COMPARISON OF CONVENTIONAL AND LAPAROSCOPIC METHODS OF INGUINAL HERNIA REPAIR IN FEMALE DOGS

RAVI KUMAR, S.

DEPARTMENT OF VETERINARY SURGERY AND RADIOLOGY

VETERINARY COLLEGE, BANGALORE-24

KARNATAKA VETERINARY, ANIMAL AND FISHERIES SCIENCES UNIVERSITY, BIDAR

JUNE, 2013

COMPARISON OF CONVENTIONAL AND LAPAROSCOPIC METHODS OF INGUINAL HERNIA REPAIR IN FEMALE DOGS

Thesis submitted to the

Karnataka Veterinary, Animal and Fisheries Sciences University, Bidar

in partial fulfilment of the requirements

for the award of the degree of

Master of Veterinary Science

in

VETERINARY SURGERY AND RADIOLOGY

By

RAVI KUMAR, S.

DEPARTMENT OF VETERINARY SURGERY AND RADIOLOGY

VETERINARY COLLEGE, BANGALORE-24

KARNATAKA VETERINARY, ANIMAL AND FISHERIES SCIENCES UNIVERSITY, BIDAR

JUNE, 2013

KARNATAKA VETERINARY, ANIMAL AND FISHERIES SCIENCES UNIVERSITY, BIDAR

DEPARTMENT OF VETERINARY SURGERY AND RADIOLOGY

VETERINARY COLLEGE, BANGALORE-24

CERTIFICATE

This is to certify that the thesis entitled ***"Comparison of conventional and laparoscopic methods of inguinal hernia repair in female dogs"*** submitted by **Mr. RAVIKUMAR, S., ID No. MVHK 1164** in partial fulfilment of the requirements for the award of **MASTER OF VETERINARY SCIENCE** in **VETERINARY SURGERY AND RADIOLOGY** of the Karnataka Veterinary, Animal & Fisheries Sciences University, Bidar is a record of bonafide research work carried out by him during the period of his study in this University under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma, associateship, fellowship or other similar titles.

Bangalore

June, 2013

Dr. L. RANGANATH
Chairperson
Professor and Head
Department of Surgery and Radiology

Approved by :

Chairperson : _____
(L. RANGANATH)

Members : 1. _____
(M.L. SATYANARAYANA)

2. _____
(B.N. NAGARAJA)

Affectionately Dedicated

To

My Beloved Parents,

Friend Harish Reddy

and my Mentor

ACKNOWLEDGEMENTS

To all those who have put up with me: my supervisors, my colleagues, my friends.

I am not entirely sure what to write. Having recently completed typing this missive, I may just be all run out of words. Nevertheless, this is the only section where colloquialisms are allowed.

The ***Almighty God****, who has helped me to get an admission in Veterinary College, Hebbal, Bangalore, advised me to select Surgery as my beloved subject, strengthened me at the time of puzzles and difficulties and blessed me with all of His graces to succeed in my studies and life, first of all I thank Him for all His goodness and blessings showered upon me.*

My diction doesn't seem to be rich enough to provide suitable words to articulate my heartfelt accolade and profound indebtedness to My guide, ***Dr. L Ranganath,*** *Professor and Head, Dept. of Veterinary Surgery and Radiology, for his constant support, timely encouragement, morals and perfect guidance.*

My sincere thanks to ***Dr. B.N. Nagaraja,*** *Professor, Dept. of Veterinary Surgery and Radiology, for his valuable suggestions and timely help during the course of my master's degree.*

I cordially extend my thanks to ***Dr. M.L. Satyanarayana,*** *Professor and Head, Dept. of Veterinary Pathology, for his immense patience, subtle creative suggestions and friendly help.*

My sincere thanks to ***Dr. B.R. Deepti****, Assistant Professor, Dept. of Veterinary Medicine, for her valuable suggestions, creative criticism, meticulous corrections in my thesis and timely help.*

It is my ***family*** *without whose support & encouragement, I would not be in this position today. At this explicable moment, I wish to express my gratitude to my father, mother, uncle, aunt and sisters for their moral support which is invaluable & inexpressible.*

My words fail to express my gratitude towards ***Dr. V. Mahesh,*** *Assistant Professor, Dept. of Veterinary Surgery and Radiology, Veterinary College, Shimogga, for his incessant encouragement, immense patience, subtle suggestions and friendly help throughout my M.V.Sc period, towards the successful completion of my research and post graduate degree programme.*

It's my pleasure to express my sincere thanks to ***Dr. Vijay Raghavan****, Laparoscopic surgeon, RMV Hospital, Bangalore and* ***Mr. Ramu*** *and* ***Dr. Avinash*** *for their help during surgery and valuable suggestions that helped me in completing the research. I am indebted to them.*

I am highly obliged to my teachers ***Dr. H.V. Veerabhadraiah*** *and* ***Dr. S. Prabhudeva,*** *(Contract Teachers) who have helped me open heartedly in all means during my post graduate study.*

Special thanks must go to ***Dr. B. Vishwanatha*** *for his help in making me understand the laparoscopic instruments and his arrivals to Bangalore to help me in the operative procedures.*

My cordial and sincere thanks to my most special person ***Dr. Nithin Prabhu*** *for his valuable help and timely support during my tough times. He will always hold a special place in my heart.*

I wish to express my hearty thanks to my seniors ***Drs. Patil Sir, Mahendra sir, Vishal sir, Rathod sir, Anirudh sir, Nandeesh, Shivaiah sir, Tarasingh, Syed*** *&* ***Baddi Sir, Santhosh C.N. Kadgi Sir*** *and* ***Manjunath Sir*** *for their suggestions with whom I have always got help from one way or other and a nice time in the period. I also acknowledge my colleagues* ***Srinath Sir, Angirus, Rajendra*** *and* ***Rajpeer*** *for providing good working environment during my stay in the department.*

My vocabulary utterly fails in expressing my accolade to my friends, ***Harish Reddy, Naveen, Manohar, Shivaraj, Prabhakar, Murali, Shanthesha, Sanath, Tahir, Gajaraj, Patila, prashanth*** *and* ***Anil k k.*** *I deeply express my sincere thanks to all my friends, whose continuous inspiration, encouragement and affection, boosted up my morale during the period of study.*

I owe special thanks to my juniors Mayur, Byregowda, Avinash, Gangadhar, Vijay and Deekshith.

The supporting staff of the department, ***Mrs. Nandini, Mr. Sridhara, Mr. Narayana, Mr. Krishnamurthy,*** *and* ***Mr. Lakshman*** *helped according to the needs and I thank each one of them.*

"THANKING YOU ALL ONCE AGAIN"

Bangalore,

24th June, 2013 ***(Ravikumar S)***

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS/SYMBOLS

%	Per cent
@	At the rate of
ALT	Alanine aminotransferase
AST	Aspartate aminotransferase
cm	Centimetre
Co2	Carbon dioxide
$^{\circ}$C	Degrees Centigrade
$^{\circ}$F	Degrees Fahrenheit
dL	Decilitre
EDTA	Ethylene diamine tetra acetic acid
hr	Hour
IU/ L	International Units per Litre
Kg	Kilogram
lb	Pound
mg	Milligrams
mg/dL	Milligrams per decilitre
mg/kg	Milligrams per kilogram
mm	Millimetre
mmHg	Millimetres of mercury
Min	Minute
Psi	Per square inch
SE	Standard error
v*iz.*	namely

Introduction

I. INTRODUCTION

The co-evolution of humans and canines has a long and fascinating history. Researchers estimate that the history of humans and dogs coexisting dates back to 15000 years. The animal we know today as the domestic dog has evolved as a human companion from its beginnings. It is no surprise that dogs became known as man's best friend. In the 1950s and 60s, dogs were kept outside more often than they tend to be today. Dogs play multiple roles in the society *viz;* acting as a guard, children's playmate, or walking companion. From the 1980s, there have been changes in the role of the pet dog, such as the increased role of dogs in the emotional support of their owners. People and dogs have become increasingly integrated and implicated in each other's lives, to the point where pet dogs actively shape the way a family and home are experienced. Therefore people treat the dog as a family member and gives utmost care when it is needed. Dogs are susceptible to various diseases. Dogs are also vulnerable to some of the similar disease conditions as humans, including diabetes, dental and heart disease, epilepsy, cancer, hypothyroidism, hernias and arthritis (Csanyi , 2005).

A hernia is an abnormal protrusion of part of the body through the structures that surround it. They can exist at birth or be acquired as a result of trauma and often are genetic. Fat and intestines are the most common tissues that can herniate. A hernia in the groin is an inguinal hernia. Inguinal hernia can be diagnosed by clinical signs and physical examination. Confirmatory diagnosis can be done using radiography and ultrasonography (Munro and Stead, 1993).

The condition should be managed surgically and although the exact surgical approach and procedure may vary, the aim of all the techniques is to relocate the herniated organs to the abdomen and to completely or partially close the inguinal canal(s) to prevent the recurrence.

Of the study of the many techniques available in a general surgeon's armamentarium, the hernia repair has been written about repeatedly (Bringman *et al.*, 2010). Over a few decades ago, the hernias were handled/corrected by conventional surgical techniques where in the abdomen was opened to locate the hernial ring by various approaches and the contents were relocated into the abdominal cavity and the ring was closed with sutures (Chaudhry *et al.*, 1975; Munro and Stead, 1993). The rapid changes that have been witnessed in open approach surgeries, prosthetic materials and laparoscopic surgeries have made hernia surgery, the most interesting field of endeavor that demands renewed discipline and dedication. Though, a variety of procedures can be performed, none can be termed as an ideal as each one is accompanied by varied early and late complications, the most significant being the recurrence (Bringman *et al.*, 2010).

Laparoscopic surgery is a minimally invasive surgical technique increasingly becoming popular in Veterinary Surgery because of its inherent benefits causing minimum trauma and stress to the animal. It is presumably less painful due to smaller incision, decreased muscular trauma, and earlier return to function (Yuen *et al*, 1998). In human medicine, laparoscopy has become the golden standard for many abdominal procedures (Hasson *et al*, 1993, Jones and Soper, 1994 and Holub *et al*, 2002). Numerous advantages have been reported in laparoscopic surgery over traditional celiotomy techniques such as

decreased postoperative stress and pain, faster recovery periods, decreased hospital stay, improved cosmesis, and improved visualization of abdominal organs (Hasson *et al*, 1993, Ellstrom *et al*, 1998 and Gyr *et al.*, 2001). However, most Veterinary surgeons have avoided this modality due the cost of equipment, procedural learning curve, and increased time of the procedure compared to traditional surgical techniques (Remedios and Ferguson, 1996).

With this background, the present study was undertaken to compare conventional and laparoscopic methods of inguinal hernia repair with the following objectives:

1. To study the occurrence of hernia in dogs for a period of one year.
2. To compare conventional and laparoscopic methods of inguinal hernia repair in female dogs.
3. To record and compare the physiological, haematological, biochemical parameters and pain score during the period of study.

Review of Literature

II. REVIEW OF LITERATURE

A hernia is the protrusion of an organ or a part through a defect in the wall of the anatomical cavity in which it lies. Most hernias involve the protrusion of abdominal contents through part of the abdominal wall, the diaphragm, or the perineum.

2.1 Hernia and its classification

The hernias can be categorized based on several factors, *viz;* the anatomical site (abdominal, diaphragmatic, and perineal); a congenital hernia, a defect already present at birth or an acquired hernia, due to blunt trauma, surgical trauma or degeneration; and if the mass in the protrusion can readily be manipulated back into the cavity or not classifies it as reducible or incarcerated (or irreducible) (Daniel and Smeak, 2002).

Inguinal hernia

Inguinal hernias are protrusions of organs or tissues through the inguinal canal adjacent to the vaginal process. It occurs less frequently than any other forms of abdominal hernias and result from a defect in the inguinal ring through which abdominal contents protrude (Ashdown, 1963).

Congenital inguinal hernias develop more often in male dogs than in females, possibly because of delayed inguinal ring narrowing from late testicular descent (Fox, 1963).

However, acquired inguinal hernias are relatively common in female dogs and most often involves middle-aged female dogs (Parks, 1981).

Both neutered and intact male and female dogs may develop non traumatic inguinal hernias. They may be unilateral or bilateral. Unilateral inguinal hernias occur more commonly on the left side than right. Sex hormones have been incriminated in the formation of inguinal hernias in mice, but their role in dogs is unclear (Hazary and Gardener, 1960). Pregnancy and obesity may be associated with inguinal hernia formation. Traumatic inguinal hernias may occur as a result of a congenital muscular weakness or abnormality of the inguinal ring (Fossum *et al*., 2002).

2.2 Anatomy of the inguinal canal

The inguinal canal is located about 1 cm cranio-medial to the femoral ring, it is a fissure or potential space between the abdominal muscles and their aponeuroses. In the male dog, the inguinal canal provides a passage way for testicular descent and contains the spermatic cord contents, including the ductus deferens and testicular artery, vein, and nerve. The cremaster muscle originates from the deeper cranial border of the canal. The genitofemoral nerve, external pudendal artery and vein, and vaginal process (a peritoneal outpouching) pass through the canal in male and female dogs. In female dogs, the round ligament of the uterus extends from the uterine horn through the ipsilateral inguinal canal to the vulva (Shahar, 1996).

The inguinal canal is connected by the external and internal inguinal rings. The internal inguinal ring is bound medially by the rectus abdominis muscle, cranially by the caudal edge of the internal abdominal oblique muscle, and both laterally and caudally by the inguinal ligament. The external inguinal ring is a longitudinal slit in the aponeurosis of the external abdominal oblique muscle (Daniel and Smeak, 2002).

2.3 Occurrence of inguinal hernia

2.3.1 Breed, sex and age

Prevention of inguinal hernias in small animals may depend on a neuromuscular reflex in addition to a normal anatomical barrier at the inguinal rings (Lunn 1948).

Female dogs may be predisposed because the inguinal canal is shorter and of larger diameter than in males (Alexander and Prudden 1966).

Akman (1962) studied the importance of sex hormones in the formation of inguinal hernia and the author stated that most inguinal hernias appear during estrus or in pregnant dogs. Acquired inguinal hernias are much less frequent in neutered females. Therefore, estrogen production is considered to have a close relationship to development of inguinal hernia.

Ashdown (1963) mentioned that weakening of the abdominal wall may be due to altered nutritional or metabolic status of an animal. Obesity increases intra-abdominal pressure, forcing abdominal fat through the inguinal canals. Furthermore, accumulation of fat around the round ligament may dilate the vaginal process and inguinal canal, allowing herniation.

Fox (1963) reported that congenital inguinal hernias may disappear spontaneously at 12 weeks of age owing to a decrease in the relative size of the inguinal rings. Traumatic inguinal hernias in dogs may be due to a preexisting anatomical weakness in the area. The author also stated that congenital inguinal hernias which regress spontaneously have been shown to be hereditary in the Basenji.

Wright (1963) found that inguinal hernia in the female may only become apparent when the uterus enlarges in pregnancy or disease, the round ligament pulling part of the uterus in to the hernial sac.

According to Alexander and Prudden (1966), factors potentially involved in inguinal hernia formation can be grouped into three major groups *viz;* anatomical, hormonal, and metabolic. Enlargement of the entrance to the vaginal process, which, unlike that in humans, remains open, is the most important cause of inguinal hernias in domestic animals. A congenital persistent vaginal orifice is essential for development of indirect inguinal hernias in humans. The internal abdominal oblique muscle in humans acts as a shutter to help prevent herniation of abdominal contents with abdominal contraction. Further, they also noted that female dogs may be predisposed to inguinal hernia because the inguinal canal is shorter and of larger diameter than in males.

Roberts (1971) reported the polygenic inheritance of inguinal hernia in Cocker Spaniels and Dachshunds.

The Basenji, Pekingese, Poodle, Basset hound, Cairn terrier, Cavalier King Charles spaniel, Chihuahua, Cocker spaniel, Dachshund, Pomeranian, Maltese, and West Highland white terrier breeds are predisposed (Hayes 1974).

Peacock and Van Winkle *(*1976) stated that sex hormones may change the strength and character of the connective tissue, weakening or enlarging the inguinal rings.

Dean *et al.* (1990) described that canalis inguinalis is open physiologically in carnivores and a cord which goes posteriorly and connects with ligamentum teres uteri.

Thus, the uterus might be the principal organ that herniates. They also reported that certain breeds like Basset Hound, Cairn terrier, Pekingese and West Highland white terrier appear to have breed predisposition to inguinal hernia.

Munro and Stead (1993) stated that the potentiality of inguinal hernia to develop in the female is because of the normal extension of the vaginal process through the inguinal canal. This process contains the gubernaculum within the broad ligament of the uterus, known as the round ligament as it traverses the inguinal canal. From the fundus of each process the gubernaculum continues caudally as a thin cord terminating on the lateral aspect of the vulva.

Waters *et al.* (1993) identified two groups of dogs with inguinal hernia: dogs with inguinal hernia surgically repaired when they were younger than four months of age and those diagnosed when they were more than four months of age. They also found it is likely that hernias in the first group are congenital and the in the second group the cause may be congenital which were not identified earlier or acquired. Further, they also found that the congenital ones are more common in males than female dogs.

Bellenger (1996) reported that no breed predilection has been documented for occurrence of inguinal hernia, although toy-breed dogs and Shar-Peis may be over represented. In one series, female dogs with inguinal herniation were older and significantly lighter than affected male dogs.

Martin *et al.* (2012) reported that the incidence of acquired inguinal hernia is higher in females than in males and it can be unilateral or bilateral.

2.4 Clinical findings and symptoms

Large inguinal hernias in females may extend caudally following the round ligament to the vulva, thus resembling a pendulous perineal hernia. Direct inguinal hernias in male dogs may resemble scrotal hernias because of swelling and edema of the testicle and spermatic cord due to venous or lymphatic obstruction at the inguinal ring (Fox, 1963 and Nicholson, 1976).

The external appearance may vary, depending on the amount of vascular occlusion and the nature of the contents. Inguinal hernias may be undetectably small or large, containing, a gravid uterus (hysterocele), bladder, or jejunum (Demartin, 1982).

Affected animals are most commonly presented with a painless, unilateral or bilateral mass with a soft, doughy consistency. Unilateral inguinal hernias occur on the left side than on the right (Bellenger, 1996).

Byers *et al.* (2007) examined a beagle dog with inguinal hernia and found a distended tubular structure on abdominal palpation. The left inguinal mass was 10.0cm x 4.3cm x 2.5cm. The mass was firm, smooth, non painful, poorly mobile and non reducible.

Martin *et al.* (2012) examined a five year old Dachshund presented with the complaint of inguinal swelling and they observed that the swellings were non painful, soft and doughy in consistency. The left inguinal swelling was bigger in size compared to the right one. The contents of both the swelling were non reducible, even on application

of moderate pressure. The bladder was catheterized, and urine was relieved and thus the possibility of vesicocele was ruled out.

2.5 Diagnosis

Catheterization of the bladder followed by withdrawal of urine and possibly contrast material or pneumocystography may be used to detect bladder involvement. Pneumoperitoneography has been used as an alternative to surgical exploration in detection of occult contralateral inguinal hernias in children (Alexander and Prudden, 1966).

Munro and Stead (1993) employed radiography and ultrasonography for confirmatory diagnosis of inguinal hernia in female dogs. They positioned the dogs in lateral and ventro-dorsal recumbency and both the views revealed the presence of a large coiled viscous in the caudo-ventral abdomen displacing the small intestinal loops craniodorsally. Further, ultrasonographic imaging revealed the complete absence of peristalsis of the loops, the fluid within the loops was anechoic, allowing for enhancement of the beam, with no evidence of fetal material.

Seyrek-Intas and Seyrek-Intas (1997) have reported that a herniated gravid or infected uterus is easily detected by plain radiography and ultrasonography by focusing on the appearance of the foetus.

Daniel and Smeak (2002) diagnosed the inguinal hernia by reduction of the hernial contents and palpation of the inguinal canal. Reduction is facilitated by elevating the hindquarters to reduce caudal intra-abdominal pressure while the animal is in dorsal

recumbency. They also opined that careful palpation of both inguinal canals is recommended because early inguinal hernias may be small and remain undetected until complications arise.

Read and Bellenger (2003) noted that incarcerated hernias present a significant diagnostic challenge, as palpation may not yield a definitive diagnosis. Further, this condition is rare and is accompanied with local inflammatory symptoms.

Singh *et al.* (2010) confirmed inguinal hernia on the basis of radiography and ultrasonography. The radiograph of the inguinal swelling showed presence of radio-opaque beads of feaces in the loops of the intestine. The entire cavity of the inguinal swelling was full of radio dense masses and radio-opaque loops of the intestine. The ultrasonographic image of the swelling revealed hyperechoic shadow of loops of the intestine at different places. Each loop of the intestine presented multiple hyperechoic layers of intestinal wall with presence of anechoic fluid in between.

Martin *et al.* (2012) suggested that the confirmatory diagnosis of inguinal hernia can be made based on history, physical inspection followed by ultrasonography. Further, they found that ultrasonographic examination of left inguinal mass would reveal strands of hypoechoic region with areas of normal echogenicity and right inguinal mass with moderate echogenicity.

2.6 Treatment

2.6.1 Surgical correction

Inguinal hernias are generally best repaired at the time of diagnosis. Delay may result in more difficulty in performing the operation and may increase the risk of complications. Successful surgical repair of inguinal hernias depends on knowledge of regional anatomy and appropriate surgical technique, which consists of apposition of strong tissues without tension and high hernial sac ligation. Uncomplicated unilateral inguinal hernias are approached over the inguinal rings.

Iverson (1977) repaired inguinal hernia by placing an inscision over the lateral aspect of the swelling parallel to the flank fold.

Bellenger (1996) repaired inguinal hernia through the abdominal cavity which involves the placement of sutures through the parietal peritoneum, the aponeurosis of the transversalis muscle, and the rectus abdominis and internal abdominal oblique muscles.

Daniel and Smeak (2002) preferred midline approach for several reasons.viz., the approach avoids incising through mammary tissue, an advantage especially in a lactating animal and if bilateral hernias are present, both repairs can be completed with one skin incision.

2.6.2 Conventional method

Chaudhry *et al.* (1975) surgically corrected inguinal hernia by placing skin incision over the apex of the swelling lateral to the fold of groin. Sac was isolated down to the hernial ring by blunt dissection. The hernial sac contained non gravid uterine horn.

The contents were placed back into the abdominal cavity. A transfixation ligature of chromic cat gut was applied to close the peritoneum. Redundant portion of the sac distal to the ligature was resected. Inguinal canal was closed by applying mattress sutures. Care was taken to avoid the damage to the external pudendal artery and vein. The skin incision was closed by applying vertical mattress sutures.

Munro and Stead (1993) performed midline laparotomy and found that the uterine body was trapped within the hernia and folded back on itself and was freed from within the abdomen, after gently breaking down a number of adhesions. Routine ovariohysterectomy was then performed. A separate incision over the hernia allowed excision of a 6 cm long hernial sac after ligating its base with chromic cat gut (3 metric; Ethicon). The inguinal ring was closed with simple interrupted sutures of polydioxanone (3 metric PDS; Ethicon), taking care to avoid the external pudendal vessels and the genitofemoral nerve. The overlying subcutaneous tissues and skin were closed in two layers.

Waters *et al.* (1993) employed inguinal, midline with contra lateral ring evaluation and celiotomy with or without inguinal exposure approaches for inguinal herniorrhaphy. They found that fat and omentum were the most common hernial contents.

Byers *et al.* (2007) used ventral midline incision. Left lateral subcutaneous dissection revealed an inguinal hernial sac with entrapped omentum and distal left uterine horn. The hernial sac was incised to reveal a severally engorged, distended, and edematous left uterine horn with numerous omental adhesions. Manual reduction was

attempted, but was unsuccessful. Ventral midline celiotomy was performed, and a fluid distended uterus with left uterine horn inguinal hernial migration was visualized. Complete utero ovarian vascular ligation was performed prior to further manipulation of entrapped viscera. Bilateral ovariohysterectomy was performed. The omentum was reduced into the peritoneal cavity. Herniorrhaphy was performed with 2-0 polypropylene in a horizontal mattress pattern. Peritoneal cavity was closed in a routine fashion.

Jahromi *et al.* (2009) placed an incision over each of the inguinal swellings separately to allow exposure of the hernial sac. In left side, they found the whole uterus along with the broad ligaments and in the right, omentum to be contained in the hernial sac. Some adhesion between the uterus and the sac was dissected free. All contents were returned to the abdominal cavity by twisting the redundant sac. The sacs were transligated and trimmed at the margin of the abdominal ring. The hernial rings were sutured by a simple interrupted suture pattern using No. 0 Vicryl. Enough room was left for crossing the external pudendal vessels and genitofemoral nerve. The subcutaneous tissue was sutured in a simple continuous pattern using No. 0 Vicryl to eliminate dead space. Finally, the skin was closed by No. 0 silk in a subcuticular pattern.

Serin *et al.* (2009) placed skin incision on the inguinal mammary gland. It was observed that the hernial sac was tightly adherent to the muscles of the abdominal wall. Therefore, it was decided to perform a ventral midline laparotomy, during which an incarcerated, brownish left uterus horn in the inguinal canal was detected. The right uterus horn was normal and totally localized in the abdominal cavity. They performed bilateral ovariohysterectomy because of the advanced incarceration and the owner's

request for spaying. Following ovariohysterectomy, herniorrhaphy was performed in a horizontal mattress pattern.

Kumar *et al.* (2010) exposed both the hernial sacs by placing two separate incisions over each inguinal swellings and found the hernial sac to contain intestine and omentum. Adhesions between the intestines was dissected free, all contents were returned to the abdominal cavity by twisting the redundant sac. The sac was transligated and trimmed at the margin of the abdominal ring, the hernial ring was sutured by a simple interrupted suture pattern using No.0 Vicryl. Enough room was left for crossing the external pudendal vessels and genitofemoral nerve, the subcutaneous tissue was sutured in a simple continuous pattern using No.0 polyglactin 910 to eliminate dead space. The skin was closed by No. 0 silk in a subcuticular pattern.

Sharma *et al.* (2010) made an elliptical incision over the swollen area on skin and exteriorized the hernial sac of 10 x 20 cm size. The content (mesentery) from the opened hernial sac was pushed back into the abdominal cavity. The ring of six cm diameter was sutured with polyglactin 910 No.1 size with interlocking suture pattern. Skin was closed with cross mattress suture pattern using braided nylon.

Singh *et al.* (2010) placed a curvilinear incision at the base of inguinal swelling and approached the hernial sac. The contents were intestinal loops. After proper flushing with the normal saline, the intestinal loops were put back into the abdominal cavity. The inguinal canal was closed with purse string technique using silk No. 1 as suture material. The overlying muscles were repaired by overlapping technique using chromic catgut No. 1 suture material.

Kalita *et al.* (2012) placed a posterior midline skin incision and the inguinal ring and hernial sac were exposed by blunt dissection. The distended uterine horns with ligaments were the contents. Ovariohysterctomy was performed after kelotomy in cranial and medial direction. The internal inguinal ring was closed with No.0 polyglactin 910 in interrupted horizontal mattress pattern. Another simple continuous suture was put in the everted edges. The skin wound was closed with two simple interrupted sutures.

Martin *et al*. (2012) approached inguinal ring through lateral aspect of the inguinal swelling parallel to the flank fold. The hernial sac was opened and the contents were found to be non gravid uterine horns with the broad ligaments. The kelotomy was performed by incising the inguinal ring in a cranio-medial direction to reduce whole non gravid uterus with the broad ligaments into the abdominal cavity. The hernial sac was ligated as close to the internal inguinal ring as possible and was sectioned to it. Both internal and external inguinal rings and the kelotomy wounds were closed in separate layers by simple continuous sutures followed by a layer of subcutaneous sutures using 3.5 metric polyglactin 910. The skin wound was apposed with horizontal mattress sutures using No. 3.0 metric nylon.

2.6.3 Laparoscopic method

Laparoscopy is a modality, which is designed for visual inspection and operative procedures of the abdominal cavity and its organs using a minimally invasive technique. It works on the principle of total internal reflection of light transmitted and captured through the glass fibers present in the scope. Laparoscopy has many applications in veterinary practice, which includes sterilization in small pet animals and mares.

Laparoscopy is also widely used in birds, lab animals and amphibians for determination of sex, affections of oral cavity and other diagnostic procedures.

2.6.3.1 History of Laparoscopy

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

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

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

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

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

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

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

2.6.3.2 Laparoscopy in Animals

2.6.3.2.1 Dog

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

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

Ger *et al.* (1990) treated fifteen animals with indirect inguinal hernia by closure of the abdominal opening of the patent processus vaginalis by the application of staples laparoscopically. The satisfactory results confirmed those obtained in a previous study, where similar openings found during laparotomy for abdominal surgery were closed by application of metal clips. Further, they opined that laparoscopic closure of the abdominal opening of a hernia sac may have advantages over the present operative management.

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

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

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

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

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

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

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

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

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

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

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

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

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

Niranjana (2010) performed laparoscopic assisted ovariohysterectomy in female dogs stated that there was a non significant variation in temperature, heart rate and respiratory rate.

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

Holey *et al.* (2012) performed comparative study of laparoscopic electrocoagulation and endostapling techniques of ovariohysterectomy in female dogs by withholding food for twenty four hours and water for four hours.

2.6.3.2.2 Other animals

Fitzgibbons *et al.* (1994) compared indirect inguinal hernia repair in pigs using polypropylene mesh in two groups of animals wherein, the group I underwent inguinal hernia correction by conventional laparotomy and the group II by laparoscopy. They found that on histological evaluation, laparoscopically placed specimens demonstrated significantly thinner fibrotic tissue above the mesh compared to the prostheses by laparotomy.

2.6.3.2.3 Laparoscopic inguinal hernia repair in humans

Dion and Morin (1992) performed 10 inguinal herniorraphies laparoscopically. All the patients underwent laparoscopic preperitoneal placement of Prolene mesh, which was fixed in place with interrupted No. 0 - Prolene sutures. All patients recovered

promptly, with less pain and minimal limping, resulting in high patient acceptance of the procedure. They noticed that there were no complications and no recurrence was noted.

Winchester *et al.* (1993) performed inguinal hernia repair with general anaesthesia through bilateral, lower abdominal and 12 mm lateral rectus sheath ports with an umbilical 30^{o} viewing laparoscope. After the peritoneum was incised and flaps were raised, an onlay patch of polypropylene mesh, secured with staples, covered both indirect and direct hernia regions in each human patient. Small hernial sacs were usually reduced and excised.

Khalid *et al.* (1994) conducted cohort study consisting of forty patients operated by TEPA (total extra-peritoneal approach). The study group consisted of 38 male and 2 female patients with a mean age of 45 years (range 30 to 60 years) at the time of operation. They opined that laparoscopic herniorrhaphy is a feasible alternative to open hernia repair and found that the median time to return to work or normal physical activity to be 8-12 days for unilateral and 10-14 days for bilateral hernia repair.

Fitzgibbons *et al*. (1995) studied three types of laparoscopic inguinal herniorrhaphies (transabdominal preperitoneal (TAPP), intraperitoneal onlay mesh (IPOM), and totally extraperitoneal (EXTRA). The study involved twenty one investigators from 19 institutions. Finally, they concluded that, laparoscopic inguinal herniorrhaphy is an effective method to correct an inguinal hernia. It can be offered safely to patients undergoing other abdominal procedures. However, the TAPP, IPOM, and EXTRA procedures appear to be equally effective and a controlled randomized trial is needed to compare this procedure with conventional inguinal herniorrhaphy.

Edleman (2002) made comparison between porcine small intestinal submucosa (SIS) mesh and polypropylene mesh to repair inguinal hernias. The author used preperitoneal approach with balloon dissection in all patients. Finally, the author concluded that both the meshes were minimally complicative with SIS requiring long term follow ups.

Liem *et al.* (2003) operated on 120 patients for inguinal hernia using the totally extraperitoneal approach by taking assistance of four laparoscopic surgeons inexperienced in this new technique in a secondary referral setting. Their learning curve was assessed through operation time, perioperative and postoperative complications, and technical difficulties. Finally the authors concluded that the learning curve for totally extraperitoneal laparoscopic hernia repair can be overcome. However, the presence of an experienced surgeon during the procedure is vital, as this may prevent unnecessary recurrences.

Memon *et al.* (2003) conducted a meta-analysis of the randomized evidence to determine the relative merits of laparoscopic (LIHR) and open (OIHR) inguinal hernia repair. The authors found that, LIHR was associated with earlier discharge from hospital, quicker return to normal activity and work, and significantly fewer postoperative complications than OIHR. However, the operating time was significantly longer and there was a trend towards an increase in the relative odds of recurrence after laparoscopic repair.

Schier (2006) performed a total of 933 laparoscopic inguinal herniorrhaphies on 666 children (597 boys and 69 girls), ranging in age from 3 weeks to 14 years (median,

3.2 years). The author placed 5-mm laparoscope through an umbilical incision, and two 2-mm or 3-mm needle drivers were inserted through the lateral abdominal wall. The neck of the sac was closed with a 4-0 monofilament suture. The needle was inserted directly through the abdominal wall, and removed together with the trocar. They closed only the umbilical fascia with an absorbable suture. No skin sutures were applied. They found that, although, in laparoscopic inguinal hernia repair the recurrence rate was slightly higher than with the open approach, it allows easy and precise identification of the type of defect and its correction.

2.6.3.2.4 Advantages and limitations of laparoscopy

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

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

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

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

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

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

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

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

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

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

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

2.6.3.2.5 Complications of laparoscopy

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

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

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

Hardie *et al.* (1996) reported splenic puncture, stomach perforation and residual subcutaneous emphysema as the complications encountered after laparoscopic stapled gastropexy in dogs. The authors also suggested that improper placement of cannula could result in damage to internal organs with immediate problems such as haemorrhage or delayed problems such as peritonitis from perforated hollow organs.

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

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

2.7 Clinical parameters

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

Kumar (2006) compared the surgical and laparoscopic methods of sterilization in female dogs and observed significant rise in rectal temperature, heart rate and mean respiratory rates at 6, 12 and 48 hrs of postoperative intervals.

Ranganath and Kumar (2007) compared the surgical and laparoscopic methods of sterilization in female dogs and observed significant rise in rectal temperature, heart rate and mean respiratory rates at 6, 12 and 48 hrs of postoperative intervals.

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

Jahromi *et al.* (2009) reported a case of inguinal hernia and they observed that there were no preoperative changes in the physiological values.

Devaraja (2010) compared conventional and laparoscopic methods of vasectomy in dogs and reported that there was a non significant variations in any of the physiological and hematobiochemical parameters at 0, 24, 48, 72hrs and 7th days of postoperative intervals.

Holey *et al.* (2012) compared laparoscopic electrocoagulation and endostapling techniques of ovariohysterectomy in female dogs and stated that there was a non significant variation in temperature, heart rate and respiratory rate.

Martin *et al.* (2012) performed inguinal herniorrhaphy and found that there were no significant changes in the physiological parameters during the postoperative period.

Vishwanatha and Ranganath (2012) compared laparoscopic endosuturing and endostapling techniques of ovariohysterectomy in female dogs and reported that there was a non significant elevation in rectal temperature, heart rate and mean respiratory rates at 0, 24, 48, 72hrs and 7th days of postoperative intervals

2.7.1 Hematological and biochemical parameters

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

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

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

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

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

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

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

Holey (2010) in his study of comparison between laparoscopic electrocoaggulation and endostapling for ovariohysterectomy in female dogs reported there was a non significant variation in haematological and biochemical parameters and a statistically non-significant decreased in total erythrocyte count which might be due to minimum blood loss during the surgical procedure in both groups.

Vishwanatha (2011) in his study of comparison between laparoscopic endosuturing and endostapling for ovariohysterectomy in female dogs reported that there was a non significant variation in haematological and biochemical parameters and the variations in the mean values of any given hematobiochemical value within the groups and between the groups.

2.8 Assessment of pain in animals

Morton and Griffith (1985) stated that anxious look, tail positioned between legs , hang dog look, distinctive bark, aggression or crying are specific signs of behaviour indicating pain, distress or discomfort in dogs.

Remedios *et al.* (1992) calculated pain scores based on wound palpation, behaviour, heart rate and respiratory rate and stated that dogs which underwent laparoscopic ovariohysterectomy had higher wound palpation scores that had resulted from abdominal insufflations or residual carbon dioxide distension.

American College of Veterinary Anaesthesiologists position paper (1998) stated some example of behaviours (change in personality or attitude, abnormal vocalization, licking, biting, shaking of painful area, change in posture or ambulation, change in activity level and appetite, facial expression, excessive sweating or salivation, oculonasal discharge, teeth grinding, diarrhoea or tenesmus and dysuria) and other parameters (increased heart rate, respiratory rate, body temperature, increased blood glucose, corticosteroids and catecholamine concentration) that were indicative of pain in animals.

Firth and Haldane (1999) developed a scale (University of Melbourne Pain Scale) to evaluate post-operative pain in dogs, which incorporated physiologic data and behavioural responses and stated that behavioural and physiological measurements could be used reliably to evaluate degree of pain in dogs during the post-operative period.

Hancock *et al.* (2005) used physiological, behavioural and biochemical parameters (blood glucose and cortisol) for evaluation of post-operative pain in dogs.

Ranganath and Kumar (2007) utilized University of Melbourne Pain Scale to evaluate post-operative pain in dogs, which included different physiological values and behavioural responses and noted that there was a significant increase in the UMPS values in the group of surgical intervention than in laparoscopic method.

Materials and Methods

III. MATERIALS AND METHODS

The present study was carried out among the dogs presented to Veterinary College Hospital, KVAFSU, Hebbal, Bangalore. The occurrence of hernia among the dogs was recorded to a period of one year.

3.1 Selection of Animals

Twelve female dogs weighing between 12-20 kg body weight with the history of inguinal hernia presented to Department of Veterinary Surgery and Radiology, Veterinary College Hospital, Hebbal, Bangalore were included in the present study. All the dogs were subjected for clinical examination and hematobiochemical assays to assess their fitness for the surgery. Only the dogs found fit with normal hematobiochemical parameters were selected for study.

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

Group A – Consisting of six female dogs which were subjected to conventional method of inguinal herniorrhaphy under isoflurane anaesthesia.

Group B - Consisting of six female dogs which were subjected to laparoscopic method of inguinal herniorrhaphy under isoflurane anaesthesia.

3.2 Instrumentation

For conventional method of inguinal herniorrhaphy

General surgical pack (Plate 1)

Halsted-mosquito hemostats, curved	2
Halsted-mosquito hemostats, straight	2
Needle holder	1
Allis tissue forceps	4
Towel clamps	4
Scissors, curved	1
Scissors, straight	1
Bard Parker handle with blade	1
Rat toothed forceps	1
Suture needles	2
Suture cutting scissors	1

For laparoscopic endo-suturing method of inguinal herniorrhaphy

i. Pneumoperitoneum needle (Veress needle) of 10 cm length with spring-mounted blunt inner cannula. (Plate 2)

ii. Laparoscopic trocar and cannula. (Plate 3)

a) One trocarless threaded cannula with multifunctional valve and insufflations stopcock of 6 mm diameter and 8.5 cm working length. (Plate 3a)

b) Trocars with pyramidal tip of 5 mm diameter and 8.5 cm working length along with cannula, multifunctional valve and insufflations stopcock. (Plate 3b)

c) One trocar with pyramidal tip of 10 mm diameter and 10.5 cm working length along with cannula, multifunctional valve and insufflations stopcock. (Plate 3c)

iii. Telescope: Forward oblique telescope (30^{o}) of 5 mm diameter and 29 cm of working length incorporated with fiber optic transmission. (Plate 4)

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

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

vi. One curved, serrated scissors: 5 mm in diameter and 36 cm length with insulation. (Plate 6a)

vii. One bipolar coagulating forceps: 5 mm in diameter and 33 cm length with insulation. (Plate 6b)

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

ix. Electronic carbon dioxide endoflator: Unit is electronically equipped to monitor, maintain and control a constant preset intra-abdominal pressure. This is capable of delivering gas flow of up to 0 to 20 litres per minute. It contains digital indicators for patient intra-abdominal pressure from 0 to 30 mmHg. (Plate 8)

x. Electro-coagulation unit: Consist of a main cord, silicon rubber patient plate, pedal foot switch, connecting cords and two control switches with bipolar maximum output of 125 watts for coagulation. (Plate 9)

xi. Light source: Cold light fountain halogen 250 twin lamps of 250 watts with fibre optic cable of 3.5 mm diameter and 180 cm of length. (Plate 10)

xii. Veterinary Video Camera III: Consist of integrated digital fiberscope filters, connecting cable, C- mount lens and vet-C mount camera head. (Plate 11)

xiii. Documentation unit: Consists of Karl Storz AIDA^{TM} control with DVD/CD writer, frame grabber board, slot bracket, Karl Storz AIDA^{TM} 2.0 software, Karl Storz USB stick, inter base desktop, connecting cable, S-video connecting cable and main cord. (Plate 12)

3.3 Sterilization of instruments

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

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

3.4 Procedure

3.4.1 Preparation of dogs and surgical site

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

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

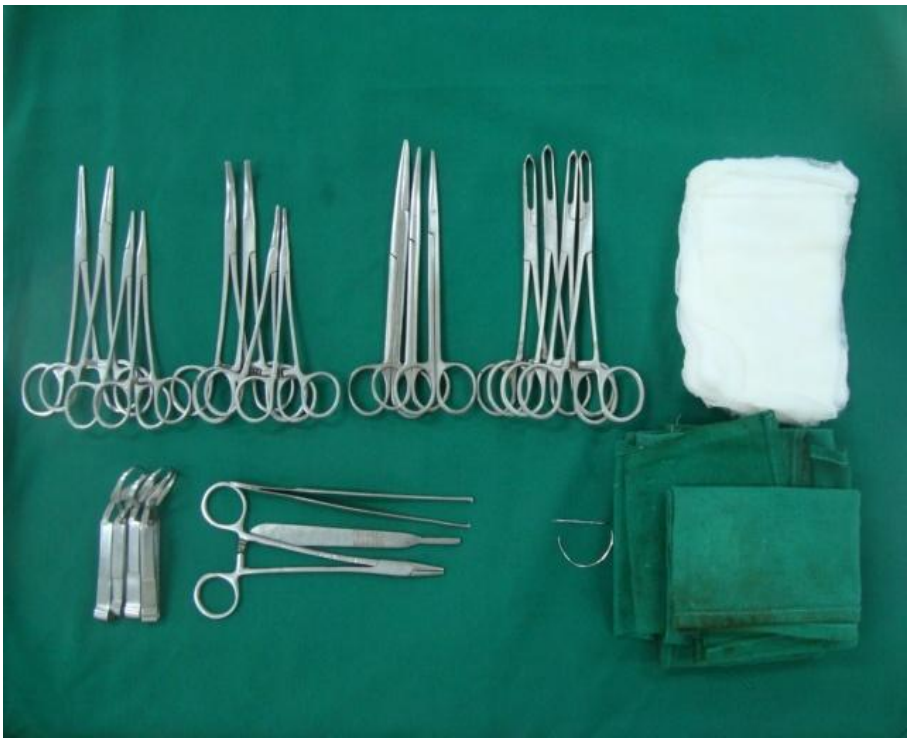


Plate 1: General Surgical pack

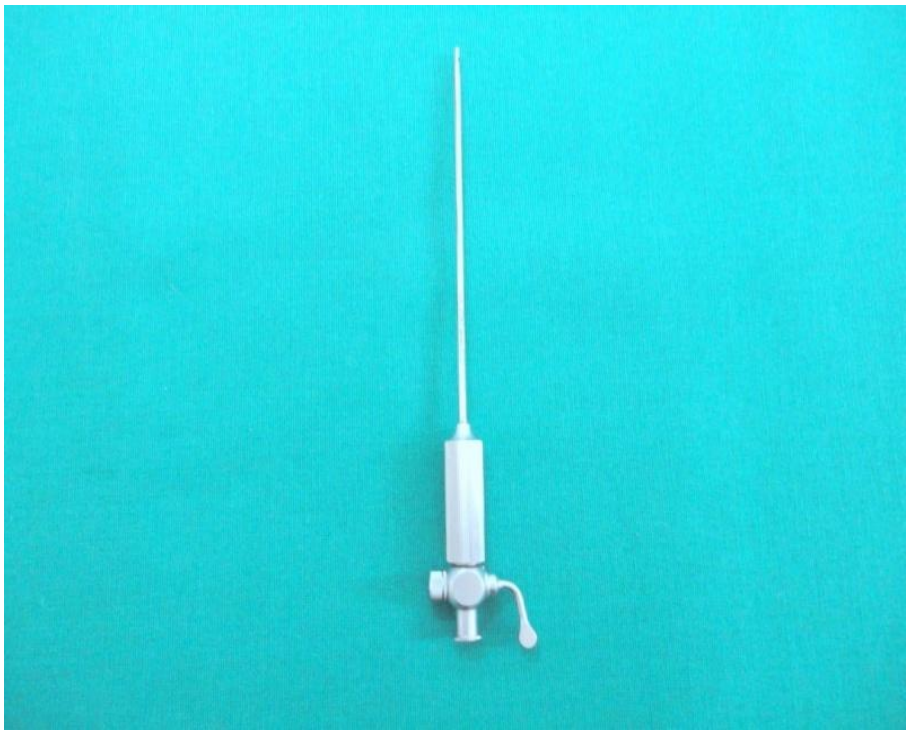


Plate 2: Pneumoperitoneum needle (Veress needle)

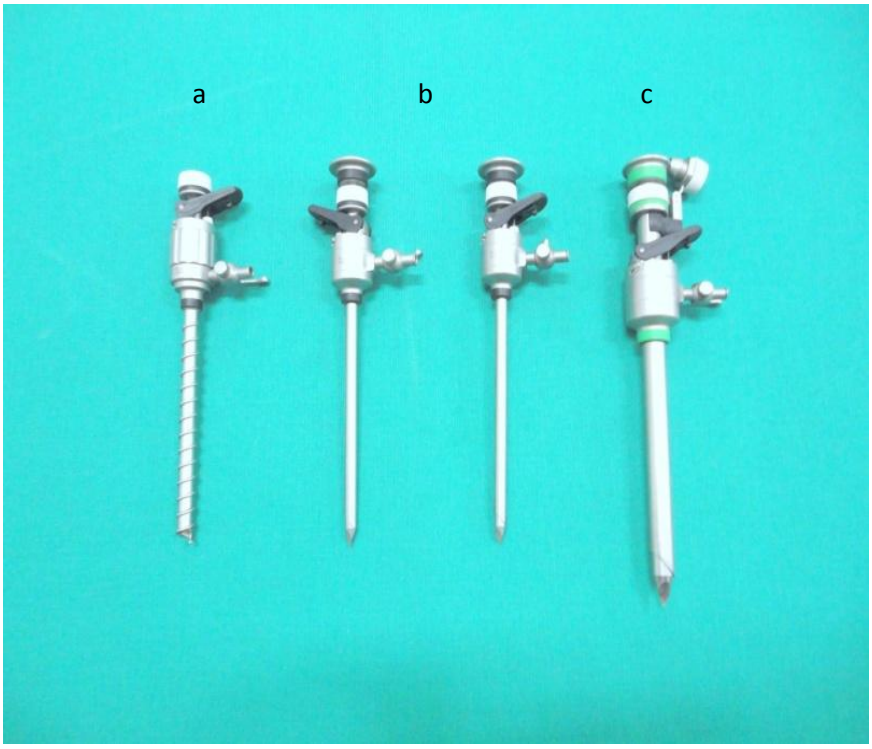


Plate 3. a) Trocarless threaded 6 mm cannula

b) Two 5 mm trocar and cannula

c) 10 mm trocar and cannula

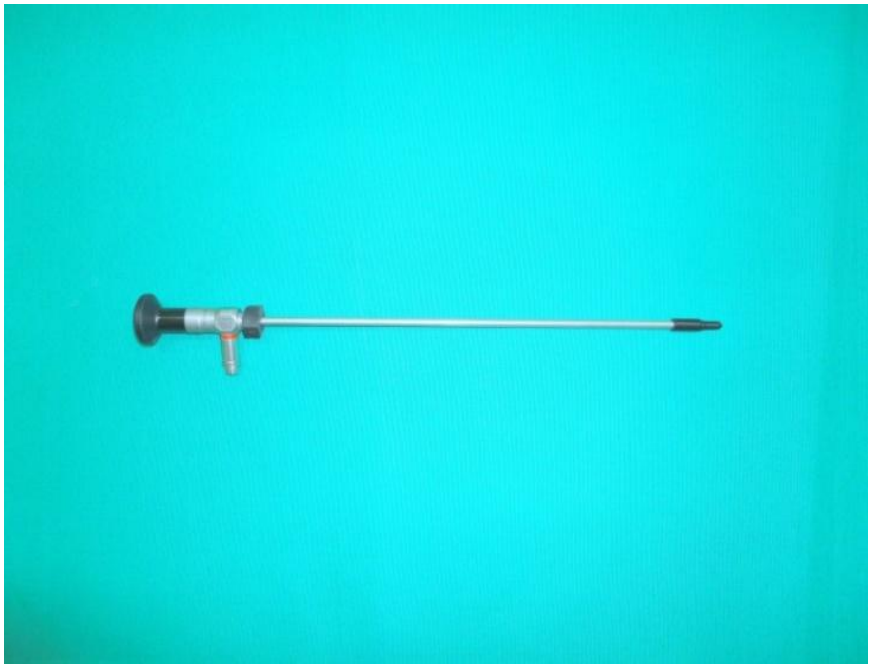


Plate 4. Forward oblique telescope (30°)

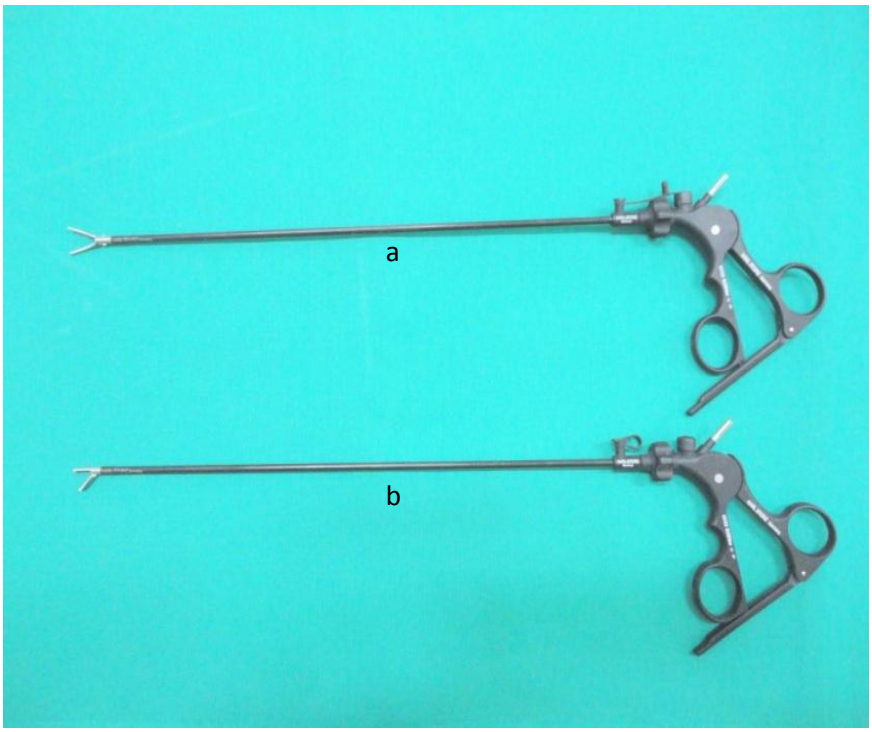


Plate 5. a) Dissecting forceps

b) Grasping forceps

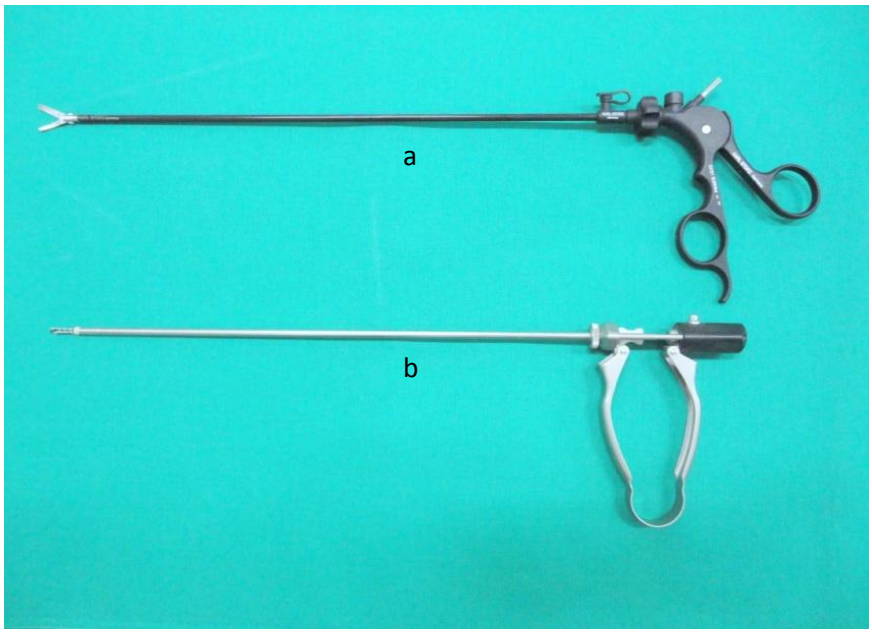


Plate 6. a) Curved, serrated scissors

b) Bipolar coagulating forceps

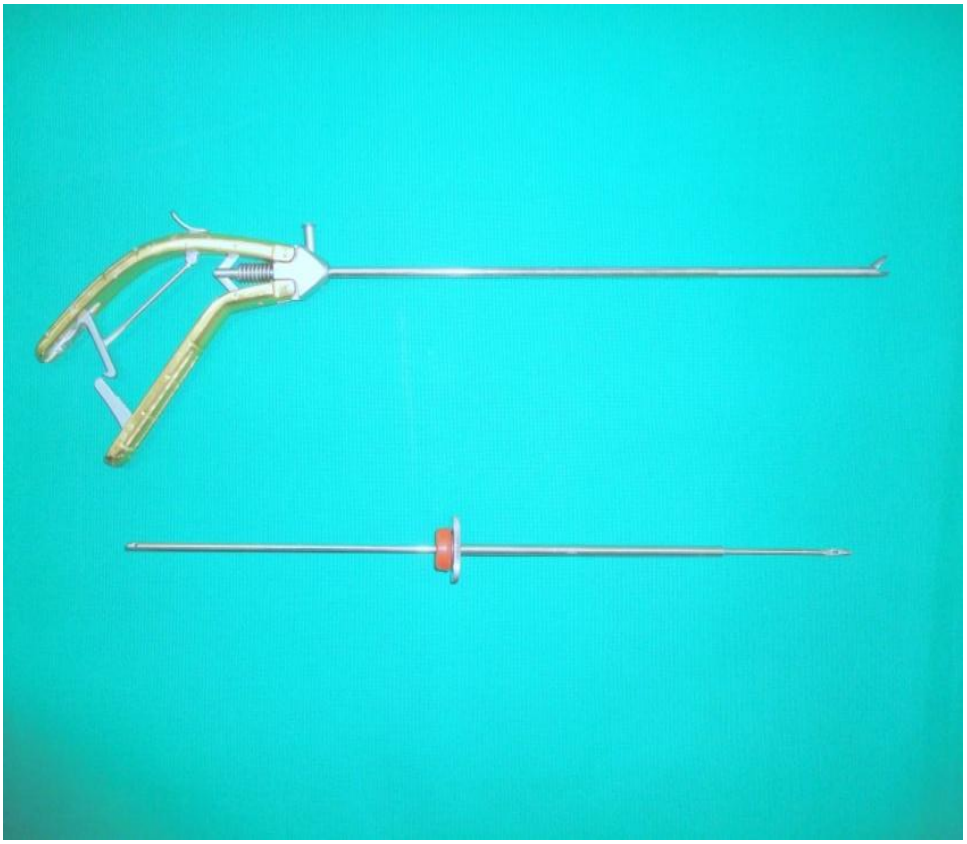


Plate 7. Laproscopic needle holder

Plate 8. Electronic Carbon dioxide endoflator

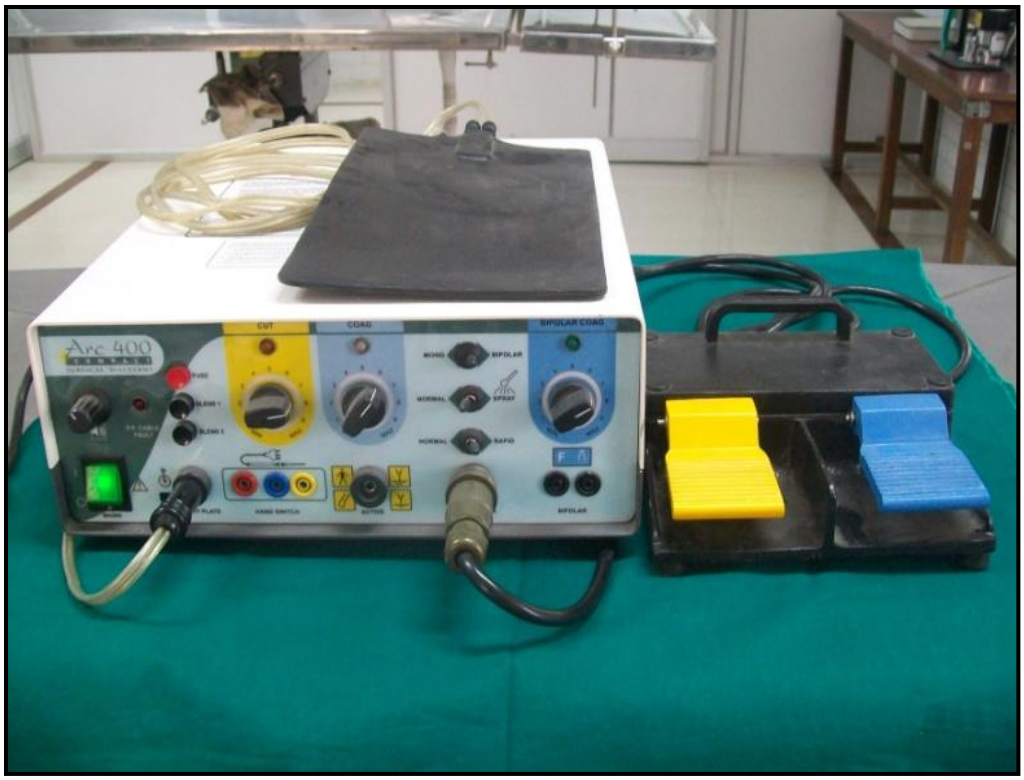


Plate 9. Electrocoagulation unit

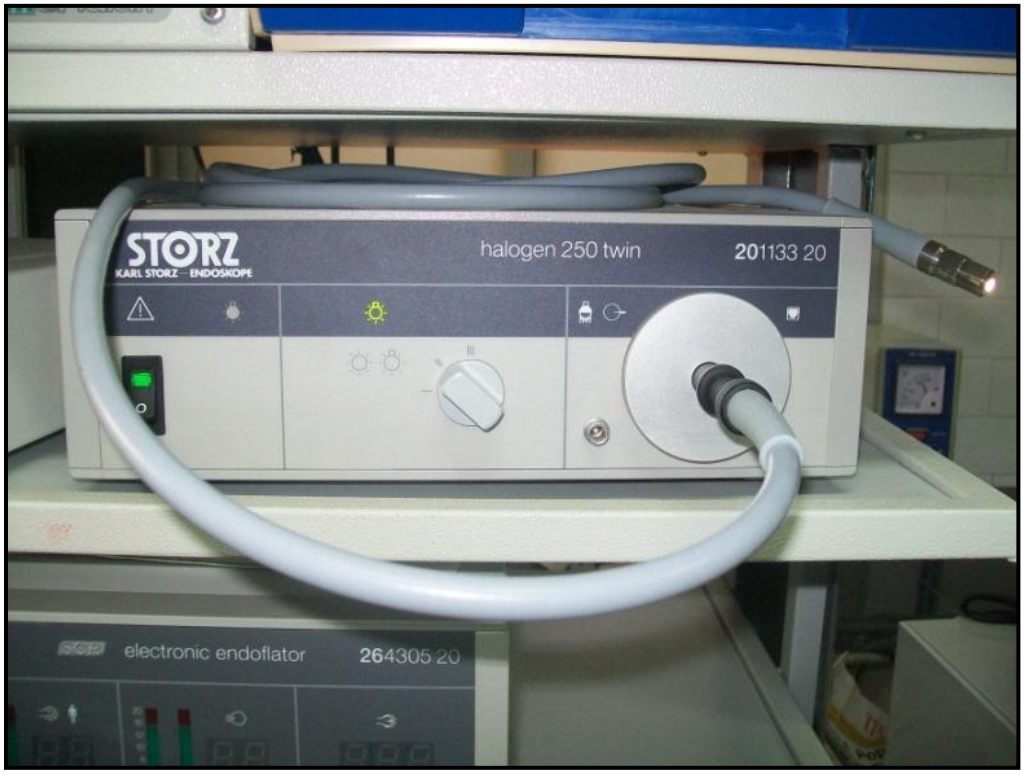


Plate 10. Light source

Plate 11. Veterinary Video Camera III

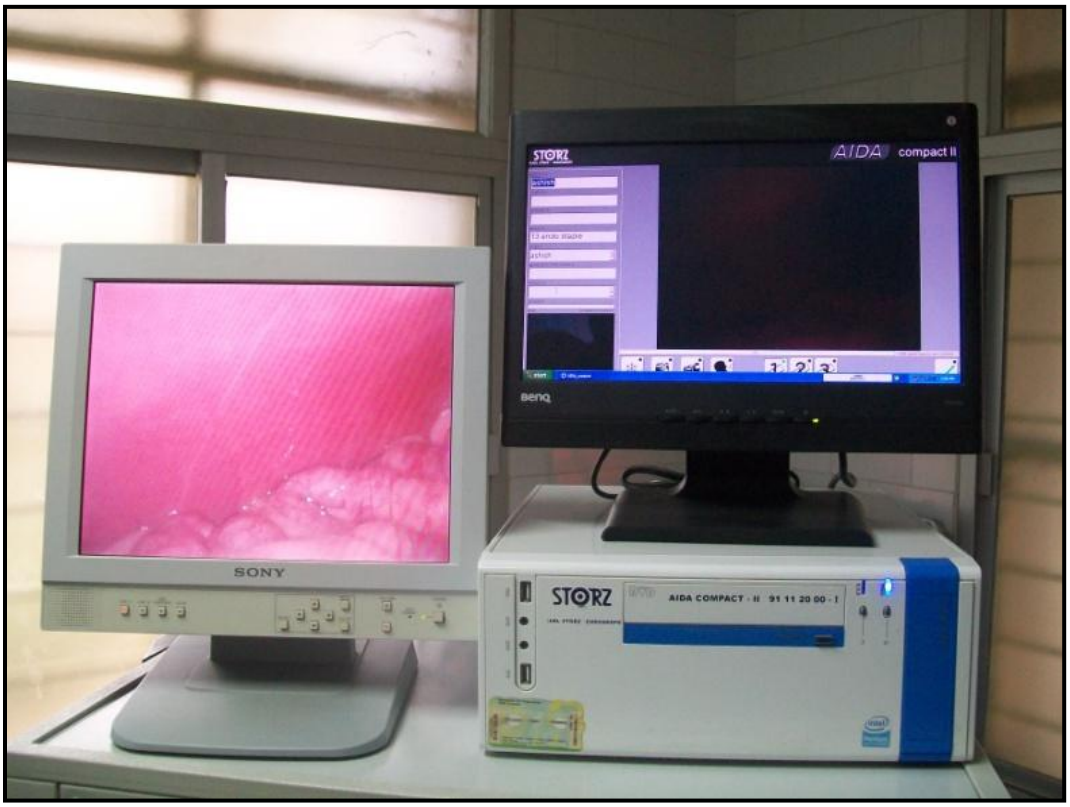


Plate 12. Documentation unit

3.4.2 Anaesthetic protocol

All the dogs of both the groups were premedicated with atropine sulphate (Atropine sulphate® injection IP. (0.6mg/ml), Harson Laboratories, Akota, Baroda – 20, India) @ 0.04 mg/kg body weight subcutaneously and diazepam (Calmpose® injection IP (10mg/2ml), Ranbaxy Laboratories Limited, Nihalgarh, H.P-25, India) @ 0.5 mg/kg body weight intravenously. After 20 minutes, general anesthesia was induced and maintained by isoflurane (Sosrane®, Metrex Pharmaceuticals Pvt. Ltd , Mumbai -93, India).

3.4.3 Positioning of the dogs and placement of ports

In Group A, each of the six dogs was positioned in dorsal recumbency with elevated pelvis (30^{o}) (Plate 13). All the limbs were secured separately and ribcage was supported by sand bags. All the dogs were anesthetized with isoflurane anaesthesia by mask induction and later intubated with endotracheal tube which was connected to the isoflurane anaesthetic apparatus.

In Group B, the dogs were placed as aforementioned and a small slit was made at umbilicus and subcutaneous tissue was separated bluntly. A spring loaded pneumoperitoneum needle was inserted into the abdomen followed by insufflation using carbon dioxide gas to an intra-abdominal pressure of 12 mmHg (Plate 14).

Immediately after establishment of the pneumoperitoneum to a 12 mmHg intra-abdominal pressure, Veress needle was removed. Median port was made by introducing 10 mm trocar at umbilicus into the abdomen directing trocar tip dorsally to avoid injury

to visceral organs (Plate 15). The tube from carbon dioxide endoflator was connected to the median port and the trocar was removed. The telescope (5 mm, 30^{o}) was inserted into the median port and abdominal wall and visceral organs were inspected for any puncture or bleeding. Two more paramedian ports were made, of which, the former was placed approximately five cm caudo-lateral to median port and the latter was placed 5 cm caudal to the former, both on the side opposite to the location of inguinal hernia by inserting two 5 mm trocars which were used as instrumental ports (Plate 16).

3.4.4 Conventional method of inguinal herniorrhaphy (Group A)

A caudal midline incision was made so as to access the abdominal cavity (Plate 17). The inguinal region was visualized by pushing aside the abdominal organs. Then, the inguinal region was examined to locate the internal inguinal ring, the ring was then observed for presence of adhesions (Plate 18). Adhesions if any, were separated by employing blunt dissection using dissecting scissors, the hernial contents (most commonly uterus and omentum, to a lesser extent intestines and urinary bladder) were pulled manually and placed back in to the abdominal cavity. Further, the internal inguinal ring was closed by placing simple interrupted sutures using polyglactin 910, No. 1 (Vicryl®, Ethicon, Johnson & Johnson, Aurangabad, India) (Plate 19). Finally, the linea alba was closed using polyglactin 910 and the skin suturing was done using polyamide No. 0 (Trulon®, Sutures India Pvt. Ltd. Bangalore, India) (Plate 20).

3.4.5 Laparoscopic method of inguinal herniorrhaphy (Group B)

Visceral organs were manipulated by laparoscopic alligator and grasping forceps. To locate inguinal ring, animal was slightly turned towards the side opposite to location

of hernia by manipulating the angle of the operating table so as to achieve better visualization of the internal inguinal ring (Plate 21). Adhesions if any, were separated using curved, serrated scissors, the hernial contents (most commonly uterus and omentum, to a lesser extent intestines and urinary bladder) were grasped with the forceps and pulled in to the abdominal cavity (Plate 22). The internal bleeding encountered in the operation process was controlled using electro-coagulation unit. Then, the internal inguinal ring was closed by placing simple interrupted sutures using polyglactin 910, No. 1 (Vicryl®, Ethicon, Johnson & Johnson, Aurangabad, India) with help of laparoscopic needle holder (Plate 23 and 24). Furthermore, during the whole procedure the images were captured using Veterinary Video Camera III and Documentation unit. The portal sites were approximated by single simple interrupted suture using nonabsorbable suture monofilament polyamide No. 0 (Trulon®, Sutures India Pvt. Ltd. Bangalore, India) (Plate 25).

To both the groups of dogs, post-operatively Ceftriaxone sodium (Intacef® inj, 500 mg vial, Intas Pharmaceticals Ltd., Ahmedabad –09, India) was administered at the dose rate of 20 mg/kg body weight, twice daily for five days along with regular wound dressing with povidone iodine.

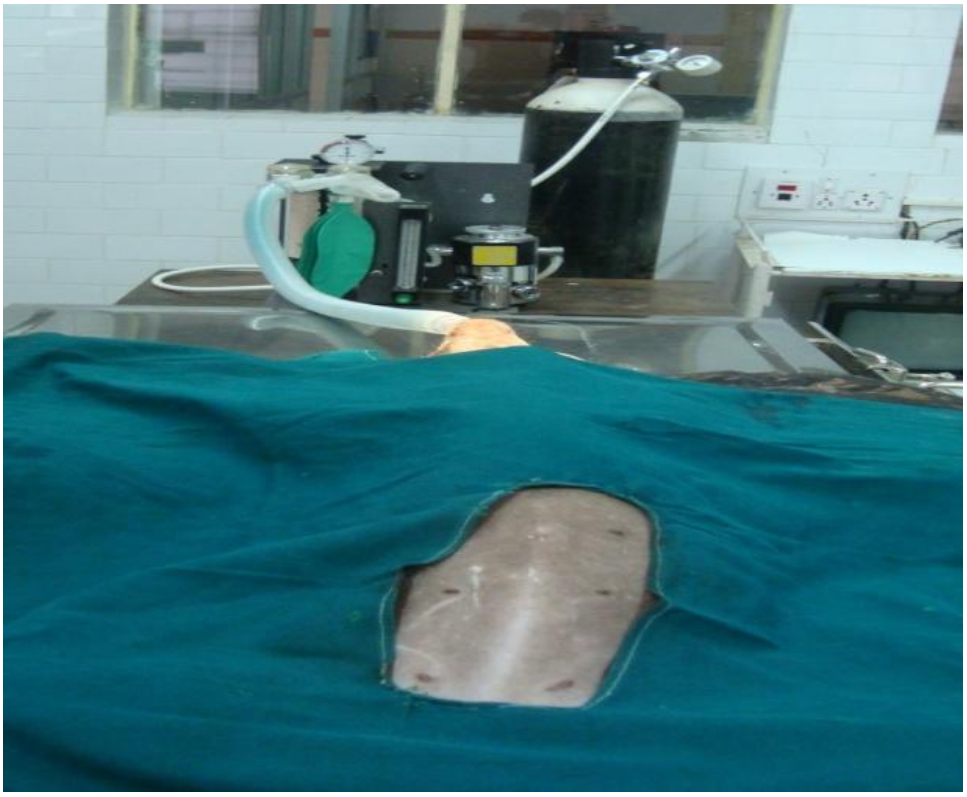


Plate 13. Positioning of the animal in dorsal recumbency with elevated pelvis (30^0)

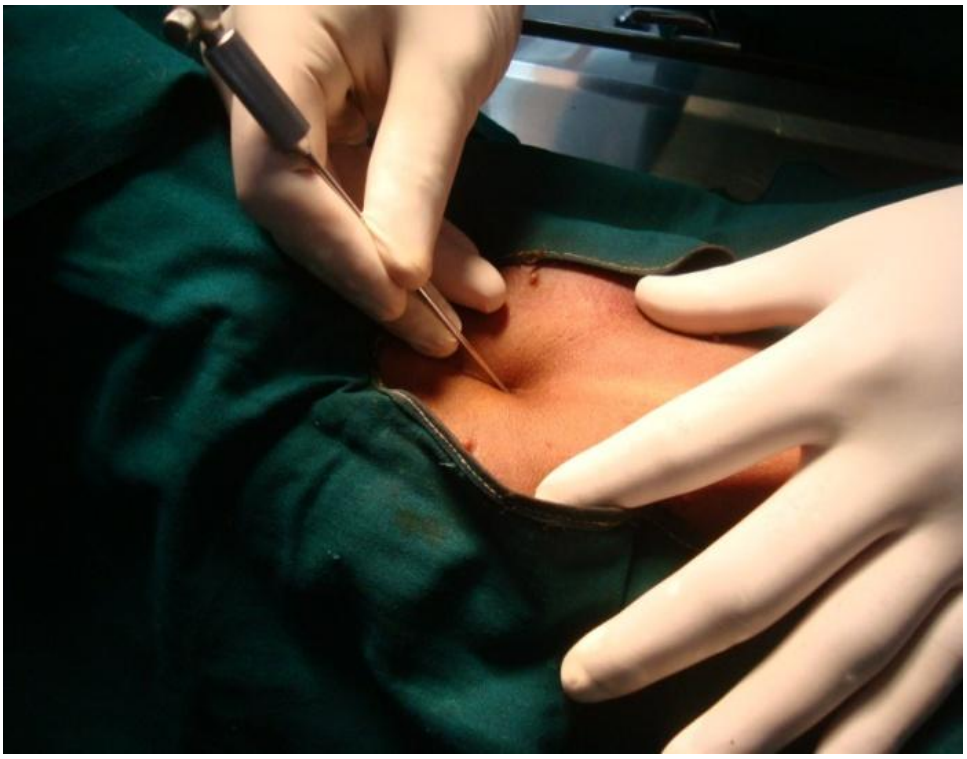


Plate 14. Group B: Insertion of Veress needle

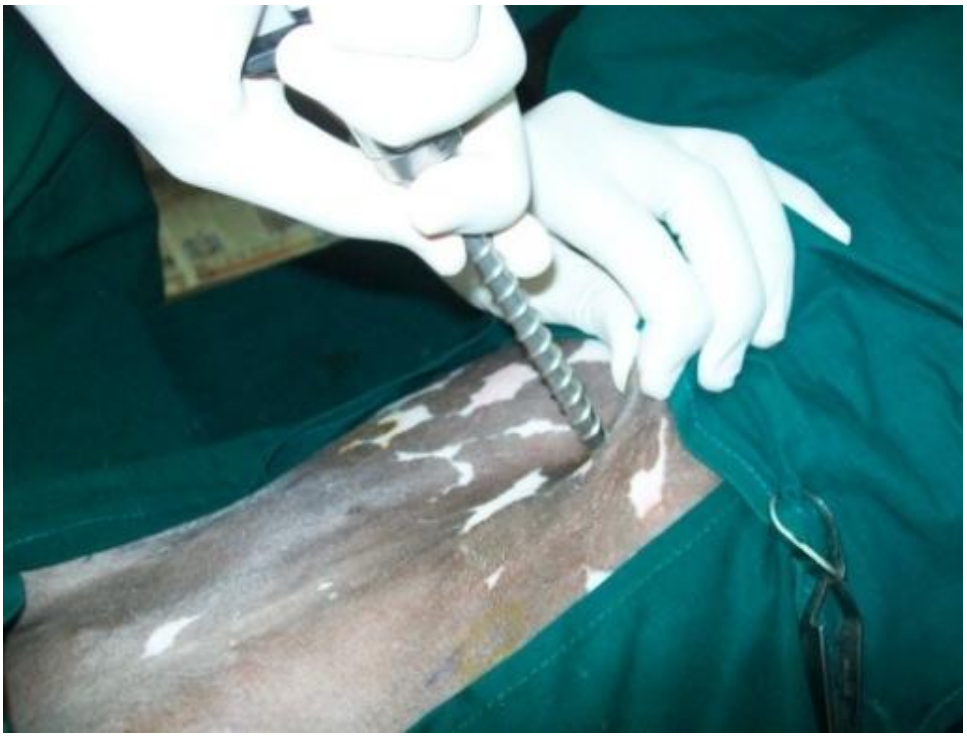


Plate 15. Group B: Insufflation of abdomen with carbon dioxide.

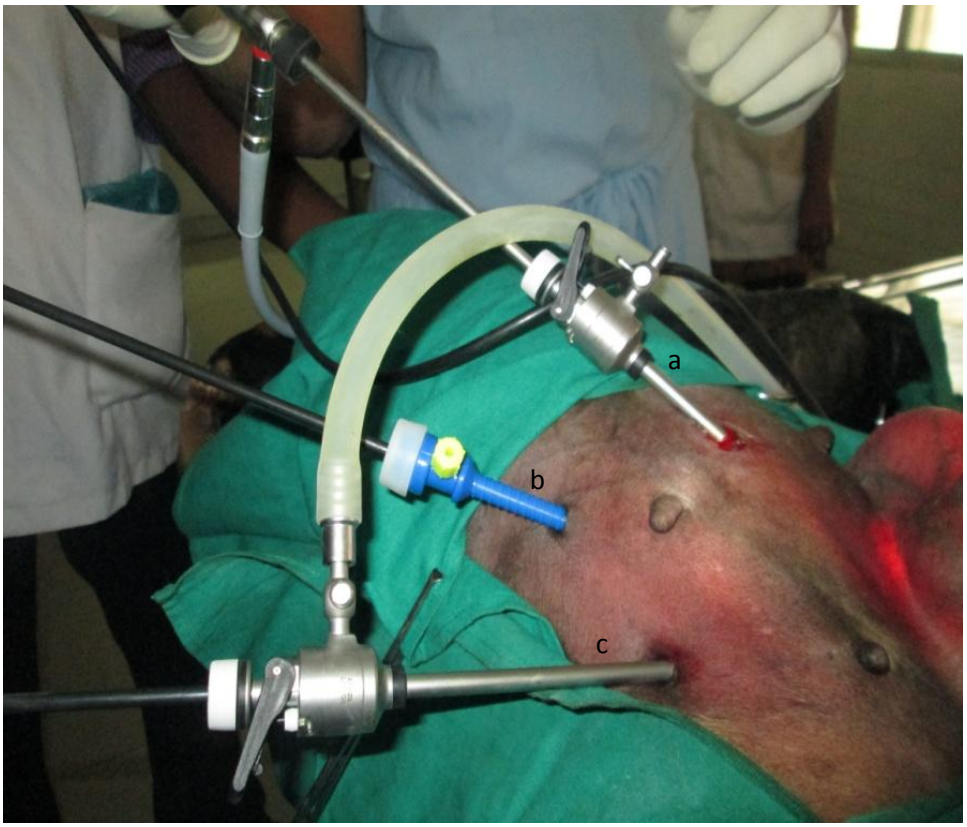


Plate 16. Group B: Insertion of trocars, one median (a) and two paramedian ports with telescope and grasping forceps (b & c).

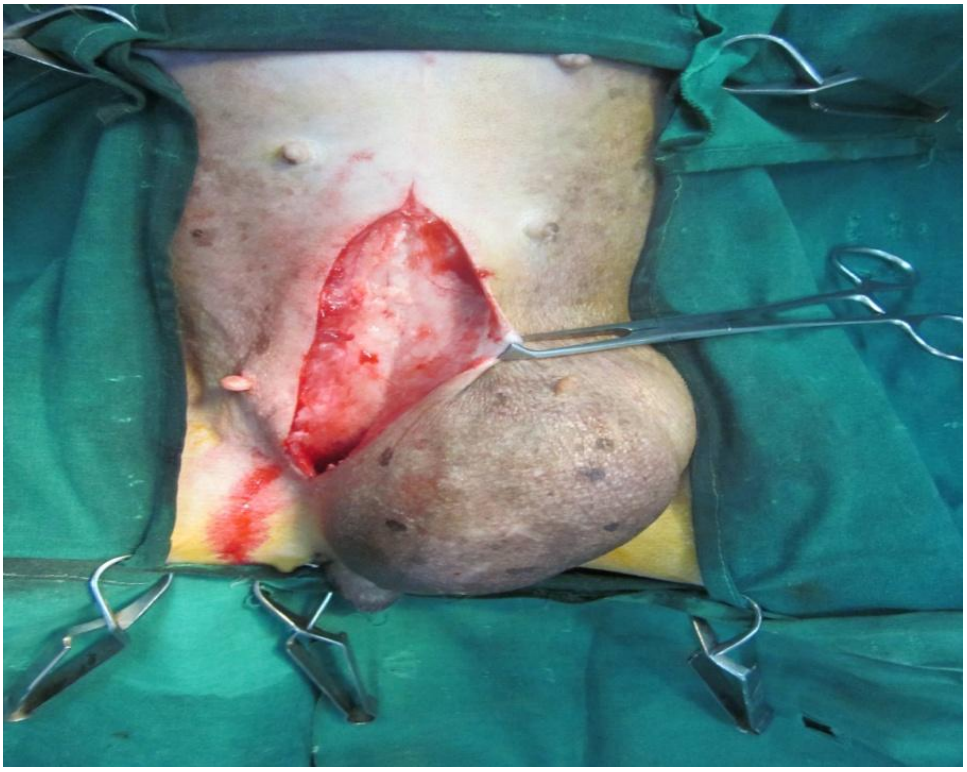


Plate 17.Group A: Caudal Midline incision

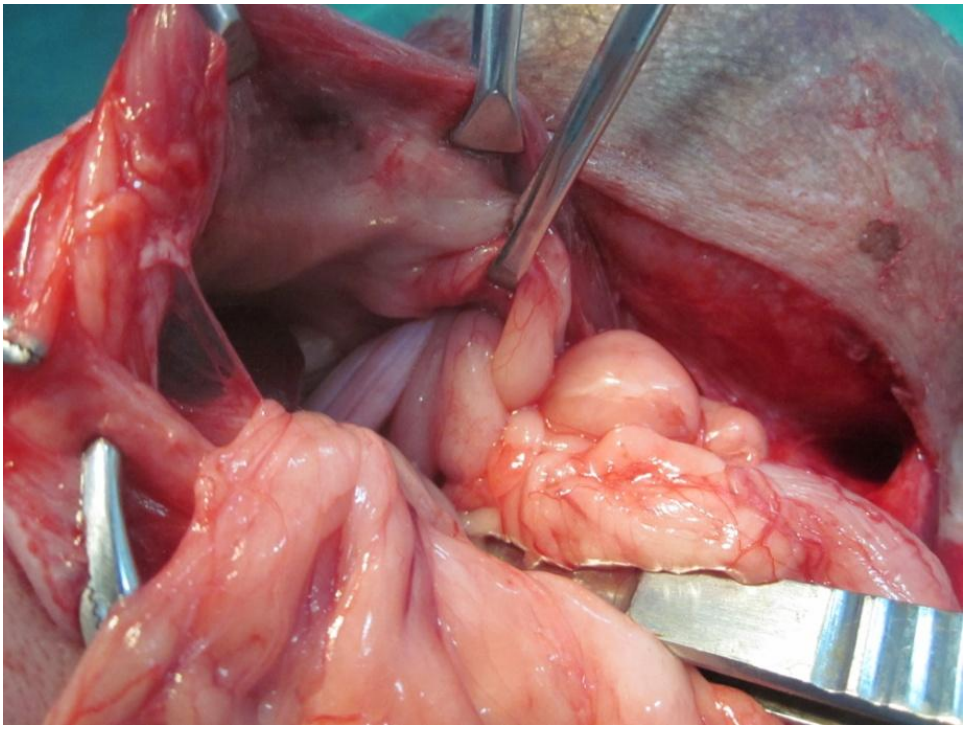


Plate 18. Group A: Location of the internal inguinal ring with the hernial contents.

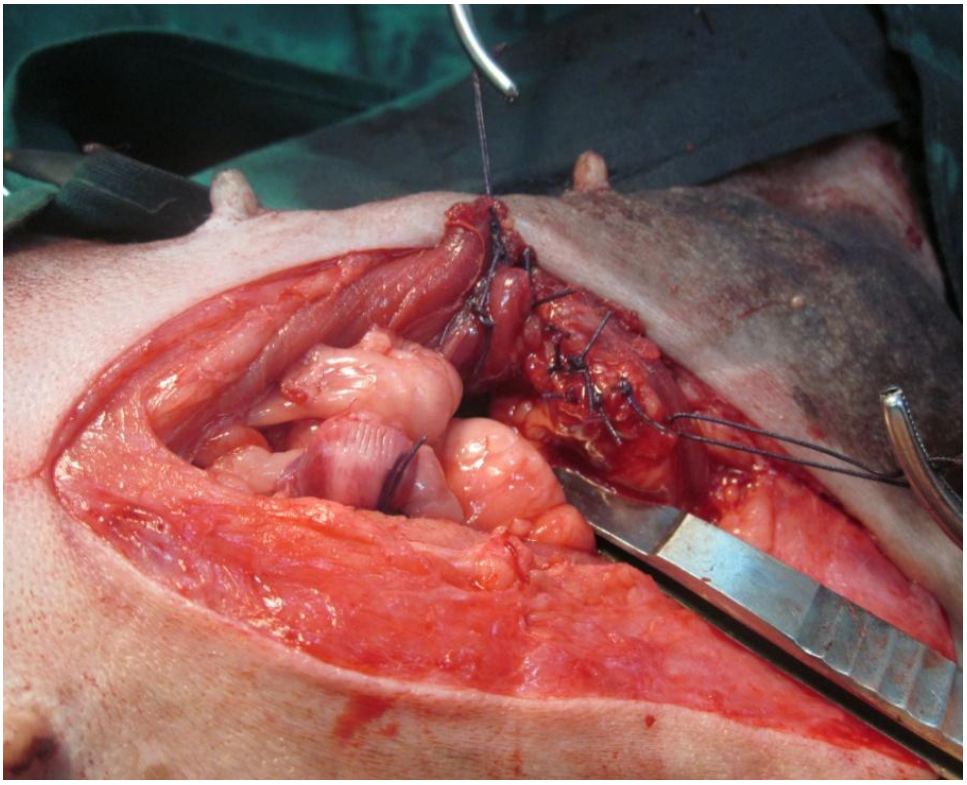


Plate 19. Group A: Closure of internal inguinal ring

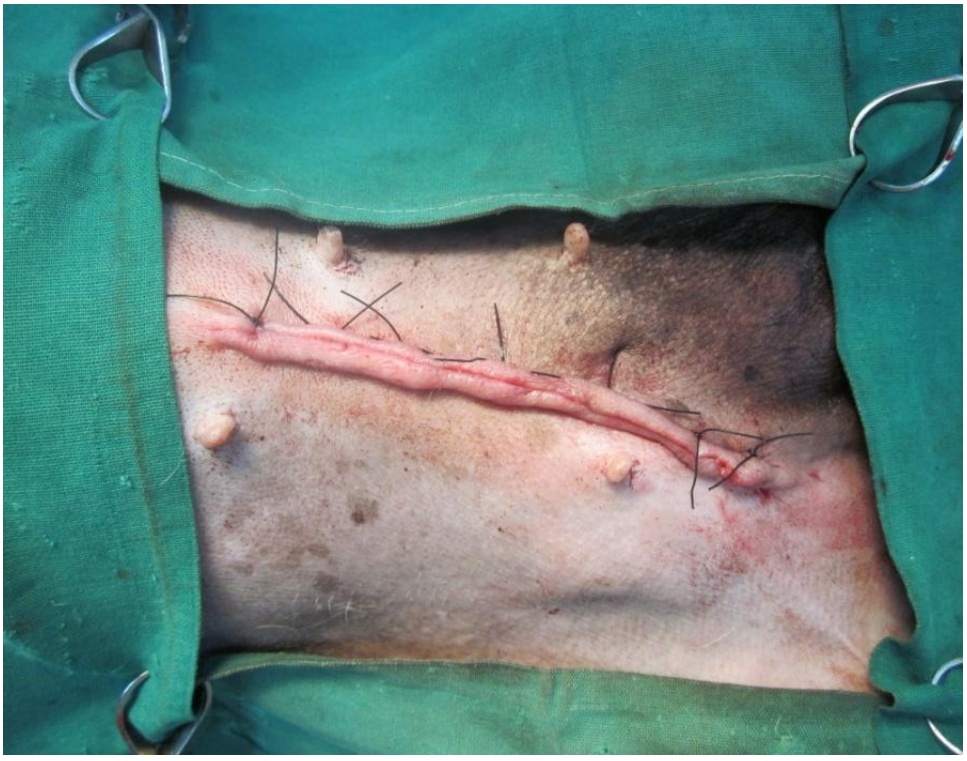


Plate 20. Group A: Closure of Skin incision

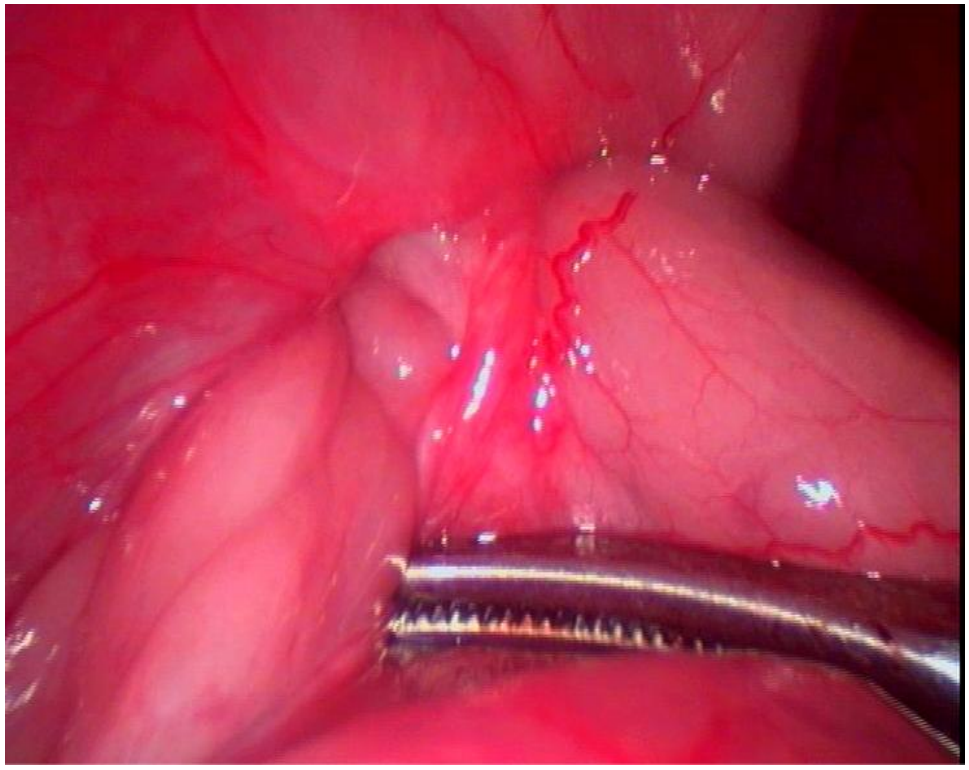


Plate 21. Group B: Location of the internal inguinal ring with the hernial contents.

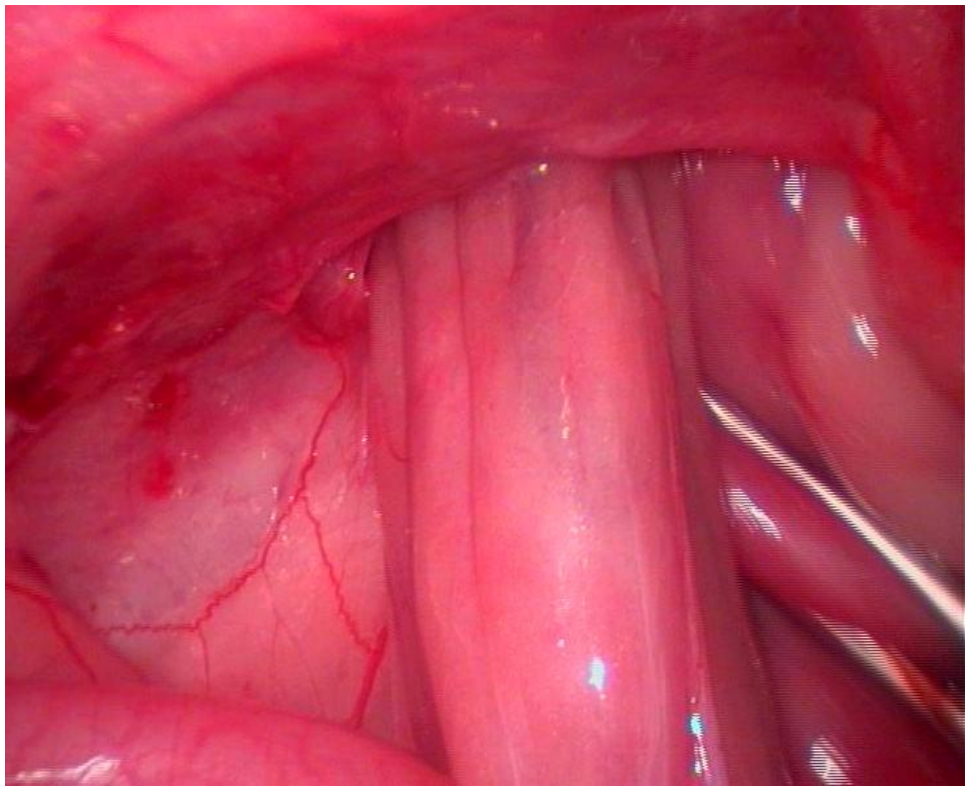


Plate 22. Group B: Reduction of hernial contents.

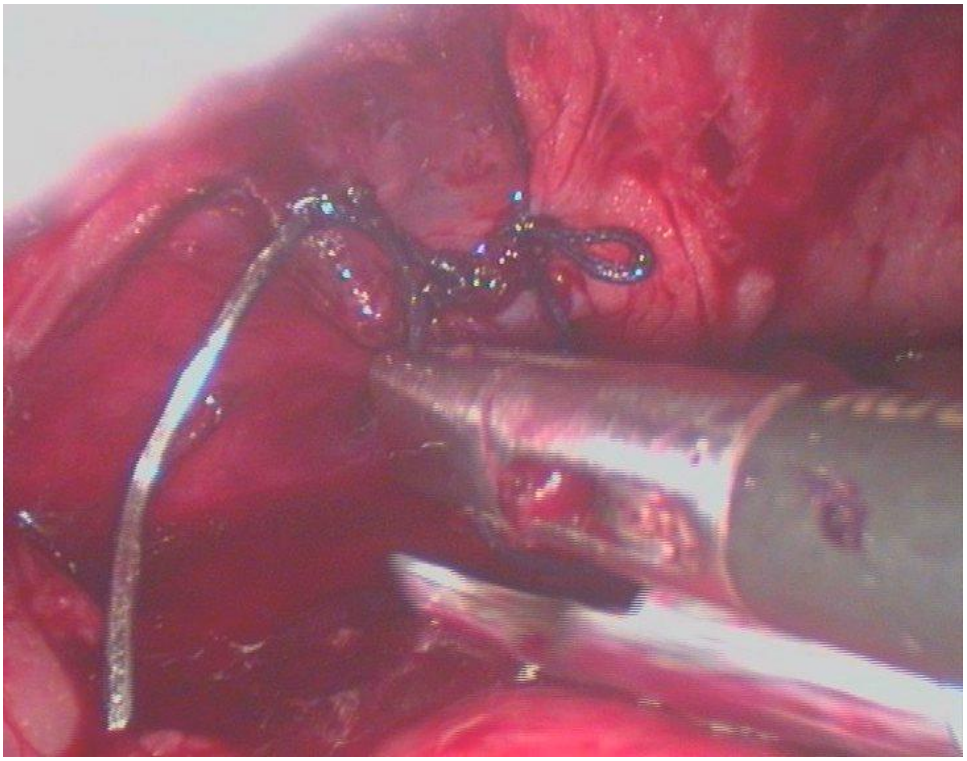


Plate 23. Group B: Suturing of the internal inguinal ring

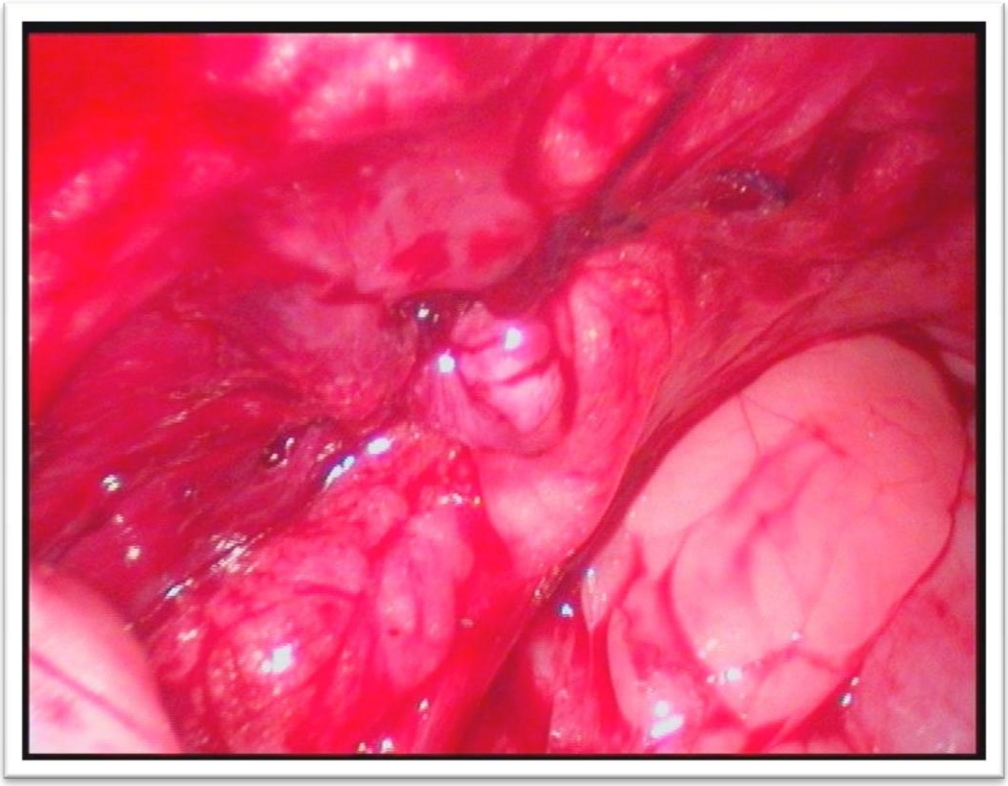


Plate 24. Group B: Suturing of the internal inguinal ring (on completion)

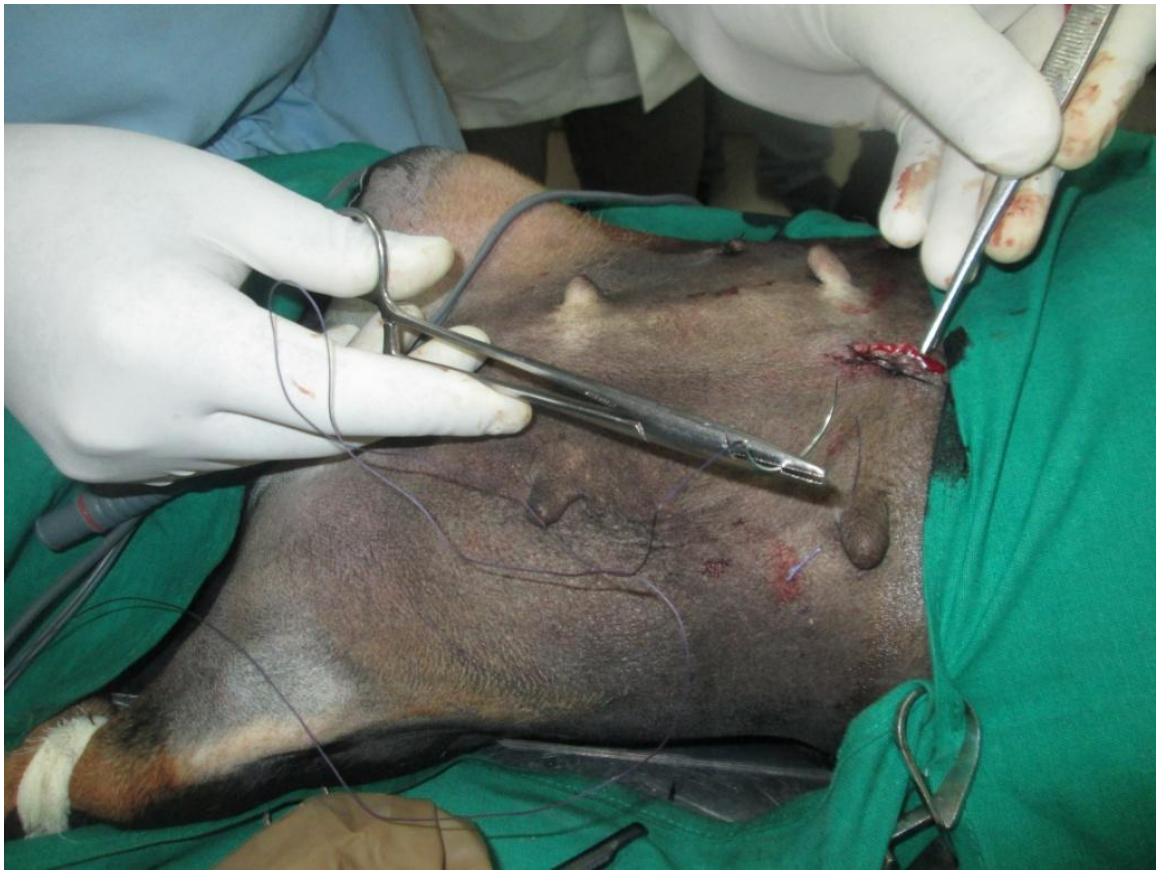


Plate 25. Group B: Closure of portal sites

3.5 Parameters studied

3.5.1 Clinical Parameters

Rectal temperature (°F), heart rate (per min) and respiratory rate (per min) were recorded before surgery and 24, 48, 72 hours, 7th day and 14th day after surgery in all the dogs of both groups.

3.5.2 Haematological Parameters

Haemoglobin (g%), total erythrocyte count (millions/cmm), total leukocyte count (thousands/cmm) and differential leukocyte count (%) were estimated by standard methods (Benjamin, 1998) by collecting 2ml of blood from cephalic vein in EDTA vial before surgery and 24, 48, 72 hours, 7th day and 14th day after surgery. All the above mentioned haematological parameters were analysed on the same day of collection.

3.5.3 Biochemical parameters

Blood samples were collected and serum was separated before surgery and 24, 48, 72 hours, 7th day and 14th day after surgery, for estimation of serum alanine aminotransferase (ALT, IU/L), serum aspartate aminotransferase (AST, IU/L) and serum creatinine (mg/dL) by standard method (Henry, 1979), using ARTOS biochemical analyzer (M/s. Swemed diagnostic, Bangalore) using respective diagnostic kits as per the manufacturer's instruction.

3.6 Post-operative pain assessment

Post-operative pain was evaluated at 24, 48, 72 hours, 7th day and 14th day after surgery. It was measured based on University of Melbourne Pain Scale (Firth and Haldane, 1999).

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

Table 1: Pain Scale parameters (University of Melbourne)

Category	Score
1. Physiological data	
a) Within reference range	0
b) Percentage increase in heart rate than pre-procedural rate	
>20%	1
>50%	2
>100%	3
c) Percentage increase in respiratory rate than pre-procedural rate	
>20%	1
>50%	2
>100%	3
2. Response to palpation	
No change	0
Guards when touched	2
Guards before touched	3
3. Activity	
Sleeping / semiconscious / eating	0
Awake	1
Restless	2
4. Mental status	
Submissive	0
Overtly friendly	1
Wary	2
Aggressive	3
5. Posture	
Lateral recumbancy	0
Sternal recumbancy / sitting	1
Abnormal posture / guarding protected area	2
6. Vocalization	
Not vocalizing	0
Vocalizing when touched	2
Continuous vocalization	3

Results

IV. RESULTS

The present study was undertaken in twelve female dogs presented to Department of Veterinary Surgery and Radiology, Veterinary College Hospital, KVAFSU, Hebbal, Bangalore, with inguinal hernia and the results of the study are presented under the following headings.

4.1 Occurrence of hernia in dogs (Fig. 1)

Totally 8201 dogs were presented to the Department of Veterinary Surgery and Radiology, Veterinary College Hospital, KVAFSU, Hebbal, Bangalore during May 2012 to April 2013. Of these, 56 (0.68 %) cases were with different types of hernia. Of this 20 were found to be with inguinal hernia. By and large, this amounted to an overall incidence of inguinal hernia at 0.25 % of 8201 cases presented to Department of Surgery and Radiology, Veterinary College Hospital.

Among these 56 dogs, 20 (35.72 %) presented with inguinal hernia (Fig. 1). Out of 20 cases of inguinal hernia, 15 were female dogs and rest were male dogs. For the present study twelve otherwise healthy dogs with normal hematobiochemical values were selected so as to maintain the uniformity in the study groups. The selected 12 dogs were randomly placed into two separate groups *viz;* Group A (Conventional inguinal herniorrhaphy) and Group B (Laparoscopic inguinal herniorrhaphy).

Table: 2. Breed wise occurrence of different types of hernia

(N=56)

BREED	PERINEAL HERNIA		UMBILICAL HERNIA		INGUNIAL HERNIA		DIAPHRAGMATIC HERNIA		VENTRAL HERNIA	
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE
POMERANIAN	5	_	_	_	1	4	1	_	_	_
LABRADOR RETRIEVER	_	_	_	_	1	2	_	_	_	_
GERMAN SHEPHERD	3	_	1	1	1	1	_	_	1	_
IRISH SETTER	_	_	_	_	_	_	_	_	_	1
NON DISCRIPT	1	1	_	_	1	3	_	_	_	_
SHIH TZU	_	_	_	1	_	_	_	_	_	_
LHASA APSO	1	_	_	1	_	_	_	_	_	_
DACHSHUND	1	_	_	_	1	2	1	_	_	_
GREAT DANE	_	1	_	_	_	_	_	_	_	_
BOXER	3	_	_	_	_	_	_	_	_	_
CROSS BREED	2	_	_	_	_	3	_	_	_	_
DOBERMAN	2	1	_	_	_	_	_	_	_	_
PUG	_	_	2	_	_	_	1	_	_	_
ROTTWEILER	4	_	_	_	_	_	_	_	_	_
TOTAL	**22**	**3**	**3**	**3**	**5**	**15**	**3**	**_**	**1**	**1**

Fig. 1. Occurrence of inguinal hernia among different types of hernia in dogs.

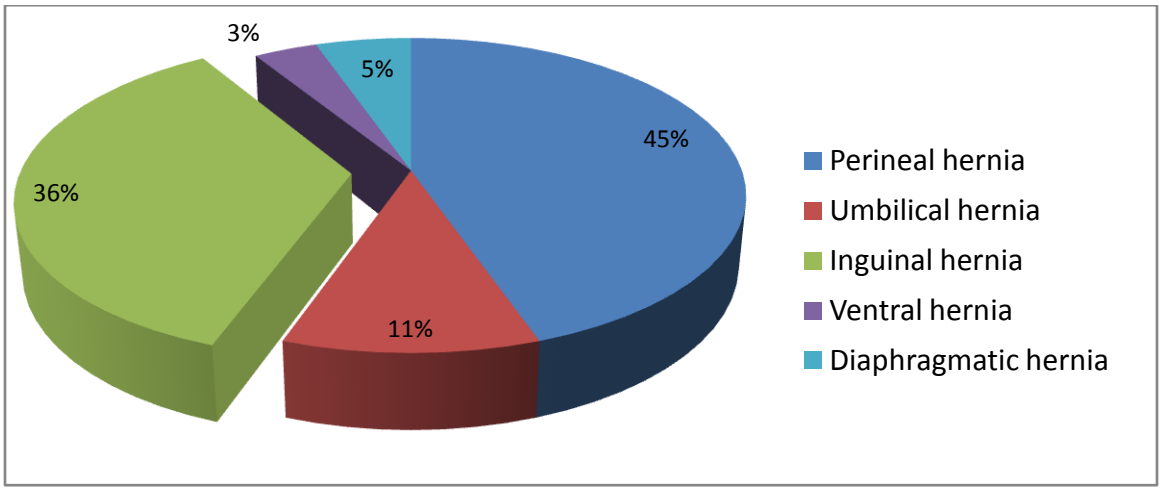


Fig. 2. Sex wise occurrence of inguinal hernia in dogs.

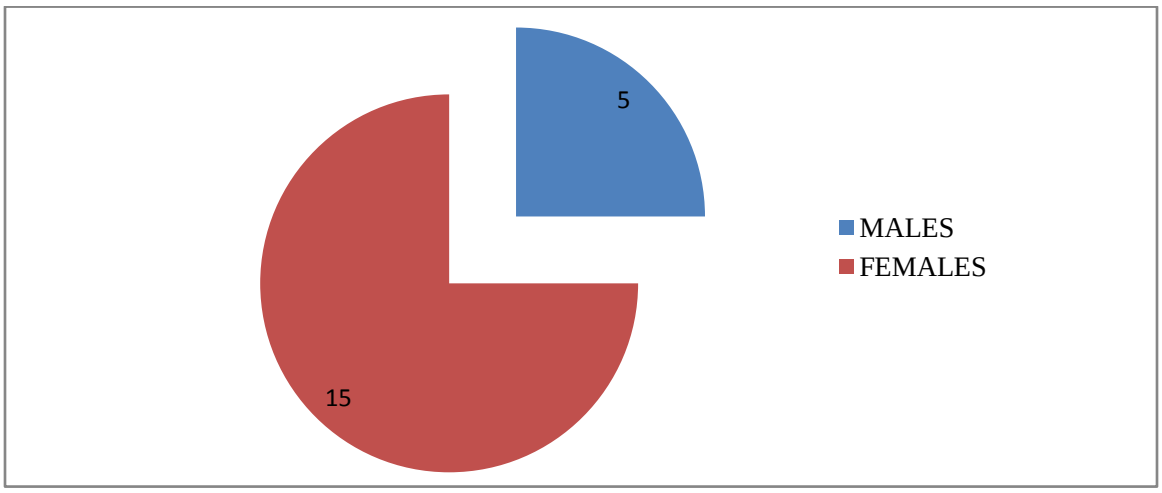
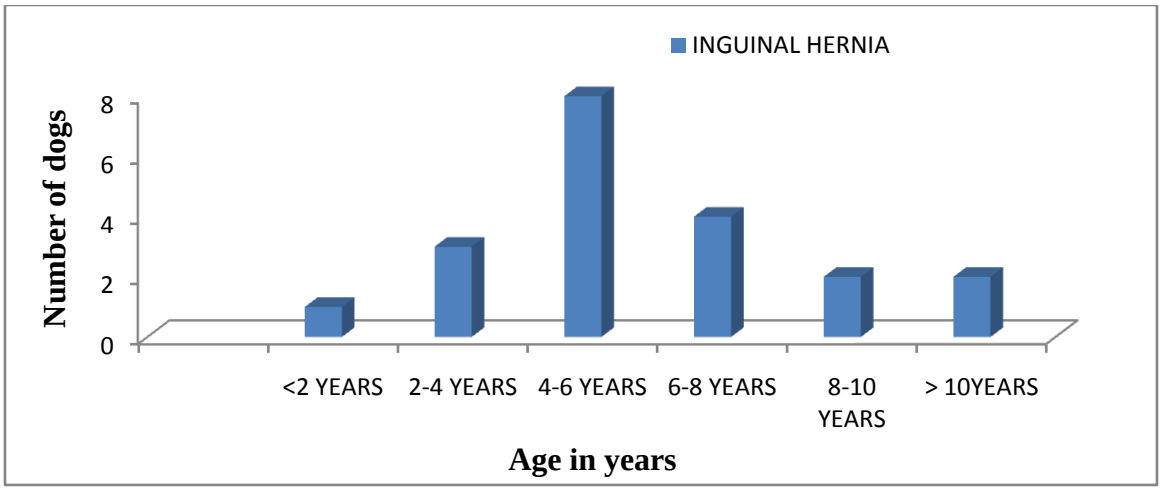


Fig. 3. Age wise occurrence of inguinal hernia in dogs.



4.2 Selection, preparation and positioning of dogs

As aforementioned, twelve female dogs presented with inguinal hernia and with normal hematobiochemical values were selected for the present study. All the dogs were subjected to clinical examination to assess their fitness for surgery.

Restriction of solid diet for 12 hours and water intake for four hours before surgery was followed in all the 12 dogs. Administration of soap water enema two hours prior to surgery and catheterization of urinary bladder just prior to anaesthetic administration facilitated good visualization of inguinal area and easy manipulation of visceral organs for herniorrhaphy. This avoided injury or punctures of intestine and bladder during laparoscopic surgery and prevents urination and defecation during administration of anaesthesia or during surgery.

4.3 Sterilization of instruments

All general surgical instruments used were sterilized by autoclaving at 121° C at 15 lbs psi for 15 minutes. The laparoscopic instruments were cleaned with 10 per cent ethyl alcohol and kept in closed formalin chamber with formaldehyde tablets for a period of 24 hours and wiped dry with sterile gauze. This was adequate to prevent local and systemic infection.

4.4 Premedication and anaesthesia

Premedication was done with atropine sulphate @ 0.04 mg/kg body weight sub-cutaneously and diazepam @ 0.5 mg/kg body weight intravenously. After 20 minutes, general anaesthesia was induced and maintained with isoflurane. Administration of

atropine sulphate reduced salivary secretion. Pre-anaesthesia with diazepam provided good sedation and muscle relaxation. Induction of anaesthesia was smooth and uneventful. No intra-operative anaesthetic complications were noticed in any of the cases. All the dogs recovered smoothly from the anaesthesia. The anaesthetic protocol followed was satisfactory for the surgical intervention.

4.5 Intra-abdominal pressure (Group B)

The intra-abdominal pressure of 12 - 14 mmHg was used for insufflations of intra-abdominal cavity in all dogs (weighing 12-20 kg body weight). This provided better visualization of abdominal organs and easy manipulation of laparoscopic instruments inside the abdominal cavity.

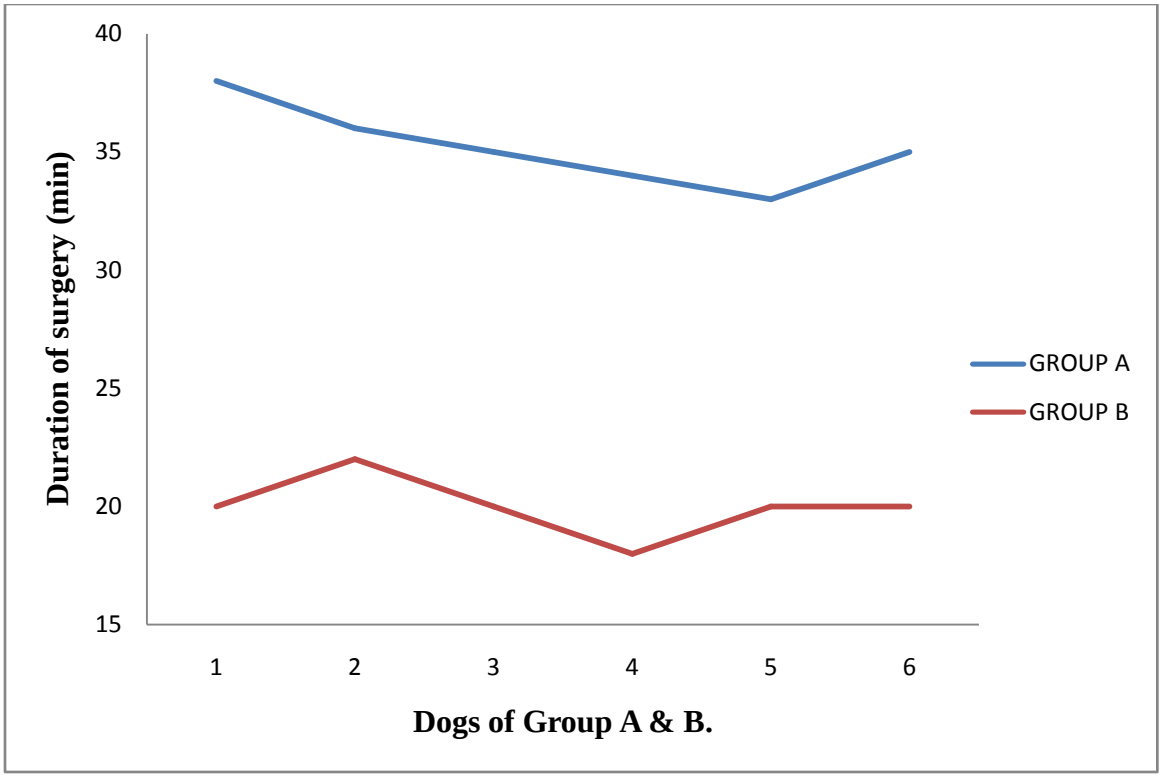
4.6 Surgical site

Internal inguinal ring was easily accessible from caudal midline laparotomy in all the dogs of Group A. Three portal sites (one median port 10 mm and two paramedian ports of 5 mm) were adequate to access internal inguinal ring in all the dogs of Group B.

4.7 Duration of procedure

The mean ± SE time (minutes) taken for surgical procedure (from skin incision to skin suturing) in Group A and Group B dogs were 35 ± 1.93 and 20 ± 0.41 respectively. There was a statistically significant ($p < 0.05$) difference in duration of surgical procedure between Group A and Group B (Fig 4).

Fig 4: Duration of surgical procedure (min) in dogs of Group A and B.



4.8 Intra-operative complication

There were no surgical complications in any of the dogs of either group.

4.9 Post-operative care and observation

Post-operatively ceftriaxone sodium was administered @ 20 mg/kg body weight, twice daily to all dogs for five days along with regular wound dressing with povidone iodine. The cutaneous wound healed within ten and seven days for Group A and B dogs respectively. Dogs of both groups recovered uneventfully.

4.10 PARAMETERS

4.10.1 Clinical evaluation

4.10.1.1 Rectal temperature (°F)

In Group A, pre-operative rectal temperature (mean ± SE) was 100.65±0.32 °F and post-operatively temperature ranged from 100.63±0.28 to 103.02±0.29 °F.

In Group B, the mean ± SE value of pre-operative rectal temperature was 100.65±0.47 °F and post-operatively it ranged from 100.85±0.44 to 102.80±0.08 °F (Table 3, Fig. 5).

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

4.10.1.2 Respiratory rate (breaths per min)

In Group A, pre-operative respiratory rate (mean ± SE) was 18.00±0.89 breaths per min. Post-operatively it ranged from 17.67±0.82 to 24.67±0.82 breaths per min and the values were within the normal range.

In Group B, the mean ± SE value of the pre-operative respiratory rate was 17.67±0.82 breaths per min and post-operatively it ranged from 17.83±0.75 to 23.33±1.75 breaths per min and the values were in the normal range (Table 3, Fig. 6).

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

4.10.1.3 Heart rate (beats per min)

In Group A, pre-operative heart rate (mean ± SE) was 99.17±1.60 beats per min. Post-operatively it ranged from 99.83±1.17 to 105.83±3.69 beats per min and the values were within the normal range.

In Group B, the mean ± SE value of the pre-operative heart rate was 99.17±0.98 beats per min and post-operatively it ranged from 99.50±1.76 to 104.17±2.04 beats per min and the values were in the normal range (Table 3, Fig. 7).

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

Table: 3. Mean ± SE values of rectal temperature, respiratory rate and heart rate in dogs of Group A and B.

TIME INTERVAL	TEMPERATURE (°F)		RESPIRATORY RATE (per min)		HEART RATE (beats/per min)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	100.65±0.32	100.65±0.47	18.00±0.89	17.67±0.82	99.17±1.60	99.17±0.98
24 H	103.02±0.29	102.80±0.08	24.67±0.82	23.33±1.75	105.00±3.69	104.17±2.04
48 H	102.07±0.28	101.83±0.10	23.83±1.33	20.33±1.03	104.17±3.37	101.50±1.52
72 H	101.33±0.19	101.20±0.25	22.33±2.07	19.17±0.98	102.50±1.64	100.33±1.86
7^{th} Day	101.07±0.20	100.92±0.36	21.50±1.22	18.33±0.82	100.67±0.82	99.50±1.76
14^{th} Day	100.63±0.28	100.85±0.44	17.67±0.82	17.83±0.75	99.83±1.17	99.50±1.76

Fig 5: Mean ± SE values of rectal temperature (˚F) in dogs of Group A and B.

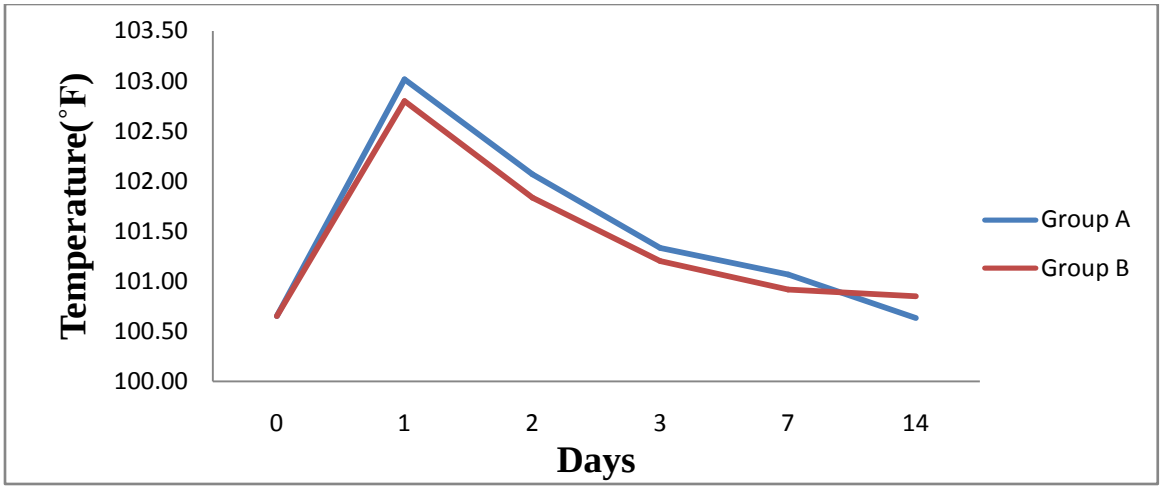


Fig 6: Mean ± SE values of respiratory rate (per min) in dogs of Group A and B.

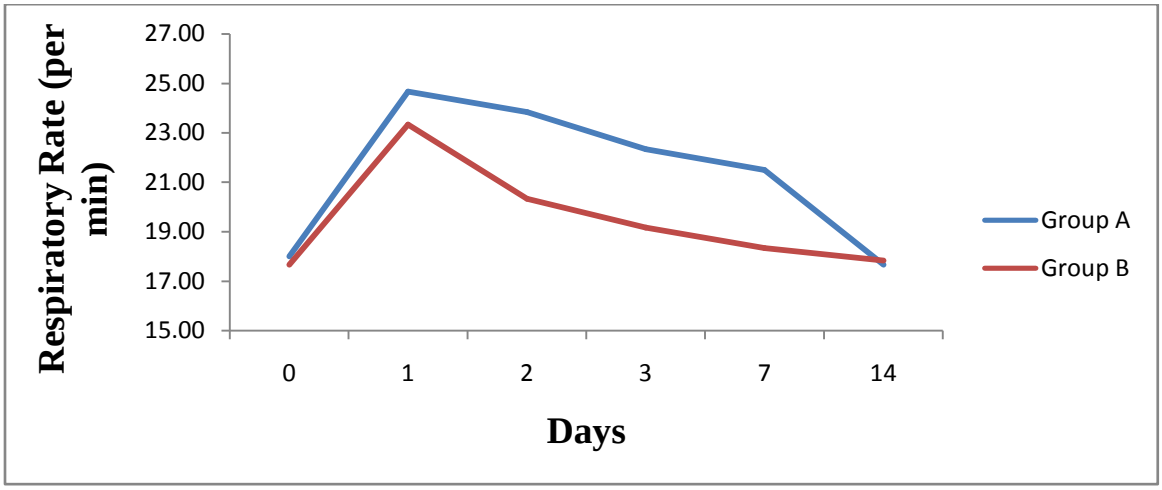
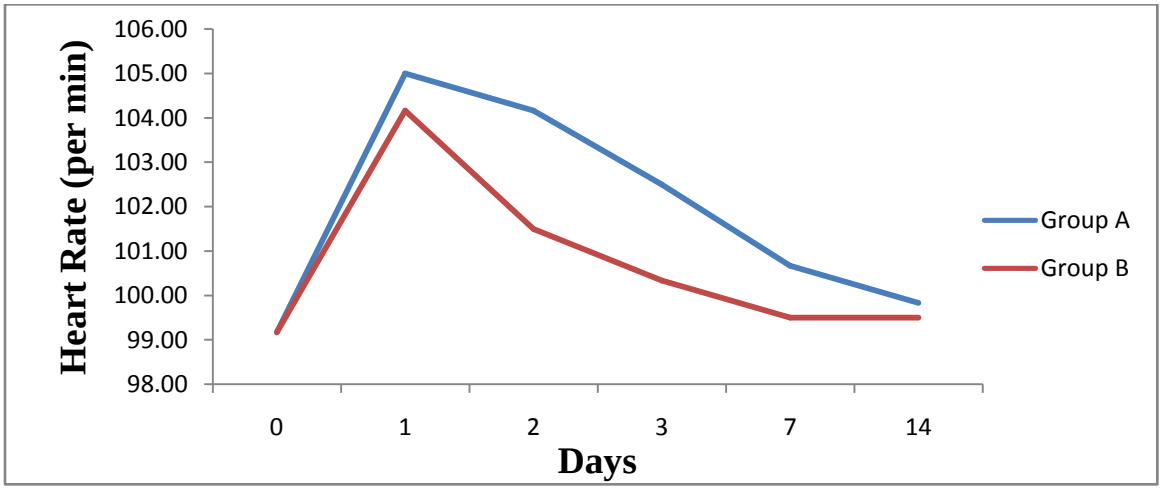


Fig 7: Mean ± SE values of heart rate (beats/per min) in dogs of Group A and B.



4.10.2 Haematological parameters

4.10.2.1 Haemoglobin (g %)

In Group A, the mean ± SE value of pre-operative haemoglobin level was 13.92±0.73 g % and post-operatively it ranged from 12.68±1.39 to 13.48±1.18 g %. However the values were within the normal range.

In Group B, the mean ± SE value of pre-operative haemoglobin level was 14.50±1.05 g % and post-operatively it ranged from 12.50±1.05 to 14.50±1.05 g %. However the values were within the normal range (Table 4, Fig. 8). The variations in the mean ± SE values of haemoglobin within the groups and between the groups were statistically non-significant ($p > 0.05$).

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

In Group A, the mean ± SE value of pre-operative total erythrocyte count was 7.32±0.36 (10^6 Cells/mm^3) and post-operatively it ranged from 6.75±0.16 to 7.07±0.57 (10^6 Cells/mm^3). However the values were within the normal range.

In Group B, the mean ± SE value of pre-operative total erythrocyte count was 7.22±0.39 (10^6 Cells/mm^3) and post-operatively it ranged from 7.00±0.33 to 7.20±0.43 (10^6 Cells/mm^3). However the values were within the normal range (Table 4, Fig 9).

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

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

In Group A, the mean ± SE value of pre-operative total leukocyte count was 10.75±0.76 (10^3 Cells/mm^3) and post-operatively it ranged from 11.08±1.16 to 14.00±0.55 (10^3 Cells/mm^3), however the values were within the normal range.

In Group B, the mean ± SE value of pre-operative total leukocyte count was 11.08±0.80 (10^3 Cells/mm^3) and post-operatively it ranged from 10.83±0.52 to 13.25±0.52 (10^3 Cells/ mm^3), however the values were within the normal range (Table 4, Fig 10).

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

4.10.2.4 Differential leukocyte count

4.10.2.4.1 Neutrophil (%)

In Group A, the pre-operative percentage value of neutrophils count was 70.67±0.82 % (mean ± SE). The Mean ± SE values of neutrophil per cent post-operatively varied from 72.33±1.97 to 79.83 ± 1.94 % and the values were within the normal range.

In Group B, the pre-operative mean ± SE value of neutrophils percentage was 71.33±4.08 %. Post-operatively the mean ± SE values of neutrophil percentage varied from 72.67±3.44 to 77.33±2.34 % (Table 5, Fig.11).

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

Table 4. Mean ± SE values of haemoglobin, total erythrocyte count and total leukocyte count in dogs of Group A and B

TIME INTERVAL	HAEMOGLOBIN (g %)		TOTAL ERYTHROCYTE COUNT (10^6 Cells/mm^3)		TOTAL LEUKOCYTE COUNT (10^3 Cells/mm^3)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	13.92±0.73	14.50±1.05	7.32±0.36	7.22±0.39	10.75±0.76	11.08±0.80
24 H	12.68±1.39	12.50±1.05	6.75±0.16	7.00±0.33	14.00±0.55	13.00±0.32
48 H	13.10±0.88	13.17±0.75	6.93±0.52	7.12±0.42	12.92±0.86	13.25±0.52
72 H	13.35±0.82	14.00±0.63	7.07±0.57	7.20±0.43	11.83±1.03	12.42±0.58
7^{th} Day	13.35±1.04	14.50±1.05	6.98±0.33	7.18±0.35	11.25±0.88	11.58±0.38
14^{th} Day	13.48±1.18	14.50±1.05	7.00±0.33	7.17±0.29	11.08±1.16	10.83±0.52

Fig 8: Mean ± SE values of haemoglobin (g%) in dogs of Group A and B.

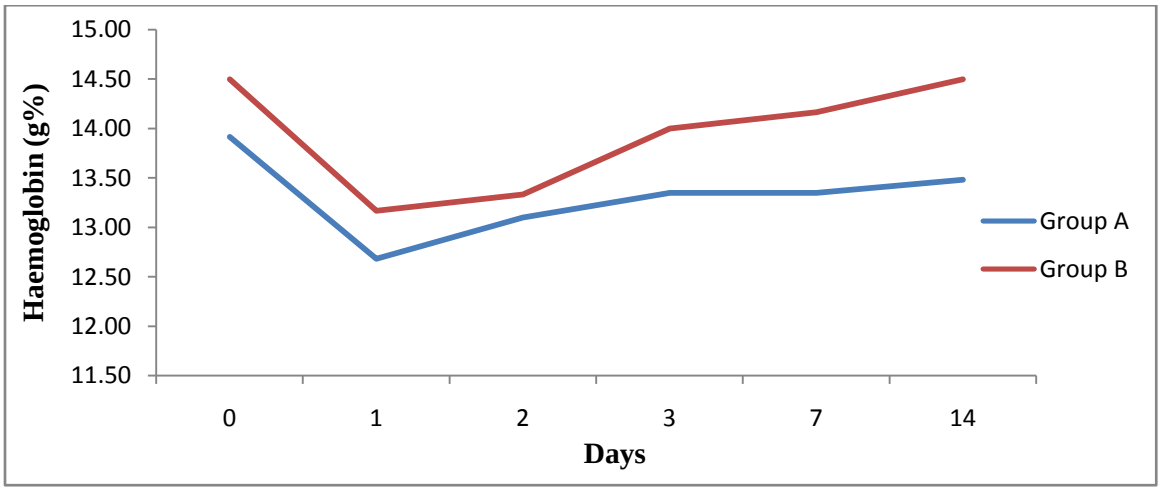


Fig 9: Mean ± SE values of total erythrocyte count (x 10^6/ mm^3) in dogs of Group A and B

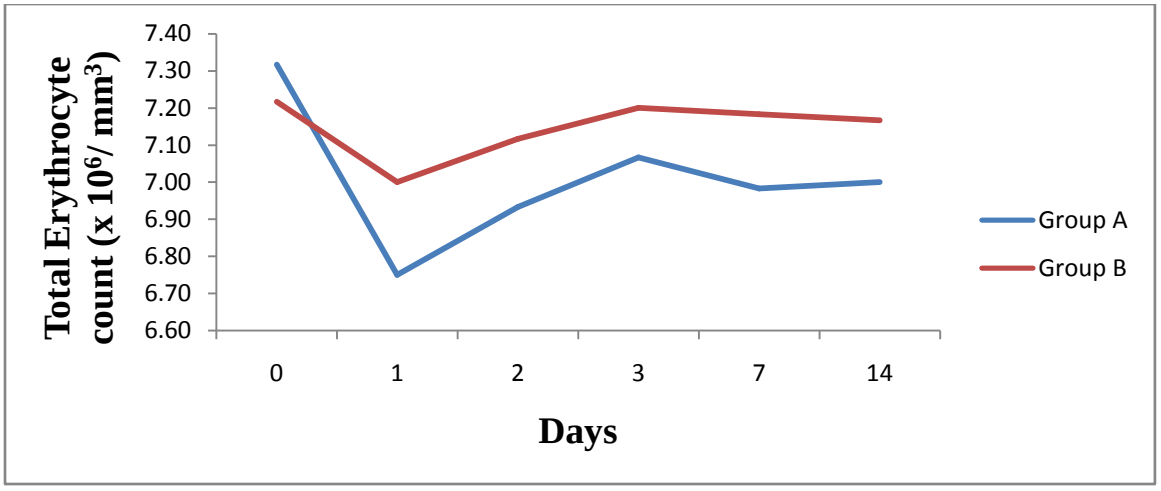
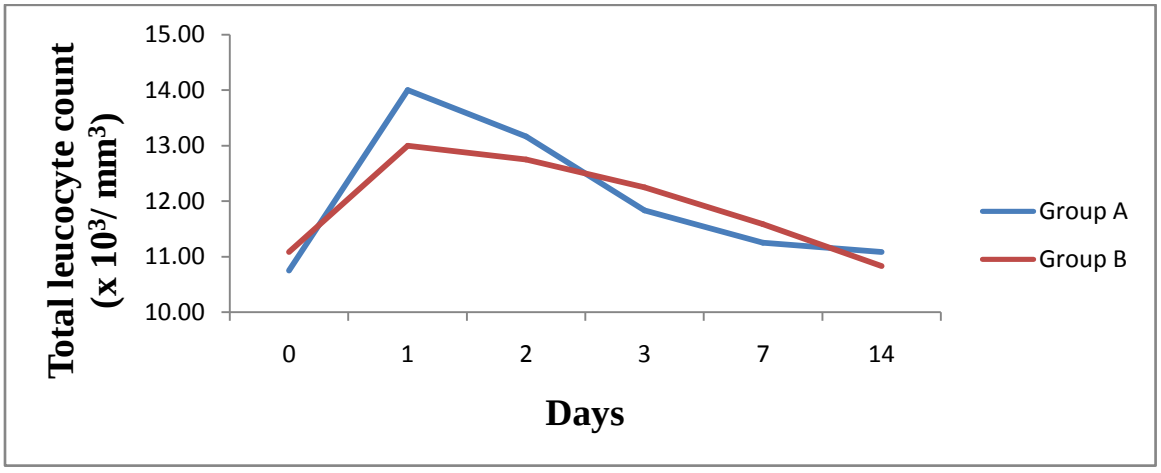


Fig 10: Mean ± SE values of total leucocyte count (x 10^3/ mm^3) in dogs of Group A and B



4.10.2.4.2 Lymphocyte (%)

In Group A, the pre-operative percentage value of lymphocyte count was 25.00±1.91 % (Mean ± SE). The mean values of lymphocyte percentage post-operatively ranged from 17.67±1.70 to 25.00±1.91 % and the values were within the normal range.

In Group B, the pre-operative mean ± SE value of lymphocyte per cent was 25.00±1.91 %. Post-operatively the mean ± SE values of lymphocyte percentage ranged from 20.17±1.46 to 25.00±1.91 % (Table 5, Fig. 12).

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

4.10.2.4.3 Eosinophil (%)

In Group A, the pre-operative percentage value of eosinophil count was 0.83±0.75 % (mean ± SE). The mean values of eosinophil percentage post-operatively ranged from 0.17±0.41 to 0.67±0.52 % and the values were within the normal range.

In Group B, the pre-operative mean ± SE value of eosinophil percentage was 0.83±0.41 %. Post-operatively the mean ± SE values of eosinophil per cent ranged from 0.50±0.55 % to 0.83±0.41 (Table 5, Fig. 13).

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

4.10.2.4.4 Monocyte (%)

In Group A, the pre-operative percentage value of monocyte count was 2.00±1.55 % (mean ± SE). The mean ± SE values of monocyte percentage post-operatively ranged from 1.00±1.55 to 1.33±1.86 % and the variations were within the normal range.

In Group B, the pre operative mean ± SE value of monocyte percentage was 1.67±0.82 %. Post-operatively the mean values of monocyte percentage ranged from 0.67±0.82 to 1.17±0.98 %. (Table 6, Fig. 14)

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

4.10.2.4.5 Basophil (%)

Basophils were not observed in any of the blood smears.

4.10.3 Biochemical parameters

4.10.3.1 Serum alanine aminotransferase (ALT) (IU/L)

In Group A, the mean ± SE value of pre-operative serum alanine aminotransferase level was 32.57±2.08 IU/L. The mean ± SE values of post-operative serum alanine aminotransferase ranged from 32.50±2.17 to 36.33±2.07 IU/L and the values were within the normal range.

In Group B, the mean ± SE value of pre-operative serum alanine aminotransferase level was 32.33±1.21 IU/L and post-operatively the mean ± SE serum

Table 5. Mean ± SE values of neutrophil, lymphocyte and eosinophil in dogs of Group A and B.

TIME INTERVAL	NEUTROPHIL (%)		LYMPHOCYTE (%)		EOSINOPHIL (%)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	70.67±0.82	71.33±4.08	25.00±1.91	25.00±1.91	0.83±0.75	0.83±0.41
24 H	79.83±1.94	77.33±2.34	17.67±1.70	20.17±1.46	0.67±0.52	0.83±0.41
48 H	77.17±2.40	76.00±2.28	20.67±2.56	21.00±1.83	0.50±0.55	0.67±0.52
72 H	75.00±1.41	75.00±2.76	22.50±2.36	22.50±2.36	0.50±0.55	0.50±0.55
7^{th} Day	73.50±1.52	73.17±3.31	24.00±2.31	24.00±2.31	0.50±0.55	0.67±0.52
14^{th} Day	72.33±1.97	72.67±3.44	25.00±1.91	25.00±1.91	0.17±0.41	0.50±0.55

TABLE 6: Mean ± SE values of monocyte and basophil in dogs of Group A and B

TIME INTERVAL	MONOCYTE (%)		BASOPHIL (%)	
	Group A	Group B	Group A	Group B
0 Day	2.00±1.55	1.67±0.82	0.00±0.00	0.00±0.00
24 H	1.17±1.47	0.83±0.41	0.00±0.00	0.00±0.00
48 H	1.00±1.10	1.17±0.98	0.00±0.00	0.00±0.00
72 H	1.17±1.94	0.67±0.82	0.00±0.00	0.00±0.00
7^{th} Day	1.33±1.86	0.67±0.52	0.00±0.00	0.00±0.00
14^{th} Day	1.00±1.55	0.83±0.98	0.00±0.00	0.00±0.00

Fig 11: Mean ± SE values of neutrophil count (%) in dogs of Group A and B

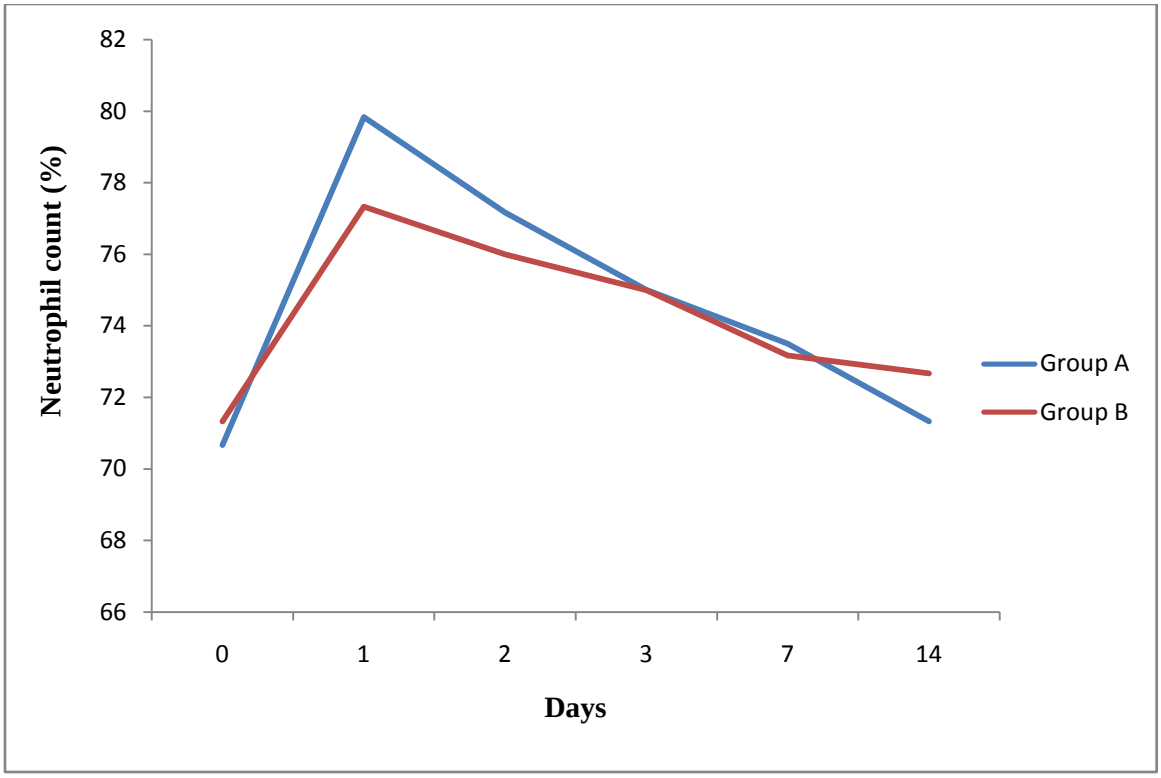


Fig 12: Mean ± SE values of lymphocyte count (%) in dogs of Group A and B

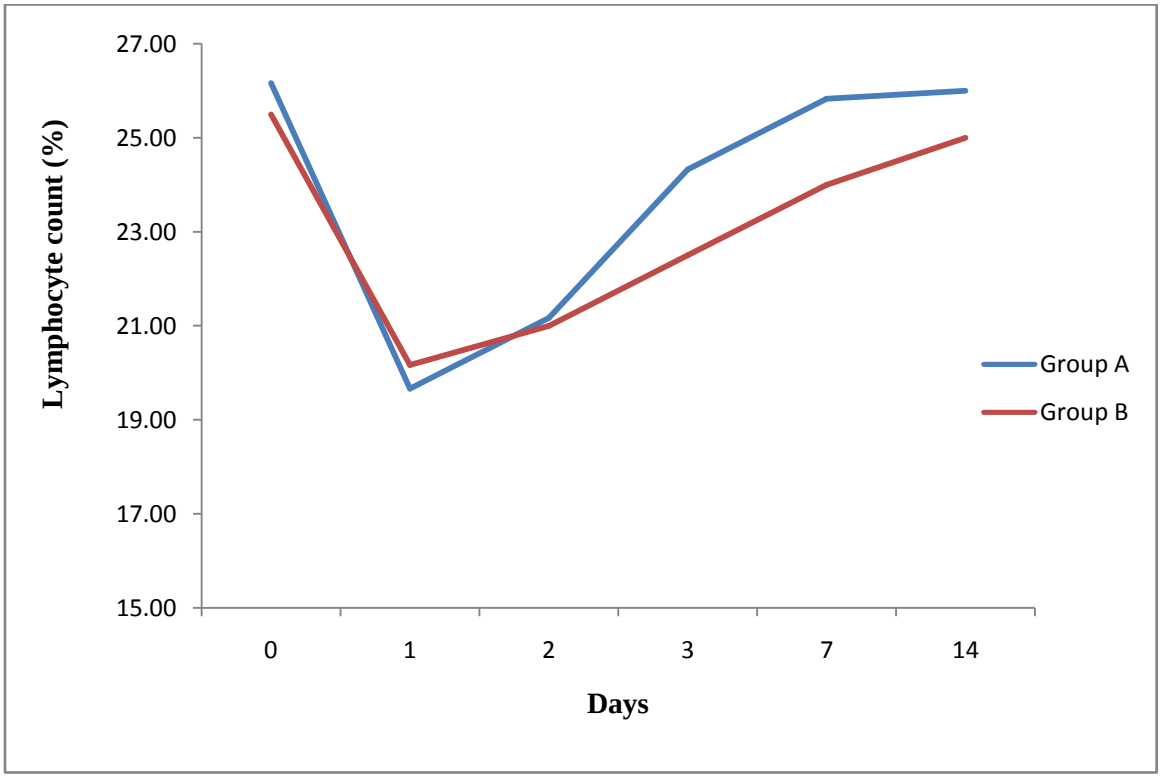


Fig 13: Mean ± SE values of eosinophil count (%) in dogs of Group A and B

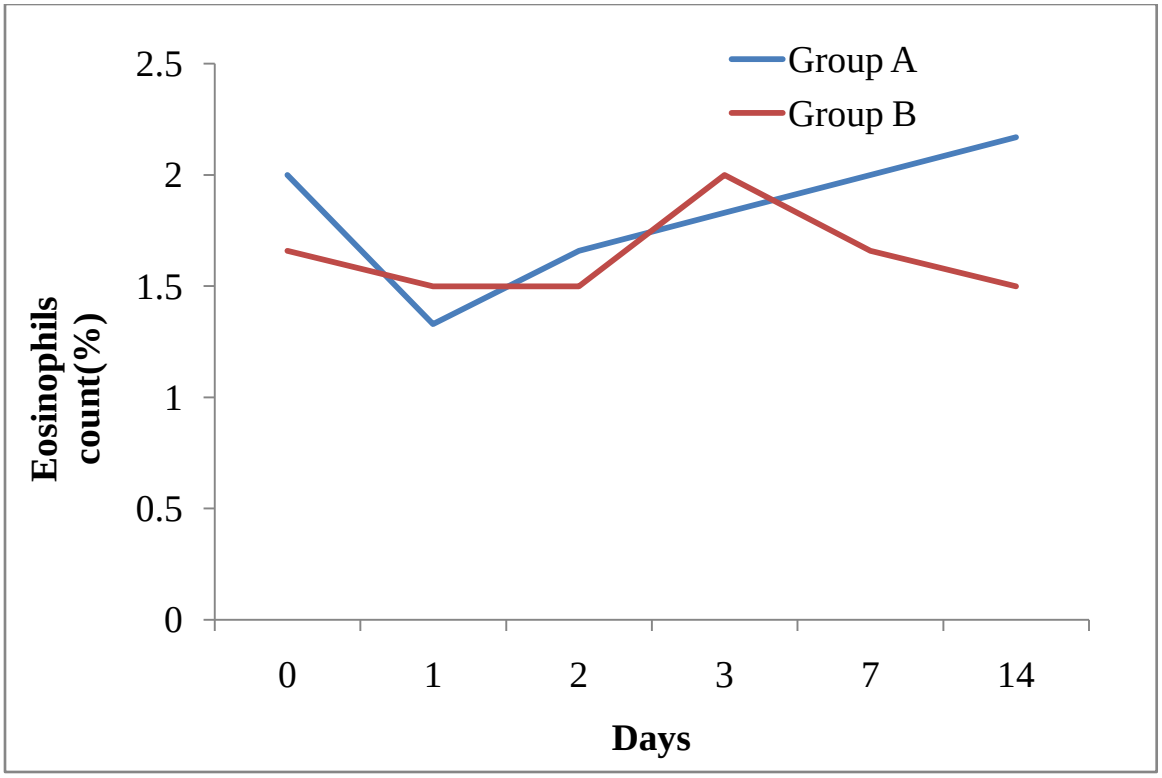
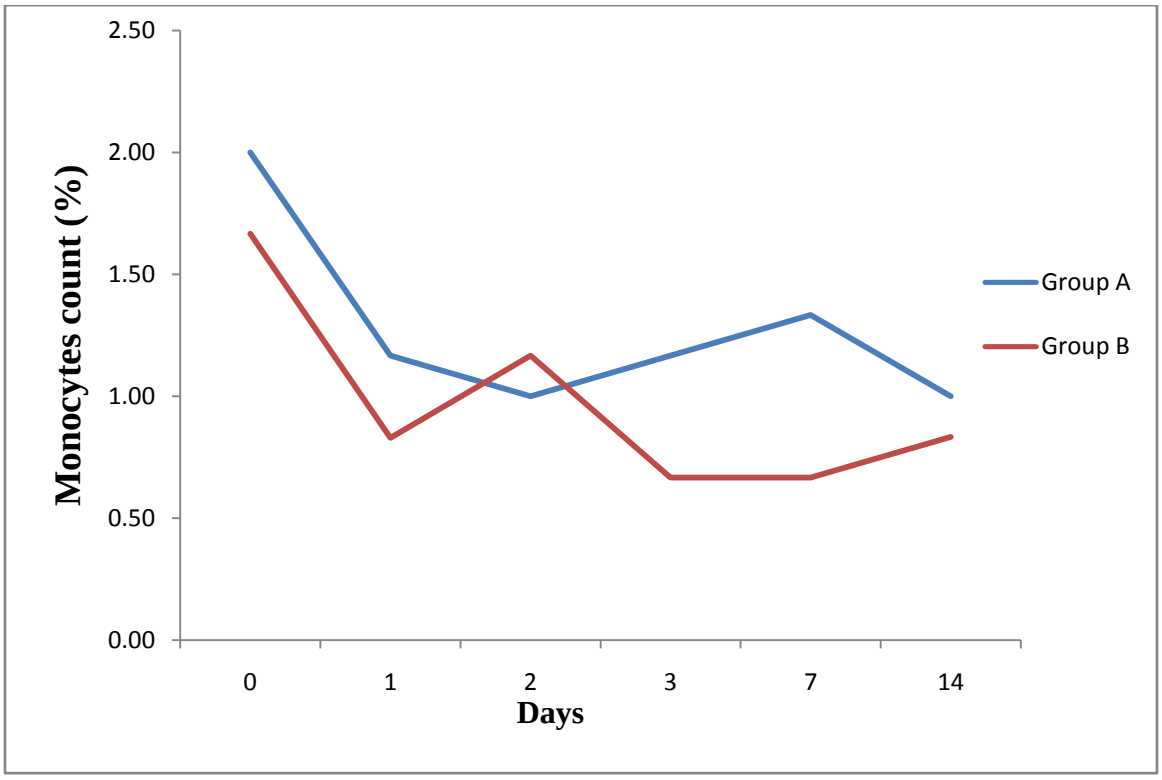


Fig 14: Mean ± SE values of monocyte count (%) in dogs of Group A and B



alanine aminotransferase level ranged from 31.83±1.17 to 34.17±1.60 IU/L (Table 7, Fig. 15).

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

4.10.3.2 Serum aspartate aminotransferase (AST) (IU/L)

In Group A, the mean ± SE value of pre-operative serum aspartate aminotransferase level was 35.33±1.63 IU/L. The mean ± SE values of post-operative serum aspartate aminotransferase ranged from 34.83±1.83 to 38.67±0.82 IU/L and the values were within the normal range.

In Group B, the mean ± SE value of pre-operative serum aspartate aminotransferase level was 33.33±1.51 IU/L and post-operatively the mean ± SE serum aspartate aminotransferase levels ranged from 33.50±1.52 to 37.67±1.63 IU/L (Table7, Fig. 16).

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

4.10.3.3 Serum creatinine (mg/dL)

In Group A, the mean ± SE value of pre-operative serum creatinine level was 0.28±0.12 mg/dL The mean ± SE values of post-operative serum creatinine ranged from 0.27 ± 0.12 to 0.43±0.12 mg/dL and the values were within the normal range.

In Group B, the mean ± SE value of pre-operative serum creatinine level was 0.23±0.10 mg/dL and post-operatively the mean serum creatinine level ranged from 0.22±0.12 to 0.42±0.17 mg/dL (Table 7, Fig. 17).

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

4.10.4 University of Melbourne Pain Score (UMPS)

Pain was evaluated and scored based on University of Melbourne pain score (UMPS). Mean±SE values of UMPS ranged from 2.00 ± 00.00 to 14.16 ± 0.88 in Group A, and mean values varied from 2.00 ± 0.00 to 5.31 ± 0.70 in Group B post-operatively (Table 8, Fig. 18). Between the groups the variations in the mean ± SE values of pain score were statistically significant ($p < 0.05$).

Table 7: Mean ± SE values of serum alanine aminotransferase, serum aspartate aminotransferase and serum creatinine in dogs of Group A and B.

TIME INTERVAL	ALANINE AMINO TRANSFERASE (IU/L)		ASPARTATE AMINO TRANSFERASE (IU/L)		CREATININE (mg/dL)	
	Group A	Group B	Group A	Group B	Group A	Group B
0 Day	32.57±2.08	32.33±1.21	35.33±1.63	33.33±1.51	0.28±0.12	0.23±0.10
4 H	36.33±2.07	34.17±1.60	38.67±0.82	37.67±1.63	0.43±0.12	0.42±0.17
48 H	33.50±2.07	32.50±1.64	36.67±1.63	35.17±0.98	0.28±0.12	0.33±0.15
72 H	32.67±1.97	32.17±1.47	35.50±2.17	34.00±2.10	0.28±0.12	0.25±0.14
7^{th} Day	32.50±2.17	32.17±1.47	34.83±1.83	33.50±2.26	0.27±0.12	0.23±0.10
14^{th} Day	32.50±2.17	31.83±1.17	35.00±1.79	33.50±1.52	0.27±0.12	0.22±0.12

Fig 15: Mean ± SE values of serum alanine aminotransferase, in dogs of Group A and B.

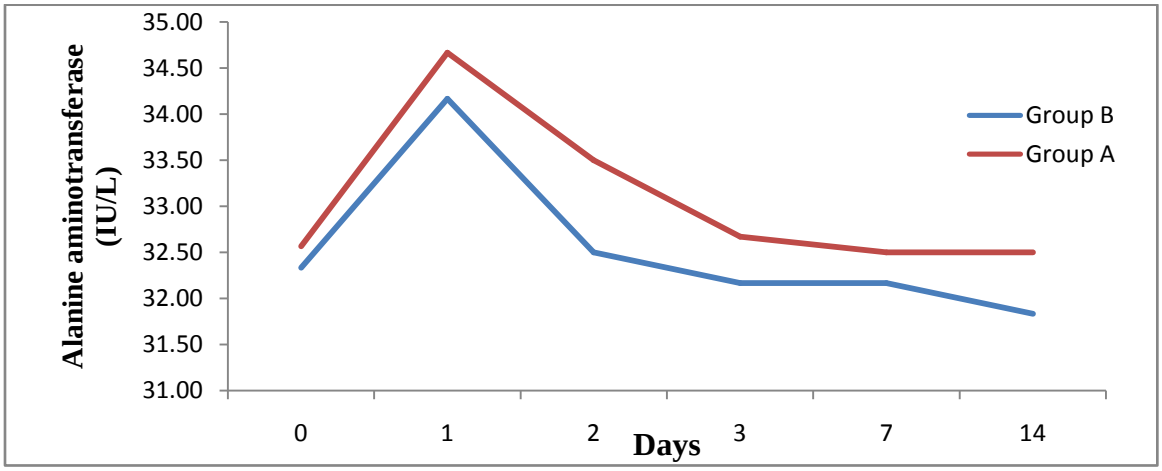


Fig 16: Mean ± SE values of serum aspartate aminotransferase in dogs of Group A and B.

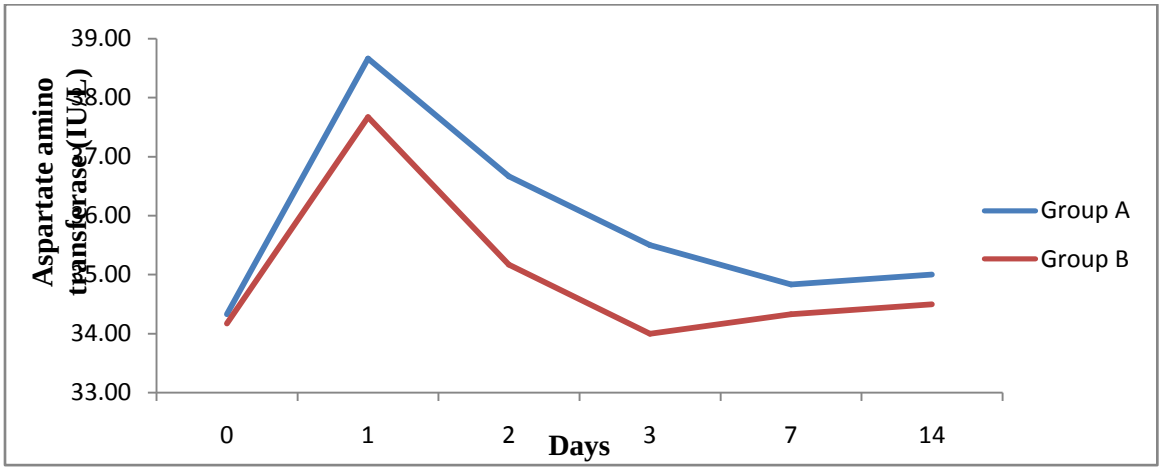


Fig 17: Mean ± SE values of serum creatinine in dogs of Group A and B.

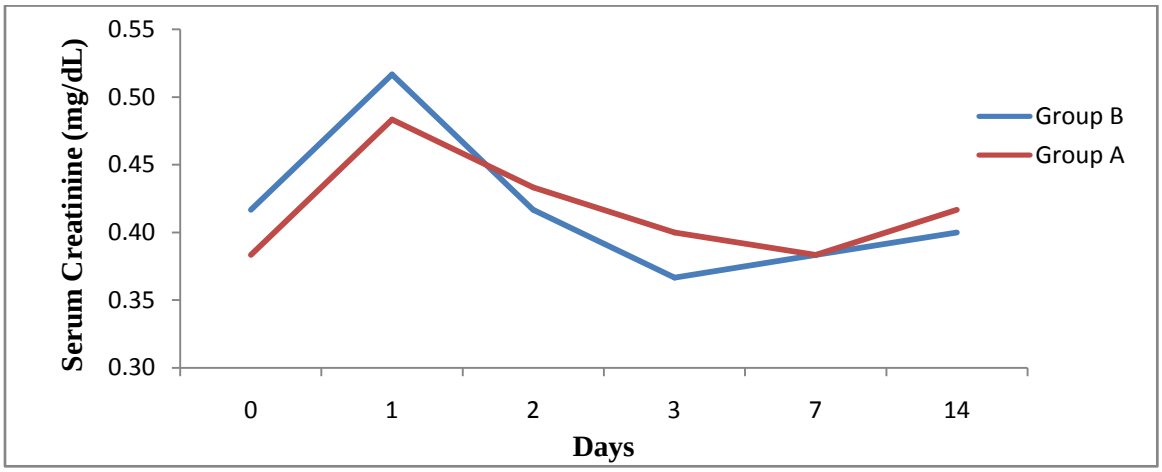
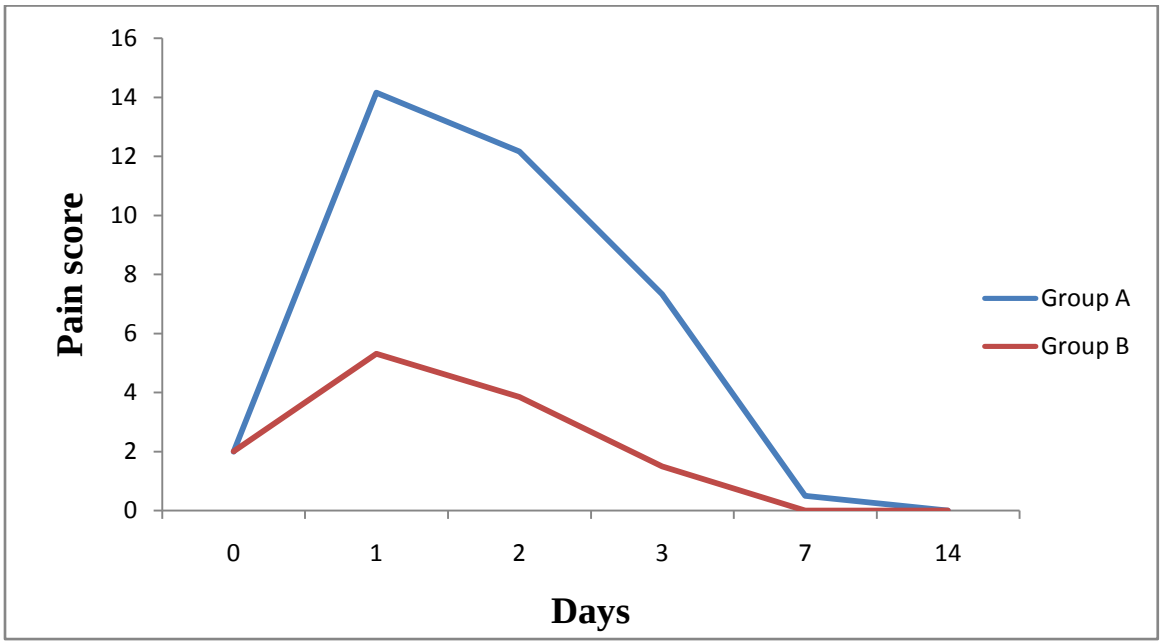


Table 8: Mean ± SE values of University of Melbourne Pain Score (UMPS) in dogs of Group A and B.

TIME INTERVAL	PAIN SCORE	
	Group A	Group B
0 Day	2.00 ± 00.00	2.00 ± 00.00
24 H	14.16 ± 0.88	5.31 ± 0.70
48 H	12.16 ± 0.95	3.85 ± 0.70
72 H	7.33 ± 0.97	1.50 ± 0.58
7th Day	0.50 ± 0.34	00.00 ± 00.00
14th Day	0.00 ± 0.00	00.00 ± 00.00

Fig 18: Mean ± SE values of University of Melbourne Pain Score (UMPS) in dogs of Group A and B.



Discussion

V. DISCUSSION

The present study was carried out to compare and evaluate the conventional and laparoscopic method of inguinal herniorrhaphy in twelve female dogs.

5.1 Occurrence of hernia

In the present study, 0.68 % (56 out of 8201) of the cases presented to the Department of Surgery and Radiology, Veterinary College Hospital, KVAFSU, Hebbal, Bangalore during May 2012 to April 2013 were diagnosed as cases of different hernias, of which 20 cases were of inguinal hernia and this accounted to an overall incidence of 0.25 % of 8201 cases presented to Department of Surgery and Radiology, Veterinary College Hospital. Many literature suggest the breed wise, age wise and sex wise predisposition to different hernias but there is a scarcity of precise reports on the occurrence and incidence values on different hernias. However, it was noteworthy that inguinal herniation is more commonly seen in intact female dogs in comparison to the males. Hayes (1974) reported breed wise predisposition of inguinal hernia and according to him, Basenji, Pekingese, Poodle, Basset hound, Cairn terrier, Cavalier King Charles spaniel, Chihuahua, Cocker spaniel, Dachshund, Pomeranian, Maltese, and West Highland white terrier breeds were more prone for the inguinal herniation. This confirms the fact that the sudden change in the size of uterus after gestation or whelping and post involution process of the uterus dramatically influences on its positioning in the abdominal cavity, further, the space in the abdominal cavity is limited in the small breeds of dogs which restricts its repositioning (Martin *et al.*, 2012).

5.2 Preparation and positioning of animal

Restriction of solid food for 12 hours and water for four hours prior to surgery gave satisfactory results. Thiele *et al.* (1993) advised 12 hours fasting with no restriction to water before the surgery. Dharmaceelan *et al.* (2000) and Holey (2010) in their study of laparoscopic ovariectomy and ovariohysterectomy, prepared the dogs by withholding food for 24 hours, water for 6 hours prior to surgery.

In the present study fasting and withholding of water was appropriate for surgical procedure in both the groups of dogs. Administration of soap water enema two hours prior to surgery and catheterization of urinary bladder just prior to anaesthesia prevented defecation and urination respectively during administration of anaesthesia or during surgery. It also provided better visualization, access to inguinal area and manipulation of viscera and avoided any injury to visceral organs during laparoscopic herniorrhaphy. Similar findings were earlier made by Dharmaceelan *et al.* (2000), Ranganath and Kumar (2007) and Holey (2010).

Both Group A and B dogs were positioned in dorsal recumbency and the Group B dogs with elevated pelvis (30°) which facilitated sliding of viscera cranially and provided better visualization of inguinal canal and easy manipulation of laparoscopic instruments. Several surgeons, Byers *et al.* (2007), Singh *et al.* (2010), Sharma *et al.* (2010), Kalita *et al.* (2012) and Martin *et al*. (2012) performed conventional method of inguinal herniorrhaphy by placing the dogs on dorsal recumbency. Dharmaceelan *et al.* (2000), Ranganath and Kumar (2007), Holey *et al.* (2012) and Vishwanatha and

Ranganath (2012) have also recorded similar positioning of dogs earlier in their studies of laparoscopic ovariohysterectomy in female dogs.

5.3 Sterilization of instruments

Laparoscopic instruments and telescope were sterilized in a closed formalin chamber with formaldehyde tablets for a period of 24 hours and were rinsed in sterile water and wiped dry with sterile gauze, which was adequate to prevent local and systemic infection. All general surgical instruments used were sterilized in an autoclave at 121°C, 15 lbs psi for 15 min, which was adequate to prevent local and systemic infection. Sumar and Bravo (1991) sterilized all laparoscopic instruments in 70 per cent alcohol that contained chlorhexidine solution. Dharmaceelan *et al.* (2000) sterilized telescope and operating instruments in closed formalin vaporizer chamber for period of 24 hours and soaked the instruments in chlorhexidine for 30 min before use and rinsed them with sterile water and wiped them dry with sterile gauze. The present protocol for sterilization of laparoscopic instruments was similar to the procedure done by Kumar (2006), Holey (2010) and Vishwanatha (2011) in their laparoscopic studies.

5.4 Premedication and anaesthesia

Pre-medication of all the dogs of both the groups with atropine sulphate @ 0.04 mg/kg subcutaneously and diazepam @ 0.5 mg/kg body weight intravenously was found to be satisfactory. The administration of atropine sulphate reduced the salivary secretions and pre-anaesthesia with diazepam provided good sedative effects along with good muscle relaxation. Anaesthesia with isoflurane and oxygen mixture provided good anaesthesia. The induction and maintenance of anaesthesia was satisfactory and the

recovery was smooth and satisfactory in both the groups of dogs. Niranjana (2010) performed laparoscopic-assisted ovariohysterectomy in female dogs with propofol (5mg/kg body weight, IV) and diazepam (0.2 mg/kg body weight IV). Further, anaesthesia was maintained with 1.5-2.0 per cent of isoflurane with oxygen. Vishwanatha and Ranganath (2012) used similar premedicaments for the laparoscopic studies but for the induction and mainatainace of anaesthesia, sevoflurane was used.

5.5 Intra-abdominal pressure (Group B)

Pneumoperitoneum with 12 mmHg - 14 mmHg intra abdominal pressure in female dogs weighing 12 to 20 kgs body weight provided enough space for manipulation of laparoscopic instruments in Group B dogs, with no complications like subcutaneous emphysema or effect on cardiopulmonary system during the postoperative period. The results are similar to the findings of Minami *et al.* (1997), Dharmaceelan *et al.* (2000), Hamdane *et al*. (2003), Davidson *et al.* (2004), Ranganath and Kumar (2007), Holey *et al.* (2012) and Vishwanatha and Ranganath (2012). These authors reported pneumoperitoneum with intra abdominal pressure varying from 8 to 15 mmHg for laparoscopic procedures in dogs.

5.6 Surgical site

In Group A dogs, the ventral abdomen was prepared aseptically and exploration of internal inguinal ring was made by caudal midline laparotomy. Daniel and Smeak (2002) preferred midline celiotomy than placing the incision over hernial swelling due to the innate advantages of the former method which avoids injury to the mammary tissue, bilateral inguinal hernias can be repaired using single incision and adhesions can be

separated easily. The similar procedure was earlier mentioned by the authors *viz.*, Byers *et al.* (2007), Singh *et al.* (2010), Sharma *et al.* (2010), Kalita *et al.* (2012) and Martin *et al*. (2012). In case of Group B dogs, the 10 mm trocar was introduced at umbilicus as a median port and two more 5 mm paramedian ports were made approximately 5 cm apart on the opposite side of the hernia in the abdomen 5 cm caudolateral to median port. There is no such ports placement was discussed earlier by any authors. However, Devaraja (2010) in his study of laparoscopic vasectomy in male dogs, approached the internal inguinal rings by placing the one median port (10mm) at umbilicus and two paramedian ports (5 mm), located approximately five cms caudolateral to median port. In the present study, the placement of median and paramedian ports were unique and convenient to access internal inguinal ring and to perform laparoscopic herniorrhaphy effectively.

5.7 Duration of procedures

The mean±SE of time (minutes) taken for surgical procedure (from skin incision to skin suturing) in Group A and Group B were 35 ± 1.93 and 20 ± 0.41 respectively.

The duration of procedure was longer in Group A compared to Group B. This increase in mean surgical time was statistically significant. The surgical time could have been minimized in laparoscopic surgery due to the non requirement of the larger incision to access the internal organs and similar note has been made by Wildt and Lawler (1985). However, Kumar (2006) in his study of conventional and laparoscopic method of ovariohysterectomy stated that the time taken for laparoscopic method was more than conventional method. The present work happens to be the first study for the comparison of conventional and laparoscopic method of inguinal hernia repair in female dogs.

5.8 Intra-operative complication

In the present study, there was no surgical complication noticed in any of the dogs of Group A and Group B. Sharma *et al.* (2010) and Kalita *et al.*(2012) reported no surgical complications during inguinal herniarrhaphy by conventional method in a dog.

The complications of intraoperative procedures were recorded by various authors which include, improper placement of cannula resulting in damage to internal organ (Hardie *et al.*, 1996).

5.9 Post-operative care and complications

Ceftriaxone sodium at a dose rate of 20 mg/kg was administered twice daily post-operatively for five days. Administration of ceftriaxone helped in preventing post-operative infection (Singh *et al.,* 2010 and Martin *et al*., 2012). Regular wound dressing with povidine iodine kept the area clean and also prevented infections.

All dogs which underwent either conventional and laparoscopic method of inguinal hernia repair recovered uneventfully. In Group A and Group B dogs, the wound healed completely by day ten and day seven respectively. During post-operative days, the dogs resumed the normal activity without any complication. It was observed that strict aseptic surgery, optimum antibiotics, in addition to adequate care and monitoring of the patient during post-operative period might have contributed significantly towards well being of the dogs. Austin *et al.* (2003) reported increased postoperative swelling of the right paramedian port incision due to the herniation of omentum through the abdominal wall. In the present study, no such complications were observed. Martin *et al*. (2012)

corrected bilateral inguinal hernia by conventional method and recorded seroma formation on the right side inguinal region.

5.10 STUDY PARAMETERS

5.10.1 Physiological parameters

5.10.1.1 Rectal temperature (°F)

There was statistically no significant variation in mean rectal temperature noticed post-operatively in both the groups after herniorrhaphy. Shirodkar *et al*. (2008) observed significant decrease in rectal temperature during operative procedure and they thought it could be due to additive effect of preoperative fasting and anaesthesia. The temperature resumed to normalcy by 6th postoperative hour. Non-significant variation was recorded by various authors *viz.,* Jahromi *et al*. (2009), Sharma *et al.* (2010) and Martin *et al.* (2012) in the conventional method of inguinal hernia repair in dogs. Further, Kumar (2006) and Devaraja (2010) also observed similar trend in the mean rectal temperatures during their studies of conventional and laparoscopic ovariohysterectomy in female dogs and vasectomy in male dogs respectively.

5.10.1.2 Respiratory rate (per min)

In the present study, there was statistically non-significant variation in respiratory rate in both the groups, which was in accordance with the reports of Hancock *et al.* (2005) and Ranganath and Kumar (2007). However, there was a slight elevation in the mean respiratory rate upto 48 hours postoperatively in both the groups. This non-

significant increase could be attributed to the pyrexia and pain evinced after the surgery (Hancock *et al.* 2005).

5.10.1.3 Heart rate (beats/per min)

Similarly, there were statistically non-significant variations in the mean heart rate after surgery in both the groups. Tanya *et al.* (1996) noticed increased heart rate and decreased stroke volume during insufflations and 30 minutes after desufflation with carbon dioxide gas. Ranganath and Kumar (2007) also reported non-significant variation in heart rate after both conventional and laparoscopic ovariohysterectomy.

5.10.2 Haematological parameters

5.10.2.1 Haemoglobin (g %)

The fluctuations observed in the mean haemoglobin concentration were within normal range and were statistically non-significant. This might be due to minimal blood loss during the surgical procedure in both the groups which was due to careful and minimal handling of the high vascular tissues in procedure in both the methods. Dharmaceelan *et al.* (2000) also found non-significant change in haemoglobin level following laparoscopic ovariectomy in female dogs. Shirodkar *et al.* (2008) observed decrease in haemoglobin concentration immediately after surgery and they presumed it to be due to splenic engorgement during anaesthesia and bleeding during the surgical procedure.

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

A statistically non-significant decrease in total erythrocyte count was noticed in this study and the variations were within the normal range. This might be due to minimal blood loss during the surgical procedure in both the groups this may be due to not handling the high vascular tissues in procedure in both the methods. Dharmaceelan *et al.* (2000) and Shirodkar *et al.* (2008) found significant decrease in the total erythrocyte count during the immediate post-operative evaluation following laparoscopic ovariectomy in female dogs and they attributed it to the increased pooling of blood in the spleen after induction of anaesthesia.

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

There was statistically non-significant elevation observed in total leukocyte count in the first 24 hrs and the elevation was within the normal range in both the groups. Coles (1986) stated that the degree of leukocytosis in response to trauma or infection depends on the severity of infection or inflammation. However, Dharmaceelan *et al.* (2000) reported significant increase in total leukocyte count on first post-operative day and stated that it could be due to surgical stress and tissue damage. Shirodkar *et al.* (2008) found acute rise in the total leukocyte count following laparoscopic ovariectomy in female dogs up to 12 hour post-operatively and they concluded that it could be due to acute inflammatory changes following surgery. However, the slight elevation in the total leukocyte count may possibly result due to the inflammatory responses to the handling of tissues (Holey *et al.*, 2012).

5.10.2.4 Differential leukocyte count

5.10.2.4.1 Neutrophil (%)

A statistically non-significant increase in mean neutrophil count upto 48 hours postoperatively was noticed in the present study in both groups. This could be due to the response of the body to tissue manipulation and inflammation (Benjamin, 1998). Further, Dharmaceelan *et al.* (2000) reported no significant change in neutrophil count after laparoscopic ovariectomy. These observations falls in line with the opinion of Venugopalan (2005) who suggested that during the first 24 hours of inflammation following tissue damage, neutrophils predominates other cells.

5.10.2.4.2 Lymphocyte (%)

There was statistically non-significant decrease in lymphocyte count up to 48 hours post-operatively in both groups and was within normal range. The lymphocyte count recorded an initial fall after the surgical intervention, followed by a reversal to the normal trend along with granulocyte per cent. Similar observations were also noticed by Dharmaceelan *et al.* (2000), Kumar (2006), Shirodkar *et al.* (2008), and Holey *et al.* (2012).

5.10.2.4.3 Eosinophil (%)

A statistically non-significant variation was observed in both groups and the variations recorded were within the normal range. Dharmaceelan *et al.* (2000), Kumar (2006), Devaraja (2010) and Holey (2010) reported similar trend in the mean eosinophil

count in their studies wherein, comparative evaluation was carried out between two methods of surgical procedures.

5.10.2.4.4 Monocyte (%)

There was a statistically non-significant change in monocytes in both groups and the mild variation was within normal range. The monocytes per cent remained almost steady and mild changes did not reveal any definite pattern between the dogs of two groups. As the monocyte is the second line of cellular defence, its role during early acute inflammation may not be vital (Sastry, 2004). These observations were in accordance with Dharmaceelan *et al.* (2000), Vishwantha (2011) and Holey *et al.* (2012).

5.10.3 Biochemical parameters

5.10.3.1 Serum alanine aminotransferase (ALT) (IU/L)

The serum alanine aminotransferase levels were marginally increased for first 48 hrs after surgery and this variation was statistically non-significant and values were within the normal range. This non-significant increase could be due to preanaesthetics, anesthesia, pre operative and post operative antibiotics or the surgical procedure that had an influence on the liver function which intern had affected the ALT values. Similar observations were also recorded earlier by Kumar (2006), Niranjana (2010) and Holey *et al.* (2012). Interestingly, Byers *et al.* (2007) recorded a drastic elevation in the ALT levels and they presumed that it could be due to the relative hepatic hypoxia secondary to hypovolemia, as well as the skeletal muscle injury associated with inguinal herniorrhaphy. Al-Badrany (2009) in rabbits observed significant elevation in alanine

aminotransferase immediately after pneumoperitoneum and it returned back to normal within 24 hours.

5.10.3.2 Serum aspartate aminotransferase (AST) (IU/L)

The serum aspartate aminotransferase levels were marginally increased for first 48 hrs after surgery and this variation was statistically non-significant and values were within the normal range. This may be related to limited muscular damage associated with the surgical procedures. Schmidt and Booker (1982) reported significant increase in aspartate amino transferase level between 4 hours to72 hours after the operation and suggested that higher AST values could be due to muscle cell damage. Furthermore, Byers *et al.* (2007) opined that the values would shoot up if muscular damage during surgery was greater. Al-Badrany (2009) observed significant elevation in serum aspartate aminotransferase in rabbits due to anaesthetic drug and pneumoperitoneum and the levels receded back to normal within 24 hours.

5.10.3.3 Serum creatinine (mg/dL)

There was statistically non-significant change in mean serum creatinine level during the present study. The variation in the serum creatinine values were within the normal range. Neither the anesthesia nor surgical procedure in the present study had any influence on the kidney function. These observations are in accordance with Kumar *et al*. (2008), Niranjana (2010) and Holey *et al.* (2012).

5.10.4 University of Melbourne Pain Score (UMPS)

In the present study, the dogs subjected to the conventional herniorrhaphy showed a significantly higher UMPS upto 72 hours after operation when compared with that of dogs in the laparoscopic group, which showed considerably lower UMPS. The variations observed were statistically significant. These variations observed in terms of UMPS values suggest that the conventional method of inguinal herniorrhaphy caused more post operative pain than laparoscopic intervention. Similar records were reported by Davidson *et al.* (2004) and Kumar (2006).

Summary

VI. SUMMARY

Inguinal hernia is an infrequently encountered problem in the dogs, in particularly in the intact female dogs and to a lesser extent in the male dogs of any age. The rapid changes that have been witnessed in open approach surgeries, prosthetic materials and laparoscopic surgeries have made hernia surgery a most interesting field of endeavor that demands renewed discipline and dedication. Laparoscopic surgeries have emerged as the effective, minimally invasive surgical technique and have increasingly gained popularity in veterinary surgery due to its inherent benefits of small incision, minimal trauma and lesser stress caused to the animal. It causes presumably less pain, with considerably limited muscular trauma, and earlier return to function. However laparoscopic inguinal herniorrhaphy remains a virgin area at least in the Indian subcontinent.

With this background the present study was carried out to compare the conventional and laparoscopic method of inguinal hernia repair in female dogs. For this, twelve female dogs with hematobiochemically normal values were selected so as to maintain the uniformities in the study groups. The selected 12 dogs were randomly placed into two separate groups *viz;* Group A (Conventional inguinal herniorrhaphy) and Group B (Laparoscopic inguinal herniorrhaphy).

Further, for the surgery all the dogs were premedicated with atropine sulphate and diazepam followed by induction and maintenance of general anaesthesia with isoflurane. The anaesthetic medicaments were found to be satisfactory in all dogs of either groups.

In Group A dogs, internal inguinal ring was approached through ventral midline laparotomy and herniorrhaphy was performed using polyglactin- 910 No. 1 which provided adequate stability for closing the ring. In Group B dogs, one 10 mm median and two paramedian (5 mm) ports provided easy access, good visualization and easy manipulation of instruments. Twelve - fourteen mmHg intra-abdominal pressure with carbon dioxide provided enough space for manipulation of laparoscopic instruments and good visualization of visceral organs. Herniorrhaphy using polyglactin- 910 No. 1 provided adequate stability and reduced hospitalisation and early return back to normal activities.

The mean surgical time for both the methods was considered in the study and significant increase in mean surgical time in Group A dogs was noticed.

Routine physiological parameters were evaluated prior to and after the surgical intervention in both the groups. There was no significant variation in mean rectal temperature, mean respiratory rate and mean heart rate in between and within the groups.

The haematological parameters viz., haemoglobin, total erythrocyte count, total leukocyte count and differential leukocyte count revealed no significant variation in both the group of dogs. The biochemical parameters like alanine aminotransferase, aspartate aminotransferase and serum creatinine levels also showed no significant variation in their levels in all the dogs of Group A and B.

However, there was a significant variation in the University of Melbourne Pain Score **(**UMPS) values. The dogs subjected to the conventional herniorrhaphy showed a

significantly higher UMPS when compared with that of dogs which undergone laparoscopic herniorrhaphy. These variations observed suggest that the conventional method of inguinal herniorrhaphy caused more post operative pain than laparoscopic intervention.

On the basis of the observations and the evaluations made during the present study, it could be concluded that both conventional and laparoscopic method of inguinal herniorrhaphy were remained free of complications and were well tolerated by the dogs. Even though the dogs of both the groups had an uneventful recovery, in the conventional group the placement of longer incisions and suturing took longer time and it has extended the time taken for the surgery. However in the laparoscopic method, application of suture and making knots was complex and somewhat cumbersome. The early and uneventful recovery could be attributed to minimal invasive nature of laparoscopic surgery.

In conclusion, the laparoscopic inguinal herniorrhaphy in dogs could be preferred over conventional approach for its minimal invasiveness and wider clinical use. Requirement of small incision, minimal trauma caused in the intervention and limited stress caused to the animal have made it is presumably less painful, popular and effective module in veterinary surgery under available circumstances.

Bibliography

VII BIBLIOGRAPHY

AKMAN, PC., 1962. A study of five hundred incisional hernias. *J. Hist. Coll. Surg.,* **37**: 125.

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

ALEXANDER, H.C., and PRUDDEN, J.F., 1966. The causes of abdominal wound disruption. *Surg. Gynecol. Obstetrics.,* **722**: 1223.

AMERICAN COLLEGE OF VETERINARY ANESTHESIOLOGISTS., 1998. American College of Veterinary Anaesthesiologist's position paper on the Treatment of pain in animals. *J. Am. Vet. Med. Assoc.,* **213**: 628-630.

ASHDOWN, R.R., 1963. The anatomy of the inguinal canal in domestic mammals. *Vet. Rec.,* **75**: 1345.

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

BELLENGER, C.R., 1996. Inguinal and scrotal herniation in 61 dogs. *Aust. Vet. Pract.,* **26**: 58.

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

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

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

BRINGMAN, S., CONZE, J., CUCCURULLO, D., DEPREST, J., JUNGE, K., KLOSTERHALFEN, B., PARRA-DAVILA, E., RAMSHAW, B. and SCHUMPELICK, V., 2010. Hernia repair: the search for ideal meshes. *Springer.*, 14: 81–87

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

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

BYERS, C.G., WILLIAMS, J. E. and SAYLOR D. K., 2007. Pyometra with inguinal herniation of the left uterine horn and omentum in a Beagle dog. *J. Vet. Emerg. Crit. care.*, **17**(1): 86-92

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

CHAUDHRY, N. I., CHAUDHRY, R. A., AZLZ, T., MUMTAZ, M. and CHEEMA, N. I., 1975. Inguinal hernia in bitches. *Pak. J. Agri. Sci.*,**12**(3-4): 249-258.

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

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

CSANYI V., 2005. Exploring the Canine Mind. *In:* If Dogs Could Talk. New York, NY: North Point Press.

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

DANIEL, D. and SMEAK., 2002. Abdominal hernias. *In:* Textbook of Small Animal Surgery. *Edn*. *3rd*., Saunders. Elsevier Science. pp 448- 471.

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

DEAN, P. W., BOJRAB, M. J. and CONSTANTINESCU, G.M., 1990. Hernias. *In*: Current techniques in small animal surgery, *Edn*. *3rd*., Lea and Febiger, Philadelphia. pp 439-441.

DEMARTIN, B.W., 1982. Ventral abdominal hernia in a dog. *Mod. Vet. Pract.* **63**: 966.

DEVARAJA, B., 2010. Comparision of laparoscopic and conventional method of vasectomy in dogs. M.V.Sc. thesis, Karnataka Veterinary, Animal and Fisheries Science University, Bidar, India.

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

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

DION, Y.M. and MORIN, J., 1992. Laparoscopic inguinal herniorrhaphy. *Can. J. Surg.*, **35**(2): 209-212.

EDELMAN, D. S., 2002. Laparoscopic herniorrhaphy with porcine small intestinal submucosa: A preliminary study. *J. Soc. Laparoend.*, **6**: 203-205.

ELLSTROM, M., OLSEN, M. F. and OLSSON, J. H., 1998. Pain and pulmonary function following laparoscopic and abdominal hysterectomy: a randomized study. *Acta. Obstet. Gynecol. Scand.*, **77**: 923-928.

FIRTH, A. M. and HALDANE, S. L., 1999. Development of a scale to evaluate postoperative pain in dogs. *J. Am. Vet. Med. Assoc.*, **214**: 651-659.

FITZGIBBONS, R. J., CAMPS, J., CORNET, D. A., NGUYEN, N. X., LITKE, B. S., ANNIBALI, R. and SALERNO, G. M., 1995. Laparoscopic inguinal herniorrhaphy. Results of a multicenter trial. *Ann. Surg*., **221**(1): 3–13.

FITZGIBBONS, R.J., SALERNO, G.M., FILIPI, C.J., HUNTER, W.J. and WATSON, P., 1994. A laparoscopic intraperitoneal onlay mesh technique for the repair of an indirect inguinal hernia. *Ann. Surg.*, **219** (2): 144-56.

FOSSUM, T. W., CHOYL, S, H., DONALD, A, H., ANN, L, J., HOWARD, B, S. and MICHAEL, D, W. 2002. Small Animal Surgery. *Edn*. 2nd., *Mosby Elsevier*. 261-267

FOX, M. W., 1963. Inherited inguinal hernia and midline defects in the dog. *J. Am. Vet. Med. Assoc.*,**143:** 602-604

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

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

GER, R., MONROE, K. and DUVIVIER, R., 1990. Management of indirect inguinal hernias by laparoscopic closure of the neck of the sac. *Am. J. Surg.*, **159**:370–373

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

GYR, T., GHEZZI, F. and ARSLANAGIC, S. 2001. Minimal invasive laparoscopic hysterectomy with ultrasonic scalpel. *Am. J. Surg*., **181**:516-519.

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

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

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

HASSON, H. M., C. ROTMAN and N. RANA, 1993. Experience with laparoscopic hysterectomy. *J. Am. Assoc. Gynecol. Laparosc*, **1**:1-11.

HAYES, H. M., 1974. Congenital umbilical and inguinal hernias in cattle. horses, swine, dogs, and cats: Risk by breed and sex among hospital patients. *Am. J. Vet. Res.,* **5:**839.

HAZARY, S. and GARDENER, W.V., 1960. The influence of sex hormones on abdominal musculature and the formation of inguinal and scrotal hernias in mice. *Anat. Rec.,* **136***:* 431.

HENRY, J. B., 1979. Clinical diagnosis and management by laboratory methods. 16th Edn., W. B. Saunders Co., Philadelphia, pp. 130.

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

HOLEY, A., RANGANATH, L., NAGARAJA, B.N., KRISHNASWAMY, A. and YATHIRAJ, S., 2012. Laparoscopic electro-coagulation and endo-stapling techniques of ovariohysterectomy in female dogs. *Indian. J. Vet. Surg.* **33**(2): 117-119.

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

HOLUB, Z., A. JABOR and L. SPRONGL, 2002. Clinical outcome, inflammatory response and tissue trauma in total laparoscopic hysterectomy: comparison to laparoscopically-assisted vaginal hysterectomy. *Ceska Gynekol*., **67**: 315-320.

IVERSON, W.O., 1977. Strangulated inguinal hemia in a basset hound. *Vet. Med. Small. Anim. clin.,* **72**: 408.

JAHROMI, A. R., NAZHVANI, S. D., GANDMANI M. J. and MEHRSHAD, S., 2009. Concurrent bilateral inguinal and umbilical hernia in a bitch. *Vet. Arhiv., **79*** (5): 517-522.

JONES, D.B. and N.J. SOPER, 1994. Laparoscopic general surgery: current status and future potential. *Am. J. Roentgenol*., **163**: 1295-1301.

KALITA, D., CHOUDHURY, M. and SAILO, L., 2012. Inguinal hysterocele and epiplocele in a bitch. *Intas Polivet.,* **13**(1): 113-114.

KHALID, M. S., KHAN, A. W. and KHAN, A. F., 1994. Laparoscopic inguinal herniorrhaphy; analysis of initial experience. *Pak. J. Med. Sci*., 22(1): 70-73.

KUMAR, S. P .V ., VEENA, P., DHANALAKSHMI, N., SANKAR, P. and KOKILA, S., 2010. Inguinal hernia in a spitz dog. *Intas Polivet* **11**(2): 337-338.

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

LIEM, M. S. ., VAN DUYN, E. B., VAN DER GRAAF, Y. and VAN VROONHOVEN, T. J., 2003. Recurrences after conventional anterior and laparoscopic inguinal hernia repair. *Ann. Surg.,* **237**(1): 136–141.

LUNN, H.F., 1948. Observations on the mammalian inguinal region. *Proc. Zool. Soc. Lond.,* **118**: 345.

MARTIN, J. K. D, PHILIP, S. B. B, SARANGOM, S. B. and KANKONKAR, A. P., 2012. Blateral inguinal hernia with distinct hysterocele and omentocele in a dachshund bitch. *J. Indian. Vet. Assoc.,* **10**(1):45-47.

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

MEMON, M. A., COOPER, J., MEMON, B., MEMON, M. I. and ABRAMS, K. R., 2003. Meta-analysis of randomized clinical trials comparing open and laparoscopic inguinal hernia repair *Brit. J. S.*, **90**(12): 1479–1492.

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

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

MORTON, D. B. and GRIFFITH, P. H. M., 1985. Guidelines on the recognition of pain, distress and discomfort in experimental animals and a hypothesis for assessment. *Vet. Rec.,* **116**: 431-436.

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

MUNRO, E. and STEAD, C., 1993. Ultrasonographic diagnosis of uterine entrapment in an inguinal Hernia. *J. Small. Anim. Pract*., **34**: 139-141.

NICHOLSON, C., 1976. Defective diaphragm associated with umbilical hemia. *Vet. Rec.*, **98***:* 433. 1976.

NIRANJANA, C., 2010. Laparoscopic -Assisted Ovariohysterectemy in Twelve Bitches. M.V.Sc. thesis, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai.

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

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

PARKS, J., HAMILTON. *In* BOJRAB, M.J., 1981 (ed): Pathophysiology *In Small Animal Surgery.* Lea & Febiger, Philadelphia. 420.

PEACOCK, E.E. and VAN WINKLE, W., 1976. Wound dehiscence. *In* Peacock EE, VAN WINKLE, W (eds): Wound Repair. WB Saunders, Philadelphia. 466.

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

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

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

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

READ R.A. and BELLENGER C.R., 2003. Hernias. *In*: SLATTER, D.(ed.): Textbook of Small Animal Surgery. WB Saunders,Philadelphia. pp 446–470.

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

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

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

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

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

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

ROBERTS, S.J. 1971. *Veterinary Obstetrics and Genital Diseases (Theriogenology),* 2nd ed. Edward Brothers. Ann Arbor, Mich,.

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

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

SCHIER, F. 2006. Laparoscopic inguinal hernia repair: a prospective personal series of 542 children. *J. Pediatr. Surg*. **41**(6): 1081–1084.

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

SERIN, G., YAYGINGUL, R., TARIMCILAR, T. and SARIERLER, M., 2009. An incarcerated inguinal hysterocele in a pregnant bitch: a case report. *Vet. Med.*, **54**(8): 382-386.

SEYREK-INTAS, K. and SEYREK-INTAS, D. 1997. Hernia inguinalis utero gravido in a bitch. *Vet. Cer. Derg.*, **3**: 36–39.

SHAHAR, R., 1996. A possible association between acquired nontraumatic inguinal and perineal hernia in adult male dogs. *Can. Vet. J.,* **37**: 614 – 616 .

SHARMA, A.K., DASS, L.L. and KUMAR, S., 2010. Inguinal hernia in a German shepherd dog. *Intas Polivet.,* **11**(2): 339-340.

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

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

SINGH, P.R.K., CHANDOLIA, N.S., BUGALIA and CHAWLA, S.K., 2010. Ultrasonographic, radiographic diagnosis and surgical treatment of inguinal hernia in a bitch. *Intas Polivet.,* **11**(2): 335-336.

SNEDECOR, G. W. and COCHRAN, W. B., 1996. Statistical methods. Oxford and IBH Pub., New Delhi, pp. 138-169.

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

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

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

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

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

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

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

VISHWANATHA, B. and RANGANATH, L., 2012. Comparison of laparoscopic methods of endostapling and endoloop suturing for ovariohysterectomy in female dogs. *Indian J. Vet.Surg.,* **33**(1): 24-26.

VISHWANATHA, B., 2011. Comparison of laparoscopic method of endostapling and endoloop suturing for ovariohysterectomy in female dogs. M.V.Sc. thesis, Karnataka Veterinary, Animal and Fisheries Science University, Bidar, India.

WATERS, D. J., ROY, R. G. and STONE, E. A., 1993. A retrospective study of inguinal hernia in 35 dogs. *Vet. Surg*., **22**(1): 44-49.

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

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

WINCHESTER, D. J., DAWES, L.G., MODELSKI, D. D., NAHRWOLD, D. L., POMERANTZ, R. A., PRYSTOWSKY, J. B., REGE, R. V. and JOEHL, R. J., 1993. Laparoscopic inguinal hernia repair: A preliminary experience. *Arch. Surg*., **128**(7): 781-786.

WRIGHT, J. R., 1963. The surgery of the inguinal canal in animals. *Vet. Rec.*,**75**: 1352-1363.

YUEN, P.M., T.W. MAK and S.F. YIM, 1998. Metabolic and inflammatory responses after laparoscopic and abdominal hysterectomy. *Am. J. Obstet. Gynecol.*, **179**:1-5.

Abstract

VIII. ABSTRACT

The study was conducted to compare and evaluate the conventional and laparoscopic method of inguinal hernia repair in female dogs. The results of the study indicated no significant variations in Physiological (Rectal temperature, Heart rate and Respiratory rate), Haematological (Hb, TLC, TEC and DLC) and biochemical parameters (creatinine, AST and ALT). Surgical time required for Group A was significantly higher as compared to Group B due to longer time taken for lengthy surgical procedure. There were no surgical complications in any of the dogs of Group A and Group B during pre, peri and post operative period. In Group B dogs the shorter surgical time and uneventful recovery could be attributed to the minimal invasive nature of laparoscopic surgery. The dogs subjected to the conventional herniorrhaphy showed significantly higher University of Melbourne Pain Score up to 72 hours after surgery when compared with that of dogs in the laparoscopic group. Finally, on the basis of the observations and the evaluations during the present study, it could be concluded that the laparoscopic inguinal herniorrhaphy may be preferred over conventional method of inguinal herniorrhaphy under available circumstances.