours after surgery is given in the table no. 4.31, 4.32 and presented graphically in fig. 29 and 30.

Table no. 4.31. Blood Urea Nitrogen (BUN) (mg/dl) before and after surgery in group I

Case No.	Before	After
1.	9.6	11.6
2.	15.1	14.3
3.	9.2	10.1
4.	18.4	17.3
5.	13.9	16.3
6.	21.2	22.1
Mean ± S.E.	14.56 ± 1.93	15.28 ± 1.76

Table no. 4.32. Blood Urea Nitrogen (BUN) (mg/dl) before and after surgery in group II

Case No.	Before	After
1.	12.1	26.5
2.	15.63	21.08
3.	13.61	23.06
4.	9.1	15.19
5.	23	25.15
6.	20	33.01
Mean ± S.E.	15.57 ± 2.10	17.63 ± 1.30

Paired t-Test in group I

Before	After	tstat	tcrit(0.05)
14.56 ± 1.93	15.28 ± 1.76	1.2	2.57

*p ≤0.05 non-significant

Paired t-Test in group II

Before	After	tstat	tcrit(0.05)
15.57 ± 2.10	17.63 ± 1.30	1.47	2.57

*p≤ 0.05 Non-significant

The mean serum blood urea nitrogen (mg/dl) values in group I before and after surgery were 14.56 ± 1.93 and 15.28 ± 1.76 respectively. While, in group II, the mean serum blood urea nitrogen values before surgery were 15.57 ± 2.10 and after surgery was 17.63 ± 1.30 .Non-significant increase in blood urea nitrogen after the surgery was observed within the groups. Whereas values were within normal physiological limits.

Goldberg *et al.* (1996) recorded similar increase in the values of serum blood urea nitrogen 24 hours after surgery under isoflurane anaesthesia in dogs and it could be due to reduced renal blood flow which results in decrease in the glomerular filtration rate. Khandekar (2011) also reported increase in the serum blood urea nitrogen values in dogs undergoing for laparoscopic ovariectomy under halothane anaesthesia. Similar observations have also been reported by Nadkarni (2014), Datir (2018) and Gulvady (2019).

(b) Serum creatinine (mg/dl)

The serum creatinine levels (mg/dl) recorded before and 24 hours after surgical procedure is given in the table no. 4.33, 4.34 and presented graphically in fig. 31 and 32.

Table no. 4.33. Serum creatinine (mg/dl) before and after surgery in group I

Case No.	Before	After
1.	1.16	1.34
2.	1.33	1.42
3.	1.3	1.2
4.	0.88	0.9
5.	1.01	1
6.	1	1.04
Mean ± S.E.	1.11 ± 0.07	1.15 ± 0.08

Table no. 4.34. Serum creatinine (mg/dl) before and after surgery in group II

Case No.	Before	After
1.	1.1	1.12
2.	1.21	1.23
3.	0.92	1
4.	1.2	1
5.	1.02	1.1
6.	0.98	1.1
Mean ± S.E.	1.07 ± 0.04	1.09 ± 0.03

Paired t-Test in Group I

Before	After	tstat	tcrit(0.05)
1.11 ± 0.07	1.15 ± 0.08	0.952	2.57

*p ≤0.05 non-significant

Paired t-Test in Group II

Before	After	tstat	tcrit(0.05)
1.07 ± 0.04	1.09 ± 0.03	0.42	2.57

*p≤ 0.05 Non-significant

The mean serum creatinine (mg/dl) recorded before and after surgery in group I was 1.04 ± 0.07 and 1.09 ± 0.09 respectively. While in group II, the mean serum creatinine before and after the surgery was 1.04 ± 0.04 and 1.09 ± 0.03**.** Non-significant increase in the serum creatinine values was observed within the groups after the procedure whereas, the values were within the normal physiological limits. Similar observations have also been noted by Gulvady (2019) in laparoscopic gastropexy in dogs. (Lumb and Jones, 1984) have stated that it could be due to decreased renal blood flow resulting into decrease in the glomerular filtration rate.

5. SUMMARY AND CONCLUSIONS

The present clinical study entitled “**Comparison of Single Incision Laparoscopic Surgery (SILS) with two port technique for Laparoscopic Ovariectomy in Dog**” was undertaken in 12 healthy bitches presented to the Department of Surgery and Radiology, Mumbai Veterinary College as well as to the outpatient department of the college and Bai Sakarbai Dinshaw Petit Hospital for animals, Parel, Mumbai.

The dogs were divided into two groups- Group I (Laparoscopic ovariectomy by SILS™ port) and Group II (Laparoscopic ovariectomy by two ports). All the dogs were pre-medicated with atropine sulphate (0.04 mg/kg BW) and dexamethasone (0.025 mg/kg BW) administered subcutaneously. The dogs were anaesthetised with the combination of butorphanol (0.2 mg/kg BW) - midazolam (0.2 mg/kg BW) propofol (4 mg/kg BW) intravenously and maintained on Isoflurane inhalation anaesthesia (2%).

Various surgical parameters such as surgical time, muscle relaxation of abdominal muscles, relaxation of uterus and ovarian ligament, ease of approach, port placement, post-operative pain, and the intraoperative and postoperative complications encountered during and after the surgical procedure were studied. Physiological parameters like rectal temperature, heart rate, respiratory rate and pulse rate were studied before, during and after the procedure.

The time required for completion of the surgery in group I and II was 43.66 ± 0.88 minutes and 40.66 ± 1.17 minutes respectively. Non-significant difference in the surgical time was found between the groups. The muscle relaxation was found good to excellent in all the cases by cumulative effect of butorphanol-midazolam and propofol anaesthesia.

All the dogs under this study showed excellent to good quality of relaxation of abdominal muscles. Overall a combination of butorphanol, midazolam propofol and maintenance with isoflurane produced adequate muscle and ovarian ligaments relaxation for laparoscopic ovariectomy.

In both the groups good to excellent quality ovarian ligaments relaxation was observed. However, 1 dog (case no. 5) from group I and 2 dogs (case no.4 and no.5) from group II showed less relaxation of ovarian ligaments. In most cases uterus was flaccid, and dogs did not exhibited sign of pain during handling and cauterization of the ovarian pedicle. Good to excellent quality of ovarian ligaments relaxation in this study could be due to the cumulative effect of the use of balanced anaesthetic protocol.

In group I, port triangulation was limited so that there was restricted range of movement for instrument handling leading to interference of the instruments and clashing in the initial stages. The tilting of the patient 20° degrees on either side for grasping of the respective ovaries minimises these drawbacks. The SILS™ port used in this study was flexible, flexibility of port aided in correcting the triangulation. In group II, while operating the ovary opposite to the second port placed similar type of clashing was seen between the telescope and the grasping forceps.

The mean pain scale of cases in group I after 24 hours of the surgery was 7.53 ± 0.61. The mean pain scale of cases in group II after 24 hours of surgery 10.83 ± 0.60 which was significantly higher than the group I. This could be attributed to the trauma caused by second port placement in group II Thus it can be concluded that animals undergone laparoscopic ovariectomy SILS technique is less invasive, with less postoperative pain and faster recovery.

In group I minimal intraoperative complications such as minor bleeding from the mesovarium during the procedure was observed bleeding was arrested by cauterising the blood vessels with the help of bipolar cautery. However, in group II inadverdent injury to the spleen was noted. This could be because of the blind insertion of the veress needle so as to create pneumoperitoneum. No cases required conversion into an open surgery in both groups.

No major post-operative complications were noted in either group. Complication like surgical wound infection was observed in case no.5 of group I and case no.2 from group II. This complication was resolved by applying an E-collar to the dog and antiseptic ointment application at the wound site.

The mean rectal temperature before, at 30 minutes during surgery and at 24 hours after surgery in group I was 101.51 ±0.27 ^{0}F, 98.81 ± 0.27 ^{0}F and 100.91 ± 0.17 ^{0}F whereas, the mean rectal temperature before, at 30 minutes during surgery and at 24 hours after surgery in group II was 100.68 ± 0.41 ^{0}F, 98.85 ± 0.27 ^{0}F and 100.81 ± 0.24 ^{0}F.. Significant drop in rectal temperature at 30 minutes during surgery was noted in both the groups.

The mean heart rate before, during and after surgery in group I was 101.33 ± 3.12, 70.33 ± 6.39 and 106 ± 3.64 beats/min respectively. The mean heart rate before, during and after surgery in group II was 102.5 ± 2.78, 78.5± 2.55 and 105.83 ± 1.55 beats/min respectively. A significant bradycardia was observed at 30 minutes of the procedure in both the groups; however, the heart rate came back to normal after the completion of surgical procedure.

In group I, the mean pulse rate recorded before, at 30 minutes during surgery and after surgery was 101.6 ± 3.00, 71.16 ± 6.72 and 106.83± 3.50 beats/min respectively. The mean pulse rate recorded before, at 30 minutes during surgery and after surgery 102.5± 2.78, 78.5± 2.55 and 105.83±1.55 beats/min respectively in group II. A significant decrease in the pulse rate was noted during the surgical procedure between and within the groups

In group I, mean respiratory rate before, at 30 minutes during surgery and at 24 hours after surgery was 20.5 ± 1.23, 16.66 ± 0.61 and 23.66 ± 0.88 breaths/ minute, while in Group II mean respiratory rate before, at 30 minutes during surgery and at 24 hours after surgery were 23.66± 1.52, 16.83 ± 0.60 and 24.33 ± 0.95 breaths/minute respectively. A significant decrease in the respiratory rate was noticed at in both the groups at 30 minutes during the procedure.

In group I, the mean haemoglobin levels before and after surgery was 16.38 ± 0.99 and 16.03 ± 0.47. The mean haemoglobin levels before and after surgery in group II were 16.53 ± 0.70 and 16.36 ± 0.24. Non-significant decrease in the levels of haemoglobin was observed within the groups however, the values were within normal physiological limits.

In group I, the mean total erythrocyte count (million/mm^3) before and after surgery was 7.16 ± 0.35 and 6.82 ± 0.25 respectively, While in group II, the mean total erythrocyte count before and after surgery was 7.27 ± 0.30 and 7.07 ± 0.14 respectively. Non-significant decrease in the total erythrocyte count after procedure was observed within the groups. However the erythrocyte count remained within normal physiological limits.

The mean total leukocyte count (thousand/mm^3) before surgery and anaesthesia in group I was 12.36 ± 0.92 and after the procedure was 12.63 ± 0.75 In group II the mean total leukocyte count before surgery and anaesthesia was 11.53 ± 0.70 and after the procedure was 12.33 ± 0.50. A non-significant increase in the total leukocyte count (TLC) was observed within the groups.

The mean packed cell volume (gram %) before surgery and anaesthesia in group I was 50.02 ±2.86 and after surgery was 46.18 ± 1.39. While in Group II was 52.46 ± 1.83 and after surgery was 50.31 ± 1.49 respectively. Non-significant decrease in the packed cell volume was observed after surgery within the groups.

The mean cortisol level in group I before and after surgery was 5.2 ± 0.65 mcg/dl and 5.93 ± 0.29 mcg/dl respectively. While, in group II, the mean cortisol level before and after the surgery was 5.2 ± 0.65 mcg/dl and 5.5 ± 0.72 mcg/dl**.** Non-significant increase in the serum cortisol value was observed within the groups after the procedure. However, the values were within the normal limits.

The mean aspartate aminotransferase (IU/l) values in group I before surgery were 34.41 ± 4.80 and after surgery were found to be 36.26 ± 2.3. While in group II the mean aspartate aminotransferase values before and after surgery was 39.73 ± 0.88 and 41 ± 1.5 respectively. Non-significant increase was noticed within the groups.

The mean serum alanine aminotransferase values (IU/L) in group I before and after surgery were 45.79 ± 2.03 and 46.33 ± 2.20 respectively. While the mean serum alanine aminotransferase values in group II, were 49.87 ± 4.17 and

50.86 ± 4.63 IU/L before and after surgery. Non-significant increase in alanine aminotransferase values were observed in within the groups.

The mean alkaline phosphatase values before and after surgery in group I were 72.54 ±7.08 and 74.6 ± 6.95. While the mean alkaline phosphatase values before surgery and after the surgery were 58.7 ± 5.62 and 60.5 ± 5.55 in group II respectively. A non-significant increase in the alkaline phosphatase value was observed in within the groups.

The mean serum blood urea nitrogen (mg/dl) values in group I before and after surgery were 14.56 ± 1.93 and 15.28 ± 1.76 respectively. While, in group II, the mean serum blood urea nitrogen values before surgery were 15.57 ± 2.10 and after surgery was 17.63 ± 1.30 .Non-significant increase in blood urea nitrogen after the surgery was observed within the groups.

The mean serum creatinine (mg/dl) recorded before and after surgery in group I was 1.04 ± 0.07 and 1.09 ± 0.09 respectively. While in group II, the mean serum creatinine before and after the surgery was 1.04 ± 0.04 and 1.09 ± 0.03**.** Non-significant increase in the serum creatinine values was observed within the groups after the procedure whereas, the values were within the normal physiological limits.

Conclusions:

1. Single Incision Laparoscopic Ovariectomy by SILS™ port is a safe, feasible and an effective minimally invasive procedure for Laparoscopic ovariectomy in dogs.

2. Single Incision Laparoscopic technique offers more effectiveness, with less post-operative pain, better recovery time as compared to two port technique for ovariectomy in dogs.

3. Single Incision Laparoscopy technique and two port technique does not cause any adverse effects on the haemato-biochemical parameters in dogs.

Bibliography

Al-Badrany, M. S., M. G. Thanoon & M. T. Al-Anaaz (2012) Laparoscopic ovariohysterectomy in dogs. Research Opinions in Animal and Veterinary Sciences, ***2*(1)**, 31-34.

Alves, A. E., A. P. C. Ribeiro, P. A. Filippo, M. F. Apparicio, T. F. Motheo, G. Q. Mostachio & A. Hotston Moore (2009) Evaluation of creatine kinase (CK) and aspartate aminotransferase (AST) activities after laparoscopic or conventional ovariectomy in queens. Schweizer Archiv für Tierheilkunde, ***151*(5)**, 223-227.

Auer, J. A., H. E. Garner, J. F. Amend, D. P. Hutcheson, and C. A. Salem. "Recovery from anaesthesia in ponies: a comparative study of the effects of isoflurane, enflurane, methoxyflurane and halothane." Equine veterinary journal 10, no. 1 (1978): **18**-23.

Austin, B., O. I. Lanz, S. M. Hamilton, R. V. Broadstone & R. A. Martin, (2003) Laparoscopic ovariohysterectomy in nine dogs. Journal of the American Animal Hospital Association, **39(4)**, 391-396.

Bendale K. R. (2010) Evaluation of anaesthetic technique for laparoscopic ovariohysterectomy in dogs-a clinical study. M.V.Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur

Bleul, U., K. Hollenstein, & W. Kähn (2005) Laparoscopic ovariectomy in standing cows. Animal reproduction science, **90(3-4)**, 193-200.

Brun, M. V., A. D. P. F. D. Silva Filho, C. A. D. C Beck, M. B. Mariano & J. R. B. D. MELLO, (2000) Laparoscopic ovariohysterectomy in canine. Brazilian Journal of Veterinary Research and Animal Science, **37(6)**, 0-0.

Brzeski, W., Z. Adamiak, M. Nowicki, M. Jalynski, A. Depta, R. Nieradka andA. Rychlik, (2002) Effect of pneumoperitoneum with carbon dioxide (CO2) on various kinds of anesthesia during laparoscopic operations in dogs.Electronic Journal of Polish Agricultural Universities, [online]. Series Veterinary Medicine **5(1)**.

Case, J. B., & G. Ellison (2013) Single incision laparoscopic- assisted intestinal surgery (SILAIS) in 7 dogs and 1 cat. Veterinary Surgery, **42(5)**, 629-634.

Chariar, V. M., D. N. Shirodkar & Y. B. Khare (2005) Minimally invasive technique cuts costs in veterinary surgery. Journal of minimal access surgery, **1(2)**, 84.

Collins, B. S. (2008). A spaying dilemma: Laparoscopic ovariectomy as an alternative to a traditional ovariohysterectomy.

Culp, W. T., P. D. Mayhew & D. C. Brown (2009). The effect of laparoscopic versus open ovariectomy on postsurgical activity in small dogs. Veterinary Surgery, **38(7)**, 811-817.

Coisman, J. G., J. B .Case, N. D. Clark, J. F. Wellehan & G. W. Ellison, (2013). Efficacy of decontamination and sterilization of a single-use single-incision laparoscopic surgery port. American journal of veterinary research, **74(6)**, 934-938.

Cusati, D., J. M. Swain, M. Kendrick & J. Bingener (2011). Evaluation of commercially available port access devices for single-incision laparoscopy. Surgical Laparoscopy Endoscopy & Percutaneous Techniques, **21(3)**, e134-e137.

Datir, A. A. (2018).Evaluation of Sub-Xiphoid and Midlateral Intercostal Thoracoscopy Examination Under Propofol-Isoflurane and Ketamine-Isoflurane Anaesthesia in Dogs. M.V.Sc. thesis submitted to Maharashtra Animal and fishery science university, Nagpur.

Davidson, E. B., H. David Moll & M. E. Payton (2004) Comparison of laparoscopic ovariohysterectomy and ovariohysterectomy in dogs. Veterinary Surgery, **33(1)**, 62-69.

Devitt, C. M., R. E. Cox & J. J. Hailey (2005) Duration, complications, stress, and pain of open ovariohysterectomy versus a simple method of laparoscopic-assisted ovariohysterectomy in dogs. Journal of the American Veterinary Medical Association, ***227*(6)**, 921-927.

Dharmaceelan, S., T. N. Ganesh & W. P. David (2000). Laparoscopic sterilization in bitches: comparison of three techniques. Indian Journal of Veterinary Surgery, ***21*(2)**, 65-68.

Duke, T. (1995) A new intravenous anesthetic agent: propofol.The Canadian Veterinary Journal, **36(3)**:181.

Dupre, G., V. Fiorbianco, M. Skalicky, N. Gueltiken, S. S. Ay & M. Findik (2009) Laparoscopic ovariectomy in dogs: comparison between single portal and two- portal access. Veterinary Surgery, ***38*(7)**, 818-824.

Duron, V. P., G. R. Nicastri & P. S. Gill (2011). Novel technique for a single-incision laparoscopic surgery (SILS) approach to cholecystectomy: single-institution case series. Surgical endoscopy, **25(5)**, 1666-1671.

Dutta, A., S. Maiti, A. P. Pillai and N. Kumar (2010) Evaluation of different laparoscopic sterilization techniques in a canine birth control program.Turkish Journal of Veterinary and Animal Sciences, **34(4)**:393-402.

Emerson, J. A., J. B. Case, A. P. Brock, A. Vigani, D. R. Graham & R. Isaza (2013) Single-incision, multicannulated, laparoscopic ovariectomy in two tigers (Panthera tigris). Veterinary Quarterly, **33(2)**, 108-111.

Epstein, M. E., I. Rodan, G. Griffenhagen, J. Kadrlik, M. C. Petty, S. A. guidelines for dogs and cats. Journal of Feline Medicine and Surgery, **17(3)**:251-272.

Falgunan (2014) Comparative Evaluation of Laparoscopic Tubectomy by Endoclip Application Versus Electrocautery In Bonnet Macaques (Macaca Radiata) M.V.Sc. thesis submitted to Kerala Veterinary and Animal Sciences University, Wayanad.

Fox, S. M., D. J. Mellor, E. C. Firth, H. Hodge & C. R. O. Lawoko (1994) Changes in plasma cortisol concentrations before, during and after analgesia, anaesthesia and anaesthesia plus ovariohysterectomy in bitches. Research in veterinary science, **57(1)**, 110-118.

Fransson, B. (2014). The future: taking veterinary laparoscopy to the next level. Journal of feline medicine and surgery, *16*(1), 42-50.

Friedrich, K. G., L. Pazzaglia, M. Valente & G. Costamagna (2009) Laparoscopic ovariohysterectomy in a brown bear (Ursus arctos) with pyometra. In Proceedings of the International Conference on Diseases of Zoo and Wild Animals, Beekse Bergen, The Netherlands, 20th-24th May 2009 (85-89). Leibniz Institute for Zoo and Wildlife Research.

Goldberg, M. E., J. Cantillo, G. E. Larijani, M. Torjman, D. Vekeman & H. Schieren (1996) Sevoflurane versus isoflurane for maintenance of anesthesia: are serum inorganic fluoride ion concentrations of concern? Anesthesia & Analgesia, 82(6), 1268-1272.

Gonzalez- Gasch, E., & E. Monnet (2015) Comparison of single port access versus multiple port access systems in elective laparoscopy: 98 dogs (2005–2014). Veterinary Surgery, 44(7), 895-899.

Gower, S., & P. Mayhew, (2008) Canine laparoscopic and laparoscopic-assisted ovariohysterectomy and ovariectomy. Compend Contin Educ Vet, *30*(8), 430-440.

Gulvady A.C. (2019) Clinical Evaluation of total Laparoscopic Gastropexy in Dog. M.V.Sc. thesis submitted to Maharashtra Animal and fishery science university, Nagpur.

Guzel, O., D. O. Erdikmen., E. Yildar, , A. Ekici, , M. Saroglu, & B. Ekiz, (2013). The effects of propofol and a diazepam/alfentanil combination in dogs aged 10 years and above on heart rate, respiratory rate, pulse oximetry data, intraocular pressure, and body temperature. Turkish Journal of Veterinary and Animal Sciences, 37(2), 170-176.

Hall, L. W., & Chambers, J. P. (1987). A clinical trial of propofol infusion anaesthesia in dogs. Journal of Small Animal Practice, 28(7), 623-637.

Hayashi, K., R. Nishimura, A. Yamaki, H. Y. Kim, S. Matsunaga, N. Sasaki & A. Takeuchi, (1994). Comparison of sedative effects induced by medetomidine, medetomidine-midazolam and medetomidine-butorphanol in dogs. Journal of Veterinary Medical Science, 56(5), 951-956.

Hellyer, P., I. Rodan, J.Brunt, R. Downing, J. E. Hagedorn, S. A. Robertson, and AAHA/AAFP Pain Management Guidelines Task Force Members (2007) AAHA/AAFP pain management guidelines for dogs and cats.Journal of Feline Medicine and Surgery, 9(6):466-480

Huhn, J. C. (2016). Advances in equipment and instrumentation in laparoscopic surgery. Veterinary Clinics of North America: Small Animal Practice, 46(1), 13-29.

Ikeda, T., D. I. Sessler, M. Kikura, T. Kazama, K. Ikeda andS. Sato (1999) Less core hypothermia when anesthesia is induced with inhaled sevoflurane than with intravenous propofol.Anesthesia andAnalgesia,88(4):921-924

Kellihan, H. B., R. L. Stepien, K. M. Hassen and L. J. Smith (2015) Sedative and echocardiographic effects of dexmedetomidine combined with butorphanol in healthy dogs. Journal of Veterinary Cardiology, 17(4): 282-292.

Khalaj, A., J. Bakhtiari & A. Niasari-Naslaji (2012) Comparison between single and three portal laparoscopic splenectomy in dogs. BMC Veterinary Research, *8*(1), 1-4.

Khanchandani V. T. (2017) Comparison of Conventional and Laparoscopic Ovariohysterectomy under Acepromazine- Butorphanol-Glycopyrrolate with Propofol Anaesthesia in Canine. M.V.Sc. thesis submitted to Maharashtra Animal and fishery science university, Nagpur.

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

Khandekar, G. S., L. B. Sarkate & K. R. Bendale (2015) Physiological and haematobiochemical changes under propofol and halothane anaesthesia in dogs undergoing laparoscopic procedures. Indian Journal of Veterinary Surgery, 36(1), 17-20.

Kim, Y. K., S. Y. Lee, S. J. Park, S. S. Lee, H. C. Lee, H. J. Lee & S. C. Yeon (2011) Feasibility of single- portal access laparoscopic ovariectomy in 17 cats. Veterinary Record, 169(7), 179-179.

Kinjavdekar, P., S. K. Tyagi, H. P. Aithal, Amarpal, A. M. Pawde, V. Malik, R. Sharma and M. C. Pathak (2013) Evaluation of continuous propofol infusion in xylazine/medetomidine and butorphanol premedicated canine orthopaedic patients. Indian Journal of Canine Practice Volume, 5(1):147.

Kulkarni, M. V. (2012) Laparoscopic ovariectomy in dogs: a comparison between single portal and two portal access. M. V. Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Kumar, S., L. Ranganath, M. S. Vasanth & R. Vijayaraghavan (2007) Laparoscopic ovariohysterectomy in bitches. Indian Journal of Veterinary Surgery, 28(2), 110-112.

Kumari L (2015) Effects of Dexmedetomidine, Midazolam and Dexmedetomidine-Midazolam Premedication in Propofol Induced Anaesthesia in Dogs during Ovariohysterectomy M.V.Sc thesis submitted to Birsa Agricultural University, Kanke, Ranchi Jharkhand.

Leclerc, A., A. Decambron, C. Commère, B. Mulot, V. Viateau, & Manassero, M. (2018). Laparoscopic ovariectomy with a single-port multiple-access device in seven African lionesses (Panthera leo). Journal of the American Veterinary Medical Association, 252(12), 1548-1554.

Lokhande, D. U. (2008) A Clinical Study on Bronchoscopy and Gastroscopy in Canine (Doctoral Dissertation, MAFSU, Nagpur).

Lumb, W. V. and E. W. Jones(1984)Veterinary Anaesthesia. Lea and Febiger. Philadelphia.

Manassero, M., D. Leperlier, R. Vallefuoco & V. Viateau (2012) Laparoscopic ovariectomy in dogs using a single- port multiple- access device. Veterinary Record, 171(3), 69-69.

Manassero, M., & V. Viateau, (2018). Advances in laparoscopic spay techniques for dogs: the past, present and future. Veterinary Record, 183(24), 742-744.

Martín, M. F., J. R. Lima, L. J Ezquerra, M. S. Carrasco & J. Usón-Gargallo, (2001) Prolonged anesthesia with desflurane and fentanyl in dogs during conventional and laparoscopic surgery. Journal of the American Veterinary Medical Association, 219(7), 941-945.

Mathews, K. A. (2000) Pain assessment and general approach to management. Veterinary Clinics: Small Animal Practice, 30(4):729-755.

Mayhew, P. D. (2014) Recent advances in soft tissue minimally invasive surgery. Journal of Small Animal Practice, 55(2), 75-83.

Mayhew, P. D., & D. C. Brown (2007) Comparison of three techniques for ovarian pedicle hemostasis during laparoscopic- assisted ovariohysterectomy. Veterinary Surgery, 36(6), 541-547.

McClaran, J. K., & N. J. Buote (2009) Complications and need for conversion to laparotomy in small animals. Veterinary Clinics of North America: Small Animal Practice, 39(5), 941-951.

Meyer, F., D. J. Coutinho, D. S. Gouveia, J. N. Lizana & L. F. Dziedricki (2012) Laparoscopic nephrectomy with single-portal access Sitracc® in swines. Acta cirurgica brasileira, *27*, 231-235.

Minami, S., Y. Okamoto, H. Eguchi, & K. Kato (1997) Successful laparoscopy assisted ovariohysterectomy in two dogs with pyometra. Journal of veterinary medical science, 59(9), 845-847.

Monteiro, E. R., C. D. Figueroa, J. C. Choma, D. Campagnol and C. M. Bettini (2008) Effects of methadone, alone or in combination with acepromazine or xylazine, on sedation and physiologic values in dogs. Veterinary Anaesthesia and Analgesia, 35(6): 519-527.

Nadkarni N.N. (2014) Comparative Study Between Laparoscopic Assisted and Conventional Cystotomy in Dogs. M. V. Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Okamoto, Y. (1998) Laparoscopy-assisted ovariohysterectomy in dogs and cats. Journal-Japan Veterinary Medical Association, *51*, 91-94.

Okkens, A. C., H. S. Kooistra & R. F. Nickel (2002) Comparison of long term side effects of ovariectomy versus ovariohisterectomy in the bitch. Tijdschrift voor diergeneeskunde, 127(11), 369-372.

Phypers, C. (2017). In cats and dogs does laparoscopic ovariectomy offer advantages over open ovariectomy for postoperative recovery?. Veterinary Evidence, 2(2).

Raibole D. P. (2012) Comparative study of conventional method and laparoscopic assisted technique for cryptorchidectomy in dogs. M.V.Sc. thesis submitted to Maharashtra Animal and fishery science university, Nagpur.

Raman, J. D., A. Bagrodia & J. A. Cadeddu (2009) Single-incision, umbilical laparoscopic versus conventional laparoscopic nephrectomy: a comparison of perioperative outcomes and short-term measures of convalescence. European urology, 55(5), 1198-1206.

Raman, J. D., J. A. Cadeddu, P. Rao & A. Rane (2008) Single- incision laparoscopic surgery: initial urological experience and comparison with natural-orifice transluminal endoscopic surgery. BJU international, 101(12), 1493-1496.

Rao, P. P., P. P. Rao & S. Bhagwat (2011) Single-incision laparoscopic surgery-current status and controversies. Journal of minimal access surgery, *7*(1), 6.

Remedios,A. M., J. F. Ferguson, D. D. Walker and P.J. Walsh, (1997) Laparscopic versus open panhysterectomy in dogs: Comparison of postoperative pain and morbidity. Vet. Surg., 26: 425.

Runge, J. J., & P. D. Mayhew (2013) Evaluation of single port access gastropexy and ovariectomy using articulating instruments and angled telescopes in dogs. Veterinary Surgery, 42(7), 807-813.

Runge, J. J., P. D. Mayhew, J. B. Case, A. Singh, K. N. Mayhew & W. T. Culp (2014) Single-port laparoscopic cryptorchidectomy in dogs and cats: 25 cases (2009–2014). Journal of the American Veterinary Medical Association, 245(11), 1258-1265.

Runge, J. J., P. G. Curcillo, S. A. King, E. R. Podolsky, D. E. Holt, J. Davidson, & K. A. Agnello (2012) Initial application of reduced port surgery using the single port access technique for laparoscopic canine ovariectomy. Veterinary Surgery, 41(7), 803-806.

Salvekar, S. P. (2017) Clinical Evaluation of Different Laparoscopic Sterilization Techniques in Bitches. M. V. Sc. Thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Sanchez-Margallo. F.M., A. Tapia-Araya, I. Diaz-Guemes. (2015) Preliminary application of a single-port access technique for laparoscopic ovariohysterectomy in dogs. Vet Rec Open. 2: e000153: 1-7

Senthil S (2006) Comparison of Surgical and Laparoscopic Method Of Sterilization In Bitches. M.V.Sc Thesis submitted to Karnataka Veterinary Animal and Fisheries Sciences University, Bidar

Shirodkar, K., V. M Chariar, P. H. Tank, M. Y. Mankad & Y. M. Paithanpagare, (2008) Laparoscopic oophorectomy in bitches. Indian Journal of Veterinary Surgery, 29(1), 11-13.

Short, C. E. & A. Bufalari (1999) Propofol anesthesia. Veterinary clinics of North America: Small animal practice, 29(3), 747-778.

Siegl, H., R. Bohm, J. Ferguson, M. Friedrich, and U. M. Losert (1994) Laparosocpic ovariohysterectomy in a bitch]. Weiner Tierarztliche Monatsschrift 81(5): 149 – 152. ISSN: 0043-535X.

Singh, S. R. R. (2014) Comparative Study on laparoscopically assisted gastropexy and belt loop gastropexy in canines-A Clinical Study. M.V.Sc. thesis submitted to Maharashtra Animal and fishery science university, Nagpur.

Skarda, R. T., and W. W. Muir 3rd. "Caudal analgesia induced by epidural or subarachnoid administration of detomidine hydrochloride solution in mares." American Journal of Veterinary Research 55, no.5 (1994):670-680.

Snedecor, G. W. and W. G. Cochran, (1994) In “Statistical methods” 8thedn. Oxford and IBH Publishing House, Calcutta.

Stedile, R., C. A. Beck, F. Schiochet, M. P. Ferreira, S. T. Oliveira, F. B. Martens andF. P. Mello (2009) Laparoscopic versus open splenectomy in dogs.Pesquisa Veterinária Brasileira, 29(8):653-660

Tapia-Araya, A. E., I. D. G. Martin-Portugués, L. F. Bermejo & F. M. Sánchez-Margallo (2015) Laparoscopic ovariectomy in dogs: comparison between laparoendoscopic single-site and three-portal access. Journal of veterinary science,

Tatelu, S. (2009) Laparoscopic Vasectomy in Dogs: A Comparison between Clip Application and Electrocoagulation. M.V.Sc Thesis submitted to Maharashtra Animal and Fishery Science University, Nagpur.

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

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

Tripathi, S. D. (2017)A Clinical Study on Laparoscopic Bariatric Procedure In Dogs for Maintenance of Good Health (Doctoral Dissertation, MAFSU, Nagpur).

Tsukamoto, A., M. Iimuro, R. Sato, J. Yamazaki, & T. Inomata (2015). Effect of midazolam and butorphanol premedication on inhalant isoflurane anesthesia in mice. Experimental animals, 14-0073.

Valocky, I., S. Paiss & I. Maracek, (1999) Methods of laparoscopic sterilization of bitches. Veterinarni Medicina, *44*(9), 269-273

Van Goethem, B., A. U. K. E. Schaefers- Okkens & J. Kirpensteijn, (2006) Making a rational choice between ovariectomy and ovariohysterectomy in the dog: a discussion of the benefits of either technique. Veterinary Surgery, 35(2), 136-143.

Van Nimwegen, S. A., C. F. Van Swol & J. Kirpensteijn, (2005) Neodymium: yttrium aluminum garnet surgical laser versus bipolar electrocoagulation for laparoscopic ovariectomy in dogs. Veterinary Surgery, 34(4), 353-357.

Vishwasrao MS (2019) Clinical evaluation of pranaesthetic combinations in conjunction with propofol-isoflurane anesthesia for laparoscopic surgery in dogs M.V.Sc thesis submitted to Maharashtra Animal and Fishery Sciences University, Nagpur.

Wakankar C. C., Vinita Kulkarni, and V. M. Chariar (1999) Laparoscopic Ovariohysterectomy in eight bitches. XXIII Annual convention of ISVS.

Wallace, M. L., J. B. Case, A. Singh, G. W. Ellison & E. Monnet (2015) Single incision, laparoscopic- assisted ovariohysterectomy for mucometra and pyometra in dogs. *Veterinary Surgery*, *44*(S1), 66-70.

Wildt, D. E., & D. F. Lawler (1985) Laparoscopic sterilization of the bitch and queen by uterine horn occlusion. American journal of veterinary research, 46(4), 864-869.

APPENDIX (a) - Tables

Two mean T test table for Pain Score

Table i. Pain score 24 hours after surgery in both the groups	
T stat	5.653
T table (0.05)	2.571
T crit (0.01)	4.032
Treatments found Significant at 1% and 5% level of significance	

Table ii. Pain score 48 hours after surgery in both the groups	
T stat	2.892
T table (0.05)	2.571
T crit (0.01)	4.032
Treatments found Significant at 5% level of significance	

Table iii: UMPS scaling for dogs in Group I.

Case no	Pupils	Percent increase in heart rate	Salivation	Response to palpation	Motor activity	Mental State	Posture	Vocalization	Total score
1.	After 24 hours								
	0	0	0	2	1	2	1	2	8
	After 48 hours								
	0	0	0	2	1	1	1	0	5
2.	After 24 hours								
	0	0	0	2	0	1	1	2	6
	After 48 hours								
	0	0	0	2	0	1	1	0	4
3.	After 24 hours								
	0	0	0	2	3	0	2	2	9
	After 48 hours								
	0	0	0	0	1	2	1	0	4
4.	After 24 hours								
	0	0	0	2	1	0	0	2	5
	After 48 hours								
	0	0	0	0	1	1	1	0	3
5.	After 24 hours								
	0		0	2	1	1	1	2	8

	After 48 hours								
	0	0	0	0	1	1	1	0	3
6.	After 24 hours								
	0	1	0	2	1	1	1	2	8
	After 48 hours								
	0	0	0	0	1	1	1	0	3

Table iv: UMPS scaling for dogs in Group II.

Case no	Pupils	Percent increase in heart rate	Salivation	Response to palpation	Motor activity	Mental State	Posture	Vocalization	Total score
1.	After 24 hours								
	0	0	0	2	1	2	2	2	9
	After 48 hours								
	0	0	0	2	1	1	1	0	5
2.	After 24 hours								
	0	0	0	2	3	3	0	2	10

	After 48 hours								
	0	0	0	2	1	2	0	2	7
3.	After 24 hours								
	0	1	0	2	1	3	2	3	12
	After 48 hours								
	0	0	0	2	1	2	1	2	8
4.	After 24 hours								
	0	1	0	3	3	1	2	0	10
	After 48 hours								
	0	0	0	2	1	0	0	0	3
5.	After 24 hours								
	0	1	0	2	1	1	1	2	11
	After 48 hours								
	0	0	0	0	1	1	1	2	5
6.	After 24 hours								
	0	1	0	3	3	3	2	2	13
	After 48 hours								
	0	0	0	0	1	1	1	0	3

APPENDIX (b) - Figures

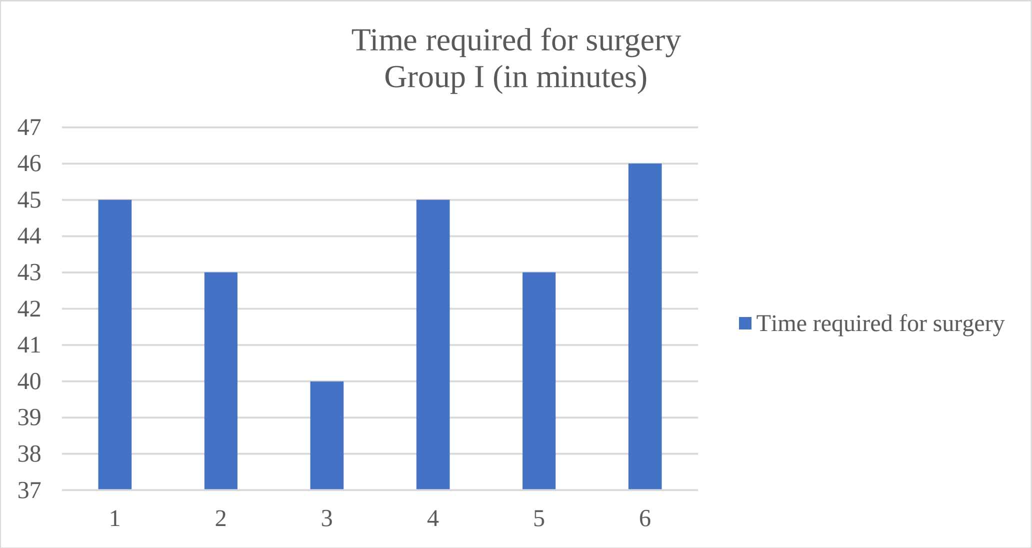

Figure 1. Graph showing Time required for laparoscopic ovariectomy in Group I

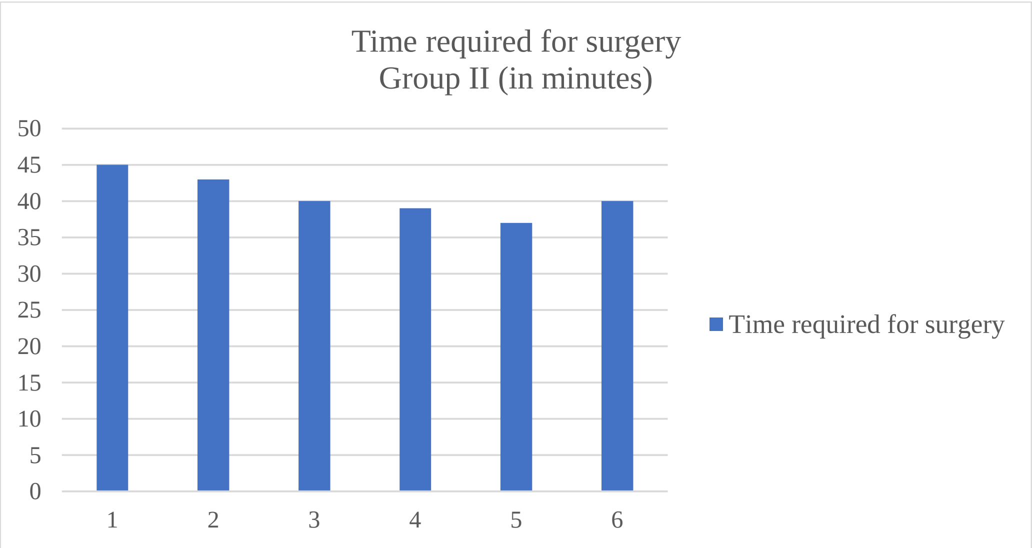

Figure 2. Graph showing Time required for laparoscopic ovariectomy in Group II

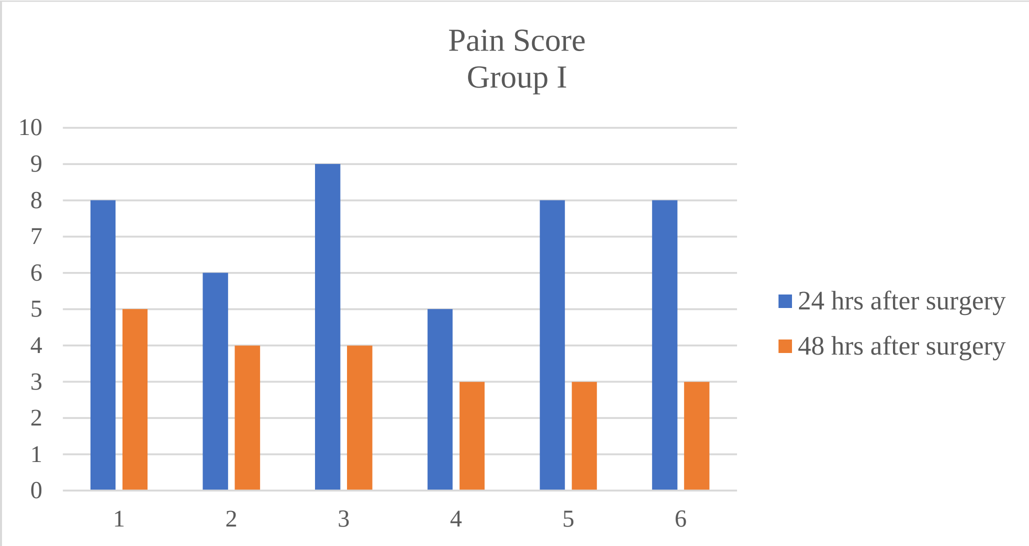

Figure 3. Graph showing Pain Score for laparoscopic ovariectomy in Group I

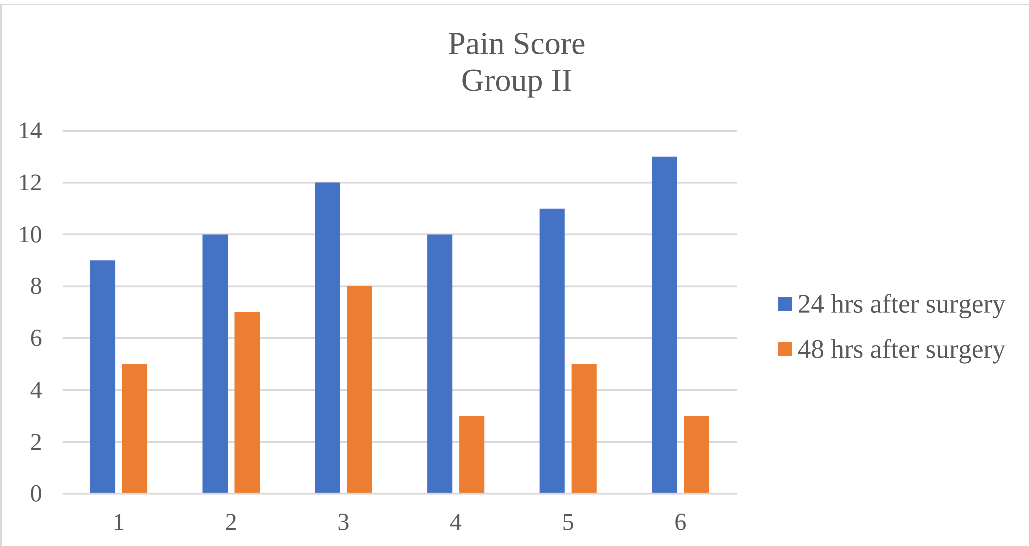

Figure 4. Graph showing Pain Score for laparoscopic ovariectomy in Group II

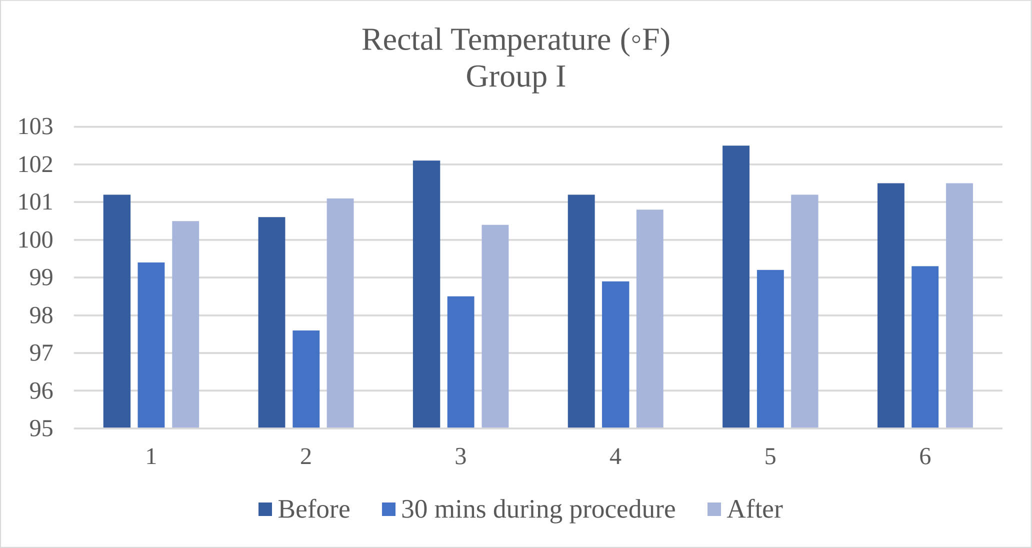

Figure 5. Graph showing Mean Rectal Temperature before, during and after surgery in Group I

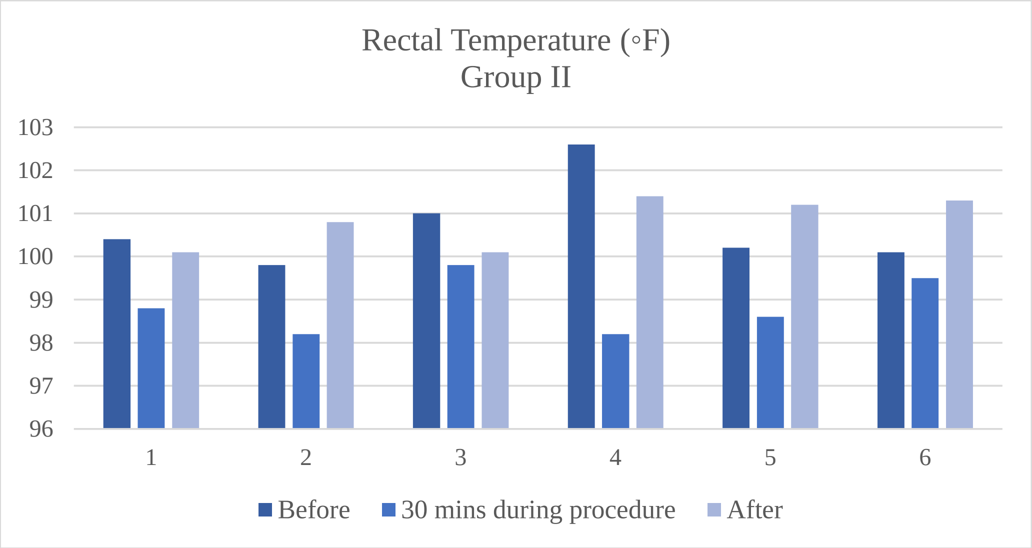

Figure 6. Graph showing Mean Rectal Temperature before, during and after surgery in Group II

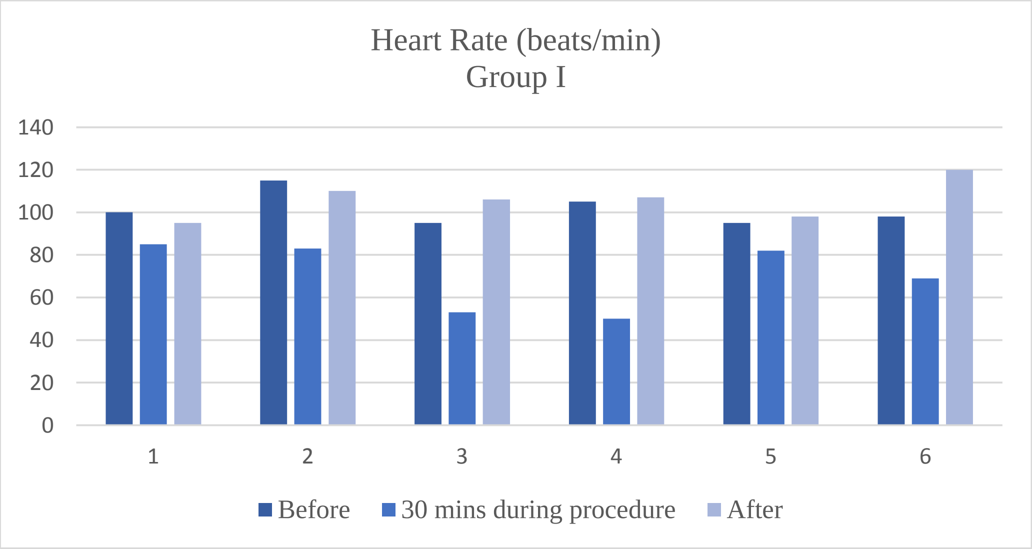

Figure 7. Graph showing Mean Heart rate before, during and after surgery in Group I

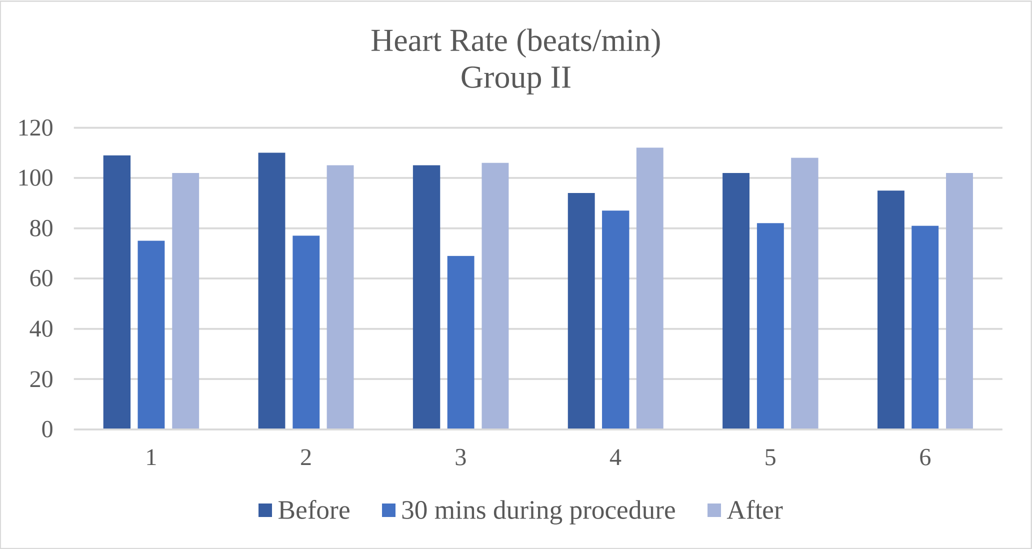

Figure 8. Graph showing Mean Heart rate before, during and after surgery in Group II

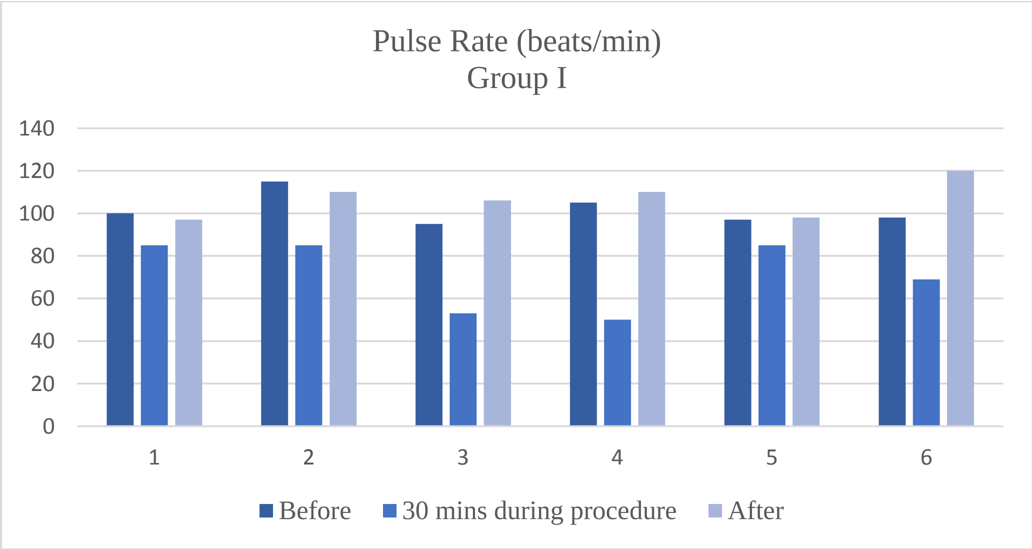

Figure 9. Graph showing Mean Pulse Rate before, during and after surgery in Group I

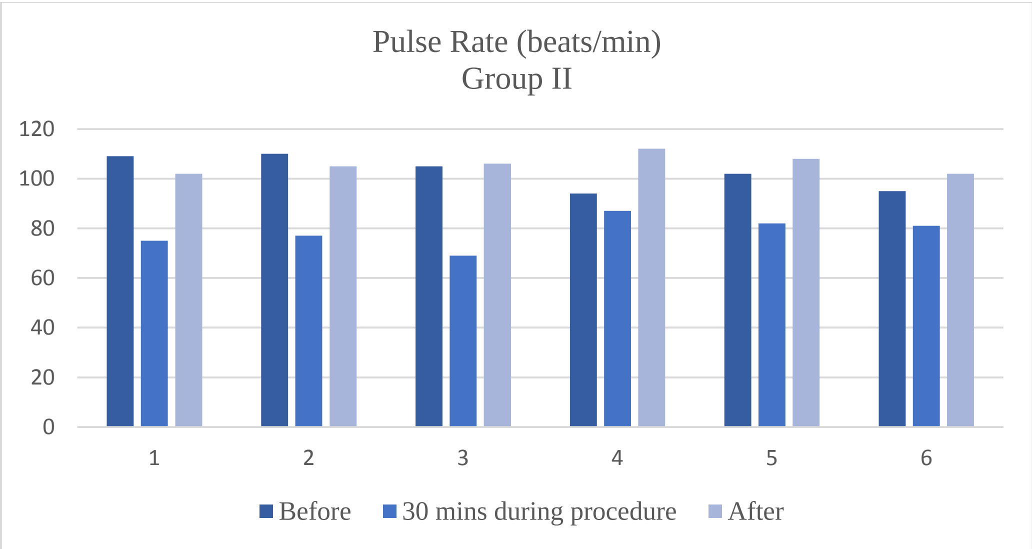

Figure 10. Graph showing Mean Pulse Rate before, during and after surgery in Group II

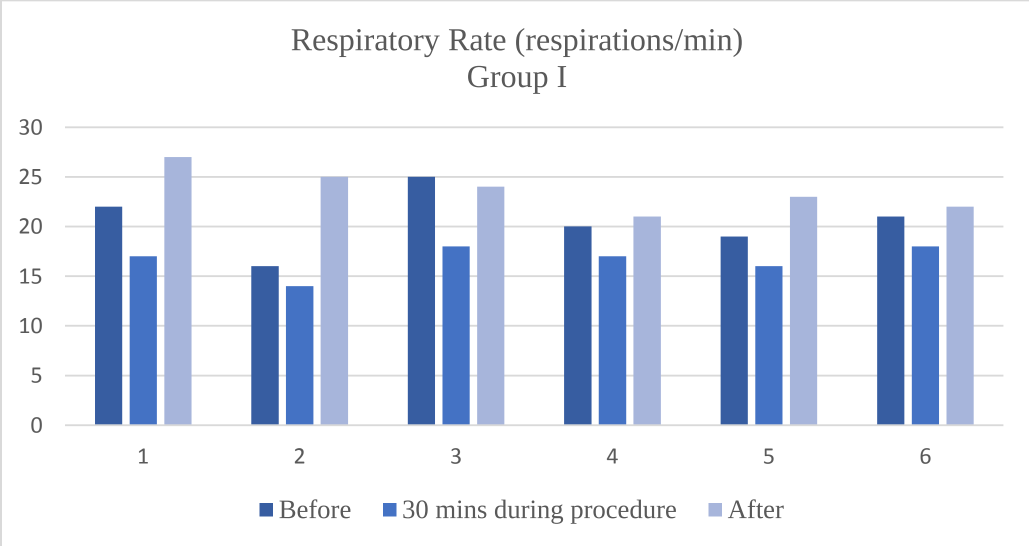

Figure 11. Graph showing Mean Respiratory Rate before, during and after surgery in Group I

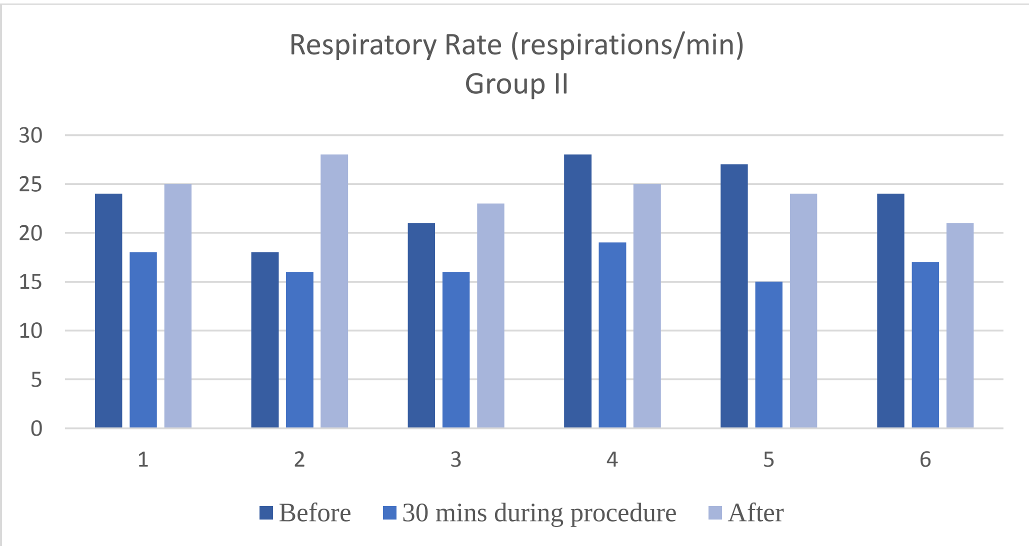

Figure 12. Graph showing Mean Respiratory Rate before, during and after surgery in Group II

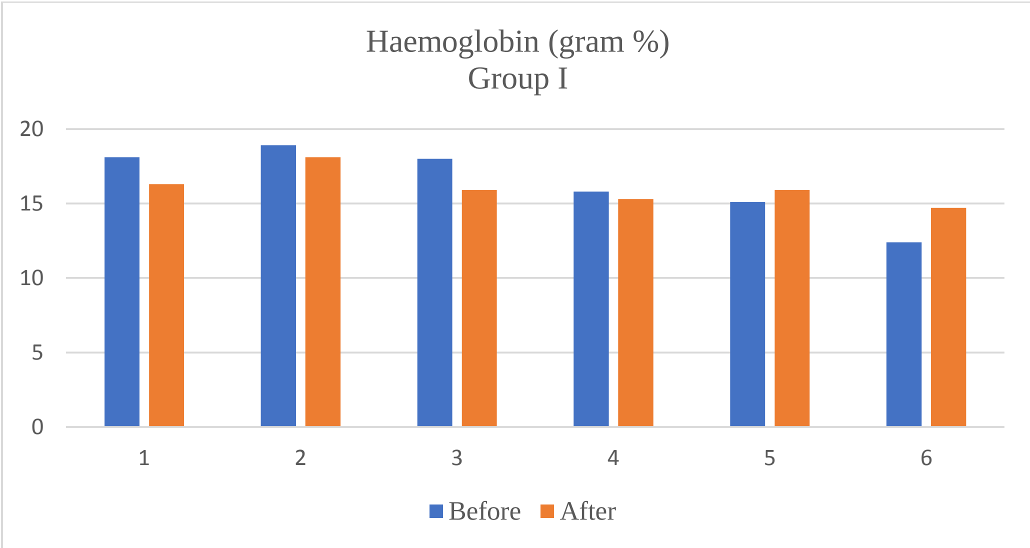

Figure 13. Graph showing Mean Hemoglobin before and after surgery in Group I

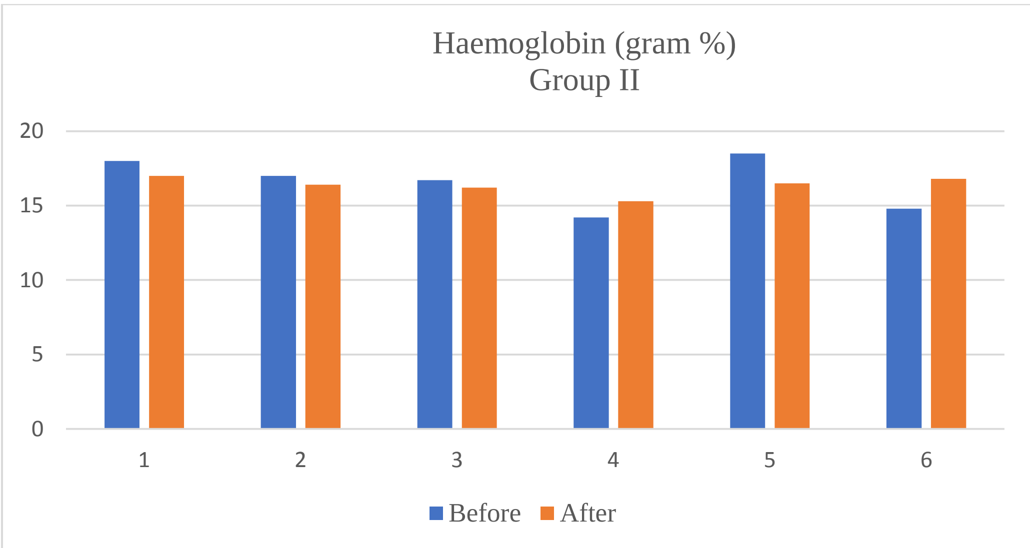

Figure 14. Graph showing Mean Hemoglobin before and after surgery in Group II

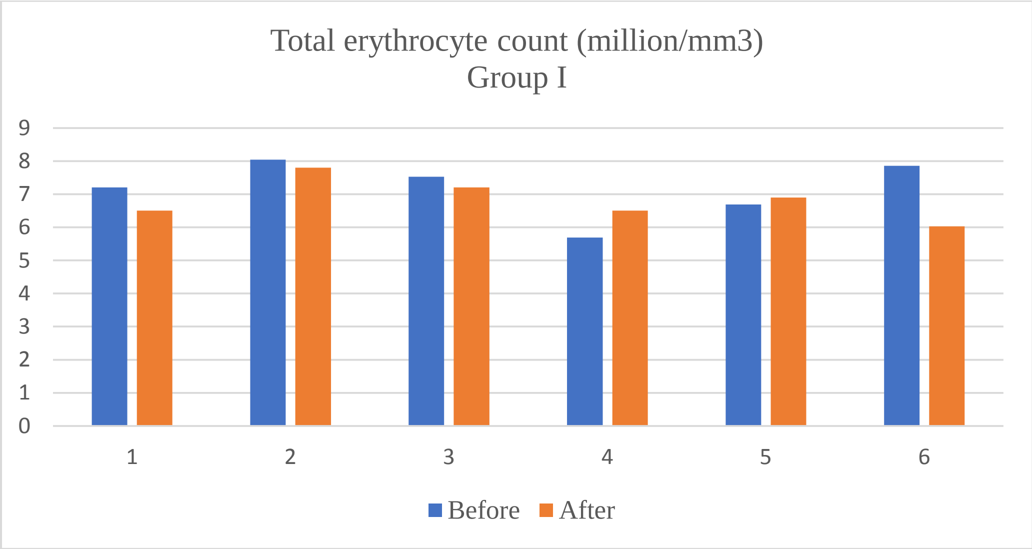

Figure 15. Graph showing Mean Total erythrocyte count before and after surgery in Group I

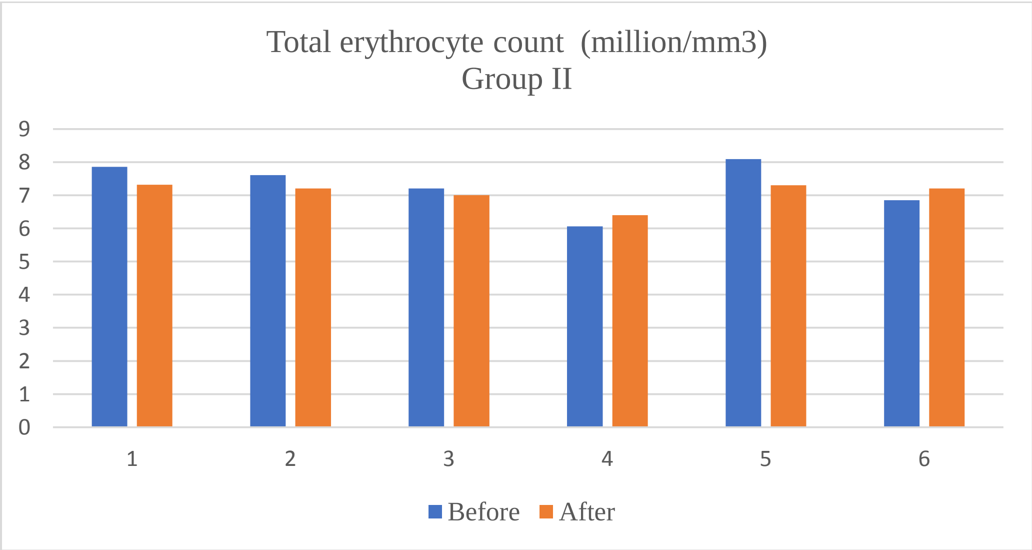

Figure 16. Graph showing Mean Total erythrocyte count before and after surgery in Group II

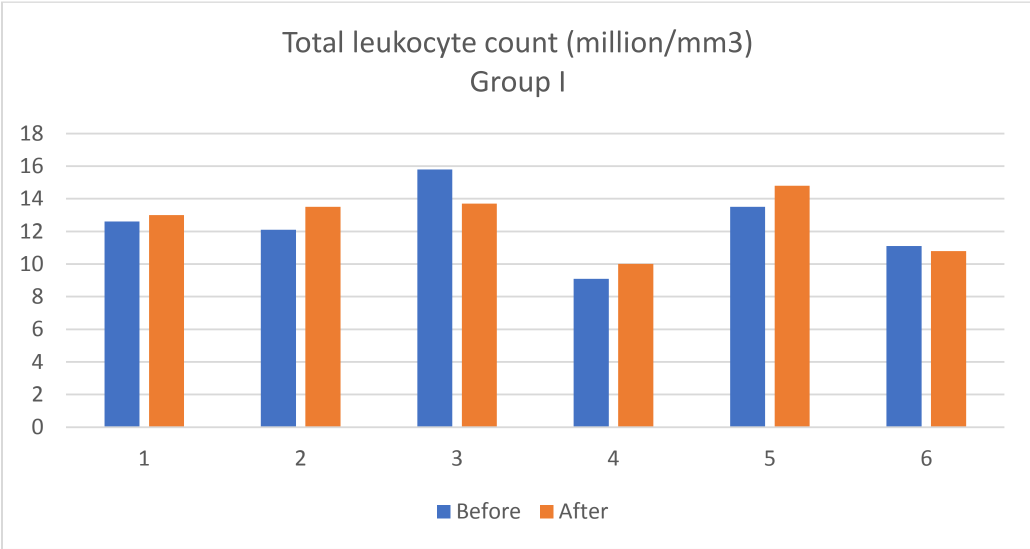

Figure 17. Graph showing Mean Total leukocyte count before and after surgery in Group I

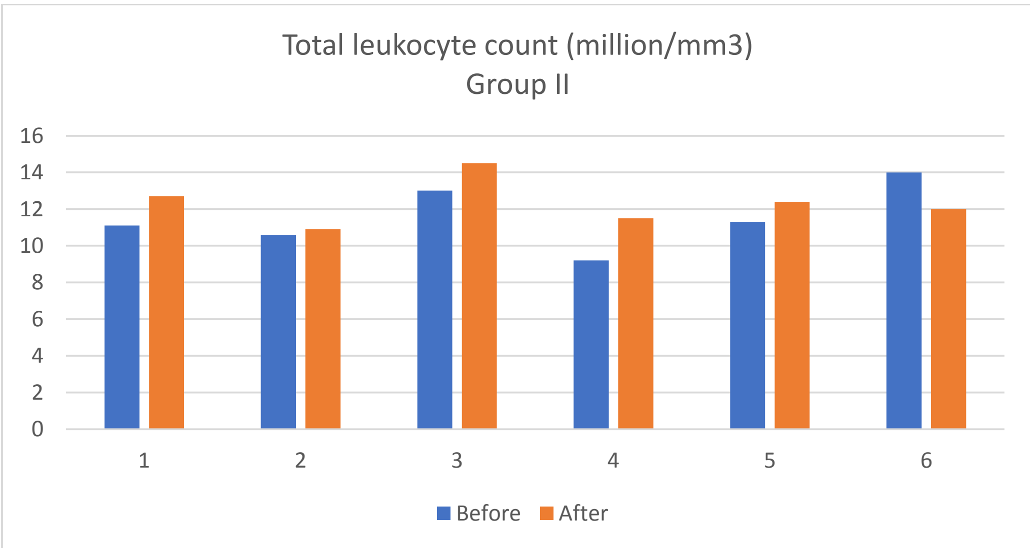

Figure 18. Graph showing Mean Total leukocyte count before and after surgery in Group II

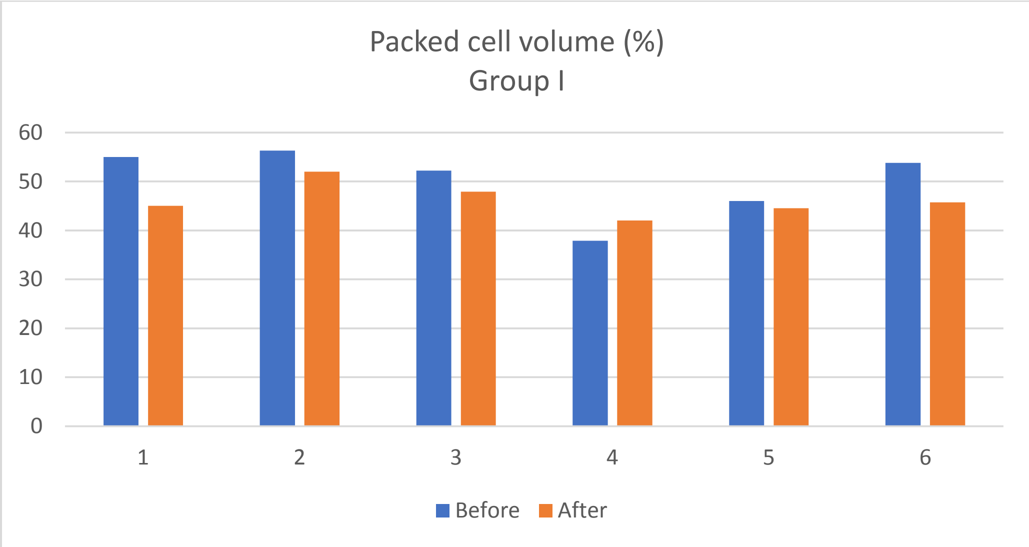

Figure 19. Graph showing Mean Packed cell volume before and after surgery in Group I

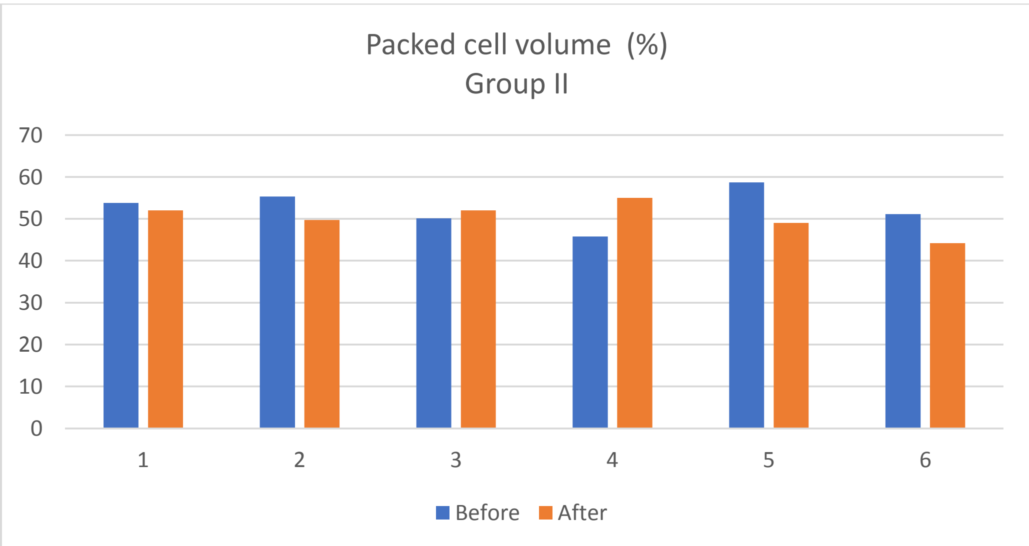

Figure 20. Graph showing Mean Packed cell volume before and after surgery in Group II

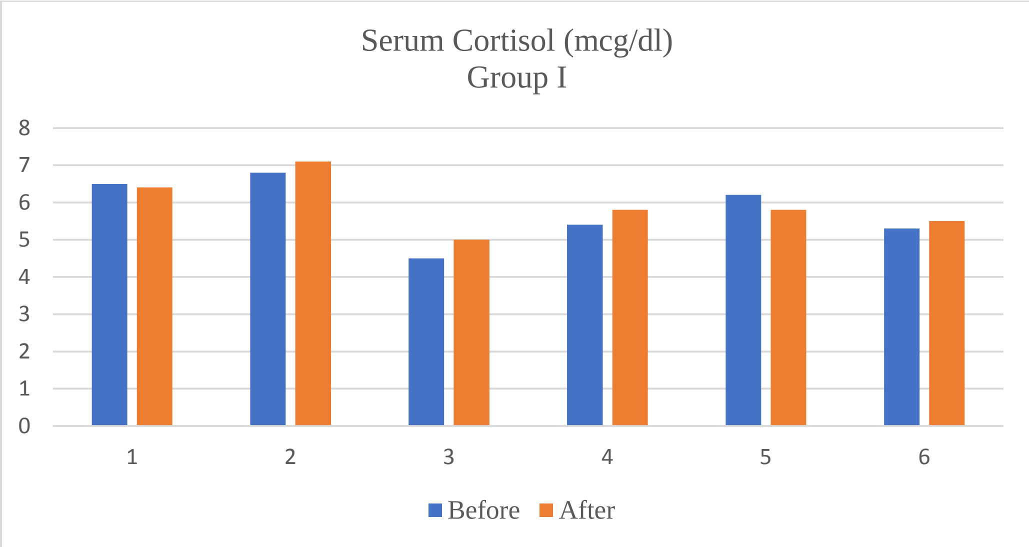

Figure 21. Graph showing Mean Serum Cortisol value before and after surgery in Group I

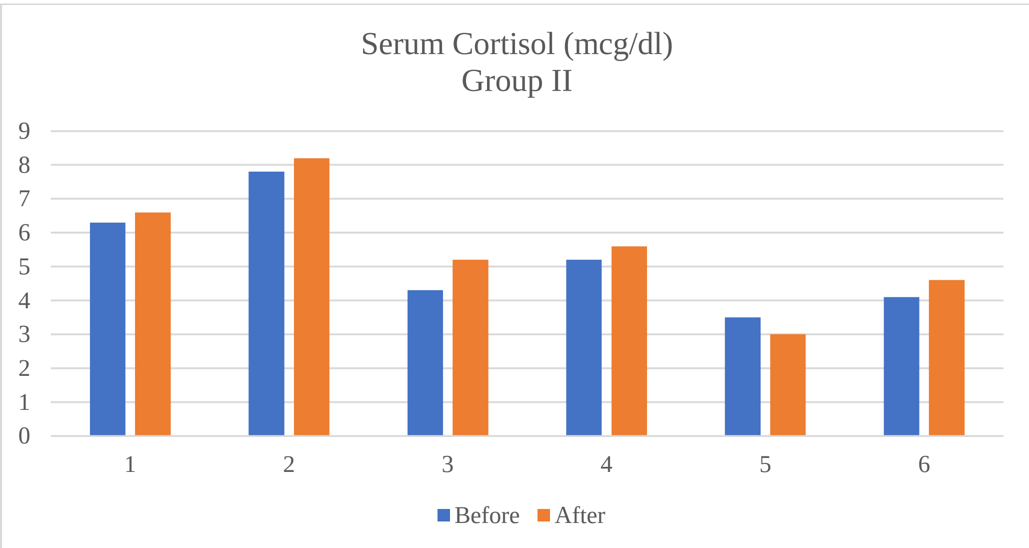

Figure 22. Graph showing Mean Serum Cortisol value before and after surgery in Group II

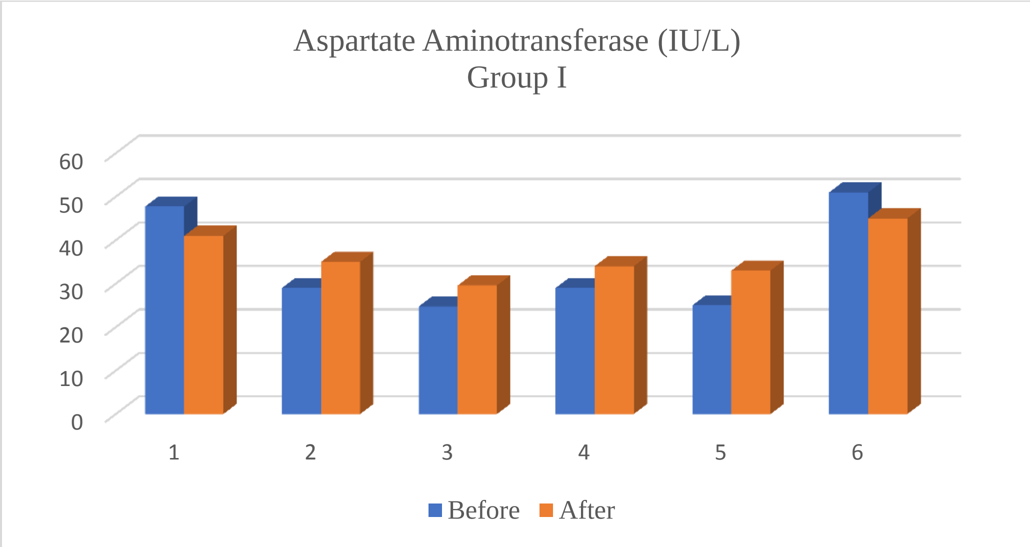

Figure 23. Graph showing Mean Aspartate Aminotransferase before and after surgery in Group I

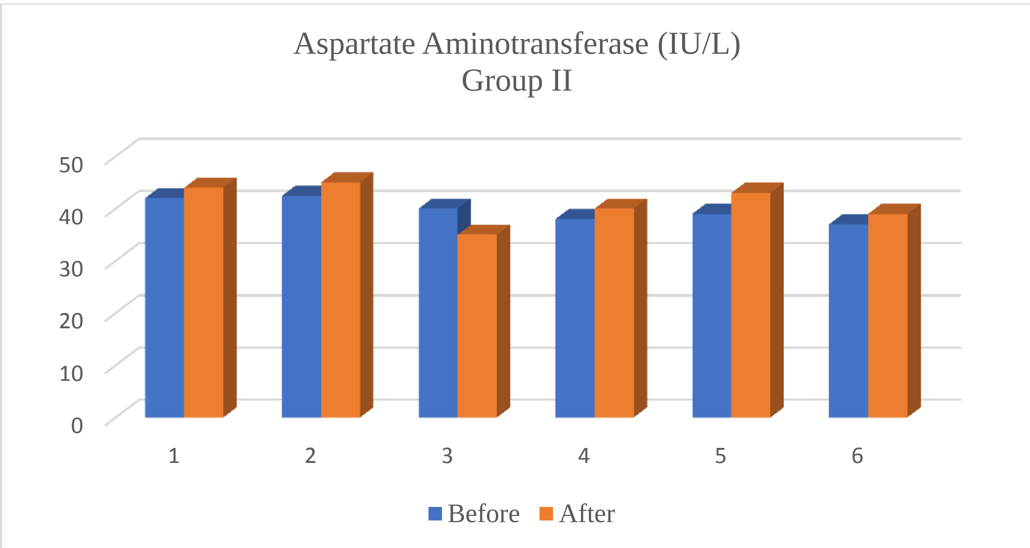

Figure 24. Graph showing Mean Aspartate Aminotransferase before and after surgery in Group II

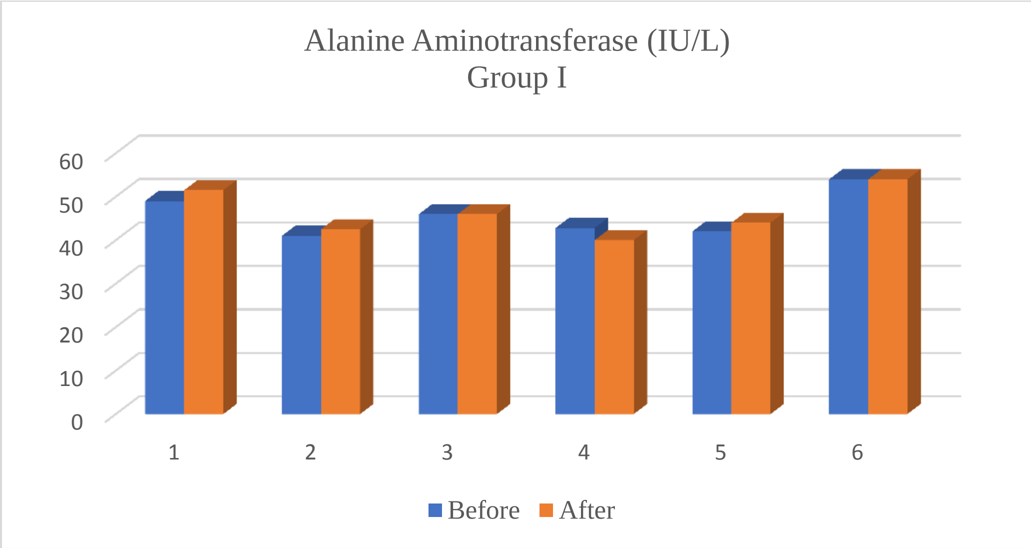

Figure 25. Graph showing Mean Alanine Aminotransferase before and after surgery in Group I

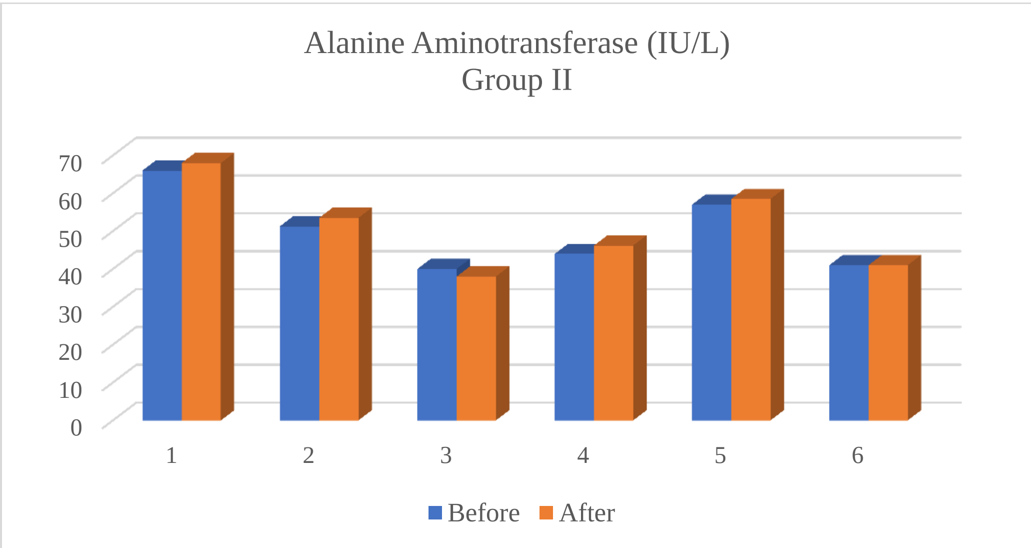

Figure 26. Graph showing Mean Alanine Aminotransferase before and after surgery in Group II

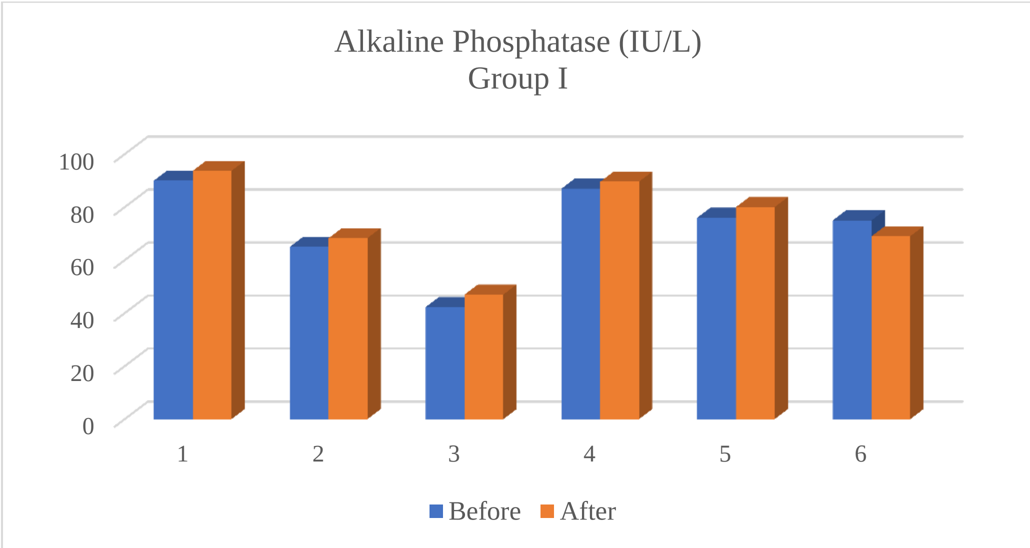

Figure 27. Graph showing Mean Alkaline Phosphatase before and after surgery in Group I

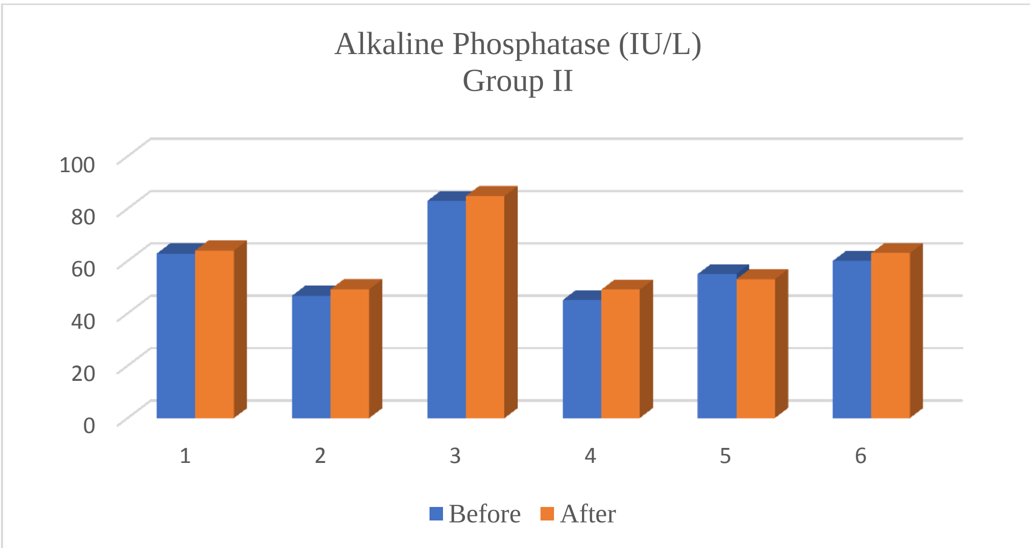

Figure 28. Graph showing Mean Alkaline Phosphatase before and after surgery in Group II

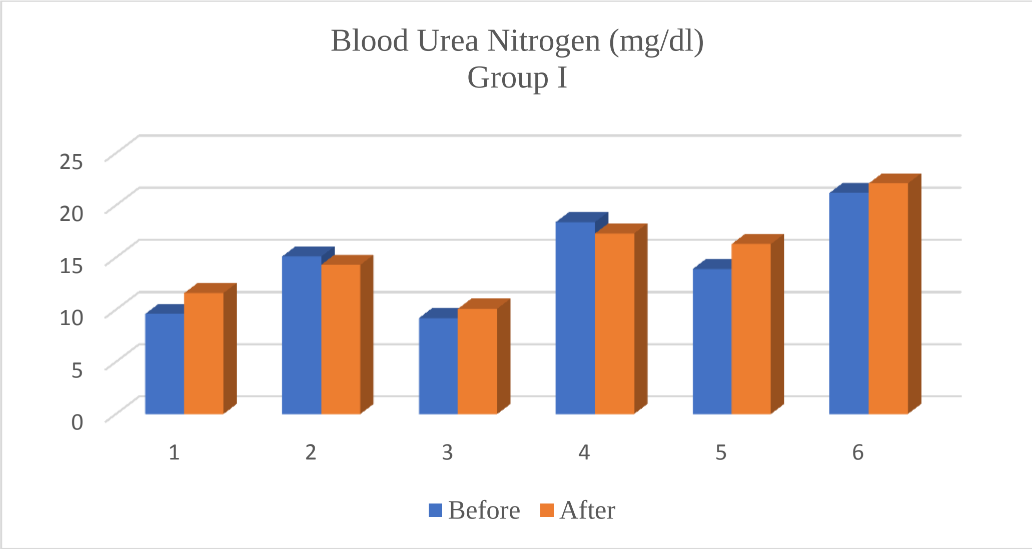

Figure 29. Graph showing Mean Blood Urea Nitrogen before and after surgery in Group I

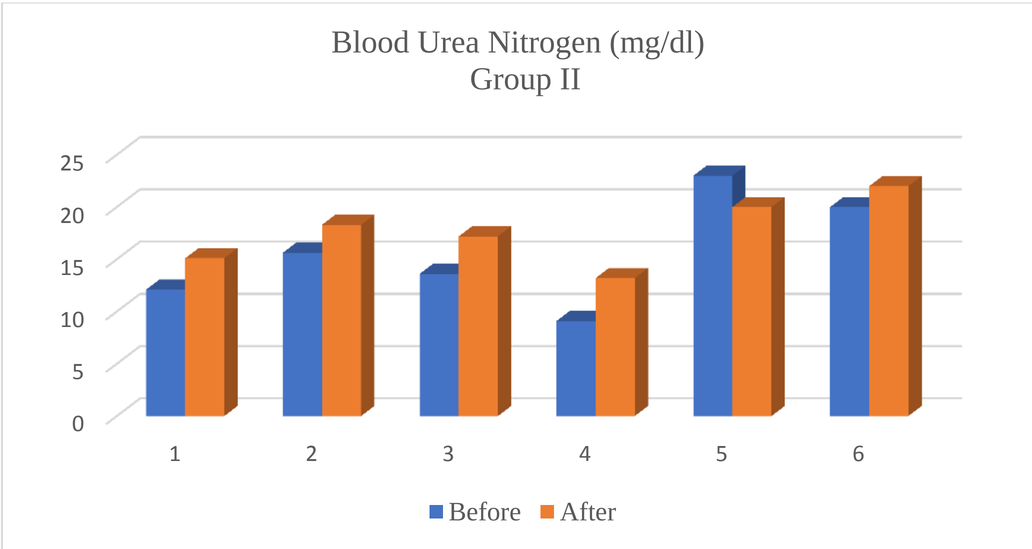

Figure 30. Graph showing Mean Blood Urea Nitrogen before and after surgery in Group II

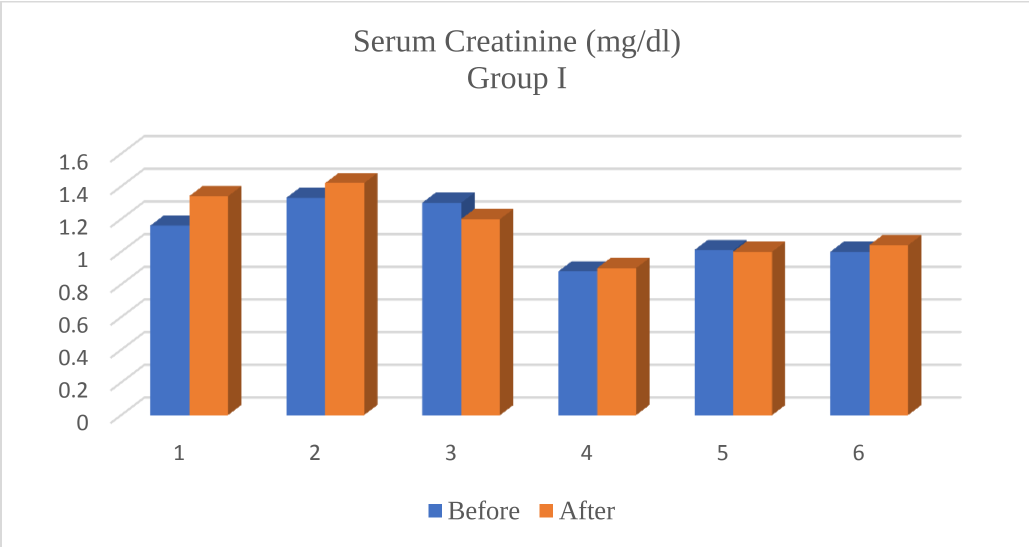

Figure 31. Graph showing Mean Serum Creatinine before and after surgery in Group I

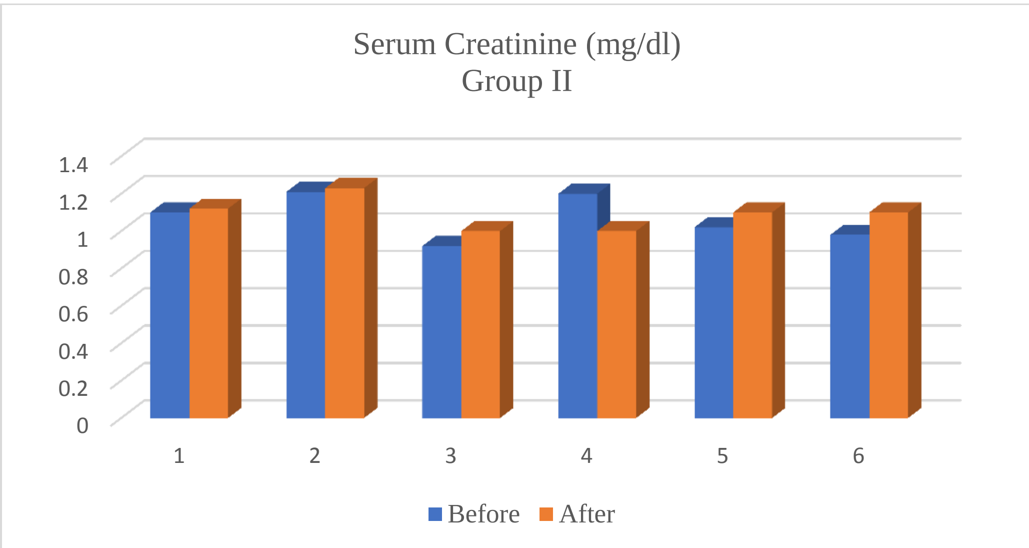

Figure 32. Graph showing Mean Serum Creatinine before and after surgery in Group II

APPENDIX (c) - Plates

Plate 1: Intravenous catheterization of cephalic vein

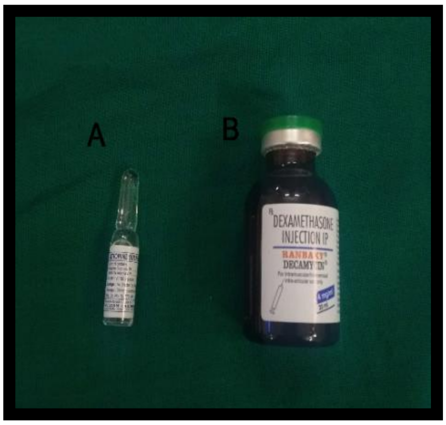

Plate 2: A- Inj. Atropine Sulphate
B- Inj. Dexamethasone sodium

Plate 3: Inj. Amoxirum forte

Plate 4: Inj. Butorphanol tartarate

Plate 5: Inj. Midazolam hydrochloride

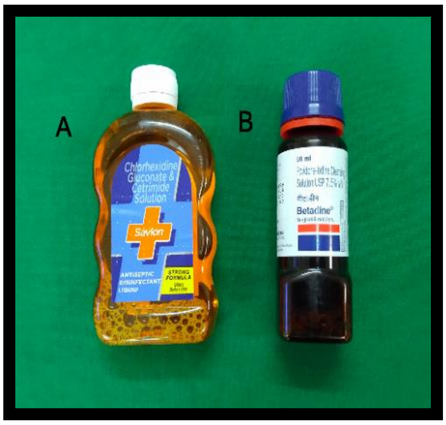

Plate 6: A- Savlon
B- Betadine scrub

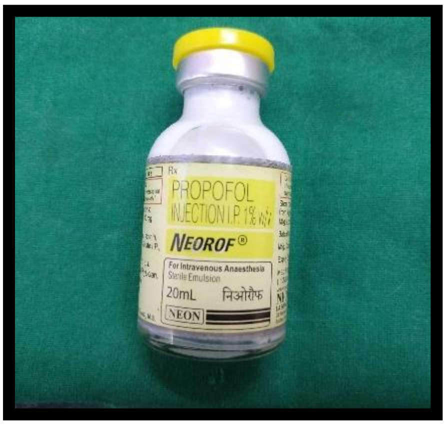

Plate 7: Inj. Propofol

Plate 8: Induction of anaesthesia with propofol

Plate 9: Endotracheal tube

Plate 10: Laryngoscope

Plate 11: Isoflurane Vaporizer

Plate 12: Isoflurane USP

Plate 13: SILS™ Flexible port with 5 mm cannulae

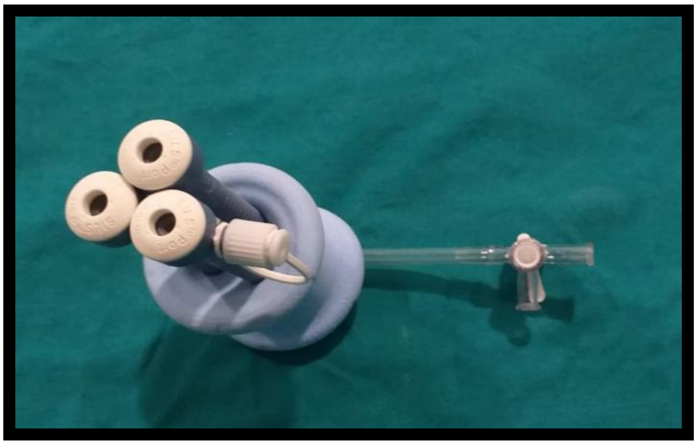

Plate 14: Assembled SILS™ Flexible port with 5 mm cannulae (3)

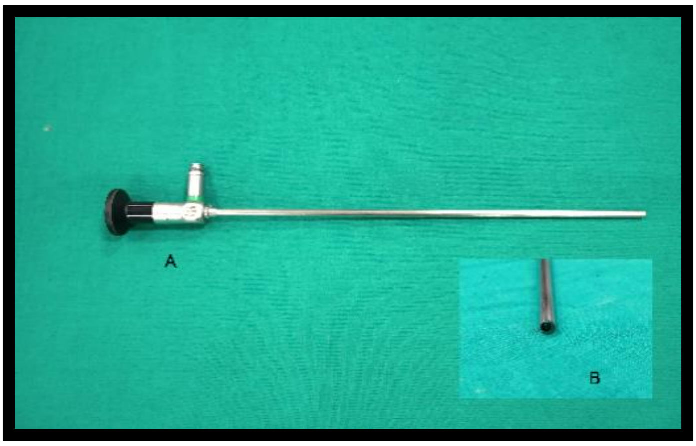

Plate 15: Hopkins forward telescope 0^0, size 5 mm.

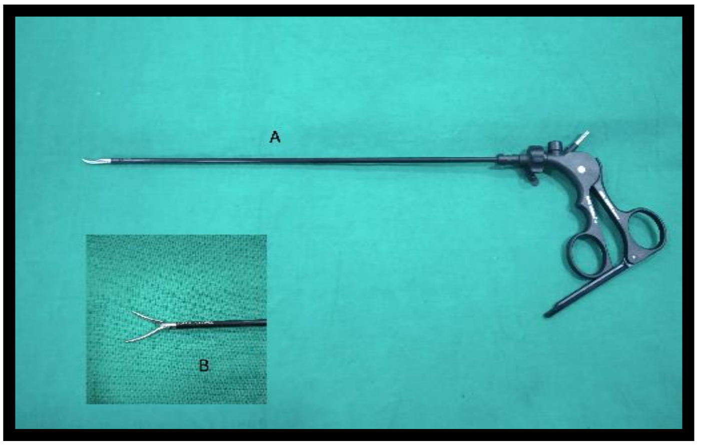

Plate 16: Clickline kellys grasping and dissecting forcep

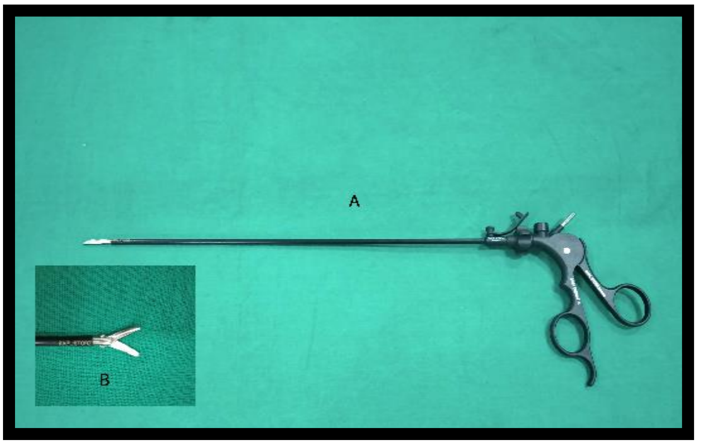

Plate 17: Clickline laparoscopic scissor

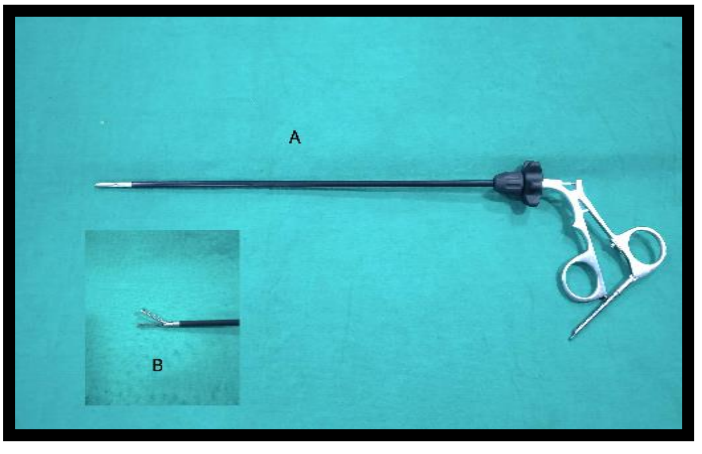

Plate 18: Grasping laparoscopic forcep

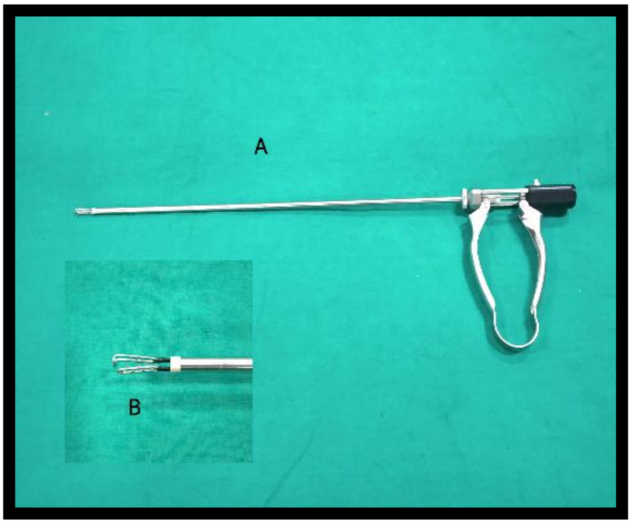

Plate 19: Bipolar grasping forcep

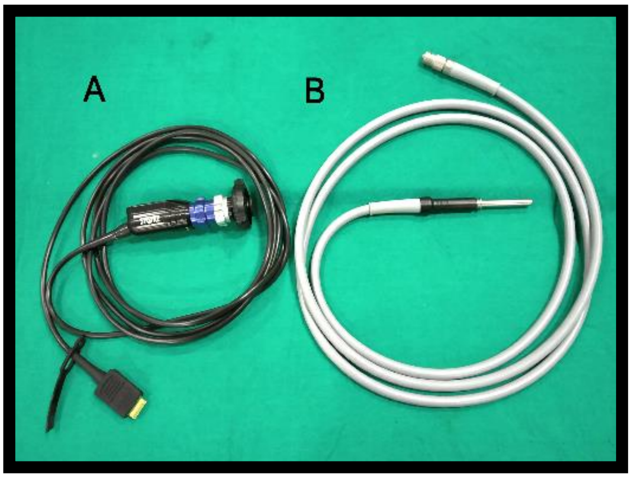

Plate 20: A-Camera head videoscope. B- Fiber optic light source cable

Plate 21: A- Telecam SL II camera control unit, B- Xenon Nova Karlz storz cold light source, C- Electric CO_2 endoflator SCB with sterile tubing and filter, D- AIDA

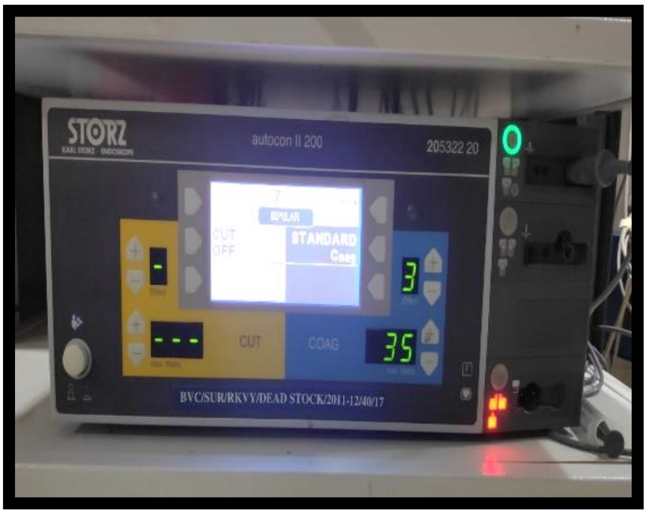

Plate 22: Electro-cautery

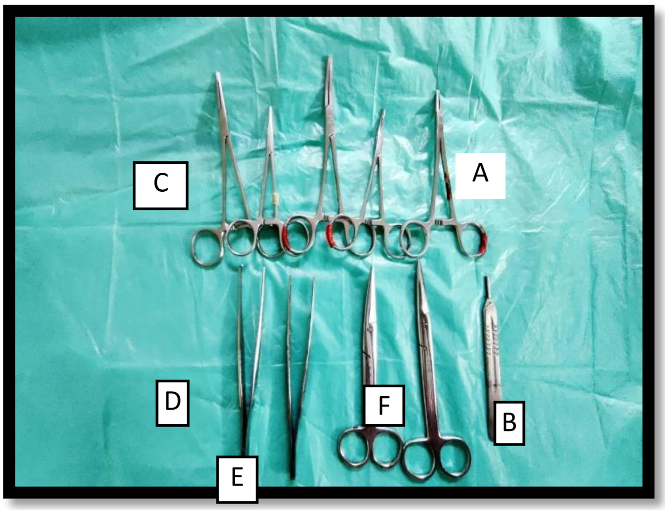

Plate 23: A- Needle holder, B- Scalpel handle no 4, C- Straight artery forceps, D- Toothed tissue forcep, E- Thumb forcep, F- Scissors

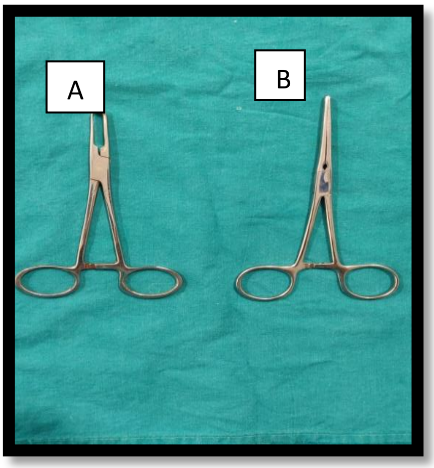

Plate 24- A- Allis forcep
B – Doyens clamp

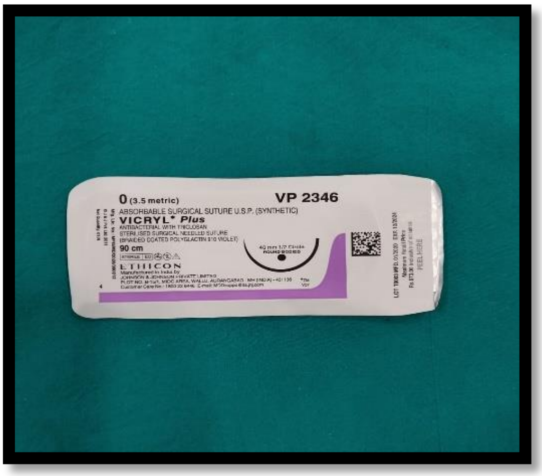

Plate 25: Absorbable suture material Vicryl 0

Plate 26: Nonabsorbable suture material Ethilon 0

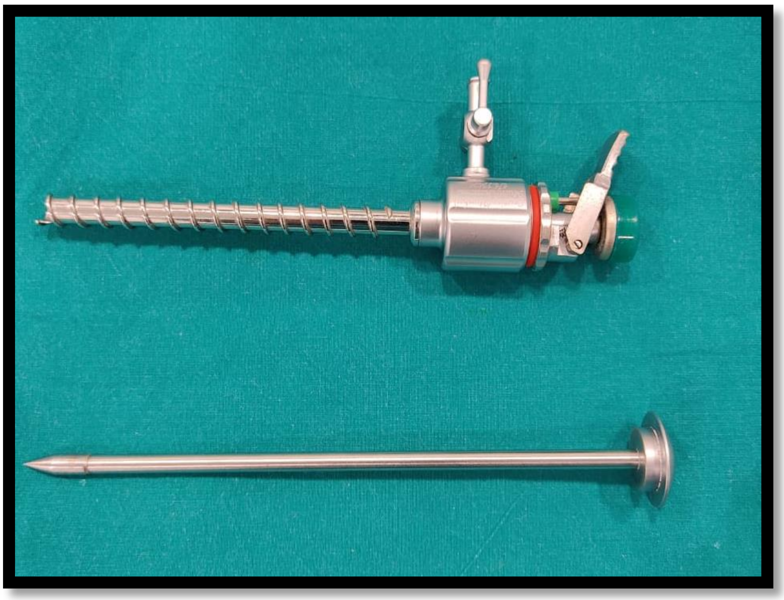

Plate 27: Ternamian endotip cannula with and multifunctional valve, size 5mm with trocar

Plate 28: Ternamian endotip cannula, size 5 mm

Plate 29: Veress Needle with luer lock

Plate 30: Hydrogen Peroxide liquid

Plate 31: Korsolex liquid

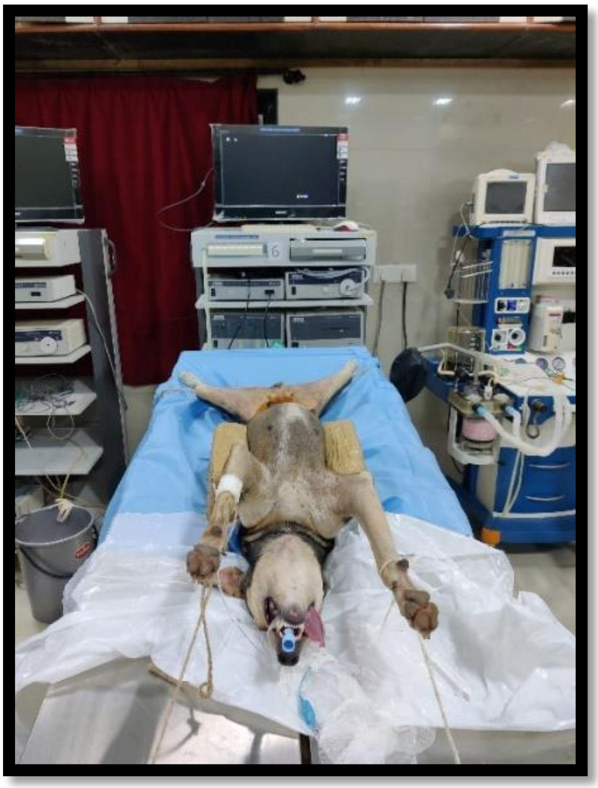

Plate 32: Patient secured in Trendelenburg position in Group I

Plate 33: Incision of 2-3 cms for port placement

Plate 34: Incising the linea alba

Plate 35: Eversion of muscle edges by Allis forcep

Plate 36: Insertion of SILS™ port by application of Doyens clamp

Plate 37: SILS™ port placed in position

Plate 38: Insufflation of abdomen with CO_2

Plate 39: Insufflator settings for pneumoperitoneum

Plate 40: Insertion of 5 mm laparoscope

Plate 41: Tilting the patient on right side

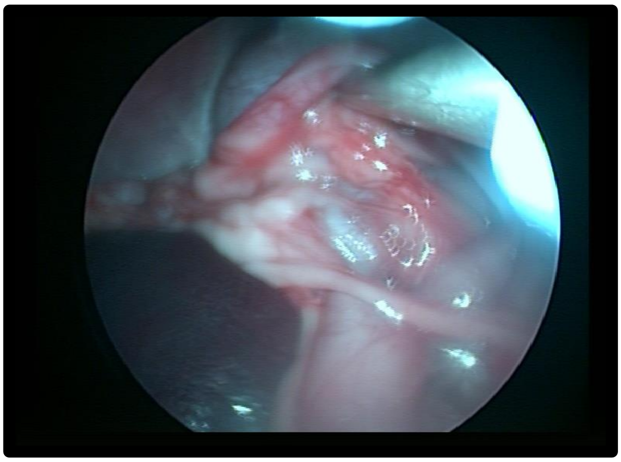

Plate 42: Locating the left horn and ovary

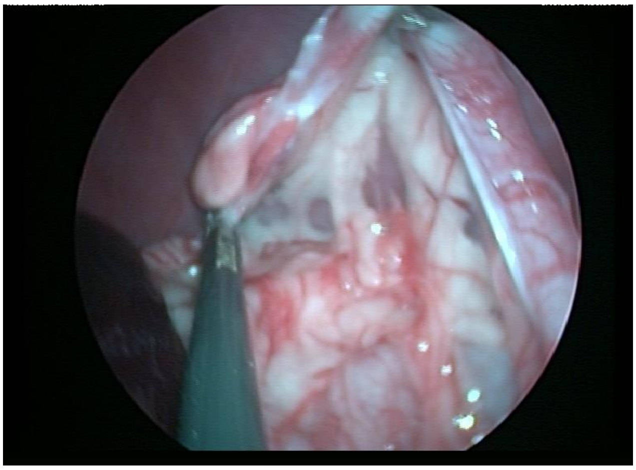

Plate 43: Grasping of left ovary with grapsing forcep

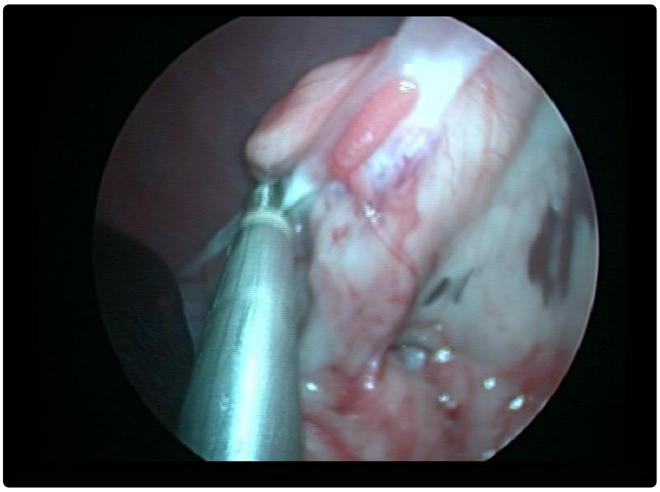

Plate 44: Cauterization of the left ovary along with the ligament

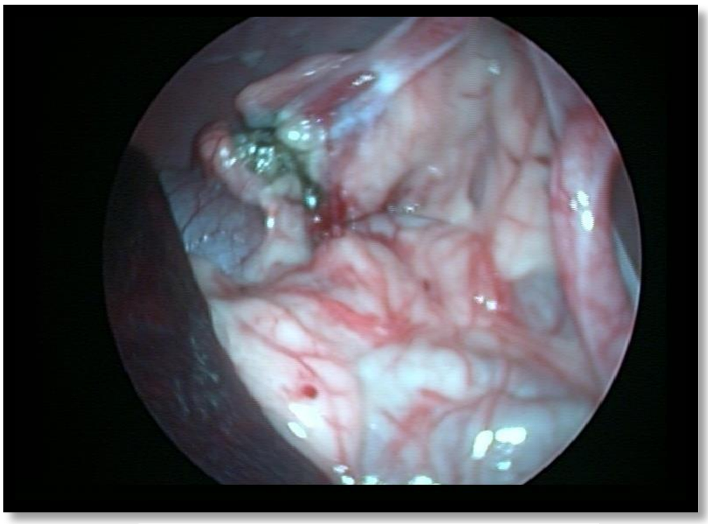

Plate 45: Completely cauterised left ovarian pedicle

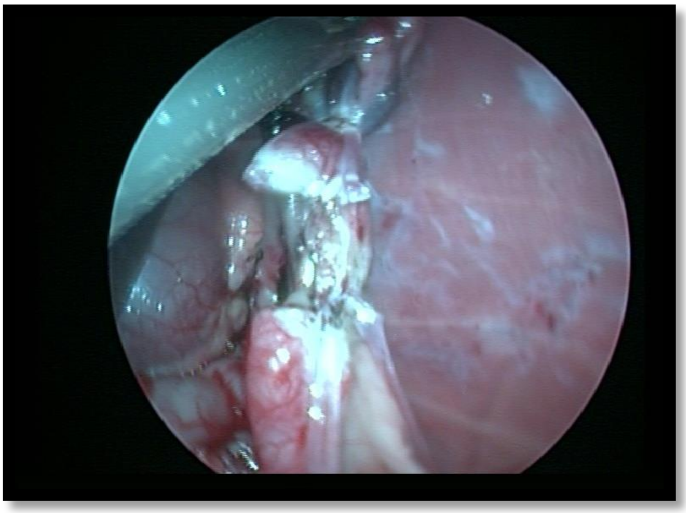

Plate 46: Transection of cauterised part of left ovary

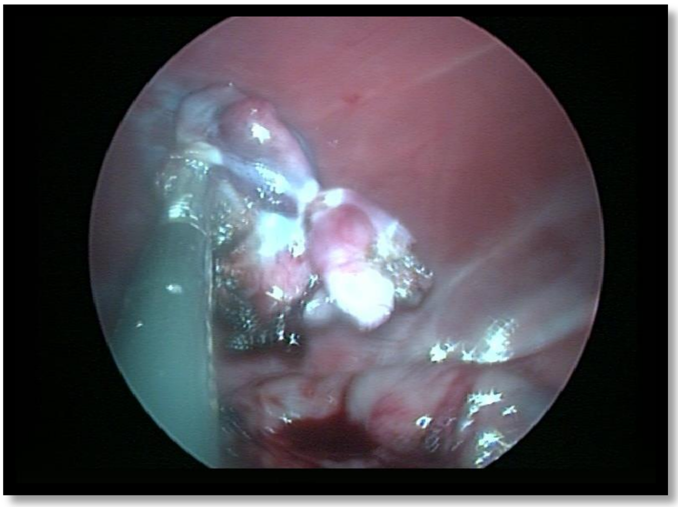

Plate 47: Transected left ovary

Plate 48: Tilting of Patient on left side

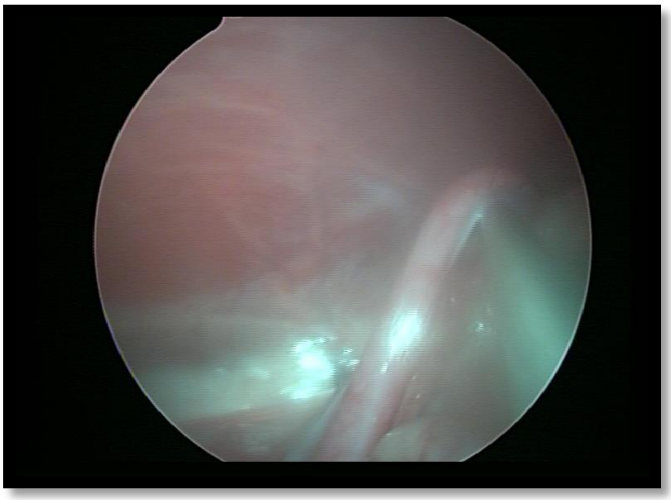

Plate 49: Right horn located

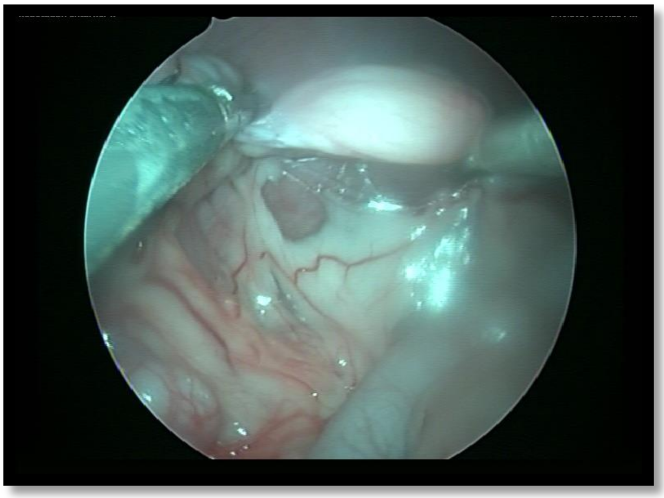

Plate 50: Grasping of the right ovary

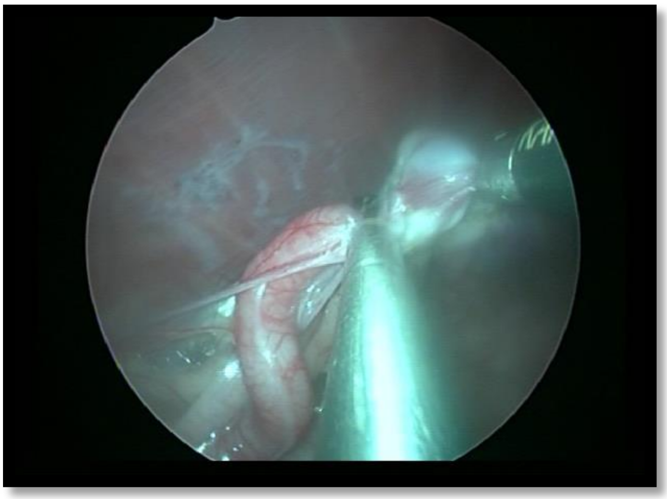

Plate 51: Cauterising of the right ovarian pedicle

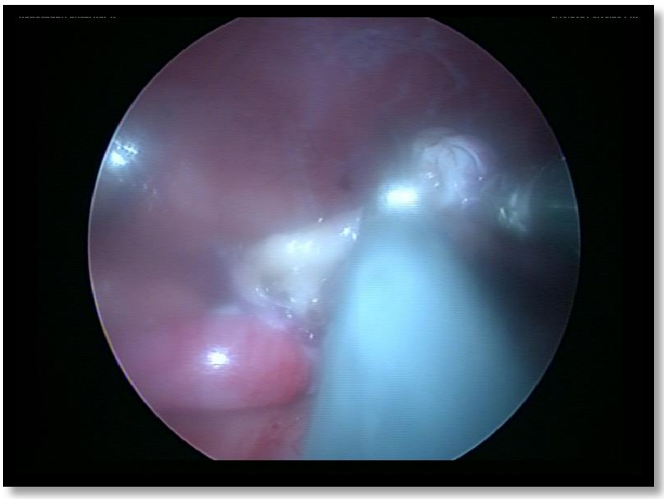

Plate 52: Transecting the cauterised part of the ovary

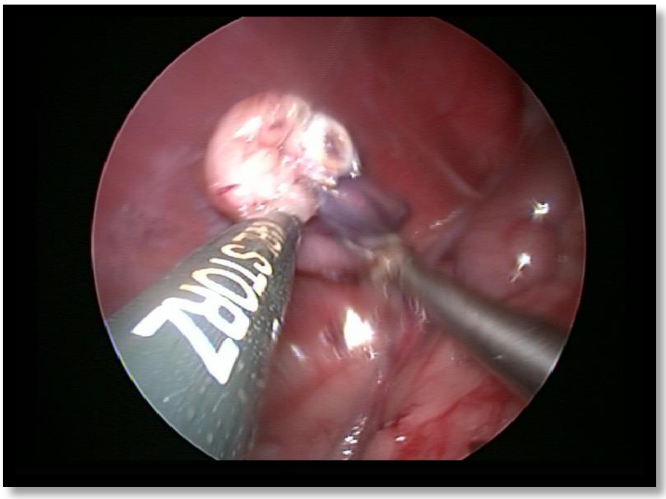

Plate 53: Transected right ovary

Plate 54: Complete removal of left and right ovaries

Plate 55: Closure of portal site by cross mattress sutures

Plate 56: Patient secured in Trendelenburg position in Group II

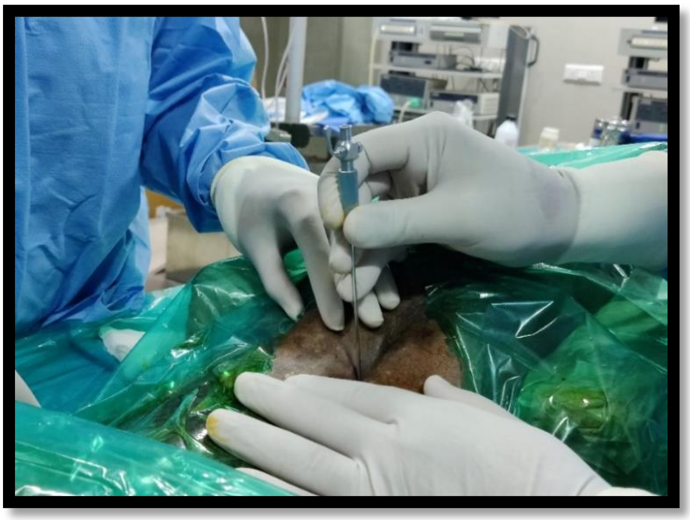

Plate 57: Insertion of Veress needle Group II

Plate 58: Hanging drop technique

Plate 59: Insufflation of abdomen with veress needle valve

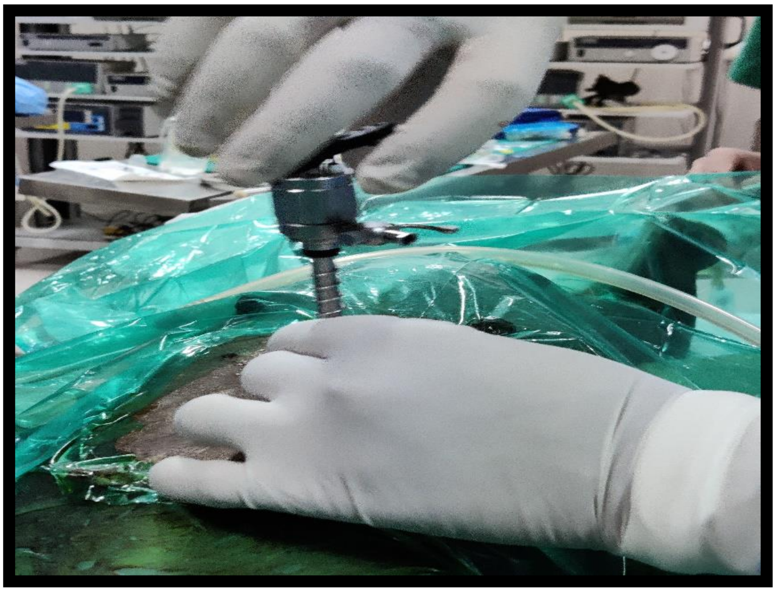

Plate 60: Insertion 5 mm Endotip cannula for Camera port placement

Plate 61: Insertion of 5 mm telescope

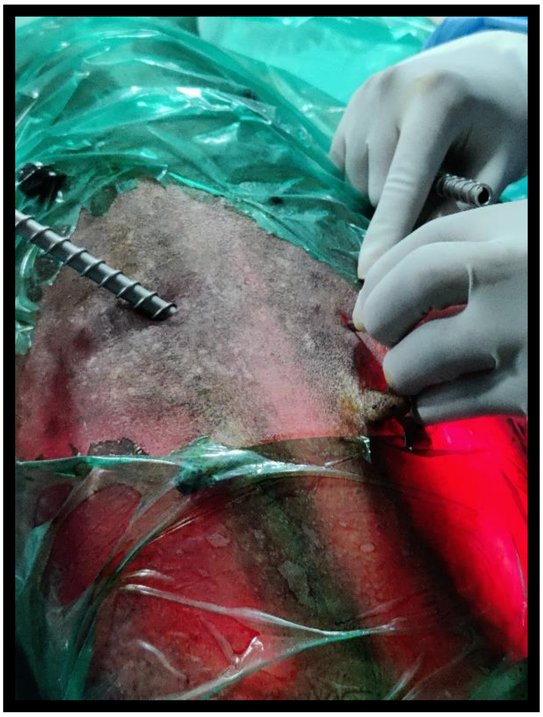

Plate 62: Incision for insertion of second port

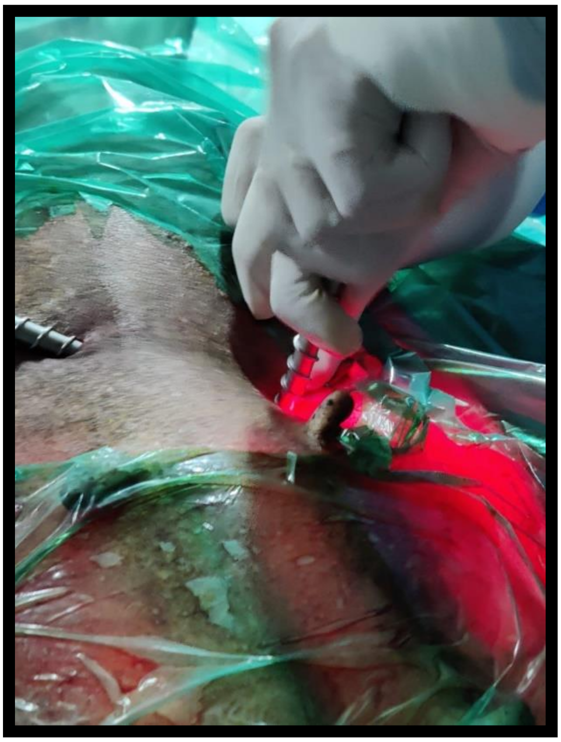

Plate 63: Insertion of 5 mm endotip cannula as a second port under the guidance of telescope

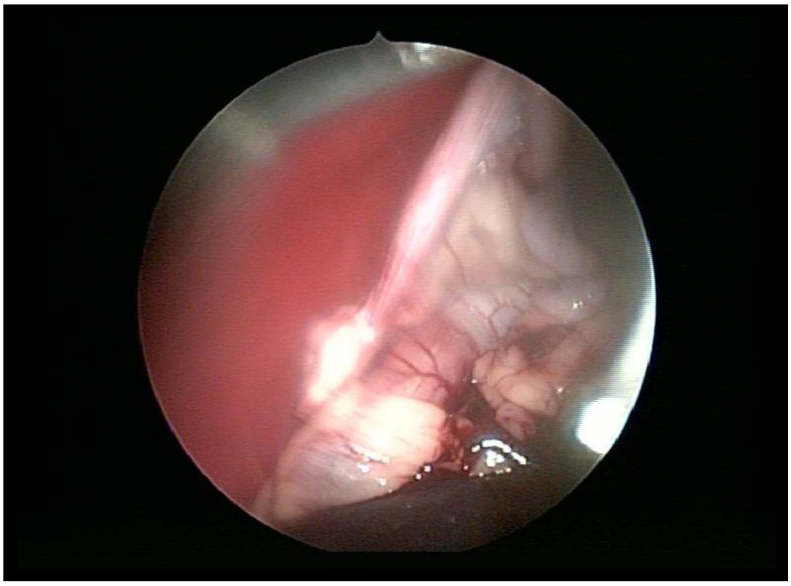

Plate 64: Grasping of the left ovary

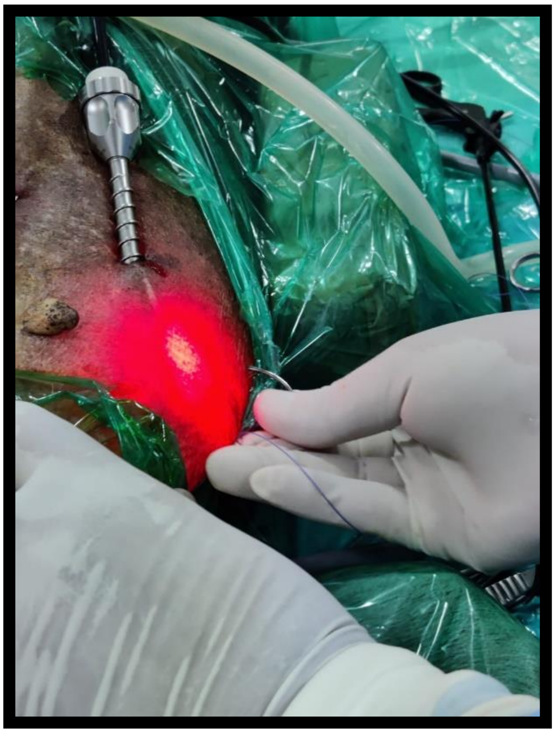

Plate 65: Passing transabdominal suspension suture Vicryl No. 0

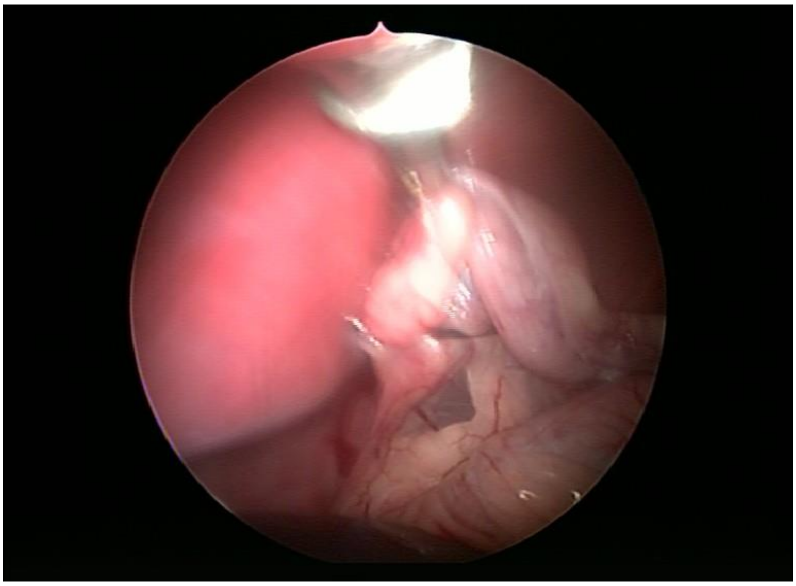

Plate 66: Needle encircling the ovary and transfixing to abdominal wall

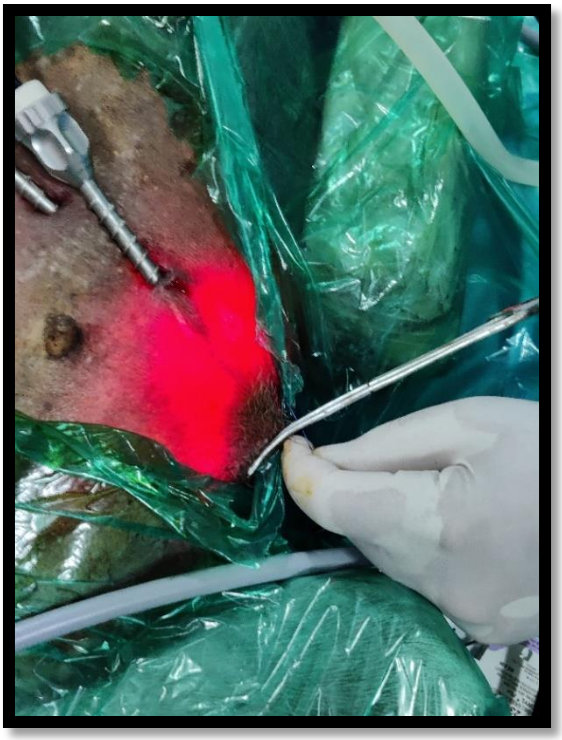

Plate 67: Clamping of both the ends of sutures with an artery forcep

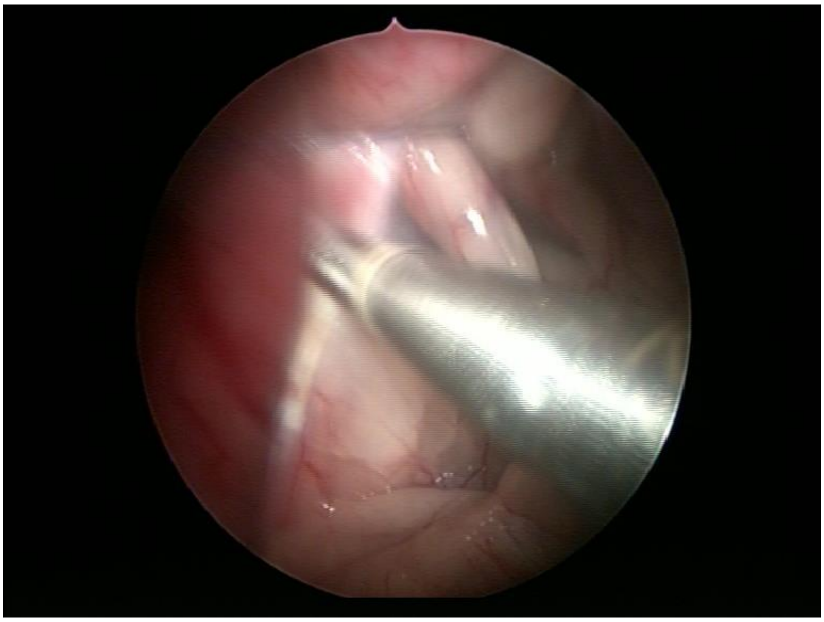

Plate 68: Cauterising the left ovarian ligament

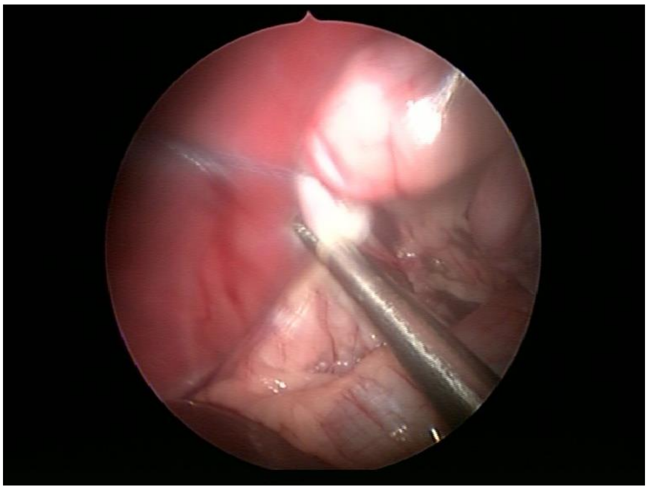

Plate 69: Cauterising of the left ovarian ligament along with blood vessels

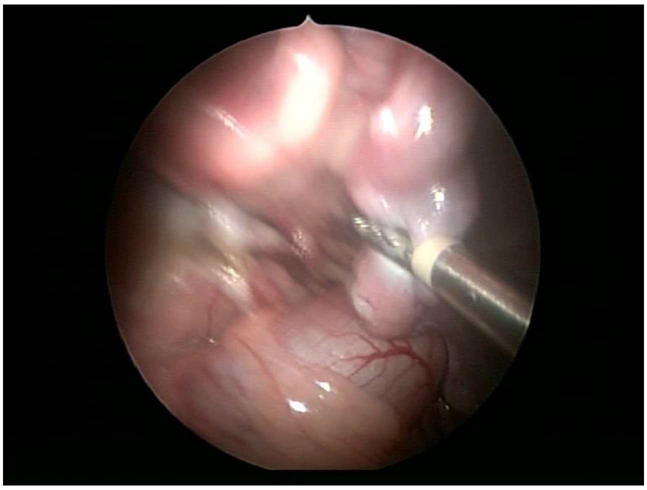

Plate 70: Cauterising of the left Horn

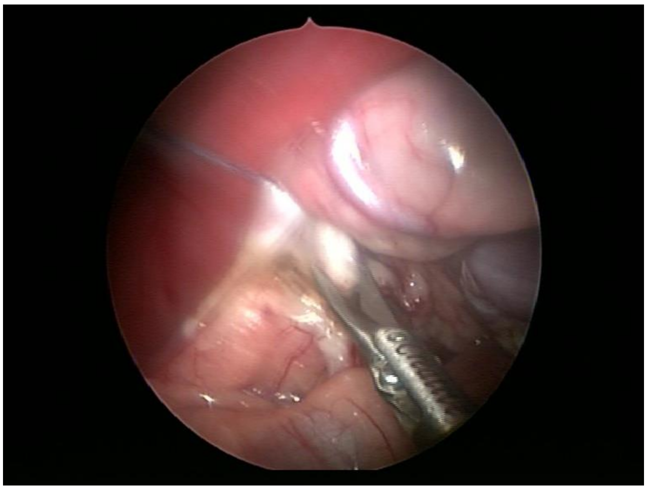

Plate 71: Transection of cauterised part of left ovary

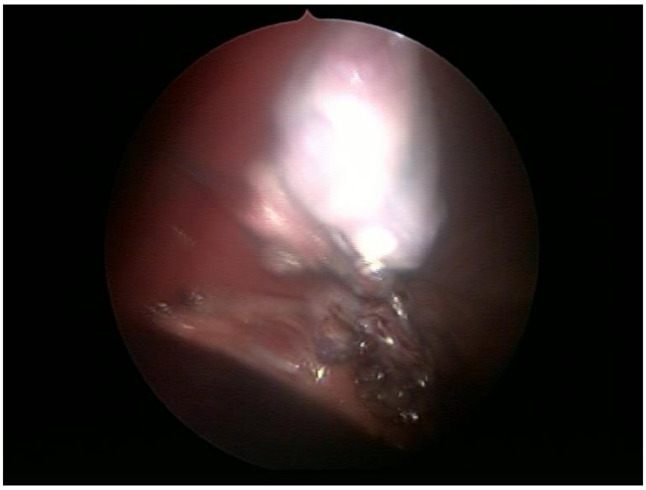

Plate 72: Transected left ovary

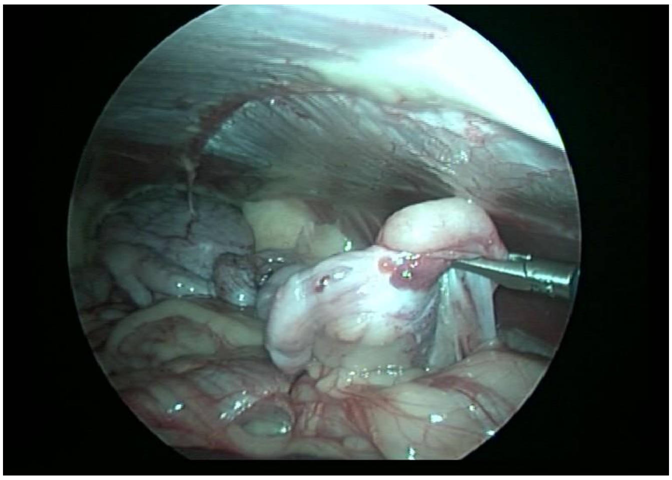

Plate 73: Grasping of the right ovary

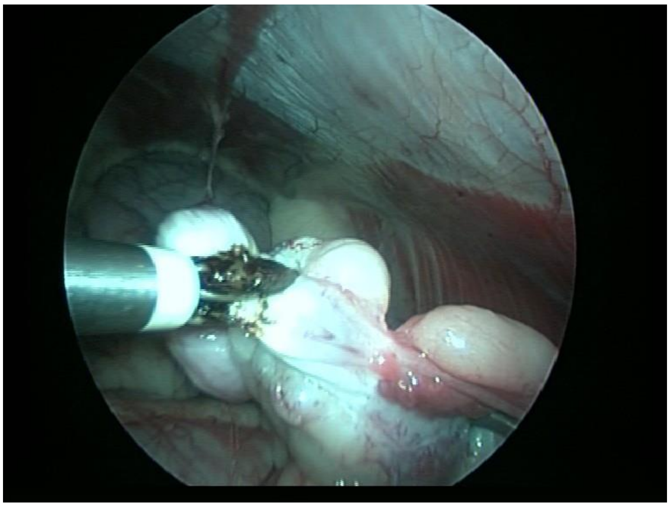

Plate 74: Cauterising of the right horn

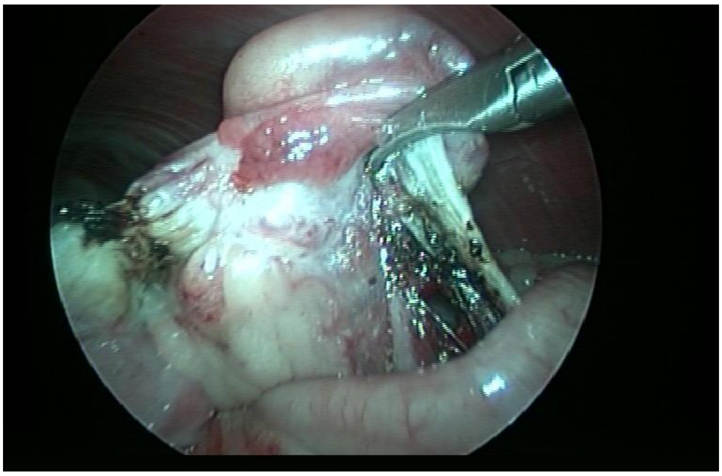

Plate 75: Completely cauterised both ends of the ovary

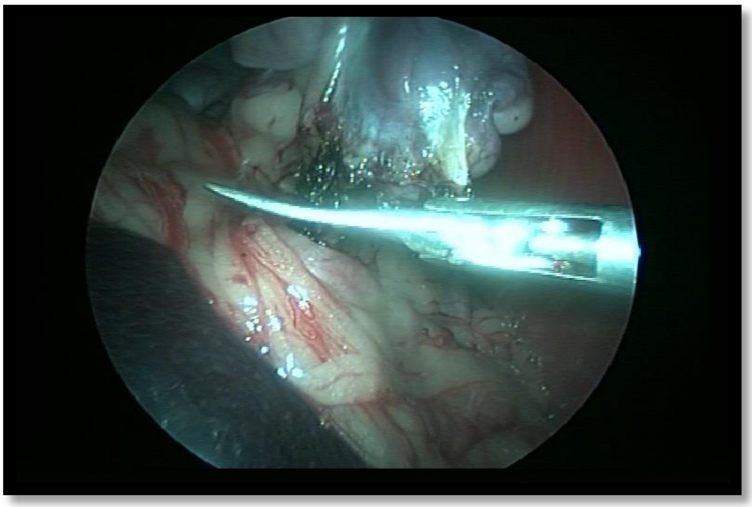

Plate 76: Transected right ovary

Plate 77: Removal of ovary from port.

Plate 78: Suturing of the portal sites with Ethilon 0

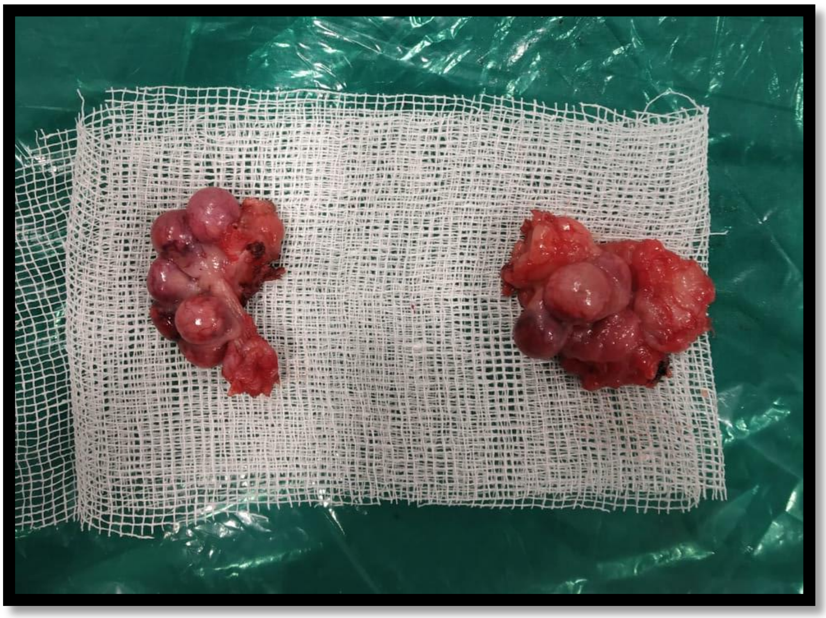

Plate 79: Complete removal of both the ovaries.

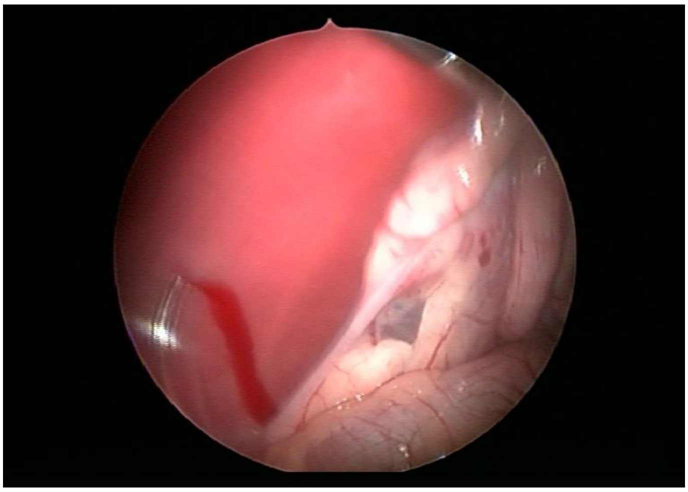

Plate 80: Trauma to the abdominal wall while passing transabdominal suspension suture in Group II

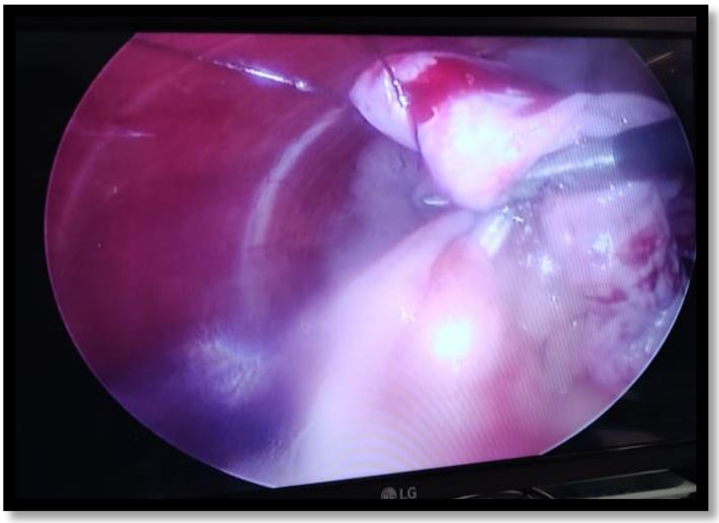

Plate 81: Bleeding of the mesovarium after transabdominal suspension suture in Group II

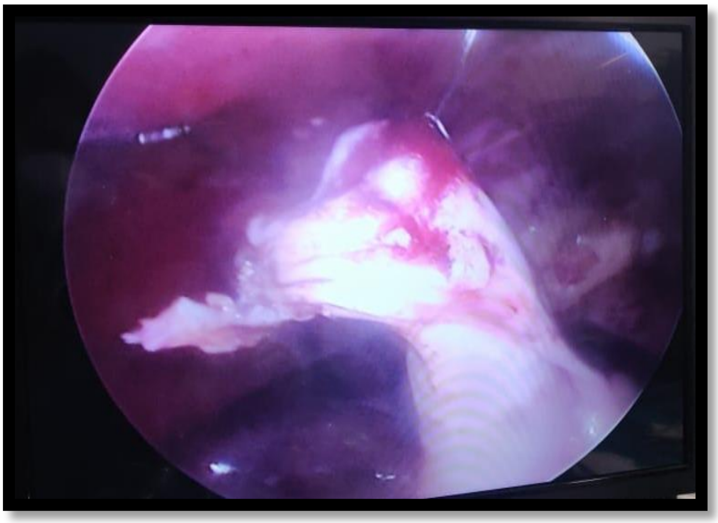

Plate 82: Bleeding of the mesovarium after transabdominal suspension suture in Group II

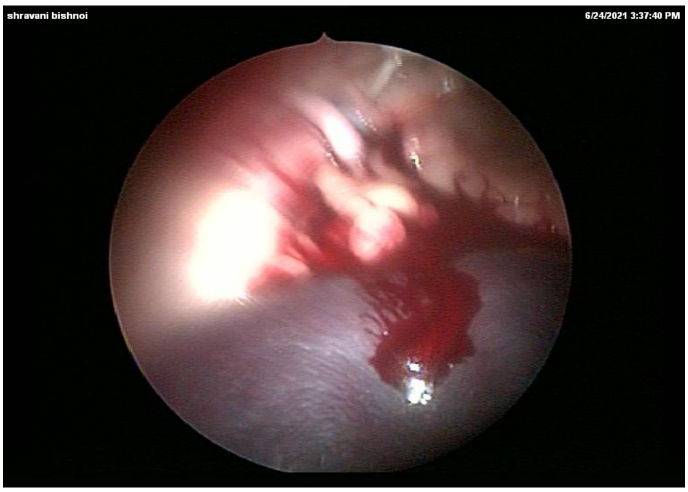

Plate 83: Splenic injury due to veress needle insertion in case no. 2 in Group II

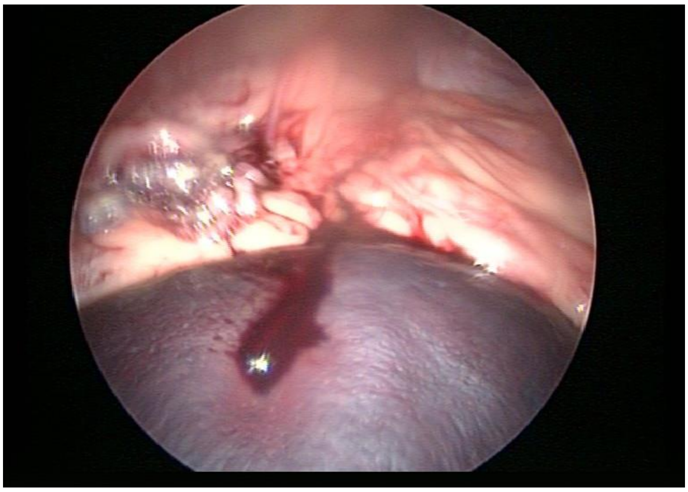

Plate 84: Splenic injury due to veress needle insertion in case no. 3 in Group II

Plate 85: Splenic injury due to veress needle insertion in case no. 5 Group II

VITA

Dr. Kaustubh Vishnupanth Anturkar was born on 12th October 1994 in Nagpur. Since childhood he always had very keen interest in biology and wanted to be a doctor. He has completed his Secondary School Certificate Examination with a Distinction in the year 2010 from Sanjuba High School, Nagpur after which he attended Shri Mathuradas Mohota Science College, Nagpur for the completion of his Higher Secondary Certification in the year 2011. After this he enrolled himself in College of Veterinary and Animal Sciences, Parbhani in year 2013 for his undergraduate degree in B.V.Sc and A.H and passed with Distinction in the year 2018.

Apart from acaedemics he has also participated in extracurricular activites. He is very fond of singing and has actively taken part in college's cultural events. He has represented University team for quiz competition in Indradhanushya 2018.

He is currently completing his post graduate degree in Veterinary Surgery and Radiology from Mumbai Veterinary College, Parel. On completion of this degree he wants to pursue further specialization in the field of Laparoscopy, Endoscopy and Small Animal Soft Tissue Surgery.

Appendix – G

THESIS ABSTRACT

a)	Title of the thesis (in Capital letters)	**:**	**COMPARISON OF SINGLE INCISION LAPAROSCOPIC SURGERY (SILS) WITH TWO PORT TECHNIQUE FOR LAPAROSCOPIC OVARIECTOMY IN DOG**
b)	Full name of student	**:**	**Mr. Anturkar Kaustubh Vishnupanth**
c)	Name and address of Major Advisor	**:**	**Dr. S. V. Gaikwad** Dept. of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, Parbhani, Parbhani- 431402
d)	Degree to be awarded	**:**	M.V.Sc.
e)	Year of award of degree	**:**	2021
f)	Major subject	**:**	Veterinary Surgery and Radiology
g)	Total number of pages in the thesis	**:**	
h)	Number of words in the abstract	**:**	275
i)	Signature of Student	**:**	
j)	Signature, Name and address of forwarding authority (HOD / SH)	**:**	**Dr. D. U. Lokhande** Dept. of Veterinary Surgery and Radiology, Mumbai Veterinary College, Parel, Mumbai-12
h)	Signature of the Associate Dean	**:**	

ABSTRACT

The research project entitled "Comparison of Single Incision Laparoscopic Surgery (SILS) with two port technique for Laparoscopic Ovariectomy in Dog" was undertaken with the objective of evaluating the efficacy Single Incision Laparoscopy by using SILS™ port with two port technique and the hemato-biochemical changes along with the complications involved. Total of 12 healthy bitches were divided into two groups. Group I (SILS™ port) and Group II (two port). The dogs were administered butorphanol tartarate (0.2 mg/kg IV) and midazolam (0.2 mg/kg IV) followed by induction with propofol (4 mg/kg IV) and maintenance with isoflurane (2%).

The ovariectomy was done using SILS™ port and two ports. In SILS™ port an approximately 2cm ventral midline incision was made to place the port in the abdominal cavity. The ovarian pedicles were cauterized and both the ovaries were taken out from the same incision. In two port technique, one port was placed ventral midline just below the umbilicus for laparoscope and the second port was placed on either right or left abdominal quadrant for grasper/cautery and a trans-abdominal suspension suture was passed to transfix the ovaries for cauterization. The ovarian pedicles were sealed and ovaries were taken out from portal site.

Surgical, physiological and haemato-biochemical parameters and complications were studied. The surgical time was more in SILS™ port technique as compared to two port technique, but there was less postoperative pain and faster recovery time. No significant alteration was observed in physiological and haemato-biochemical parameters before and after the surgery. No major complications were noted in both the procedures.

Single incision laparoscopic ovariectomy using SILS™ port was found safe, feasible and minimally invasive procedure for laparoscopic ovariectomy in dogs.

प्रबंध सारांश

a)	प्रबंधाचे शीर्षक	:	कुत्र्यांमधील लॅप्रोस्कोपिक अंडाशयासाठी दोन पोर्ट तंत्रासह सिंगल चीरा लेप्रोस्कोपी सर्जरीची तुलना
b)	विद्यार्थ्याचे नाव	:	अंतूरकर कौस्तुभ विष्णुपंत
c)	मार्गदर्शकाचे नाव आणि पत्ता	:	डॉ. एस. व्ही. गायकवाड सहाय्यक प्राध्यापक, पशु शल्यचिकित्साशास्त्र व क्ष-किरण शास्त्र विभाग, पशुवैद्यक वा पशुविज्ञान महाविद्यालय, परभणी, ४३१४०२
d)	पदवी	:	पदव्युत्तर पदवी
e)	पदवी प्रदान करण्याचे वर्ष	:	२०२१
f)	मुख्य विषय	:	पशुवैद्यकीय शस्त्रक्रिया आणि क्ष-किरण शास्त्र
g)	प्रबंधातील एकूण पानांची संख्या	:	
h)	प्रबंध सारांशातील एकूण शब्दांची संख्या	:	
i)	विद्यार्थ्याची सही	:	
j)	विभागप्रमुखाचे नाव, सही आणि पत्ता	:	**डॉ. डी. यू. लोखंडे,** प्राध्यापक, पशु शल्यचिकित्साशास्त्र व क्ष-किरण शास्त्र विभाग, मुंबई पशुवैद्यकीय महाविद्यालय, परळ, मुंबई - ४०००१२
k)	सहयोगी अधिष्ठाता, मुंबई पशुवैद्यक महाविद्यालय, परेल, मुंबई ४०००१२.	:	

प्रबंध सारांश

“**कुत्र्यांमधील लॅप्रोस्कोपिक अंडाशयासाठी दोन पोर्ट तंत्रासह सिंगल चीरा लेप्रोस्कोपी सर्जरीची तुलना**” हे शीर्षक असलेले संशोधन, पशुवैद्यकीय शल्यचिकित्सा व क्षकिरणचिकित्सा विभाग विभाग, मुंबई पशुवैद्यकीय महाविद्यालय, परळ, येथे करण्यात आले.

डोळ्याच्या बाहुलीच्या पारदर्शक पडद्यावर व्रण असलेले 12 श्वान दोन उपचार गटात विभागले.गट अ मध्ये (n=६) हिऱ्याच्या खरीसरखा पृष्ठभाग असलेले यंत्रव मऊ संपर्क पट्टी वापरुन केलेले उपचार तर गट ब मध्ये (n=६) पारदर्शक पडदा व नेत्रश्लेष्मलाचे स्थानांतरण करून उपचारकरण्यात आले॰

सर्व श्वानांच्या डोळ्याच्या विविध न्युरो-नेत्ररोग तपासण्या करण्यात आल्या. भुलपुर्व औषोधोपचारात ग्लायकोपायरोलेट @१ मि. ग्रॅ./किलो, डाईझेपाम @०.५ मि. ग्रॅ./किलो आणि ब्युटोरफेनोल@०.२ मि. ग्रॅ./किलो शिरेतूनदेण्यात आले. भूल देण्यासाठी प्रोपोफोल@४ मि. ग्रॅ./किलो शिरेतून आणि प्राणवायू व आयसोफ्लूरेन वायूची वाफ २% यांचे मिश्रण वापरण्यात आले.

श्वानास एका बाजूवर झोपवून शस्त्रक्रिया करण्यात आली. गट अ मध्ये अल्जरब्रशच्या सहाय्याने व्रणाच्या भोवतालचा १-२ मि.मी. भाग खरवडल्यावर,बाहुलीच्या पारदर्शक पडद्यावर मऊ संपर्क पट्टीलावण्यात आली. गट ब मध्ये व्रणावर, व्रणाचा आकार लक्षात घेऊन पारदर्शक पडद्याचा काही भाग व नेत्रश्लेष्मल यांच्यापासून बनविलेला पातळ पडदा,९.०नंबरचे पोलीग्लाकटीनटाके वापरून शिवण्यात आला, तसेच काहीकाळासाठी आघातापासून संरक्षण देण्यासाठी,बाधित डोळ्यांच्या पापण्या शस्त्रक्रियेने बंद केल्या.

शल्यचिकित्सा,शरीरक्रिया, रक्तघटकासंबंधित मापदंड आणि शस्त्रक्रियेतील गुंतागुंत यांचा अभ्यास केला असता, शस्त्रक्रियेनंतरच्या २४ तासात वरील मापदंडात दोन्ही गटामधे विशेष फरक आणि गुंतागुंत आढळली नाही.

परीक्षणांती,श्वानाच्याडोळ्याच्या बाहुलीच्या पारदर्शक पडद्याच्या व्रणाच्या उपचारात, दोन्ही उपचार पद्धती सुरक्षित,व्यवहार्यआणि परिणामकारक असल्याचे आढळून आले.