EVALUATION OF PORT PLACEMENT APPROACHES FOR THORACOSCOPIC EXAMINATION IN CATTLE

T H E S I S

Submitted

In partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

VETERINARY SURGERY AND RADIOLOGY

BY

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Enrollment No. V/13/192

COLLEGE OF VETERINARY AND ANIMAL SCIENCES, UDGIR

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DECLARATION OF STUDENT

I, hereby declare that the experimental research work and interpretation of the thesis entitled **"EVALUATION OF PORT PLACEMENT APPROACHES FOR THORACOSCOPIC EXAMINATION IN CATTLE"** or part thereof has not been submitted for any other degree or diploma of any university, nor the data have been derived from any thesis/publication of any University or Scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged.

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

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This is to certify that the thesis entitled, **"EVALUATION OF PORT PLACEMENT APPROACHES FOR THORACOSCOPIC EXAMINATION IN CATTLE"** submitted by Shri **BORAKHEDE SURAJ SANTOSH** to the Maharashtra Animal and Fishery Sciences University in partial fulfillment of the requirement for the degree of **MASTER OF VETERINARY SCIENCE** has been approved by the Student's Advisory Committee after examination in collaboration with the External Examiner.

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(Dr. Suraj Santosh Borakhede)

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%	:	Per cent
*	:	P<0.05
**	:	P<0.01
/	:	Per
@	:	At the rate
^{0}c	:	Degree Celsius
^{0}F	:	Degree Fahrenheit
A	:	Aorta
ABK	:	Acepromazine-butorphanol-ketamine
ALKP	:	Alkaline phosphatase
ALT	:	Alanine aminotransferase
ANOVA	:	Analysis of variance
AP	:	Arterial pressure
AST	:	Aspartate aminotransferase
AZ	:	Azygous vein
B.I.D.	:	Bis in die
B.P.	:	Bard-parker
b.wt.	:	Bodyweight
BAL	:	Bronchoalveolar lavage
Bpm	:	Beats per minute
BPN	:	Buprenorphine hydrochloride
BUN	:	Blood urea nitrogen
CBC	:	Complete blood count
CBD	:	Chronic bronchial disease
CD	:	Critical difference
Cm	:	Centimeter
CO	:	Cardiac output

CO2	:	Carbon dioxide
CV	:	Controlled ventilation
CVP	:	Central venous pressure
D	:	Diaphragm
DV	:	Dorsal vagus nerve
E	:	Esophagus
EDTA	:	Ethylene diamine tetra acetic acid
EEG	:	Electro encephalogram
et al	:	and others
Fig.	:	Figure
G	:	gauge
g %	:	Gram percent
HCl	:	Hydrochloride
HF	:	Holstein friesian
HR	:	Heart rate
hrs/hr	:	Hours
IC	:	Idiopathic chylothorax
ICS	:	Intercostal space
IM	:	Intra muscular
IU/L	:	International units per liter
IV	:	Intra venous
L	:	Liter
L/min	:	Liter per minutes
LCD	:	Liquid crystal display
LL	:	Left lung
MAC	:	Minimum alveolar concentration
mg/dl	:	Milligram per deciliter
mg/Kg	:	Milligram per kilogram
mg/kg/min	:	Milligram per kilogram per Minute
Millions/mm3	:	Millions per cubic millimeter

mL	:	Milliliter
mm	:	Millimeter
mm Hg	:	Millimeter of mercury
mm^3	:	Cubic millimeter
MPE	:	malignant pleural effusion
No	:	Number
NS	:	Non-Significant
OLV	:	One-lung ventilation
PaCo2	:	Arteria partial pressure of carbon dioxide
PaO_2	:	Partial pressure of oxygen in arterial blood
pCO2	:	Partial Pressure of carbon dioxide
PCV	:	Packed cell volume
pO2	:	Partial pressure of oxygen
ppm	:	Pulse per minute
PRAA	:	Persistent right aortic arch
RL	:	Right lung
RR	:	Respiration rate
S.E.	:	Standard error
SaO2	:	Saturation of arterial oxygen
SGOT	:	Serum glutamic oxaloacetate transaminase
SGPT	:	Serum glutamic pyruvate transaminase
Spo2	:	Saturation of peripheral oxygen
ST	:	Sympathetic trunk
SV	:	Spontaneous ventilation
T.I.D.	:	Ter in die
TA	:	Thoraco abdominal
TEC	:	Total erythrocyte count
Thousands/mm3	:	Thousands per cubic millimeter

TIVA	:	Total intra venous anaesthesia
TLC	:	Total leucocyte count
VAC	:	Volts alternating current
VATS	:	Video assisted thoracic surgery
Viz.	:	Which is/ that is
VTLB	:	Videothoracoscopy lung biopsy
µg/dl	:	Microgram per deciliter
µg/Kg	:	Microgram per kilogram

Introduction

1. INTRODUCTION

Thoracic affections are one of the major clinical problems in large animal practice, the common thoracic disorders are pleural effusion, pneumothorax, diseases of the pleural space, space-occupying lesions such as diaphragmatic hernia, pericardial effusions, tumors, etc. Death due to thoracic diseases are high because most of these cases remain undiagnosed due to the unavailability of diagnostic imaging facility. Diagnostic imaging consists of many invasive and non-invasive techniques used routinely in human as well as companion animal medicine. However, in large animals, its use is still limited. It is often difficult to differentiate whether the condition requires medicinal or surgical treatment or both. Therefore, it is very important for a surgeon dealing with these types of conditions to have a fundamental knowledge of the anatomy and physiology of the systems.

Cardiothoracic disorders have always been a challenge for veterinary physicians and surgeons as well as human surgeons, this is basically because of the decreased sensitivity specificity of diagnostic tests for localizing the affections of the lung and thorax. Generally, radiography, ultrasonography along with open methods is commonly used for the diagnosis of various surgical conditions in large animals. Accurate diagnosis of thoracic disorder is essential for management and treatment of such cases.

Thoracic radiography has shown efficacy in the diagnosis of various disorders including airway diseases, however, radiography does not always confirm doubt. Ultrasound examination play an important role in the diagnosis of intrathoracic disease conditions like mediastinal masses, pleural effusions, lung consolidation, diaphragmatic hernia, etc., since the poor penetration of ultrasound beam in air and bony structure, it has limitations to evaluate non-cardiothoracic structures within the thoracic cavity or adjacent to the thoracic wall by parasternal, intercostal or thoracic inlet imaging window (Vignoli and Saunders, 2011).

Ultrasonography and radiography could be choices of diagnostic modality for the diagnosis of diaphragmatic hernia and thoracic affections in animals. Diagnosis and staging of disease like neoplasia may be possible with the thoracic radiograph and ultrasound however, complete evaluation and exploration of the thoracic cavity with one modality is still not possible (Radlinsky, 2014). The advent of radiography, computed radiography, digital radiography and ultrasound have made it possible for early diagnosis in a lot of cases, however, the treatment options especially surgical treatment options continue to be limited in veterinary practice.

Minimal invasive surgery is considered as a gold standard procedure for diagnosis as well as therapeutic purpose in human medicine. Thoracoscopy or thoracoscopic assisted surgical procedures like lung biopsy and pleural biopsy have become standard treatment protocols for initial lung cancers in human patients (Schwarz, 1998). Direct visualization of the organ with a token invasive method helps the clinicians to imply an attentive control over the technique without invasive exploratory surgery and proves its dominance over other non-invasive diagnostic techniques like X-ray, ultrasound, MRI, etc.

Thoracoscopy was first introduced by Jacobeus in 1910 since the introduction of thoracoscopy in humans, many exciting advances have been made in thoracic surgery. The Primary indication for thoracoscopy is exploration and diagnosis of intrathoracic lesions and masses which are undetected by other diagnostic methods. With this trend, the need has come to evaluate minimal invasive thoracoscopic diagnostic protocol and interventional thoracoscopy, for accurate and definitive diagnosis and disease staging information along with interventional surgical procedures that otherwise would only be possible with open thoracotomy (Monnet, 2009).

The benefits of thoracoscopy include decreased pain and healing time of surgical wound, a short stay in hospital and fewer complications over the conventional thoracic surgeries (Daly *et al*., 2002). Thoracotomy is replacing by

using thoracoscopy in many operative procedures to advance the visibility of thoracic structures. (Isakow *et al*., 2000 and Dupre *et al*., 2001). Thoracoscopy provides direct visualization of intrathoracic organs and disease pathologies with highly magnified images. Thoracoscopy has become more powerful tool for examination of the thoracic cavity as it gives an access to surgically inaccessible intrathoracic areas (McCarthy, 1999).

In veterinary field, thoracoscopy has been used for direct observation of the pleural cavity and intrathoracic structures, collection of biopsies and some surgical interventions like pericardiectomy, lung lobectomy, fenestration of thoracic intervertebral disks and diaphragmatic hernia repair in dogs. Video-assisted thoracic procedure has been applied by many researchers in veterinary patients for partial pericardiectomy, lung biopsy, removal of mass lesions of lung and pleura, biopsy of pleura, biopsy of mediastinum masses, complete and partial lung lobectomy, pleural effusion, chylothorax, pericardial effusions, pneumothorax and persistent right aortic arch (Potter and Hendrickson 1998, Brissot *et al*., 2003, Pigatto *et al*., 2008, Basso *et al*., 2010 and Mayhew *et al*., 2012).

In horses thoracoscopy has been used for examination of pleural cavity in standing position (Peroni *et al*., 2000) and for biopsy of lung, lymph nodes, window pericardectomy, drain placement in pleural effusions and abscess, exploration before thoracotomy, traction of pleural adhesion and decortication, diaphragmatic hernia repair and partial pneumonectomy (Vachon and Fisher, 1998).

Visual examination of thorax by thoracoscopy provides more accurate diagnosis and prognosis in horses affected with neoplasia, pleuropneumonia and esophageal disorders (Mackey and Wheat, 1985). In bovines, thoracoscopy was performed for examination of normal anatomy in standing position under local anesthesia (Scharner *et al*., 2014). A standing position thoracoscopic pericardiotomy can be performed as a palliative treatment in bovine to reduce clinical signs of heart failure and to prolong life (Biervliet *et al*., 2006). It results less morbidity and post-

operative pain than conventional thoracotomies, this makes thoracoscopy more effective.

The surgeon must be familiar with thoracoscopic anatomy, thoracoscopic techniques, limitations of the technique and possible complications. The port choice for thoracoscope insertion into the thoracic cavity can make the difference between a successful examination and a failed one. There is still much to learn about indications, contraindications, advantages, disadvantages and complications of veterinary thoracoscopy. However, while performing thoracoscopy in veterinary practice, need of adequate knowledge of thoracic anatomy of patients is very essential (De Rycke et al., 2001). Keeping in view the referral practice of large animals especially bovines in Teaching Veterinary Clinical Complex of Udgir the present study was undertaken. The study was designed mainly to explore its diagnostic utility in large animal practice and to obtain a normal thoracoscopic anatomy of the thorax for clinical application.

Objectives:

1. To evaluate different port placement positions for thoracoscopic examination in cattle
2. To study the physio-biochemical parameters in cattle undergoing thoracoscopy.


Review
of
Literature

2. REVIEW OF LITERATURE

The review of literature of the present study entitled "evaluation of port placement approaches for thoracoscopic examination in cattle" has been cited under the following heads:

2.1 Thoracoscopy

2.2 Anesthesia

2.3 Radiography

2.1 Thoracoscopy

Shulman and Aronson (1984) observed the venous embolism of carbon dioxide during elective diagnostic laparoscopy in a healthy adult female. The diagnosis of gas embolism was made on the basis of the sudden abrupt onset of systolic and diastolic murmurs. The continuously recorded end-tidal carbon dioxide concentration increased abruptly from 3.8 to 4.2 per cent and then slowly decreased to 4.0 per cent over the subsequent 30 seconds. CO_2 insufflation was terminated immediately following the establishment of the diagnosis. The patient recovered uneventfully. A transient but rapid rise in $ETCO_2$was suggested as a useful early sign of venous CO_2 embolism during laparoscopy.

Macky and Wheat (1985) performed endoscopic examination of pleural cavities in 15 horses. Blunt entry by teat cannula after skin incision 130^0 rigid endoscope placed at 10^{th} intercostal space. Mid thorax, diaphragm costo phrenic angle mediastinum and its structures were observed without complications. Negative pressure established by suction pump after examination and incision closed by non-absorbable suture material was found suitable. They stated that pleuroscopy was useful in horses with suspected intrathoracic masses, abscesses and severe adhesion

formation and concluded that in conjunction with thoracic radiography and diagnostic ultrasound examination might be offered for more accurate diagnosis and prognosis.

Mack *et al.* (1992) evaluated role of thoracoscopy in diagnosis and treatment of diseases of chest, in seventy human patients and reported that thoracoscopy was preferred procedure for the definitive diagnosis of pleural effusions and treatment, they further reported that, thoracoscopic treatment reduced the rate of reoccurrence of pleural effusions. On the basis of their study they concluded that thoracoscopy had markedly expanded role in diagnosis and treatment of thoracic diseases with less postoperative morbidity.

Boutin *et al.* (1993) explained diagnostic and therapeutic thoracoscopy and suggested that basic requirement of thoracoscopy like rigid telescope scissors, forceps, stapler and video recorder. They also explained that techniques, position of the patient, anesthesia, point of entry and induction of pneumothorax. They concluded that thoracoscopy was useful for diagnosis of number of lung diseases, needle pleural biopsy, fluid cytology, accurate staging etc.

Landreneau *et al.* (1993) studied one hundred thirty-eight consecutive, nonrandomized patients, with equivalent demographic and preoperative physiologic parameters. Video-assisted thoracic surgery was associated with reduced pain, shoulder dysfunction, and early pulmonary impairment compared with LLT for select patients requiring pulmonary resection.

Hendrickson *et al.* (1996) studied instrumentation and techniques for laparoscopic and thoracoscopic surgery in the horse. They suggested that rigid telescopes for thoracoscopy were available in different sizes whereas commonly used rigid telescopes of 5 to 10 mm in diameter and 30 to 60 cm in length. They stated that 150 W and 300 W xenon light source were beneficial for surgery. Electronic insufflator, veress needle, french trocar catheter, teat cannula, reusable cannula and trocars, disposable trocars and cannulas, serrated scissors, acute claw grasper,

babcock forceps, reusable cautery instruments and endoscopic suture material were also be used for thoracic surgery.

Hill *et al.* (1996) conducted selective lung ventilation during thoracoscopy and evaluate effects of insufflation on hemodynamics in six healthy adult pigs weighing between 50 - 70 kg. A 12 mm trocar with valve was inserted and 0^0thoracoscope was placed through trocar. After placing of telescope ipsilateral hemithorax was explored. CO_2 gas was used for insufflation. They concluded that there was no significant change in base line data and obtained data from study.

Krasna *et al.* (1996) studied complications of thoracoscopy from the data of three hundred forty eight procedures. A variety of thoracoscopy procedures for different indications were performed from which pulmonary infiltrates, lung cancer staging, solitary pulmonary nodules, esophagus cancer staging, pleural diseases, emphysema, bullae and bleb, biopsies of mediastinal mass and nodules, sympathectomy and spalnchinectomy and others were carried out. They concluded that twenty seven patients required open thoracotomy for various indications. Twelve patient required resection of primary carcinoma. Extensive adhesions were observed in six patients. In two patients, lesions were not found and too big to remove from thoracoscopy and required thoracotomy. Two patients had anesthetic complications. Complications were classified into the early postoperative complications and delayed post-operative complications.

Zaal *et al.* (1997) evaluated the role of thoracoscopy in beagle dogs and stated that, thoracoscopy provided excellent visualization of all the lung lobes and thoracoscopic removal of all lung lobes could be performed. Further they opined that although thoracoscopy technique is still in a developmental stage, it required specialized equipment and extensive developments in the field of thoracic surgery by using thoracoscopy. They suggested that thoracic exploration, biopsy procedures, lung lobectomy, and partial pericardiectomy could be indications for thoracoscopy in dogs.

Faunt *et al.* (1998) studied cardiopulmonary effects of bilateral hemithorax ventilation and diagnostic thoracoscopy in dogs and concluded that diagnostic thoracoscopy with bilateral hemithorax ventilation was well tolerated in clinically normal dogs and could provide a diagnostic modality enabling intrathoracic procedures with less morbidity.

Garcia *et al.* (1998) conducted a clinical study on the feasibility of thoracoscopy for examination of thoracic cavity and thoracoscopic lung lobectomy in 8 mongrel dogs and concluded that, thoracoscopic procedure could be used in dogs for examination of thoracic cavity and collection of biopsies of various intra-thoracic organs as well as anatomical lung lobectomy in dogs.

Loddenkemper *et al.* (1998) explained thoracoscopy as a state of art, in which given details about indication like pleural effusion, diffuse lung disease, localized lung lesions, chest wall lesions, mediastinal tumour, pneumothorax, malignant tumour, tuberculosis. They stated that patient position, equipment required, thoracoscopic procedure were played important in thoracoscopic procedure to avoid complication.

Vachon and Fisher (1998) performed thirty-two thoracoscopies in 28 horses from which sixteen horses affected with pleuropneumonia and 12 were affected with various other thoracic conditions. Thoracoscopies performed by using 30^0, 57 cm rigid laparoscope in standing position under sedation. Also they performed biopsy of lung and lymph nodes, drain placement into pleural effusion, abscess and transection of pleural adhesion and repair of diaphragmatic hernia. They recommended that thoracoscopy is useful diagnostic and safe technique in case of thoracic diseases.

Jackson *et al.* (1999) evaluated feasibility and outcome of thoracoscopic partial pericardiectomy for the treatment of pericardial effusions in thirteen dogs with cardiac tamponade resulting from pericardial effusion. They observed that lateral thoracoscopic approach allowed adequate exposure to remove 4 to 5 cm diameter section of pericardium in all dogs. 10 out of 13 dogs (76.9%) were

diagnosed with neoplastic pericardial effusion. Three 3 of 13 patients (23.1%) were diagnosed as idiopathic pericardial effusion. They further noticed that the procedure was technically successful in all dogs and no anaesthetic adverse clinical complications were noted. They concluded that, thoracoscopic partial pericardiectomy was technically feasible and offered several advantages over conventional open thoracic pericardiectomy.

McCarthy *et al.* (1999) explained diagnostic thoracoscopy for diagnosis of intrathoracic diseases. Instrumentation needed for thoracoscopy was similar to the laparoscopy. Most common telescope used for thoracoscopy was 10 mm for large dogs breed, 5 mm telescope for medium size dogs and 2.5 mm for small dogs or cats. The important feature is viewing angle that ranges from 0^0 to more than 90^0. 0^0 telescopes that look straight ahead and provided true image with least distortions. Cannulas were same as laparoscopic cannulas and xenon light source was recommended. They suggested that laparoscopic sample collection instrumentations can also be used to collect sample from thorax through thoracoscopy for diagnosis of diseases.

Walsh *et al*. (1999) compared post-operative pain and morbidity in thoracoscopy versus open partial pericardiectomy in fourteen dogs. Seven dogs had a partial pericardectomy through a standard left lateral thoracotomy at fifth intercostal space. Remaining seven dogs undertook selective lung ventilation and thoracoscopy partial pericardectomy. They used Co_2 insufflation to facilitate collapse of the lung field and maintain 8 mm Hg pressure and examine thorax by using 0^0 video scopes for thoracoscopy. They opioned that thoracoscopic partial pericardiectomy was better and significant than open surgery including decreased post-operative pain, fewer wound complications and more rapid return to function.

Cantwell (2000) evaluated One Lung Ventilation is a feasible procedure in anesthetized dogs to better facilitate thoracic procedures such as bronchopleural fistula repair and thoracoscopy.

Isakow *et al.* (2000) implemented video-assisted thoracoscopic dissection of the ligamentum arteriosum in two dogs with persistent right aortic arch. Dog was positioned in right lateral recumbency and a 10-mm rigid cannula was placed through fifth intercostal space and 0^0 thoracoscope was inserted through the cannula. Further, process was carried out by other two ports located at fourth and sixth intercostal space. They stated that, video assisted division of the ligamentum arteriosum could be performed successfully in dogs with minimal postoperative complications and hospitalization time. Single lung ventilation and thoracic insufflation was not compulsory.

Klohnen and Peroni (2000) explained thoracoscopy in horses. They recommended that most commonly used telescope was 10 mm diameter and 57 cm in length and a 150 W light source was used to viewing but 300 W xenon light for video recording. They concluded that thoracoscopy could be performed in standing position with sedation in horses under xylazine 0.5-1.1 mg/kg b.wt. or detomidine 0.005-0.02 mg/kg b.wt.

Peroni *et al.* (2000) studied cardiovascular and pleuropulmonary consequence of thoracoscopy performed in six healthy, awake and pharmacologically restrained mature horses in standing position to detect presence of postoperative complications occurred in 48 hours after thoracoscopy. They stated that, thoracoscopy performed in horses didn't showed detrimental cardiopulmonary effects and postoperative complications within the first 48 hours period.

Dupre *et al*. (2001) performed thoracoscopic pericardectomy without pulmonary exclusion in dogs. Thoracoscope was introduced into the thorax to the xyphoid process. The operating instruments were introduced at the level of the ventral third of each sixth intercostal space. The pericardium was cut and retrieved through 1 instrument port. There were no interference of lung inflation with surgical dissection and less iatrogenic trauma was found. Thoracoscopic pericardectomy offers several

advantages over open techniques in dorsal recumbency in dogs with mechanical ventilation.

MacPhail *et al.* (2001) performed thoracoscopic correction of persistent right aortic arch in 15 week old male intact dog. A 0^0, 5 mm telescope with video camera was used to perform surgery under general anesthesia. Telescope was placed through the cannula and complete thoracoscopic examination was carried out. They recommended that, thoracoscopy was a possible alternative to intercostal thoracotomy for correction of persistent right aortic arch, with advantages like less postoperative pain, excellent visualization of the ligamentum arteriosum.

Malone *et al.* (2001) performed thoracoscopic assisted diaphragmatic hernia repair using thoracic rib resection in six-year-old Dutch warm-blood horse, presented for colic due to diaphragmatic hernia and reported that, thoracoscopy alone could be adequate to determine the lesion location and subsequent surgical approach. Thoracic rib resection could provide access to diaphragmatic hernias in adult horses. Thoracoscopy or a flank incision, or both, could aid in determining which rib is best resected. However, many of the complications of the ventral approach (depth of lesion, poor exposure, and obscuring viscera) could limit flank approach.

Peroni *et al.* (2001) explained thoracoscopy with normal anatomy and surgical techniques. During thoracoscopic procedure endoscopic portal located just ventral to the serratus dorsalis muscle and below the line of local anesthesia was found suitable. They used a 30^0, 57 cm long, 10 mm diameter rigid telescope, attached to video camera and xenon light. Within 15 min. thoracoscopy was performed and all procedure was recorded and maximum part of thorax was examined and recorded. Thoracoscopy was completely successful in horses in standing positions. Further, they concluded that in horses complete examination of thorax through 10^{th} and 12^{th} intercostal space was easy and examination through 8^{th} intercostal showed discomfort to horse.

DeRycke *et al.* (2001) studied and demonstrated thoracoscopic anatomy in 4 German Shepherd dogs, positioned in lateral recumbency and reported that, veterinary operative thoracoscopy was still in the developmental stage, and opined that the trend toward minimally invasive surgery would certainly progress in the future. The images of thoracoscopic anatomy in dogs presented in their study could be guide for the operator for performing thoracoscopic surgery.

Walton *et al.* (2001) conducted video assisted thoracoscopy in dogs and cats. They indicated thoracoscopy for evaluation and visual inspection of thoracic cavity using a minimally invasive technique. They suggested that telescope used for thoracoscopy was 10 mm for large dogs breed, 5 mm telescope for medium size dogs and 2.5 mm for small dogs or cats. Hence, recommended that 0^0 viewing angle of telescope was preferred which was straightforward view which provide more natural field. Xenon light sources ranges from 175 to 300 W, the 175 W light source was adequate for small animal applications.

Daly *et al*. (2002) studied the effects of incremental positive insufflation of the intrathoracic space on cardiac output (CO), heart rate (HR), arterial pressure (AP), central venous pressure (CVP), and percent saturation of hemoglobin with oxygen (SPO2) in seven healthy anesthetized adult dogs. Observations were recorded at before introduction of thoracic catheter, at intrathoracic pressure of 0 mm Hg, 3 mm Hg, and additional increments of 1 mm Hg until the SPO2 remained less than 85%. They observed that, there was a significant decrease in SPO2 at 10 mm Hg and significant increase in CVP was noted at 6 mm Hg. There was significant decrease in heart rate at 5 to 6 mm Hg, but was not decreased above 6 mm Hg. On the basis of their findings they concluded that insufflation aided thoracoscopy could be used with caution and at the lowest possible insufflation pressure along with standard anesthetic monitoring.

Lee *et al*. (2002) conducted clinical study to determine indications and outcomes of positive-pressure ventilation (PPV) and to describe ventilator

management, and identify factors associated with outcome, in 53 cats underwent for PPV. In their study, PPV was initiated for management of respiratory failure (36 cats 68%), cardiac arrest 9 (17%), neurologic impairment 6 (11%), and nonresponsive hypotension 2 (4%). Eight cats (15%) survived, 19 (36%) died and 26 (49%) were euthanatized while undergoing PPV. They noticed that survived cats had a longer duration of ventilation than those died or which were euthanized and had a significantly higher incidence of ventilator-associated pneumonia. Cats showing no clinical evidence of pulmonary disease but required PPV because of primary neurologic disease had a higher survival rate (2/6) than cats that required PPV because of respiratory failure (5/36), cardiac arrest (1/9), or nonresponsive hypotension (0/2). Further, they concluded that, survival rate for cats requiring PPV could be lower than reported survival rates for dogs. Death was attributable to progressive respiratory failure, nonresponsive hypotension, kidney failure, or neurologic impairment.

Migliore *et al*. (2002) used thoracoscopy for diagnosis and management of pleural diseases in 39 human patients and observed that, mean operative time was 45.7 min (range, 20 to 90 min), 23 effusions were diagnosed as simple pleural disease and 16 effusions were complex. They administered talc in 28 patients. Complications reordered were intraoperative bleeding (one patient), hyperpyrexia (eight patients), and atrial fibrillation (two patients). The mean time for removal of the chest drain was 5.6 days. Further, they concluded that thoracoscopy could be effective technique for diagnosis and management of pleural diseases.

Radlinsky *et al.* (2002) studied thoracoscopic visualization and ligation of the thoracic duct in five mature dogs. In sternal recumbency three thoracoscopic ports were placed for introduction of surgical instruments. A 2.5 cm long incision was made at mid thorax in the intercostal space for placement telescope having outer diameter 8 mm, 30^0viewing angle and procedure of thoracic duct ligation was carried out. They suggested that video assisted thoracic surgery of right hemithorax could be

used to visualize and apply vascular clips to occlude the flow of lymph in the thoracic duct in normal dogs.

Brissot *et al.* (2003) treated three dogs which had bullous emphysema by thoracoscopic technique. Dogs were positioned in dorsal recumbency and 10 mm 0^0thoracoscope was used with all endoscopic equipment like endoscopic graspers, irrigation suction unit, atraumatic Babcock's forceps and surgical stapler devices. Further, they recommended that thoracoscopy was useful to scan pleural surface of the lung for bullous lesions.

Beck *et al*. (2004) conducted experimental study on evaluation of thoracoscopy for diagnosis and treatment of diaphragmatic hernias in eight dogs. They reported that, thoracoscopic surgery proved to be effective in diagnosis of disruptions, dislocations and the surgical treatment of visceral replacement and diaphragmatic suture. They further opined that, success could depend on its use in the corresponding hemithorax breakage and video-thoracoscopic access made it feasible to perform the re-positioning maneuvers of diaphragmatic abdominal structures and synthesis in diaphragmatic hernias up to a week of existence in clinically stable dogs.

Kudnig *et al.* (2004) conducted experimental study on cardiopulmonary effect of thoracoscopy in anaesthetized eight normal dogs. They compared the effect of open chest condition and thoracoscopy on oxygen delivery and recorded that there was no significant effect on hemodynamic function during open chest thoracostomy although, there was significant increase in the heart rate, mean pulmonary arterial pressure, diastolic pulmonary arterial pressure, shunt fraction, physiologic dead space etc. They also noted that, gas exchange and pulmonary distribution was less affected on thoracoscopy than open chest thoracostomy.

Lansdowne *et al.* (2005) conducted thoracoscopic lung lobectomy for treatment of lung tumors in nine dogs. They administered general anesthesia with one lung ventilation and used 5mm, 30^0 telescope for viewing and 30-60 mm

endoscopic gastrointestinal anastomosis stapler to perform thoracoscopic lung lobectomy and resulted that metastatic and primary lung tumor were resected by thoracoscopic lobectomy. They stated that thoracoscopic lung lobectomy could be performed effectively in dogs.

Biervliet *et al.* (2006) performed standing thoracoscopic pericardiotomy along with possible corticosteroids as a palliative treatment in a 5 yr old HF cow with pericardial lymphoma. They used 30^{o} rigid laparoscope with 300-W light source and was inserted through 8^{th} intercostal space. Pneumothorax achieved by inserting metal teat cannula. They reported that thoracoscopic pericardiotomy as a minimally invasive, palliative treatment for successful management of recurrent pericardial effusion of non-infectious nature in adult cow.

Kirschvink *et al.* (2006) explained the challenge of calculating inflammatory and structural changes in lower equine airways. They performed thoracoscopic guided pulmonary biopsies from various sides in standing position with sedation in heaves affected horse. They recommended that thoracoscopic guided lung biopsies provide repeatable information about remodeling associated changes.

Pollock *et al.* (2006) performed standing thoracoscopy for diagnosis of lymphosarcoma in a horse. After creation of pneumothorax 10 mm, 57 cm 30^{0} equine laparoscope attached to video camera and xenon light was inserted between 10^{th} and 12^{th} intercostal space and examine the thorax. Pale pink to white nodules over the surface of both lungs were observed.

Van (2006) studied a case of 5-year-old Holstein cow, pregnant with a valuable calf, was presented with signs of heart failure(tachycardia, peripheral edema, and distended jugular veins) related to pericardial lymphoma and associated cardiac tamponade. In addition, pleural effusion was present in both hemithoraxes. Medical treatment, which consisted of repeated pericardiosentesis, placement of indwelling pleural catheters, administration of intravenous fluid therapy, antibiotics and anti-inflammatory drugs, was ineffective in controlling recurrence of clinical signs despite

a temporary improvement. A standing thoracoscopic pericardiotomy was performed in an attempt to reduce clinical signs of heart failure and to prolong life. Clinical signs of heart failure abated and no recurrence was seen. Standing thoracoscopic pericardiotomy along with possible corticosteroids can be recommended as palliative treatment in an effort to extend life for reproductive performance in genetically valuable animals.

Abarkar *et al.* (2007) evaluated intraoperative complications in pericardiectomy with transdiaphragmatic thoracoscopic approach in 9 healthy dogs under one lung ventilation inhalation anesthesia and concluded that thoracoscopic total pericardiectomy was feasible via paraxiphoid transdiaphragmatic camera port in dog, with intensive anesthetic monitoring, gentle handling of operative instrument in thoracic cavity and good experience in thoracoscopy.

Staffieri *et al.* (2007) stated that carbon dioxide (CO2) embolism is a possible complication of capnoperitoneum during laparoscopic surgery. Experimentally induced venous CO2 embolism has been studied in pigs. In this paper we report a case of spontaneous CO2 embolism. The sudden decrease of PeCO2 and lung compliance combined with the sudden decrease in systolic blood pressure, heart rate and a poor response to resuscitation suggest a case of fatal gaseous venous embolism.

Anderson and Jean (2008) performed thoracoscopy infrequently in cattle however, the complete separation of the thorax by the mediastinum allows examination with creation of hemi pneumothorax examination of the thorax and collection of diagnostic specimens (fine-needle aspirates, biopsy) is performed and the carbon dioxide gas removed by suction. They also evaluated pulmonary abscesses and pleuritis in several adult cattle.

Relave *et al.* (2008) evaluated thoracoscopic techniques using ligating loops to obtain large lung biopsies in five standing healthy and six heaves affected horses. Pneumothorax created by using teat cannula. A 0^0 laparoscope used to evaluate the

thorax and ligating loop introduced through 12^{th} intercostal space portal and grasped the part of lung for biopsy procedure.

Dhumeaux and Haudiquet (2009) studied the efficacy of surgical stapler for lobectomy, partial lobectomy and pneumonectomy using stapling equipment in 34 dogs and 3 cats suffering from lung neoplasia by thoracotomy. They reported that stapling device could be applied with considerable traction on the lung parenchyma, to enhance access to the lesion and could be used successfully, to remove these lesions. Stapling device was advantageous in the excision of metastatic disease when the location of all lesions was not known before thoracotomy.

Mayhew *et al.* (2009) performed subphrenic pericardectomy using double lumen endotracheal intubation for alternating one lung ventilation in mature seven dogs. Left sided double lumen endotracheal tube was placed with help of 2.7mm flexible bronchoscope. A 5 mm 30^0 thoracoscope used to view the thoracic cavity and further procedure was carried out using endo surgical tools. They concluded that thoracoscopic subphrenic pericardectomy using one lung ventilation was a technically feasible procedure in healthy dogs and indication of this technique was adjunctive treatment of constructive pericarditis.

Monnet *et al.* (2009) discussed the interventional thoracoscopy in small animals and thoracoscopically assisted procedure like pericardial window and subtotal pericardiectomy. Further, they studied the transdiaphragmatic approach and intercostal approach. Surgical techniques like pericardial window, subtotal pericardiectomy, partial lung lobectomy, complete lung lobectomy, correction of persistent right aortic arch, ligation of thoracic duct, ligation of patent ductus arteriosus and treatment of pyothorax was carried out in small animals.

Schmiedt *et al.* (2009) explained small animal exploratory thoracoscopy by using standard endoscopic instrument like telescope 0^0 or 30^0. They suggested that 30^0telescope offers more flexibility and require less optical space with minimal image distortion and it was great choice for intrathoracic observation. They used 10 mm

diameter telescope for large dog breed whereas, small dogs and cats required 5 mm diameter telescope. Further, they recommended the xenon light for illumination of surgical field. They concluded that thoracoscopy by using telescope is less invasive and less complicated than open method.

Allman *et al*. (2010) conducted thoracic duct ligation and thoracoscopic pericardectomy for treatment of chylothorax in twelve dogs. They took dog on sternal recumbency tilted slightly towards left and video monitor was placed on dog's left side. Skin incision was made at midthorax in the 10^{th} intercostal space. A 5 mm outer diameter, 30^0rigid telescope was introduced through portal. Other ports were used to conduct further process by using the endo surgical instrument and concluded that thoracoscopic, thoracic duct ligation and pericardectomy was safe, feasible and effective for treatment of chylothorax in dogs.

Brisson *et al.* (2010) observed during thoracoscopic exploration, parietal pleura and mediastinum were covered by miliary white to tan nodules 1 to 3 mm in diameter. Biopsy specimens were obtained, and partial pericardiectomy was performed. Portal sites were closed routinely. Cytological evaluation of the pleural fluid revealed high protein concentration and cellularity, with cellular changes consistent with an exfoliating carcinoma.

Crumbaker *et al.* (2010) recorded a case of subtotal pericardectomy and right arterial mass resection in 10 old year female Corgi mix dog. Initially they performed pericardiosentesis and later on after one week performed thoracoscopy. They observed that no surgical complications were noted, and the dog was discharged approximately 28 hours after surgery. Histological examination indicated a grade 2 hemangiosarcoma with incomplete margins. Treatment with doxorubicin was initiated 35 days post-surgery. The dog survived for total 177 days after mass resection. They concluded that thoracoscopic right atrial mass removal combined with adjunct doxorubicin treatment may be a viable alternative to thoracotomy in dogs with right atrial masses.

Relave *et al.* (2010) studied thoracoscopic lung biopsies in twelve heaves affected horses using a bipolar tissue sealing system. A 13^{th} intercostal space was used to insert thoracoscope and other instruments inserted through 12^{th} and 15^{th} intercostal space. Ligasure vessel sealing system was used to perform thoracoscopic lung tissue biopsies. Post operatively pneumothorax was evaluated. They recommended that ligasure vessel sealing system was rapid and effective techniques to harvest peripheral lung tissues from heaves affected horses.

Lao *et al.* (2010) performed thoracoscopic repair of congenital diaphragmatic hernia in infancy. They put patient in the lateral decubitus position, utilizing three to four of 3 or 5 mm size ports for access the chest and 4 mm$HgCo_2$ was used to insufflation. They recommended that thoracoscopic congenital diaphragmatic hernia repair was safe and feasible in a variety of children.

Moore *et al.* (2010) explained thoracoscopy in cats and dogs with surgical approaches like lung biopsy, pericardiectomy, pleural biopsy, pyothorax thoracic duct ligation, pulmonary lobectomy. They concluded that, the basic instruments used for thoracoscopy is the same as for laparoscopy, with some specific variations and additions. A 30^0 viewing scope preferred to a straight viewing scope. Trocar and cannulas are also same as laparoscopy. During thoracoscopy, insufflation was not usually required.

Matyjasik *et al.* (2011) performed laparoscopic procedures in dogs and cats by using available laparoscope provide viewing angles of 0^0 to 180^0 and diameter about 1.7 mm to 10 mm. They recommended 150 W light for diagnostic and 300 W bulb for video documentation. Veress needle was a cannula with blunt end which prevent internal organ damage. Insufflator was used to produce pneumoperitoneum and CO_2 gas was most frequent used for insufflation.

Mehler *et al.* (2011) explained small animal thoracoscopy and suggested that thoracoscopy was easy to perform than laparoscopy because there were fewer organs to complicate to observation. Pneumothorax is easier than pneumoperitoneum. They

concluded that telescope with 0^0 lens obliquity also maximizes light transmission when compared with endoscopes with a balance viewing angle. Most common angled telescope used in veterinary medicine has a 30^0 angle. Thoracoscopy has many advantages like decreased pain, more rapid recovery, shortened hospital stay and more rapid return to normal activity than open method of thoracotomy.

Plesman *et al.* (2011) treated congenital persistent right aortic arch in young cat by thoracoscopy and opined that thoracoscopic ligation of PRAA in young cat of 1.5 kg was feasible and associated with minimal complications and good visualization. They concluded that, thoracoscopy had potential use for diagnosis and treatment of thoracic disorders in cat.

Jimenez *et al.* (2012) conducted that thoracoscopic foreign body removal and right middle lung lobectomy to treat pyothorax in three year old spayed female. Thoracoscopic exploration was performed using one lung ventilation. A vegetal foreign body and an abscess were observed in the distal part of the right middle lung lobe. The foreign body was removed and right middle lung lobectomy was performed. They recommended that thoracoscopy was a minimally invasive alternative to thoracotomy to explore and successfully treat some non-chronic pyothoraces in dogs, including lesions affecting the right middle lung lobe.

Turk *et al.* (2012) recorded unusual case of hydatid cyst and spontaneous hemothorax diagnosed by thoracoscopy in 54-year-oldman. They reported that video thoracoscopy could be effective tool for diagnosis and treatment of hydatid cyst.

Atencia *et al.* (2013) performed thoracoscopic pericardial window for management of pericardial effusion in dog. The animal was placed in dorsal recumbency after anesthetic protocol. Initially 6 mm cannula was placed in paraxiphoid position and 5 mm 0^0 telescopes were placed through this cannula for examination of thoracic cavity. Further, process was carried in all dogs, size of window was based on size of dog. They also evaluated the postoperative pneumothorax and resulted that thoracoscopic pericardial window was successfully

completed as a sole surgery in the majority of dogs with acceptable complication rate, less mortality, rapid surgery and relatively short hospitalization time.

Case *et al.* (2013) studied outcome evaluation of a thoracoscopic pericardial window procedure or subtotal pericardectomy via thoracotomy for treatment of pericardial effusion in 58 dogs. Dogs suffering from pericardial effusion were included in the study and underwent a thoracoscopic pericardial window procedure or subtotal pericardectomy via thoracotomy. They opioned that dogs with idiopathic pericardial effusion treated with a subtotal pericardectomy via thoracotomy had a significantly longer disease free interval and median survival time compared with dogs treated by the thoracoscopic pericardial window procedure.

Lee *et al.* (2013) performed standing thoracoscopic biopsy in two horses for diagnosis of thoracic lymphoma by using thoracoscopic biopsy. In this study 30^0 rigid telescope measuring 56cm and 10mm diameter was used. They used 13^{th} intercostal space as endoscopic port and 11^{th} intercostal spaces instrumental port. They concluded that, thoracoscopic procedure was well tolerated in standing horses and less expensive when compared with treatment in the absence of diagnosis.

Ployart *et al.* (2013) performed thoracoscopic resection of right auricular masses in nine dogs. A telescope was introduced into cannula in the transdiaphragmatic approach other two ports located at different intercostal spaces a pericardial window was created at the apex of the heart and extended towards the base. They stated that thoracoscopy was a viable minimally invasive tool in the diagnosis and management of patient with right atrial masses and allowed to definitive histopathologic diagnosis.

Guedes *et al.* (2014) evaluated cervical and transdiaphragmatic thoracoscopic approaches, in 12 healthy dogs for implementation of intrathoracic examination, placement of a chest tube and treatment of pneumothorax. They observed that transdiaphragmatic paraxiphoid and cervical approaches did not show differences between dogs subjected to pneumothorax with respect to the

physiological parameters. Further they noticed that both techniques allowed examination of the thoracic cavity according to the anatomical configuration and placement of thoracic drain successfully. However, they opined that the cervical approach as a primary access was non-safe procedure, and not recommended as a substitute for transdiaphragmatic paraxiphoid technique for insertion of thoracic drains and exploration of thoracic cavity in dogs.

Michaux *et al.* (2014) performed thoracoscopy via 9^{th} intercostal space 15 cm ventral to the transverse process of the thoracic vertebrae by using 30^{o} rigid laparoscope (diameter 10mm and length 57 cm) connected with 300 W xenon light which provided optimal visibility of structures in both left and right hemithorax. Most of structures in both the left and right hemisphere were visible from both sides except esophagus and dorsal branch of the vagus nerve, which were best observed in left hemithorax and pericardium which was best observed in right hemithorax. During the procedure, mild increase in heart rate and respiratory rate and decrease in arterial oxygen saturation and PaO_2 were moderate. They stated that all cow remained standing throughout procedure and well tolerated the procedure cow without respiratory distress.

Radlinsky *et al.* (2014) explained thoracoscopy, limitation of working within the thoracic cavity, placement of ports, approaches to the chest, and complications of thoracoscopy in cat. They opined that patient selection for thoracoscopy was generally the same as that for open thoracotomy but thoracoscopic approaches were minimized morbidity and duration of hospitalization in feline patients.

Scharner *et al.* (2014) performed thoracoscopic examination in 15 healthy HF cows by using 30^{0}, 57 cm long, 10 mm diameter rigid telescope. Each cow had four thoracoscopic examinations, two on each side. In the beginning, the left hemithorax was examined after passive lung collapse and 24 hrs later examination was performed with CO_2 insufflation, similarly right hemithorax was examined same as left hemithorax. They concluded that. CO_2 insufflation did not significantly improve

visibility within the pleural space. Esophagus, diaphragm, collapsed lung, aorta and azygos vein were readily viewed however, the pericardial region was not consistently visible. In one cow minor laceration of the lung occurred with adhesions, whereas, there were no postoperative complications were noted. Further, they opined that thoracoscopy was easier through 9^{th} and 10^{th} intercostal space as compared to 8^{th} intercostal space.

Skinner *et al.* (2014) conducted pericardioscopic imaging findings in cadaveric dogs for comparison of an apical pericardial window and sub phrenic pericardectomy. A 5 mm, 30^0 rigid Thoracoscope was introduced into subxyphoid portals. Dissection of ventral mediastinal attachment was removed with sharp instrument like 5 mm endoscopic scissors. Both hemithorax was checked for anatomical abnormalities. They noted that, all portals were placed with minimal difficulty and thoracoscopic observations were excellent. Thoracoscopic sub phrenic pericardial windows were completed successfully in every dog.

Wormser *et al.* (2014) performed thoracoscopic assisted pulmonary surgery for partial and complete lung lobectomy in dogs and cats. All patients were anesthetized with general anesthesia and positioned in lateral recumbency with the affected hemithorax uppermost. A 5 to 10 mm incision was made for insertion of 30^0 telescope about 5 to 7 rib spaces away from site of the pulmonary lesion in the dorsal third of the thorax, minithoracotomy incision was made with direct thoracoscopic visualization without use of rigid rib retractor intraoperatively lymph nodes were inspected and thoracostomy tube was placed in all patient. They recommended that, thoracoscopic assisted pulmonary surgery provide both technically and anesthetically best approach with minimally invasive thoracic surgery without one lung ventilation.

Alwen *et al.* (2015) studied portal site metastasis after thoracoscopic resection of cranial mediastinal mass in an 11 year old castrated dog.In veterinary practice more commonly performed thoracoscopic procedures include lung lobectomy, thoracic duct ligation, pericardial window procedure subtotal pericardiectomy,

ligation of patent ductus arteriosus and treatment of chylothorax. They opioned that portal site metastasis was very meager in veterinary practice.

Bleakly *et al.* (2015) performed thoracoscopic lung lobectomy for primary lung tumors in 13 dogs. Intercostal approach with three cannulas was used to perform thoracoscopy in lateral recumbency in an oblique position. Eight dogs were diagnosed with bronchoalveolar carcinoma, four with histiocytic sarcoma and one with pulmonary adenocarcinoma. They opioned thoracoscopy was safely used for the surgical treatment of primary lung tumors in dogs.

Howes *et al.* (2016) observed a case of nine-year-old Labrador retriever, presented for routine postoperative thoracic radiographs following open pericardiectomy via median sternotomy. The pericardiectomy was performed six weeks previously for the treatment of restrictive pericarditis. The dog recovered normally and had normal physiological parameters however; on radiographic examination of the thoracic cavity, they revealed a retained surgical swab. Further, they performed successful thoracoscopic assisted surgery for removal of the retained surgical swab and concluded that, thoracoscopy offered a minimally invasive option for exploration of the thoracic cavity which facilitated removal of foreign material with reduced morbidity.

Scott *et al.* (2017) reviewed video-assisted thoracic surgery for the management of pyothorax in 14 dogs presented during 2010 to 2016. They concluded that Video-assisted thoracic surgery (VATS) was feasible and applicable for the treatment of pyothorax without morbidity. Further, they recommended advanced preoperative imaging, for the selection of patient for VATS.

Villalobus *et al.* (2017) examined thorax in bovine respiratory disease affected calves, via right side dorso-caudal approach at the 5^{th} intercostal space which allowed complete examination of right-side lung within 15 minutes by using flexible endoscope without compromising calf welfare. They found dorsocaudal approach optimal for examination of lung lesion, however, discomfort was found in rigid

endoscope. Minimal complications or mortality due to thoracoscopy were observed up to 28 days after the procedure. Further, they observed that videoscope was as safe as endoscope, however, better image quality provided by endoscope.

Hartmann *et al.* (2019) performed thoracoscopic pericardiectomy associated with fully implantable catheter via thoracoscopy in the management of mesothelioma in dog. Patient was maintained in a dorsal decubitus inclined to the right. The first portal was placed through the 8^{th} left intercostal space. Under endoscopic visualization, the paraxiphoid portal was then placed. The third access (intercostal) was performed on the left side pursuing for triangulation with the previous ones. At the end of procedure they concluded that, dog suffering from mesothelioma with a history of cardiac tamponade that underwent thoracoscopic pericardiectomy with thoracoscopic implantation of a fully implantable catheter to function as a thoracic drain and was possible with thoracoscopy.

Scott *et al.* (2019) studied determination of optimal location for thoracoscopic assisted pulmonary surgery for lung lobectomy in eight cats. In lateral recumbency 5 mm, 30^0 telescopes were used. They recommended that an optimal intercostal space for a minithoracotomy incision was > 3 cm to allow removal of larger masses through ICS incision for thoracoscopic assisted lung lobectomy in cats. Further they removed tumors of large size from 2.9 and 11.4 cm through minithoracotomy incision.

2.2 Anesthesia

Mackey and Wheat (1985) explained thoracoscopic examination of equine thorax in horse. The horse was tranquilized by using acepromazine maleate and confined in surgical stocks to reduce movement during the procedure. The horses were apprehensive or in pain because of pleurities might benefit from Sedation and analgesia provided by the combination of xylazine and butorphenol. After that Skin and subcutaneous tissue and all deep layers, including the costal pleura infiltrated with local anaesthesia. Performed thoracoscopic examination of equine thorax. They

concluded that thoracoscopic examination was well tolerated by horse in standing positions.

Hendrickson *et al.* (1996) explained techniques for laparoscopic and thoracoscopic surgery in which they suggested that standing thoracoscopy could be performed under sedation by using xylazine 0.5 mg/kg IV or detomidine 0.02 mg/kg along with butorphenol 0.05 mg/kg and local anesthetic combination.

Krasna *et al.* (1996) studied complications of thoracoscopy in three hundred forty eighth procedures in human under general anesthesia. All patients were anesthetized with a double lumen tube except two ventilators depends patients. They noted that one lung ventilation was important and safe in human practice and the procedure of thoracoscopy needs the general anesthesia.

Ronald *et al.* (1996) performed selective lung ventilation during thoracoscopy and studied effect of insufflation on hemodynamics in six adult pigs those were anesthetized with telezol (2.72 mg/kg), xylazine (2.0 mg/kg) and glycopyrrolate (0.11 mg/kg) intramuscularly and maintenance with isoflurane (1 to 3%) in semi closed circuit.

Vachon and Fisher (1998) performed thirty two thoracoscopy in 28 horses in which 16 horses were affected with pleuropneumonia and 12 were affected with other thoracic affection. All the horses were divided in two groups standing with local anesthesia and recumbent position under general anesthesia. In standing group of animals they sedated by using detomidine (0.005-0.02 mg/kg b.wt) or xylazine (0.5-1.1 mg/kg b.wt) and torbugesic (0.2 mg/kg b.wt) along with infiltration of local anesthesia. Whereas, in second group general anesthesia was introduced with xylazine (1.1 mg/kg b.wt), ketamine (3 mg/kg b.wt) and diazepam (0.01 mg/kg b.wt) followed by maintenance with halothane in oxygen in semi closed system. They concluded that standing thoracoscopy by using detomidine (0.005-0.02 mg/kg b.wt) or xylazine (0.5-1.1 mg/kg b.wt) and torbugesic (0.2 mg/kg b.wt) along with

infiltration of local anesthesia was allowed to examine many organs and well tolerated by minimum restraint.

McCarthy *et al.* (1999) explained diagnostic thoracoscopy in small animals under general anesthesia and concluded that preparation of patient, anesthesia and positioning was essentially same for thoracoscopy as for standard thoracotomy.

Walsh *et al.* (1999) compared thoracoscopic versus open partial pericardectomy in fourteen dogs. Post-operative pain and morbidity was also compared. The dog was premedicated with acepromazine maleate (0.05mg/kg IM) and morphine sulfate (0.6mg/kg, IM) and general anesthesia was induced by using thiopental sodium (10 mg/kg, IV) followed by maintenance with halothane using semi closed system. They opioned that thoracoscopic partial pericardiectomy under general anesthesia with thiopental sodium was better and significant than open surgery

Isakow *et al.* (2000) performed video assisted thoracoscopic division of the ligamentum arteriosum in two dogs with persistent right aortic arch. They used hydromorphone 0.2 mg/kg of body weight and 0.2 mg/kg body weight of midazolam for sedation and propofol 4 mg/kg for induction and maintained under isoflurane 1.5% with oxygen.

Klohnen and Peroni. (2000) explained standing thoracoscopy in horses. Horse was restrained in stocks and analgesic and sedative medications are administered (xylazine 0.5 to 1.1 mg/kg of body weight) or detomidine (0.005-0.02 mg/kg of body weight) and torbugesic (0.2 mg/kg of body weight). They opined that, standing thoracoscopy was well tolerated in horse with either xylazine or detomidine sedation.

Peroni *et al*. (2000) studied pleuropulmonary and cardiovascular consequences of thoracoscopy in healthy standing horses and opined that thoracoscopy performed in healthy, awake and pharmacologically restrained horses

did not showed detrimental cardiopulmonary effects and minimal postoperative complications within the first 48 hours.

Duke (2001) explained anesthesia and restrained of the horse during laparoscopy and thoracoscopy. Concluded that detomidine @ 1.1 mg/kg and butorphenol @ 0.1mg/kg combination were found suitable for sedation and analgesia with no significant adverse effects on the cardiopulmonary system.

MacPhail *et al.* (2001) performed thoracoscopic correction of persistent right aortic arch in a dog. The dog was premedicated with morphine sulfate 0.5mg/kg body weight, subcutaneously, acepromazine maleate 0.1 mg/kg body weight, subcutaneously and atropine 0.04 mg/kg body weight, subcutaneously. They stated that anesthetic induction was accomplished with propofol 18.5 mg, IV. The dog was intubated with a 6.0 mm endotracheal tube and maintained on isoflurane through a non-rebreathing system.

Malone *et al.* (2001) performed thoracoscopic assisted diaphragmatic hernia repair using a thoracic rib resection under general anesthesia by using guaifenesin and ketamine and maintained with isoflurane in oxygen using positive pressure ventilation.

Peroni *et al.* (2001) conducted equine thoracoscopy in six horses. They used detomidine HCl 6mcg/kg single intravenous bolus and followed by a continuous intravenous infusion (0.8 mg/kg/bwt/min) for sedation and regional anesthesia for port placement.

Walton *et al.* (2001) described anesthetic techniques viz. sedation only, general anesthesia, special techniques (one lung ventilation) for video assisted thoracoscopy in animals. They concluded that general anesthesia is usually recommended with endotracheal intubation. Use of gas inhalation anesthetics and mechanical ventilation is indorsed however, is not absolutely necessary.

Radlinsky *et al.* (2002) performed thoracoscopic visualization and ligation of the thoracic duct in dogs. They premedicated the dog with an intramuscular injection of acepromazine (0.05 mg/kg), morphine (0.5 mg/kg), and atropine (0.04 mg/kg) and induced by intravenous thiopental (14mg/kg/hr) the anesthesia was maintained under isoflurane in oxygen (1 L/min) delivered through a circle breathing system and IV ringer lactated solution administered at 10ml/kg/hr throughout the anesthesia. They opined that thoracoscopy used to identify the thoracic duct and help to apply vascular clip to occlude the flow of lymph in normal dogs and minimal complications occurred in process and anesthesia was found suitable for the technique.

Brissot *et al*. (2003) performed thoracic treatment of bullous emphysema in 3 dogs that were premedicated with diazepam (0.2mg/kg IV) and morphine chlorhydrate (0.1 mg/kg SC). Anesthesia was induced with sodium thiopental (8mg/kg IV) and maintained with isoflurane in oxygen. They concluded that, the general anesthesia was suitable to thoracoscopy for treatment and diagnosis of idiopathic pneumothorax, including ease of identification of bullae and reduced postoperative pain and morbidity.

Dave *et al.* (2005) explained anesthetic implications of paediatric thoracoscopy in which local anaesthesia in older adolescents. Regional techniques include thoracic epidural anaesthesia, multiple intercostal blocks or intrapleural anesthesia, paravertebral blocade. Regional and local anaesthesia with sedation help to maintain spontaneous ventilation. General and one lung ventilation allowed the lung on the operative side to be collapsed and motionless. Which help to easy handling of instrument in thoracic cavity.

Lansdowne *et al.* (2005) performed thoracoscopic lung lobectomy for treatment of lung tumors in dogs. Dogs were administered a combination of morphine 1 mg/kg, SC, and glycopyrrolate 0.01 mg/kg SC or atropine 0.04 mg/kg SC, with or without acepromazine 0.02–0.03 mg/kg SC. Oxymorphone 0.05 mg/kg SC instead of morphine was used in 1 dog. Anesthesia was induced with propofol 1.3–3.5 mg/kg,

IV and diazepam 0.1 mg/kg in 7 dogs or midazolam 0.2 mg/kg IV in 1 dog, and in the other dog with thiopental 4 mg/kg IV and diazepam 0.4 mg/kg IV. Intraoperative IV fentanyl was used either as bolus injection 2–3 mg/kg in 7 dogs or constant rate infusion in 3 dogs at 10–20 mg/kg/h. Anesthesia was maintained using isoflurane (0.5–2.5% inspired) or sevoflurane (0.75– 2.5% inspired) in oxygen with 1-lung ventilation and positive end expiratory pressure (PEEP) in a semi-closed circle system

Biervliet *et al.* (2006) performed thoracoscopic pericardiotomy as a palliative treatment in a 5 yr old HF cow, pregnant with valuable calf, with signs of heart failure. They used local anesthesia (2%lidocaine) to desensitize the skin. They administered intranasal oxygen at 10 L/h. They opioned that, standing thoracoscopy provided optimal ease and space to handling instrument through port without any complication with less post-operative pain.

Pollock *et al.* (2006) used detomidine hydrochloride 0.01 mg/kg and 0.05 mg/kg butorphenol tartrate administered IV for standing thoracoscopy in the diagnosis of lymphosarcoma in a horse. They stated that adequate sedation was achieved with the use of detomidine.

Relave *et al.* (2008) used detomidine HCl (6mcg/kg) infusion for sedation and butorphenol (0.02 mg / kg IV) for additional anesthesia and local infiltration of lidocaine (2%) in standing position for evaluation of a thoracoscopic techniques using ligating loops to obtain large lung biopsies in standing healthy and heaves affected horses.

Mayhew *et al.* (2009) performed thoracoscopic subphrenic pericardectomy using double-lumen endobronchial intubation for alternating one-lung ventilation. Dogs were administered an IM premedication combination of hydromorphone hydrochloride (0.2 mg/kg), acepromazine maleate (0.02 mg/kg), and also atropine sulfate (0.02 mg/kg) or glycopyrrolate (0.01 mg/kg). Anesthesia was induced with thiopental sodium (8–12 mg/kg to effect IV). Initial intubation was with a single-

lumen endotracheal tube. Before placement of the double-lumen endobronchial tube, all dogs were manually ventilated by the anesthetist to a minute ventilation of 150 mL/kg (tidal volume 15 mL/kg, respiratory rate 10/min) using a standard circle system. Anesthesia was maintained using isoflurane concentrations between 1.5% and 2% in oxygen found suitable.

Schmiedt *et al.* (2009) suggested that exploratory thoracoscopy was best under general anesthesia. To increase the working space and optical space one lung ventilation or main-stem bronchial blockade was effective under general anesthesia.

Allman *et al.* (2010) used different protocols of general anesthesia for dogs and performed thoracoscopic thoracic duct ligation and pericardectomy for chylothorax in 12 dogs with early recovery.

Crumbaker *et al.* (2010) performed thoracoscopic subtotal pericardiectomy and right atrial mass resection in a ten year old spayed female. The dog was premedicated with hydromorphone 0.05 mg/kg SC and anesthesia was induced with a combination of propofol 5 mg/kg IV and midazolam 0.2 mg/kg and maintained with isoflurane in oxygen. This anesthetic protocol was suitable to carry out the thoracoscopic subtotal pericardiectomy.

Hilton *et al.* (2010) performed standing lateral thoracotomy in sixteen horses without any complication. They used combination of detomidine HCl and butorphenol tartrate @ 0.006-0.02 mg/kg IV or IM was commonly administered for sedation. Regional analgesia was achieved by 3% mepivacaine or 2% lidocaine HCl at intercostal space. They stated that standing lateral thoracotomy was performed in horses without any complications.

Piccioni *et al.* (2010) performed thoracic paravertebral anaesthesia for awake video-assisted thoracoscopic surgery in humans. The paravertebral anesthesia was achieved with 1% ropivacaine at the site of T3, T4, T5 & T6 were administered and found suitable for videos assisted thoracoscopic surgery.

Relave *et al.* (2010) sedated horses by using detomidine (6mcg/kg) infusion for sedation and butorphenol (0.02 mg / kg IV) for additional anesthesia and local infiltration of lidocaine (2%) in standing position for thoracoscopic lung biopsies in heaves affected horses using a bipolar tissue sealing system.

Lee *et al.* (2012) diagnosed thoracic lymphoma using thoracoscopy in two horses in standing position under local anaesthesia using 2% mepivacaine in the skin and deep subcutaneous tissues in the proximal portion of the intercostal spaces just ventral to the line of the epaxial vasculature. Histopathology of sample revealed sheet of neoplastic lymphocytes effacing the parenchyma of lymph node.

Atencia *et al.* (2013) premedicated the dogs by using 0.03 mg/kg methadone IM alone or in combination with 0.01 mg/kg acepromazine IM. Induced with 1 to 4 mg/kg propofol IV and standard single lumen endotracheal tube was placed and maintain using isoflurane between 1.5 to 2% in oxygen. They successfully performed thoracoscopic pericardial window for management of pericardial effusion in 15 dogs.

Chu *et al.* (2013) compared hemodynamic and inflammatory changes between transoral and transthoracic thoracoscopic surgery in 28 dogs under general anesthesia by using xylazine 10 mg/kg IM and 5mg/kg ketamine. Animal was placed on supine position and intubated with a homemade endotracheal tube into main-stem bronchus to provide single lung ventilation during surgery and maintained with 2% isoflurane. They opioned that, both techniques were comparable with respect to procedure success rate, hemodynamic impact and inflammatory changes.

Skinner *et al.* (2013) performed pericardioscopic imaging findings in five cadaveric dogs under general anesthesia and proved that pericardioscopic imaging could be beneficial in canine with improved visibility.

Michaux *et al.* (2014) performed thoracoscopies in 6 healthy adult HF cows by using local (2% lidocaine) regional anesthesia in the intercostal space for the proposed site of port placement and the ICS just cranial and caudal with, an 18 G and

3.5-inch spinal needle. They stated that standing thoracoscopic procedure was well tolerated under local anesthesia with less operatively complication.

Scharner *et al*. (2014) performed thoracoscopies in 15 HF cows in standing position where each cow had four thoracoscopic examination left and right hemithorax was examined by passive lung collapse and each portal sites were locally infiltrate with 2% procaine (15-20mL) injected locally into the subcutaneous, muscular and pleural tissues of the selected intercostal space. All cows recovered without any complication and less signs of discomfort and no local swelling or emphysema at any portals.

Wormser *et al.* (2014) used various protocols of general anesthesia in eleven dogs and cats for thoracoscopic assisted pulmonary surgery for partial and complete lung lobectomy. They concluded that thoracoscopic assisted pulmonary surgery offered more technically feasible approach from both surgical and anesthetic standpoint without necessity of one lung ventilation.

Alwen *et al.* (2015) used morphine sulfate (1 mg/kg) and atropine sulfate (0.02 mg/kg) were administered as a premedication and general anesthesia was induced with ketamine HCl (5.2 mg/kg) and diazepam (0.47 m/kg) and Robert shaw double lumen endotracheal tube was placed under endoscopic guidance and studied portal site metastasis after thoracoscopic resection of a cranial mediastinal mass in dog.

Villalobus *et al.* (2017) performed thoracoscopy for exploring bovine respiratory diseases affected thorax in 17 calves and in 2 healthy calves. Further, the procedure was performed in standing position in 17 calves and in recumbent position in two cases which were recumbent due to disease. Lidocaine 2% and adrenaline 2% were administered SC to the puncture area 15 min before the first incision. Sedation was achieved with 1 ml of xylazine IV and the skin, SC tissues and all deeper layers, including the costal pleura, infiltrated by using local anesthetic, which provided sufficient sedation and analgesia, respectively.

2.3 Radiography

Farrow (1999) explained diagnostic explanation, imaging pitfall, cognitive pitfall, supplementary imaging and problem of pattern in the bovine thoracic radiography. Concluded that, pulmonary consolidation was the foremost radiographic indicator of pneumonia and might involve some or all of an infected lobe. In severe infections, multiple lobes might be affected. In general, the ventral half of the lung was more consolidated than the dorsal half.

Lee (1974) studied radiographic examination in 42 animals and standing lateral radiographs were taken and studied normal anatomy, bovine parasitic bronchitis, extrinsic allergic alveolitis, diffuse fibrosing alveolitis, chronic pneumonia and bronchopneumonia. They concluded that, radiographic techniques utilized in obtaining standing lateral thoracic radiographs of adult bovines were found suitable. The radiological appearance of the normal bovine lung field and the features observed in bovine parasitic bronchitis, bovine Farmer's lung, diffuse fibrosing alveolitis, bronchopneumonia, chronic pneumonia and similar chronic respiratory problems in the bovine were described and illustrated and the appearances related to the pathologic changes.

Boy and Sweeny (2000) studied the characteristics of respiration (e.g., coughing, respiratory effort or distress, abdominal effort, nostril flare, open mouthed breathing, mucous membrane color, rectal temperature, evidence of external trauma, results of radiography, ultrasonography, or both were recorded in horses. They resulted that horses developed pneumothorax secondary to pleuropneumonia (17 horses), open wounds of the thorax (9), closed trauma to the thorax (7), surgery on the upper portion of the respiratory tract (3), surgery involving the thoracic cavity (1), and 3 horses had pneumothorax of unknown cause. Clinical signs included tachypnea, dyspnea, cyanosis, and lack of lung sounds on auscultation of the dorsal aspect of the thorax, fever, and tachycardia, signs of depression or anxiousness, and cough. Radiography and ultrasonography were useful to definitively diagnose

pneumothorax. Further, the concluded that, pneumothorax was bilateral in 47.5% (19/40) and unilateral in 42.5% (17/40) of horses, Horses with pneumothorax secondary to pleuropneumonia more commonly had unilateral pneumothorax (64.7% for unilateral vs 29.4% for bilateral, not specified for horse). Horses with pneumothorax secondary to pleuropneumonia were less likely to survive than horses with pneumothorax secondary to other causes (35.3 vs 69.6% survived, respectively). Concluded that, pleuropneumonia was an important cause of pneumothorax in horses. Classic clinical signs of pneumothorax may not be evident. Radiography, ultrasonography, or both may be required for diagnosis.

Nigam *et al*. (1980) diagnosed various thoracic disorders radiographically in 362 cattle and buffaloes, which accounted for 18.7% of total cases involving these 2 species. Of these 362 cases, diaphragmatic hernia accounted for about 42%, tuberculosis 18% and bronchopneumonia 15%. Other disorders included metastatic neoplasia, pericarditis with or without foreign-body involvement, hydrothorax and foreign bodies.

Tegtmeier and Arnbjerg (2000) evaluated radiology as a technique to visualize pulmonary lesions in young calves, e.g. as a selection criterion for research animals in order to eliminate animals with lung lesions prior to experimental studies of pneumonia. Five calves with acute clinical signs of pneumonia were included in a direct comparative study of radiological and post mortem findings. Also, a number of animals with no signs of pneumonia were included as controls. The study revealed good agreement between the radiological and post mortem findings. They concluded that, radiology considered as a useful objective tool to predict the presence of pulmonary lesions in young calves.

Material And Methods

3. MATERIALS AND METHODS

The study on "Evaluation of port placement approaches for thoracoscopic examination in cattle" was carried out in the Department of Veterinary Surgery and Radiology, Collage of Veterinary and Animal Sciences, Udgir.

The present clinical study was conducted on twelve clinical cases with the history of chronic cough, anorexia, dyspnea, exercise intolerance, labored breathing, nasal discharge etc. These animals were randomly divided into two equal groups for thoracoscopy based on the placement of port, in group I animals port was created dorsally in 9^{th} and 10^{th} intercostal space of right and left hemithorax and in group II placement of port was created ventrally in 7^{th} and 8^{th} intercostal space of right and left hemithorax. The thoracoscopy was carried out to evaluate the different port placement positions for thoracoscopic examination in cattle and to study the physio-biochemical parameters in cattle undergoing thoracoscopy.

The details of animals included in the study with respect to breed, sex, age, weight and clinical symptoms are shown in Table 3.1 and 3.2.

Table 3.1: Details of the animal from group I and group II

Sr. No.	Breed	Sex	Age (yrs.)	Body wt. (kgs)
Group I				
1.	Deoni	Female	10	300
2.	Holstein Friesen	Female	6	400
3.	Red Kandhari	Male	12	420
4.	Khillar	Male	8	400
5.	Non-Descript	Female	9	300
6.	Deoni	Male	2	250
Group II				
1.	Non-Descript	Male	6	300
2.	Non-Descript	Male	7	380
3.	Deoni	Male	7	400
4.	Red Kandhari	Male	10	390
5.	Non-Descript	Female	6	350
6.	Deoni	Female	10	370

Table 3.2: Details of the clinical symptoms observed in animals from group I and group II

Sr. No.	Breed	Sex	Clinical symptoms
Group I			
1.	Deoni	Female	Anorexia and nasal discharge
2.	Holstein Friesen	Female	Anorexia, nasal discharge, chronic cough and dyspnea
3.	Red Kandhari	Male	Anorexia, nasal discharge, exercise intolerance and dyspnea
4.	Khillar	Male	Anorexia, nasal discharge and labored breathing
5.	Non-Descript	Female	Anorexia and nasal discharge
6.	Deoni	Male	Anorexia, nasal discharge, dyspnea and exercise intolerance
Group II			
1.	Non-Descript	Male	Anorexia, nasal discharge and exercise intolerance
2.	Non-Descript	Male	Anorexia and nasal discharge
3.	Deoni	Male	Anorexia, nasal discharge, exercise intolerance and chronic cough
4.	Red Kandhari	Male	Anorexia and nasal discharge
5.	Non-Descript	Female	Anorexia and nasal discharge
6.	Deoni	Female	Anorexia, nasal discharge and exercise intolerance

3.1 Preparation of animal

All the animals were prepared for the thoracoscopy by fasting for at least 24 hours and water was withheld for 12 -18 hrs. After thoracoscopic examination of left hemithorax, the feed was allowed to the animal for 12 hrs and again feed was withheld for 12 hrs before right hemithorax examination (Michaux *et al*., 2014).

The approximate weight of each animal was calculated for administration of premedication such as, Inj. Meloxicam[1] @ 0.5 mg/kg b.wt. IM and Inj. Cefoperazone and sulbactum[2] @ 10 mg/kg b.wt. IM. The clinical status of the animals were assessed by recording heart rate, respiratory rate and rectal temperature. The surgical

[1]Melonex -Intas Pharmaceuticals Ltd., Ahmedabad – 388 630, India.
[2] Pathocef - Zydus Animal Health, Division of Cadila Health Care Ltd., Ahmedabad – 380 015, India.

site was prepared ascetically by scrubbing and shaving extending caudally from the caudal border of scapula to the 13th rib and ventrally from dorsal midline to the level of the elbow joint from left (Plate 3.1) and right hemithorax. All port sites were marked by applying sterile piece of surgical tape with label viz. (7th ICS, 8th ICS, 9th ICS and 10th ICS). Window was created on sterile drape at the marked portal site and sterile drape fixed to the skin by adhesive tape to cover the thorax and abdomen.

3.2 Radiographic examination of thorax:

All the animals (group I and II) incorporated in the study from cattle exhibiting clinical symptoms like of chronic cough, exercise intolerance, dyspnea, anorexia with respiratory problem, labored breathing and nasal discharge were subjected to the radiographic examination of thorax before and 24 hrs after thoracoscopy to evaluate thoracic abnormalities and pneumothorax if any.

The thoracic radiograph from group I and II animals were recorded with 800 mA x-ray machine[3] the forelimb was pulled cranial, to avoid elbow to overlap the area of exposure in right lateral recumbancy. The exposure factors for radiographic examination were adjusted according to the thickness of chest of animal. The exposure factors used for the study were 20-60 mAs, 90-100 KVP at a film focal distance of 90–110 cm. The cassette (14″X17″) after radiography was processed with computed radiographic system[4].

3.3 Patient positioning

The thoracoscopic procedures were carried out in standing position of all the animals of group I and II, to avoid the risk associated with general anesthesia and development of tympany in lateral position. Animals were restrained in travis (Plate 3.2) for safety of instrument, surgeons and also to restrict the unnecessary movement

[3] Siemens X-Ray Unit Polydoros, LX I tube, Germany
[4] Konica Minolta Inc, Regius Model 210, 1 Sakura-Machi, Hino-Shi, Tokyo-191-8511, Japan

of animals during thoracoscopy. The tail was secured to prevent contamination of the operative field.

3.4 Anaesthesia for thoracoscopy

3.4.1 Standing sedation

All the animals from group I and II were administered Inj. Butorphanol tartrate[5] @ 0.05 mg/Kg b.wt. IV for standing sedation.

3.4.2 Local infiltration

In group I animals five mins later as the animal showed calmness and standing restraint, dorsal portal site at the 15 cm ventral to transverse process of thoracic vertebra in 9th and 10th intercostal space was infiltrated with Inj. Lignocaine HCl[6] 2% locally into the subcutaneous, muscular and pleural tissues for local analgesia in left and right hemithorax (Plate 3.3 and 3.4).

Similarly, in group II animals ventral portal site at the 30-35 cm ventral to transverse process of thoracic vertebra between 7th and 8th ICS (Plate 3.5 and 3.6) were anesthetized locally with Inj. Lignocaine HCl 2% in both hemithorax.

3.5 Instruments used for thoracoscopy[7]

1. Laparoscopic tower (Plate 3.7).
2. Ternamian endo tip cannula 11 mm diameter and working length 15 cm (Plate 3.8)
3. Hopkins telescope 0^0, 10 mm diameter, 57 cm long (Plate 3.9).
4. Advanced image and data archiving system control NEO, 20046120, (Plate 3.10)

[5] Butrum – Aristo Pharmaceuticals Pvt. Ltd. Mandideep - 462 046 Dist. Raisen, M.P., India
[6] Xylocaine 2% – German remedies Khatraj Dist. Gandhinagar -382220, Gujarat, India
[7] Karl Storz GmbH & CO. KG, 785332, Tuttligen, Germany

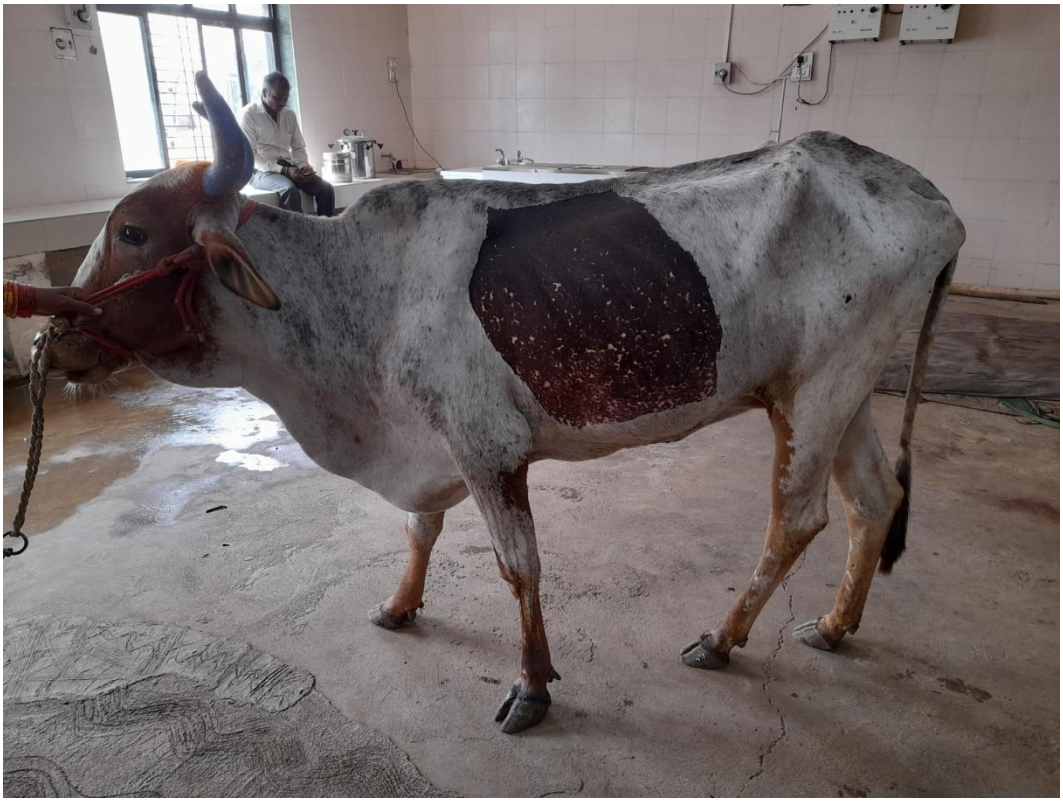


Plate 3.1: Surgical site prepared ascetically by scrubbing and shaving extending caudally from the caudal border of scapula to the 13th rib and ventrally from dorsal midline to the level of the elbow joint of left hemithorax of group I animal

Plate 3.2: Animal restrained in travis for thoracoscopy from group I

Plate 3.3: Local infiltration with Inj. Lignocaine HCl 2% at the dorsal port of left hemithorax in 10th intercostal space of group I animal

Plate 3.4: Local infiltration with Inj. Lignocaine HCl 2% at the dorsal port of right hemithorax in 9th intercostal space of group I animal

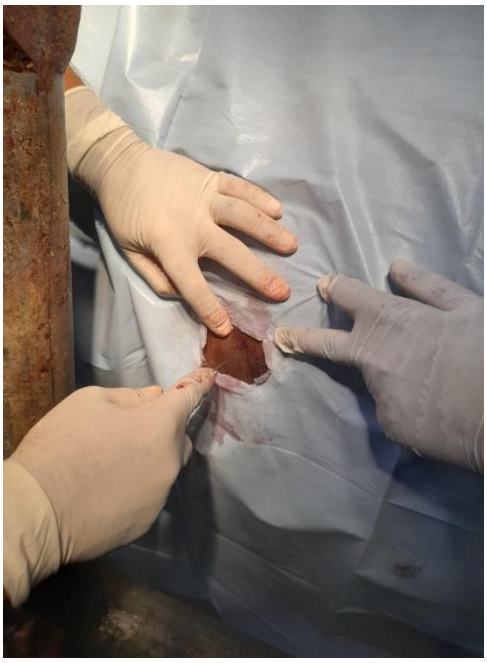


Plate 3.5: Local infiltration with Inj. Lignocaine HCl 2% at the ventral port of left hemithorax in 7th intercostal space of group II animal

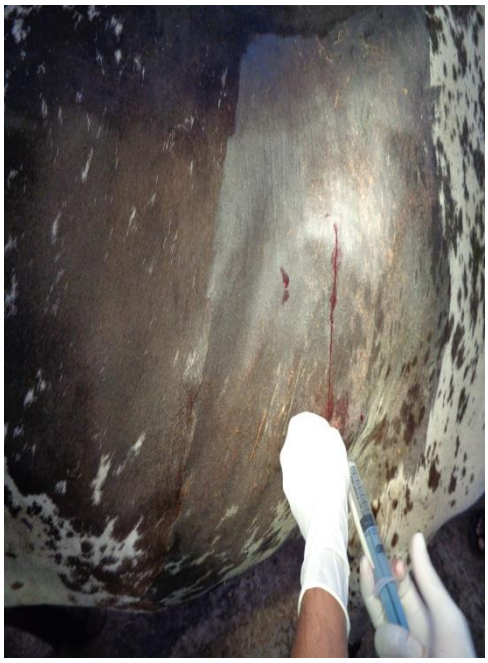


Plate 3.6: Local infiltration with Inj. Lignocaine HCl 2% at the ventral port of right hemithorax in 8th intercostal space of group II animal

Plate 3.7: Laparoscopy tower used for thoracoscopy in group I and II animal

Plate 3.8: Ternamian endotip cannula 11 mm diameter, 15 cm long used during thoracoscopic examination of group I and II animals

Plate 3.9: Hopkins telescope 0^0, 10 mm diameter 57 cm long used during thoracoscopic examination of group I and II animals

5. Fiber optic light cable size 4.8 mm diameter, length 250 cm (Plate 3.11)
6. Xenon nova cold light fountain 175 W (20131520) (Plate 3.12).
7. Veterinary video camera III (69236020) (Plate 3.13)
8. Sony LCD colour television 22" (Plate 3.14)
9. Samsung LCD monitor 18.5" (Plate 3.14)
10. Suction unit, vet pump 2 (69321620) (Plate 3.15).
11. Clickline forceps and scissors (Plate 3.16)
12. Autocon II 80, electrocautery (20530820) (Plate 3.17)

3.6 Sterilization of instruments

All the thoracoscopic instruments required were sterilized by activated glutaraldehyde solution[8] (Plate 3.18) for 20 min, in a stainless steel (304/18/8 medical grade) laparoscopic sterilization tray[9] (Plate 3.19) long enough to immerse the instruments completely without damaging the tip of the instruments. All the instrument after 20 mins of sterilization, rinsed with sterile water to remove the glutaraldehyde residue and the sterile instruments were kept in acrylic formalin chamber[10] (Plate 3.20) for vaporized formalin tablets[11] (Plate 3.21) to maintain the sterility of the instruments throughout the procedure.

3.7 Port sites for thoracoscopy

Standardization of port placement was done by dividing the thorax in four region viz. left dorsal, right dorsal, left ventral and right ventral. Accordingly, dorsal port placement was created at the 15 cm ventral to transverse process of thoracic vertebra in 9^{th} and 10^{th} intercostal space of left hemithorax (Plate 3.22) and right hemithorax. In both the procedures of left and right thoracoscopy the 24 hrs interval

[8] Cidex solution, Johnson and Johnson Limited, Baddi – 173 205, Himchal Pradesh.
[9] Cidex tray, SS Medical Grade DIC brand, Dipak, Salem, Tamil Nadu
[10] Acralycic Formaline Chamber, Size 65 X 21 X 21 Cm, Latur, MS (India)
[11] Tablet Formalin, Sigma International, Asaf Ali Rd, New Delhi – 110 002 (India)

was maintained to minimize the effect of procedure on cardiovascular and pulmonary functions in animals of group I and II (Table 3.3).

Table 3.3: Thoracoscopic port placement from group I and group II animals

ICS port placement sites				
Group I	(n=06)	Dorsal hemithorax	Left	15 cm ventral to transverse process of thoracic vertebra in 9th and 10th ICS
			Right	
Group II	(n=06)	Ventral hemithorax	Left	30-35 cm ventral to transverse process of thoracic vertebra in 7th and 8th ICS
			Right	

Whereas, in group II animals the port placement was created at 30-35 cm ventral to transverse process of thoracic vertebra in 7th and 8th intercostal space of left hemithorax and right hemithorax (Plate 3.23) similarly as per group I, 24 hrs interval was maintained in both the procedures of left and right thoracoscopy (Table 3.3).

3.8 Thoracoscopy procedure

Thoracoscopic examination was carried out as per standard method described by Michaux *et al*. (2014) in group I and group II animals. After local analgesia, one cm skin was incised in the selected intercostal space through which scope was introduced. The subcutaneous tissue and a portion of the underlying intercostal muscle layers were also incised. A nine cm long stainless steel teat cannula with a blunt end was inserted into the incision at the cranial aspect of the caudal rib to avoid trauma to the neuromuscular bundle. The teat cannula was inserted (Plate 3.24) until it entered the pleural cavity as determined by the whistling sound (Audio clip 01) of air passing through the cannula into the pleural cavity. After sound of air was completely stopped, teat cannula was replaced with 15 cm long 11 mm diameter trocar cannula unit (Plate 3.25). A 57 cm, 0^0 rigid telescope with diameter 10 mm was introduced (Plate 3.26) into pleural cavity through cannula. The telescpoe was connected to a video camera and optic fiber cable for transmission of light and recording was started.

Plate 3.10: Advance image and data archiving system used during thoracoscopic examination of group I and II animals

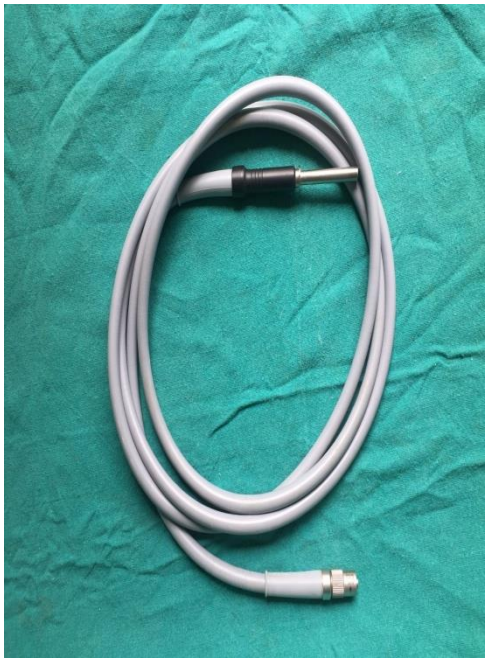


Plate 3.11: Fiber optic light cable size 4.8 mm diameter length 250 cm used for transmission of light to the telescope during thorascopy examination of group I and II animals

Plate 3.12: Xenon nova, cold light fountain 175 W used for illumination during thoracoscopic examination of group I and II animals

Plate 3.13: Veterinary video camera III used for capturing the images and video during thoracoscopic examination of group I and II animals

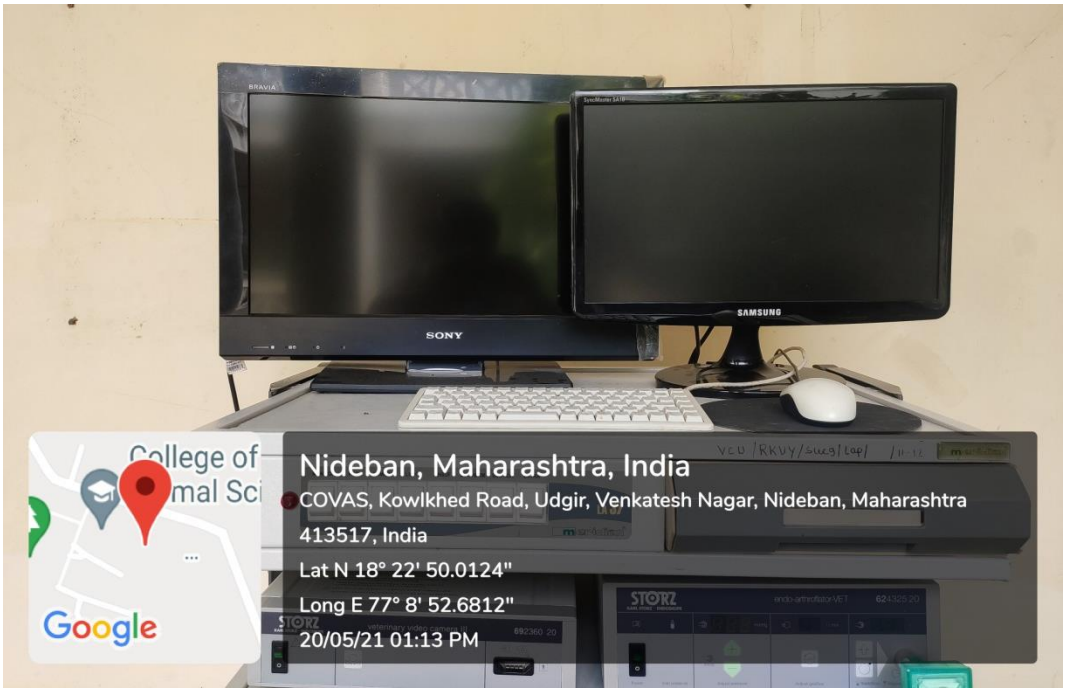


Plate 3.14: Sony LCD colour television 22” (left) and Samsung LCD monitor 18.5” (right) used for visualization of structures during thoracoscopic examination of group I and II animals

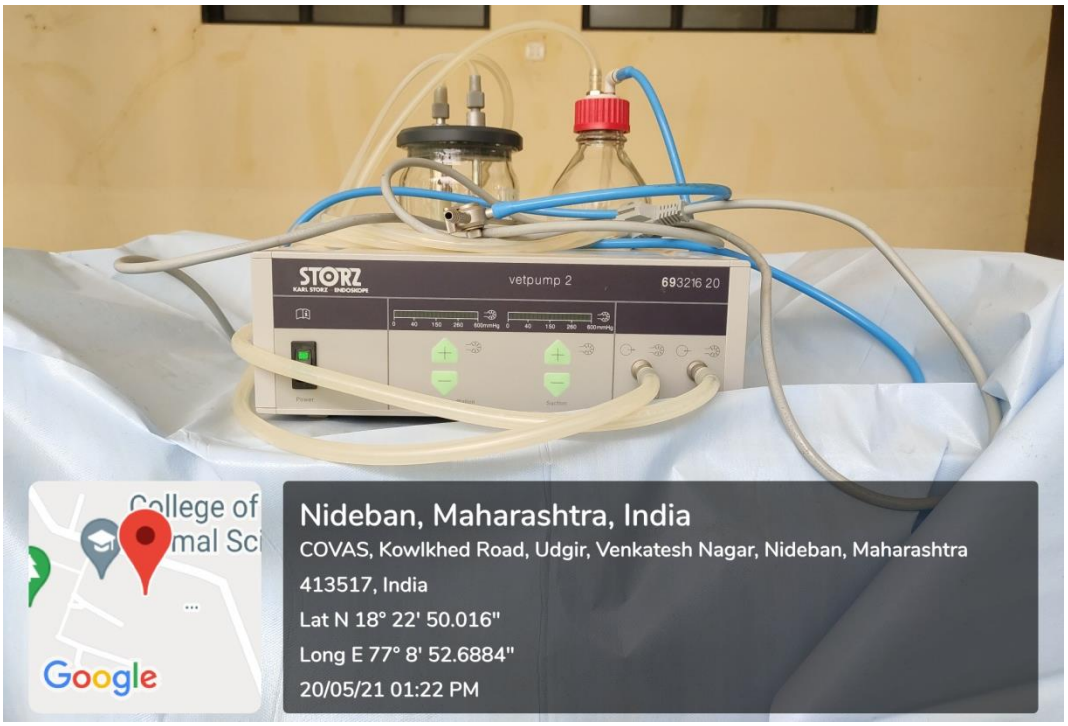


Plate 3.15: Suction unit, vet pump 2 used for suction of fluid during thoracoscopic examination of group I and II animals

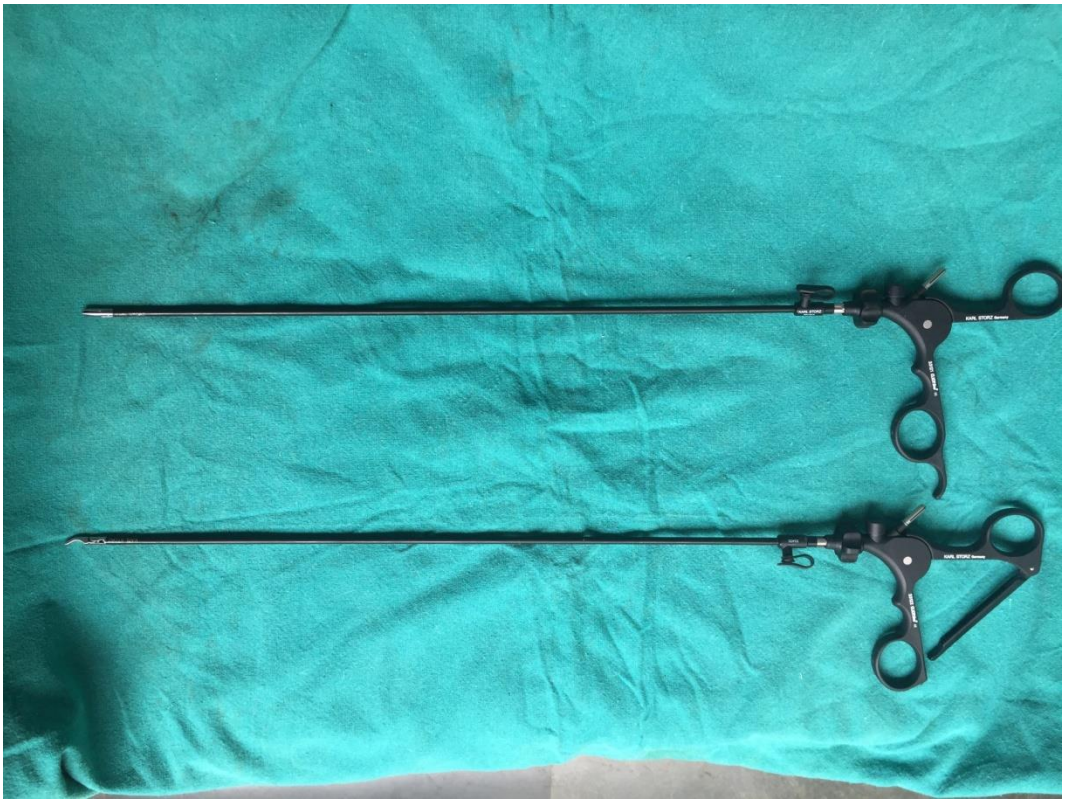


Plate 3.16: Clickline forceps (upper) and scissors (lower) used during thoracoscopic examination of group I and II animals

Plate 3.17: Autocon II 80, electrocautery used during thoracoscopic examination of group I and II animals

Plate 3.18: Cidex solution used for sterilization of instruments before thoracoscopic examination of group I and II animals

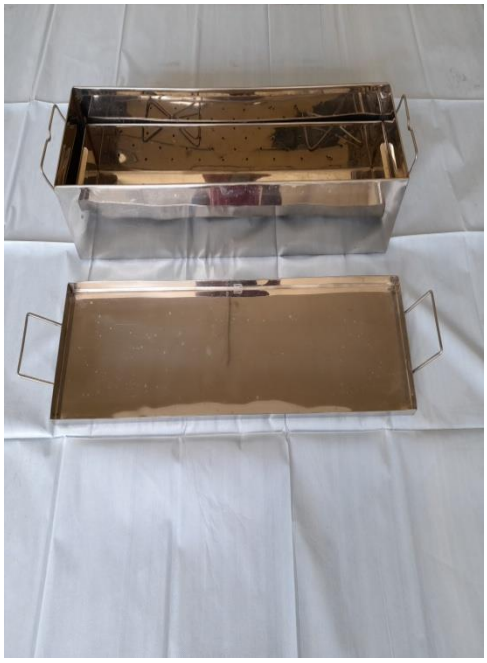


Plate 3.19: Cidex tray used for sterilization of instruments before thoracoscopic examination of group I and II animals

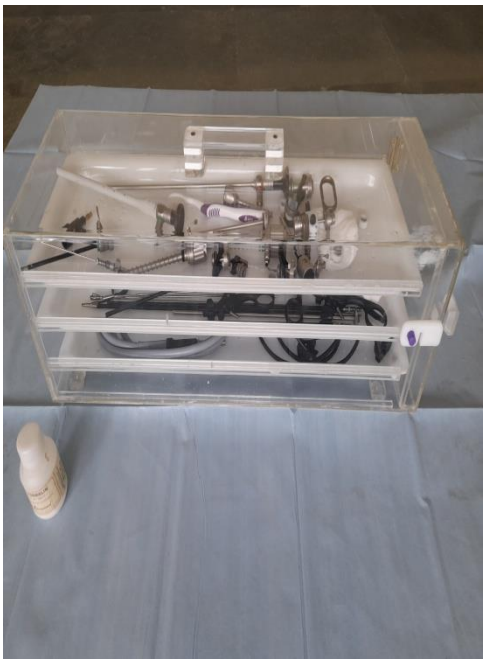


Plate 3.20: Acrylic formalin chamber used for storage of sterile laparoscopic instruments during thoracoscopic examination of group I and II animals

Plate 3.21: Formalin tablets used for sterilization of chamber during and after thoracoscopic examination of group I and II animals

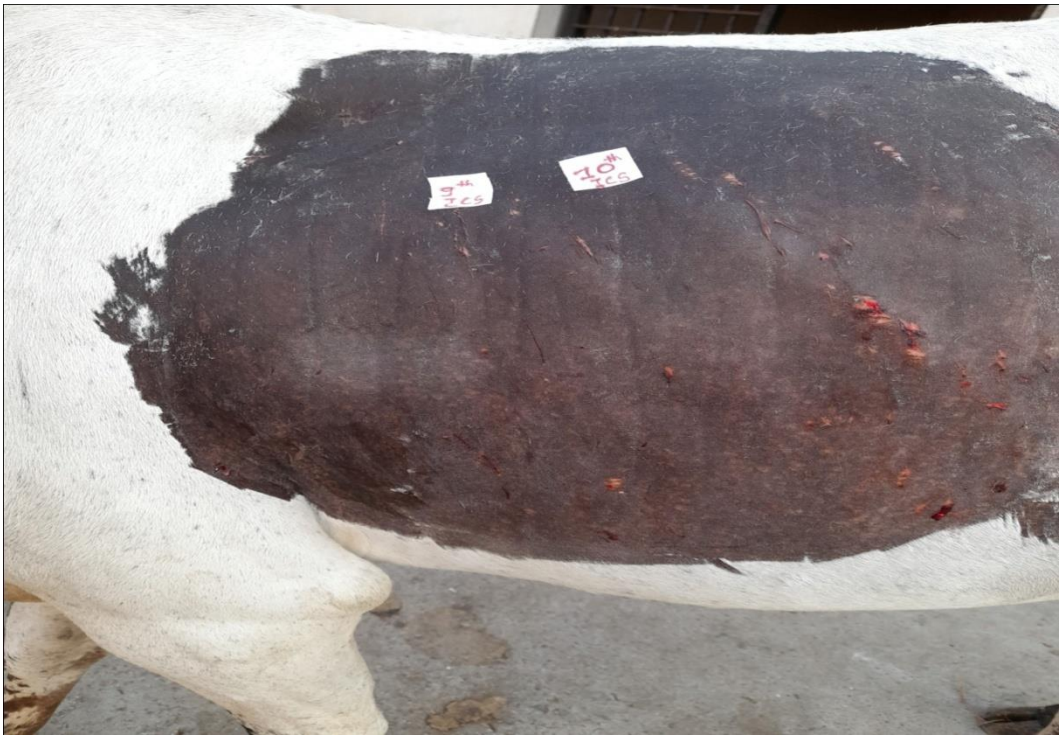


Plate 3.22: Marking of dorsal port placement from left hemithorax of group I animal

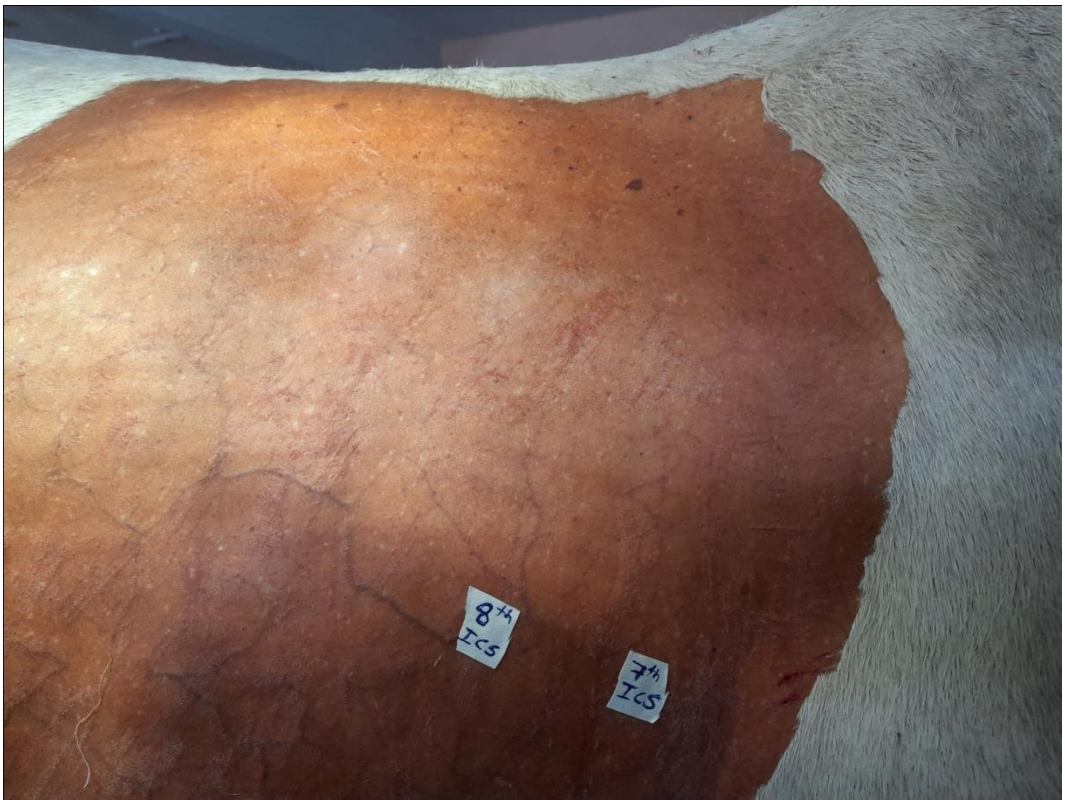


Plate 3.23: Marking of ventral port placement from right hemithorax of group II animal

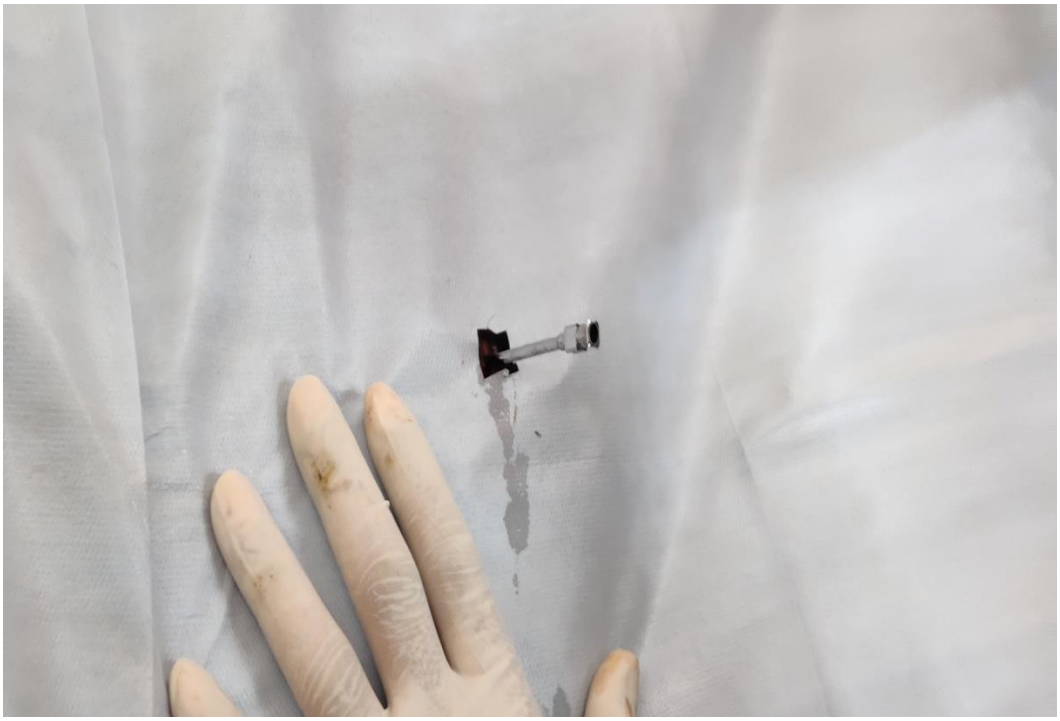


Plate 3.24: Placement of teat cannula in the plural space of 9th ICS of left hemithorax from group I animal

Plate 3.25: Placement of Ternamian endotip cannula in the plural space of 9th ICS of left hemithorax from group I animal

Plate 3.26: Thoracoscopic examination and recognition of anatomic structures from group I animal through 9th ICS of left hemithorax.

Thoracoscopic examinations from group I animals were started through left dorsal hemithorax 15 cm ventral to transverse process of thoracic vertebra in 9th ICS then followed by 10th ICS, all visible structures were identified and noted, whereas, contralateral thoracoscopic examination was performed in the same manner after 24 hrs of initial procedure in the 9th and 10th ICS (Table 3.4).

Table 3.4: Thoracoscopy from group I and group II animals

Particulars	Procedure	Portal sites	
Group I (n=06)	Thoracoscopy	Left	Dorsal hemithorax 15 cm ventral to transverse process of thoracic vertebra in 9th and 10th ICS
		Right	
Group II (n=06)		Left	Ventral hemithorax 30-35 cm ventral to transverse process of thoracic vertebra in 7th and 8th ICS
		Right	

In group II animals, the ventral ports were created through left ventral hemithorax, 30-35 cm ventral to transverse process of thoracic vertebra in 7th and 8th ICS, all visible structures were identified and noted and similar procedures were repeated on the right hemithorax after 24 hrs.

In group I and II animals, after examination of dorsal and ventral port the procedures were recorded and saved on the advanced image and data archiving system in DICOM format.

3.10 Termination of procedure

In all the animals of both groups at the end of the procedure the cranial port site wound was sutured by cruciate technique, and while removing the scope from the caudal port site suction was applied @80 to 120 mm Hg to resolve the pneumothorax the telescope was removed from the port just before the lung came into contact with the scope and surgical wound was sutured with cruciate technique by using sterilized nylon. Each animal from group I and II were shifted to separate IPD ward within 15 *min*s after procedure under observation and complications if any were recorded.

3.11 Post-operative Care

Postoperatively all the animals from group I and II were administered with broad spectrum antibiotic Inj. Cefoperazone and sulbactum @ 10 mg/kg IM and inj. Meloxicam @ 0.5 mg/kg IM once daily for five days. The surgical wound was dressed daily with povidone iodine and applied povidone iodine ointment. Clinical and routine observations of operated cases were noted and complications if any were recorded.

3.12 Parameters

3.12.1 Port placement

a) Ease of port placement

Group I and group II animals were evaluated for ease of port placement among the entire port site i.e. dorsal and ventral at selected location in both hemithorax was recorded.

b) Ease of approaching organs

During thoracoscopy of both hemithorax, the approached organs through dorsal 9^{th} and 10^{th} ICS and ventral 7^{th} and 8^{th} ICS port were listed from both the groups of animals.

c) Anatomical structures observed

From group I and group II animals the different anatomical structures from both hemithorax were observed from dorsal 9^{th} and 10^{th} ICS and ventral 7^{th} and 8^{th} ICS. Further, anatomical structures observed were recorded to illustrate anatomy of the thoracic cavity of cattle through thoracoscopy.

3.12.2 Physiological parameters:

Physiological parameters from group I and group II animals at 15 min before procedure, during procedure at 10 min (after 10th ICS from group I and 8th ICS from group II animals) and 24 hrs after procedure with the help of multipara patient monitoring unit[12] were recorded. Heart rate, respiratory rate and hemoglobin oxygen saturation were monitored on multipara patient monitoring unit. Hair was shaved from left and right elbow of forelimb and stifle fold of the left limb for ECG probe to record the HR. SpO_2 probe was placed on the non-pigmented area of the ear pinna by thoroughly de-waxing.

a) Heart rate (HR)

The heart rate was recorded by multipara patient monitoring unit and expressed in beats/min.

b) Respiratory rate (RR)

The respiratory rate was recorded by multipara patient monitoring unit and expressed in breaths/min.

c) Haemoglobin oxygen saturation (SpO2)

Haemoglobin oxygen saturation was measured by multipara patient monitoring unit. The values were expressed in %.

3.12.3 Peri-operative/post-operative complications

a) Subcutaneous emphysema

Peri-operative or post-operative sub cutaneous emphysema if any, developed at any of the portal site was recorded.

[12] BM5 Vet, Bionet America, INC. USA

b) Discomfort to the patient

Discomfort to the patient if any, was noted during and after the thoracoscopy.

c) Complication if any

The complications viz. intra/extra thoracic hemorrhages, pneumothorax, pneumonia, pleuritis, lung collapse, lung lacerations, post-operative air leak etc. during and after the procedures were recorded from each animal.

3.12.4 Biochemical parameters

A total 3 ml of blood was collected aseptically from jugular vein before sedation, during procedure at 10 min and 24 hours after recovery from each animal of group I and Group II in a plain vial for serum biochemistry.

a) Aspartate aminotransferase (AST)

Aspartate aminotransferase was estimated by Semi-Automatic Clinical Chemistry Analyzer, Model RX 50V made by Micro Lab Instruments, Ahmedabad, India using the diagnostic kits manufactured by Tulip diagnostic (p) Ltd, Mumbai, India and values were expressed in IU/L.

b) Alanine aminotransferase (ALT)

Alanine aminotransferase was estimated by Semi-Automatic Clinical Chemistry Analyzer, Model RX 50V made by Micro Lab Instruments, Ahmedabad, India using the diagnostic kits manufactured by Tulip diagnostic (p) Ltd, Mumbai, India and values were expressed in IU/L.

c) Alkaline phosphatase (ALKP)

Alkaline phosphatase was estimated by Semi-Automatic Clinical Chemistry Analyzer, Model RX 50V made by Micro Lab Instruments, Ahmedabad, India using the diagnostic kits manufactured by Tulip diagnostic (p) Ltd, Mumbai, India and values were expressed in IU/L.

d) Blood urea nitrogen (BUN)

Blood urea nitrogen was estimated by Semi-Automatic Clinical Chemistry Analyzer, Model RX 50V made by Micro Lab Instruments, Ahmedabad, India using the diagnostic kits manufactured by Tulip diagnostic (p) Ltd, Mumbai, India and values were expressed in mg/dL.

e) Serum creatinine

Serum creatinine was estimated by Semi-Automatic Clinical Chemistry Analyzer, Model RX 50V made by Micro Lab Instruments, Ahmedabad, India using the diagnostic kits manufactured by Tulip diagnostic (p) Ltd, Mumbai, India and values were expressed in mg/dL.

3.13 Statistical analysis

The data of this research study was statistically analysed using complete randomized design one way analysis of variance (ANOVA) for physiological and biochemical parameters as per Snedecor and Cochran (1980).

Result And Discussion

4. RESULTS AND DISCUSSION

The clinical study entitled "Evaluation of port placement approaches for thoracoscopic examination in cattle" was undertaken on twelve clinical cases referred to the Department of Surgery and Radiology, College of Veterinary and Animal Sciences, Udgir.

Twelve clinical cases of cattle with history of chronic cough, anorexia with respiratory problem, dyspnea, exercise intolerance, labored breathing, nasal discharge were included in the study. Different port placement approaches for hauling out thoracoscopic examination with respect to anatomical structures and to study the physio-biochemical parameters in cattle undergoing thoracoscopy were evaluated in this study

4.1 Fasting of cattle

In the present study, animals from group I and group II didn't show any untoward complications during thoracoscopy due to fasting for 24 hours and withholding water for 12-18 hrs. After examination of first hemithorax, feed was allowed to the animal for 12 hrs and again feed was withheld for 12 hrs before next hemithorax examination, this pattern of feeding decreased ruminal atony as well as distension associated with sedation and also, minimized the pressure of the rumen on the diaphragm during thoracoscopy similar, findings were in accordance with Michaux *et al.* (2014) and no any complications were noted.

Further, Michaux *et al.* (2014) noted that the 12 hrs feed restriction period allowed insufflation of sufficient amount of air into the hemithorax of cows to view ventrally located structures. Similarly, fasting of 12 hrs in all the animals of group I and group II visualized ventrally located structures very well without insufflation in this study. However, passive pneumothorax was well created without complications

hence, fasting of cattle for 12 hrs before each hemithorax was found suitable in both the groups.

4.2 Radiographic examination

All the animals (group I and II) incorporated in the study from cattle exhibiting clinical symptoms like of chronic cough, exercise intolerance, dyspnea, anorexia with respiratory problem, labored breathing and nasal discharge were subjected to the radiographic examination of thorax before and 24 hrs after thoracoscopy to evaluate thoracic abnormalities and pneumothorax.

Radiographic examination in right lateral recumbency was performed preoperatively and 24 hrs of last procedure of thoracoscopy. Radiography before thoracoscopic procedure was helped to diagnose and to correlate the signs and symptoms of patient with previous associated history. Isakow *et al*., (2000) taken thoracic radiograph prior to surgery to confirm no evidence of pneumonia in dogs for video assisted thoracoscopy and an enlarged cardiac silhouette with varying degrees of pleural effusion was seen in the thoracic radiographs in all dogs.

Jackson *et al*. (1999) included thoracic radiography as presurgical diagnostic procedure for thoracoscopic partial pericardiectomy in dogs. Anderson and Jean (2008) stated that radiographic examination was indicated when physical examination had isolated the disease to specific area however, not sufficiently determine the nature or severity of the disease and radiograph was useful to identify lesions to the a specific segment of the respiratory system.

Radiographic examination had included 4 standard views of the lungs, cranioventral, caudoventral, craniodorsal, caudodorsal (Masseau *et al*., 2008). In the animals of both groups showed mild to moderate lung consolidation in lungs during pre-operative radiographic examination. Farrow (1999) mentioned that consolidation was the foremost radiographic indicator of pneumonia and might involve some or all of an infected lobe. In severe infections, multiple lobes may be affected. In general,

the ventral half of the lung was more consolidated than the dorsal half and also suggested that, this sign had proven to be a consistently reliable indicator of pneumonia in cattle.

In group I two animal, Khillar bullock and Deoni bull showed widely spread homogenous increased density of lung field specially in the ventral thorax and perivascular infiltration with loss of vascular markings and the cardiac shadow was indistinct and diaphragmatic line was hazy in pre-operative radiographs that indicated the hydrothorax (Plate 4.1 and 4.2) and it was confirmed during thoracoscopy.

Nigam *et al*. (1980) reported that 0.41% incidence of hydrothorax in bovine thoracic disorders. Thoracic radiography in large animals was thorough and limited to lateral view and information obtained was valuable to define the thoracic disorder in bovines (Nigam *et al*., 1980). Disease processes involving lungs were more common in cattle than buffalo.

Post thoracoscopic radiographic examination was carried out in all animals of group I and II and no incidence of pneumothorax was observed. The complications viz, pneumothorax, pneumonia, pleuritis, lung collapse, lung lacerations, post-operative air leak etc. were not found in any animal of group I and II animals. Similarly, Scharner *et al*. (2013) noted no incidence of residual pneumothorax 24 hrs after the last thoracoscopic examination. No incidence of pneumothorax was found in this study. Relave *et al*. (2008) reported higher incidence of pneumothorax 95.45% post operatively and resolved spontaneously within 3 weeks.

Loddenkemper (1998) suggested that in human patient an absolute prerequisite for thoracoscopy was the presence of an adequate pleural space. If not present, a pneumothorax was induced, immediately or the day before thoracoscopy under radiographic control in contrast to this no such complications was found in the present study.

4.3 Standing position

All the thoracoscopy procedures in both the groups were carried out in standing position. McDonell, (1996) stated that many physiological considerations applicable to horses with regards to respiratory system were also applied to cattle therefore, standing sedation was planned in this study for thoracoscopic examinations and were well tolerated by all the animals of group I and II. Vachon and Fischer (1998) suggested that standing thoracoscopy offers good access to the dorsal and lateral structures of the thorax except ventral structures, whereas, ventral structures and diaphragmatic surface of lung lobe were approached under general anesthesia in either lateral or dorsal position in horse. However, McCarthy (1999) stated that position and technique selected were based on the needs of the individual animal, not on superiority of one technique over the other.

Whereas, standing thoracoscopy was performed in bovines without complications by Michaux *et al.* (2014) and Scharner *et al*. (2013). Further, they opined that thoracoscopy could be safely performed in cattle under sedation in standing position.

Similarly, standing thoracoscopy was performed in horses by Peroni *et al*. (2000), Peroni *et al*. (2001), Hilton *et al*. (2010) and Lee *et al.* (2012). Further, they suggested that thoracoscopy was well tolerated in standing position in horses with minimal complications. However, Radlinsky *et al*. (2002) performed thoracic duct visualization and ligation in dog in sternal recumbency under general anesthesia for allowing the lungs to gravitate ventrally when pneumothorax was created.

Further, Schmiedt (2009) suggested that to increase the optical and working space and improve visualization, in lateral recumbency, one lung intubation or main stem bronchial blockade was effective in small animals, whereas, patients were positioned in dorsal, lateral or sternal recumbency depending on the specific region of interest.

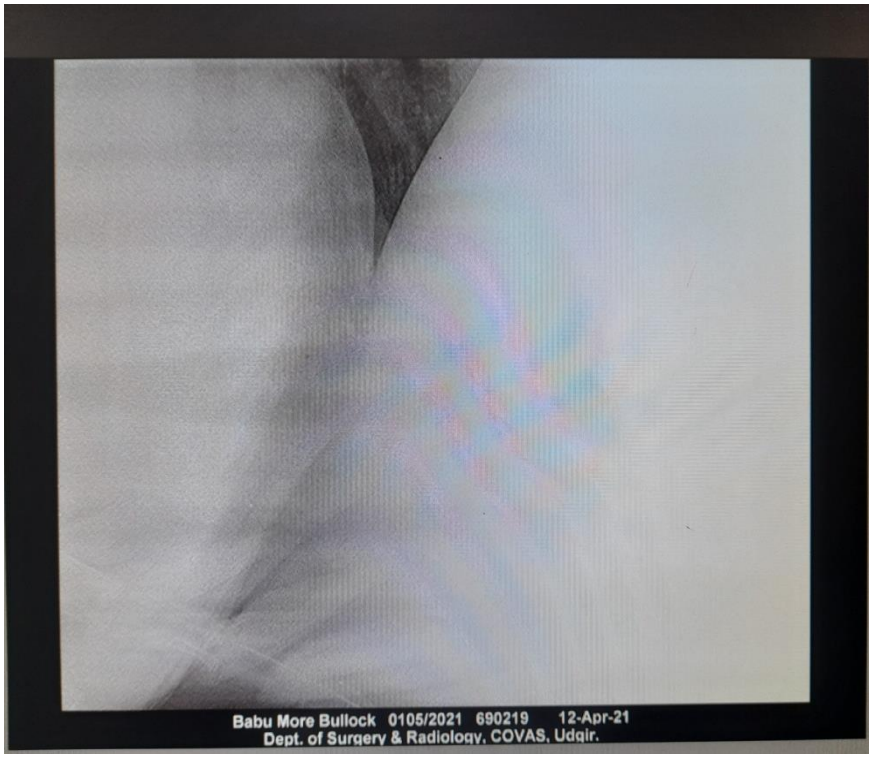


Plate 4.1: Radiograph showing homogenous increased density of lung field with loss of vascular markings and the cardiac shadow and diaphragmatic line was hazy of Khillar bullock of group I

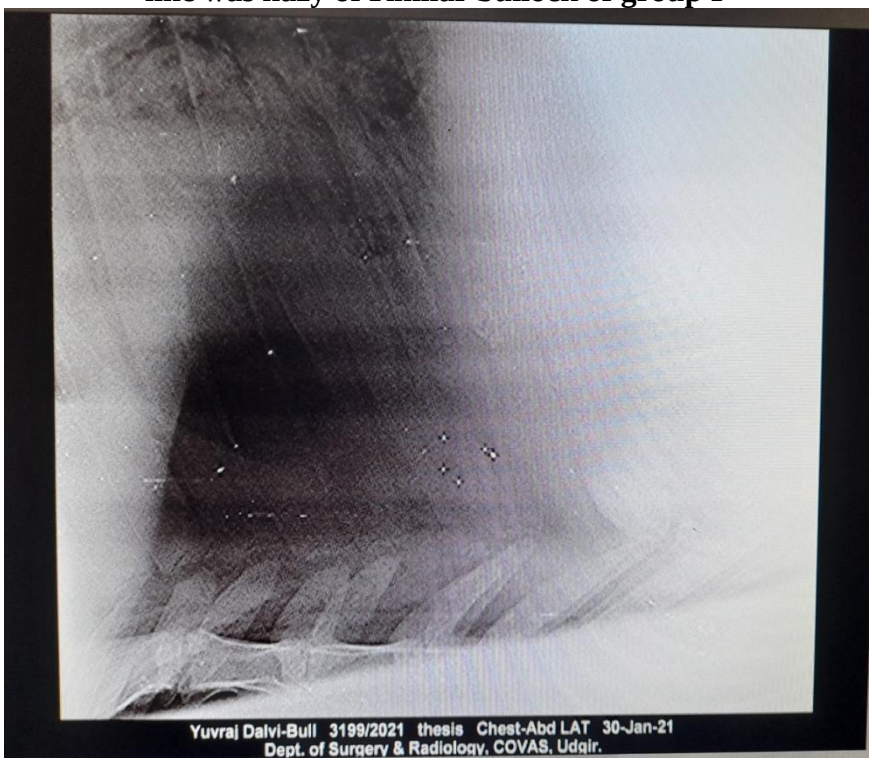


Plate 4.2: Radiograph showing homogenous altered density of lung field with loss of vascular markings and the cardiac shadow and diaphragmatic line was hazy of Deoni Bull from group I

Villalobos *et al*. (2017) reported that thoracoscopy procedure in calves severely affected by bovine respiratory syndrome was performed in standing position except two calves which had recumbency because of prior injury. Similarly, in the present study the standing thoracoscopy was found suitable in all the animals of both groups with minimal impulsive complications. Whereas, two animals (33.33%) Red Kandhari bullock (10 yrs) and Non-Descript cow (6 yrs) from group II were showed weight shifting and discomfort during thoracoscopic procedure.

4.4 Sedation of animal

All the animals (100%) from both the groups tolerated the standing thoracoscopy well with Inj. Butorphanol @ 0.05 mg/Kg b.wt. IV. Similarly, Relave *et al.* (2008) used butorphanol @ 0.02 mg/kg IV preoperatively as an additional analgesia with detomidine in horses during thoracoscopic lung biopsy procedure.

Further, Boutin *et al.* (1993) recommended use light anesthesia combining local anesthesia and neuroleptanalgesia, Kumar *et al*. (2013) recommended to use butorphanol @ 0.02 mg/kg IV during low flow isoflurane anesthesia in cattle and Villalobos *et al.* (2017) suggested that sedation was necessary to ensure the safety of animals and surgeons.

However, horses were showed signs of anxiety, flaring of nostrils, restlessness and increased respiratory rate at beginning and intermittently during thoracoscopy. Whereas, in present study no any signs of anxiety or restlessness and increased respiratory rate except in one (16.66%) animal from group II (Deoni male 7 yrs) was noticed.

Further, sedation along with local anaesthesia was well tolerated by the animals of group I and II for standing thoracoscopy in both the hemithorax.

4.5 Local anesthesia

In the present study, dorsal port site at 9^{th} and 10^{th} ICS in group I and ventral port sites at 7^{th} and 8^{th} ICS in group II were anesthetized by using an 18 G, 1.5 inch needle to infiltrate 2% lignocaine HCl (15-20 mL) locally into the subcutaneous, muscular and pleural tissues of the selected ICS. Relave *et al.* (2010) in horses infiltrated 20 mL of lignocaine at the portal site in accordance to thickness of muscle or body wall of animal to provide analgesia at the site whereas, Scharner *et al.* (2013) suggested 2% procaine in cattle.

One bullock from group II which had very thick body wall, an 18 G, 1.5 inch needle was not sufficient to inject the anesthesia up to the plural tissues hence, 18 G 6 inch long spinal needle was used to infiltrate 2% lignocaine HCl however, Peroni *et al.* (2001) experienced that the 7^{th}, 8^{th}, and 9^{th} intercostal nerves were difficult to anesthetized because of large amounts of subcutaneous tissue and heavier muscular coverage was present on the cranial thoracic regions in horses and suggested that spinal needle required to anesthetize the intercostal nerve.

In present study lignocaine HCl was found sufficient to provide adequate analgesia in entire procedure of thoracoscopy in both the groups. Further, it is suggested that the obese animal may necessitate the spinal needle to inject the anaesthetic in plural tissues of the selected ICS specifically ventral portal site.

4.6 Telescope for thoracoscopy

In present study, A 57 cm, 0^0 rigid telescopes was used while McCarthy *et al.* (1999) explained important feature of viewing angle that ranges from 0^0 to more than 90^0. They suggested that 0^0 telescope that look straight ahead and provided true image with least distortion for diagnostic thoracoscopy in dogs and cats.

Isakow *et al*. (2000), Dupre *et al.* (2001), Peroni *et al*. (2001), Schmiedt (2009) and Scharner *et al.* (2013) used a 0^0 rigid telescope for thoracoscopy.

Walton (2001) also used that straight forward or 0^0 telescope was used for more natural field of view and normal organ orientation to operator than 30^0 telescope. Further, Walton (2001) and Moore (2010) opined that 0^0 telescopes was preferred for beginners, once little experience was gained then 30^0 telescope could be used for improved view.

Michaux *et al.* (2014) used telescope with a 30^0 viewing angle, which allowed examination of a larger portion of hemithorax than telescope with a 0^0 viewing angle. However, in this study a 57 cm, 0^0 rigid telescope with a diameter of 10 mm was found suitable for examination of organs from both hemothorax of cattle in both group I and group II.

4.6 Light source

Xenon Nova Cold Light Fountain 175 W light was used with 0^0 rigid telescope for thoracoscopy in both group I and II.

Hendrickson and Wilson (1996) advised that 150 W light source was adequate for direct viewing and it illuminated small portion of the abdomen or thorax in adult horses. Further, they recommended 300 W xenon light source as it provided much better illumination.

However, Klohnen and Peroni (2000) suggested 150 W, Walton (2001) 175 W, Matyjasik *et al*. (2011) 150 W, Scharner *et al.* (2013) 300 W xenon light source for thoracoscopy with good illumination.

In the present study, xenon nova cold light fountain 175 W was found suitable with 0^0 rigid telescope for thoracoscopy in both group I and II animals.

4.7 Passive lung collapse.

Teat cannula was inserted at the selected port site until it entered the pleural cavity of animal in both the group I and II. Entry of teat cannula in thorax was

determined by the whistling sound of air passing through the cannula into the pleural cavity. After 3-4 respiratory cycles, the teat cannula was removed and 11 mm diameter, 15 cm long trocar cannula unit was inserted from both group I and group II animals this technique didn't show any life threatening respiratory or circulatory disturbances.

Further, Isakow *et al.* (2000) noticed that insufflations was not routinely practiced when performing video assisted thoracic surgery, because the thoracic wall didn't collapse when pneumothorax was induced in dogs. However, Anderson and Jean (2008) stated that open thoracic wound was not life threatening because the complete mediastinum in cattle was present and cattle blood could be oxygenated by one healthy lung. In accordance to this, passive lung collapse was well tolerable and there was no need of ventilator under general anesthesia for thoracoscopic examination.

Whereas, in present study passive lung collapse was used by using teat cannula techniques and it was found suitable in all the animals from group I and II. Similar, technique was used by Scharner *et al.* (2013) and Pollock and Russell (2006) to create passive lung collapse for thoracoscopy. Further, they opinioned that, passive lung collapse was safe, no any lung laceration and complications were found in their study.

4.8 Port placement and thoracoscopic procedures

For all the animals, from both the groups I and II, placement of the teat cannula into the pleural cavity was easily determined by whistling sound of air passing through the cannula in to the pleural cavity immediately upon the cannula breaching the parietal pleura and the loss of negative pressure within the cavity was observed.

Peroni *et al*. (2001) noticed that port placement required additional considerations and port site incision should involve only skin and subcutaneous

tissue, large or deep incision could not provide appropriate seal around the cannula and it might be difficult to maintain negative pleural pressure and cause peri incisional postoperative subcutaneous emphysema. Hence, one cm skin incision was created in the animals of both group and found suitable as suggested by Mackey and Wheat (1985), Peroni *et al*. (2001) and Biervliet *et al*. (2006) without air leakage during thoracoscopy. Boutin *et al.* (1993) reported port placement at 5^{th}, 6^{th} or 7^{th} ICS were best for pleural effusion in human patients.

Peri-operatively during thoracoscopic examinations, minute blood clots were found within the pleural cavity in two (33.33%) animals, one each from both the groups, which was suspected to be concern of hemorrhage (Plate 4.3 and 4.4) from the parietal pleura rather than from the lungs, these findings were in accordance with the findings of Michaux *et al.* (2014).

The structures were visible through the dorsal port of left and right hemithorax (group I) were almost same and did not vary regardless of port placement either located in 9^{th} or 10^{th} ICS, 15 cm ventral to transverse process of thoracic vertebra.

However, placement of port in 10^{th} ICS made manipulation of the telescope in the ventral and caudal direction more difficult, compared with that of port location in the 9^{th} ICS, due to its closer proximity to the diaphragm. Similarly, the Scharner *et al*. (2013) also find the difficulty on the movement of telescope towards the ventral side because of short distance of the diaphragm from 10^{th} ICS.

Lee *et al*. (2013) suggested the port placement at 13^{th} ICS and instrument port at 11^{th} ICS found suitable in thoracoscopic biopsy of lymphoma in horse. They also, suggested that earlier use of thoracoscopy allowed to expedite diagnosis.

In group I, two animals found suffering from hydrothorax (Plate 4.5 and 4.6), from one animal (Khillar) 2.5 L and 1.8 L fluid was suctioned (Plate 4.7 and 4.8) with suction unit from the left and right hemithorax respectively, unfortunately the animal died after 24 hrs of last thoracoscopic procedure and it was already tested positive for

theileriosis this might be the reason of death of animal. Radostits (1994) noted that in necropsy of theileria affected animal the most striking lesion was a massive pulmonary oedema, hyperemia and emphysema along with hydrothorax and hydro pericardium. Further, the 24 hrs interval was kept in the two thoracoscopic procedures. From another animal (Deoni) a total of 2.7 L fluid (Plate 4.8 and 4.9) was withdrawn from left and right hemithorax whereas, after 36 hrs the animal was died.

The postmortem examination of this case, the severe hemorrhages in the form of large clots within lumen of intestines and widespread petechial hemorrhages over both kidneys were evident. Excessive accumulation of serous fluid within thoracic and abdominal cavity was also evident. Ultimately the excessive blood (due to hemorrhage) and fluid loss (due to hydrothorax and ascites) may have led to resultant hypovolemic shock leading to general systemic hypoxia and cardiovascular collapse. Similar findings were noted by Vegad (2007). Similarly, Biervliet *et al.* (2006) reported that 8^{th} ICS was used for removal of 11 L serosanguinous pleural fluid and 4L fluid from pericardium during thoracoscopic pericardiotomy in cow.

Further, Pollock and Russell (2006) drained approximate 40 L of hemorrhagic fluid from bilateral thoracentesis and then decision was taken to explore thorax of horse by using thoracoscopy through 10^{th} and 12^{th} ICS whereas, in the present study from two animals of group I pleural fluid was suctioned during thoracoscopy.

In group II, ventral port was located in the 7^{th} and 8^{th} ICS, 30-35 cm from the transverse process of thoracic vertebra. Manipulation of telescope in group II animals through ventral port was more difficult than manipulation of telescope through dorsal port in group I animals, this might be because of 8^{th} rib was the last sternal rib which distracting the telescope to advance cranially (Peroni *et al.*, 2000 and Scharner *et al*., 2014). Biervliet *et al.* (2006) suggested 8^{th} ICS for thoracoscopic pericardiotomy as a palliative treatment in cow with pericardial lymphoma hence, the 8^{th} ICS for thoracoscopic examination was preferred.

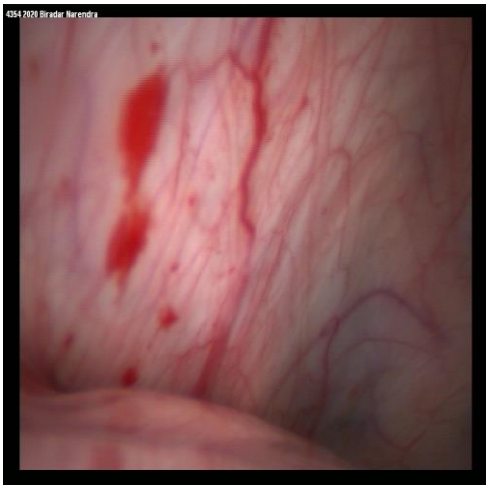


Plate 4.3: Hemorrhage in pleural cavity from animal of group I

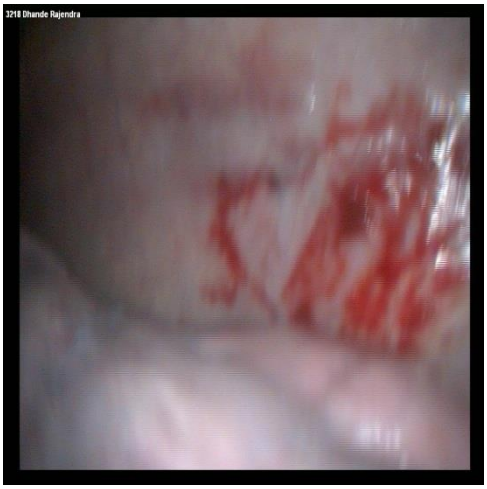


Plate 4.4: Hemorrhage and blood clot in pleural cavity from animal of group II

Plate 4.5: Hazy vision because of immersion of telescope in the thoracic fluid from group I animal

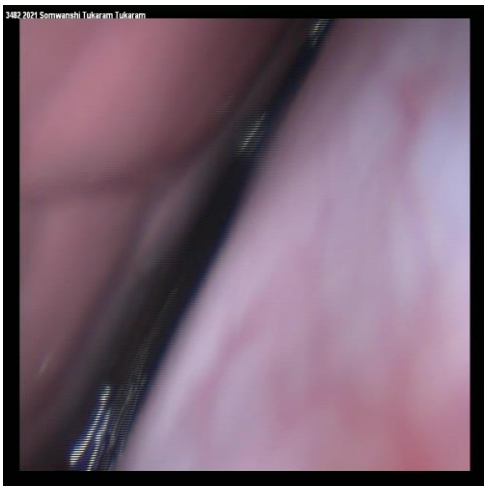


Plate 4.6: Hydrothorax from group I animal

Plate 4.7: Thoracic fluid suctioning with the help of suction unit from group I animal

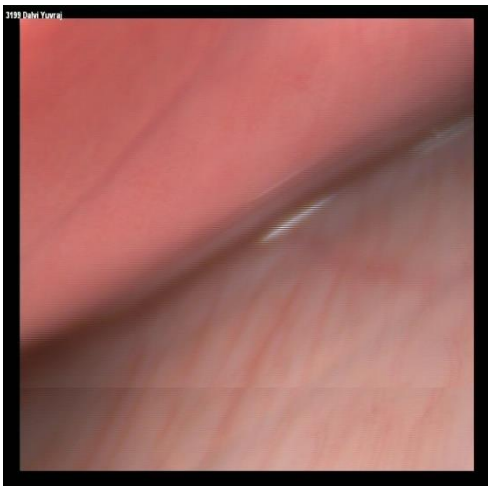


Plate 4.8: Plural fluid in left hemithorax of group I animal

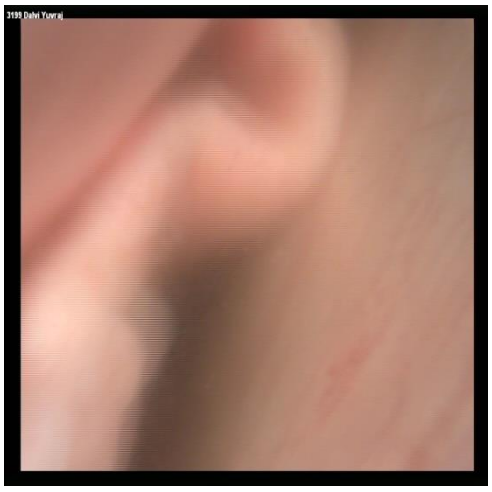


Plate 4.9: Free floating of lung border in the plural fluid from group I animal

However, signs of pains were stimulated when telescope was moved cranially and caudally via ventral port as evidenced by agitation and shifting of weight by animals and reluctance to the procedure by the group II animals. From group II animals, the ports were allowed visualisation of structures in the cranioventral aspect of left and right hemithorax, further, these structures were better observed when port was located in the 7th ICS than it was located in the 8th ICS. The 8th rib was the last sternal rib which distracting the telescope to advance cranially (Peroni et al., 2000 and Scharner et al., 2014).

Further, Michaux *et al.* (2014) reported, thoracoscopic examination was easier through port at 9th ICS approximately 15 cm ventral to the transverse processes of the thoracic vertebrae in healthy cattle. They stated that most of thoracic structures were observed through port located at 9th ICS.

Thoracoscopic examination through the ventral port allowed improved visualization through telescope at 8th ICS in the ventral aspect of the hemithorax such as the heart and pericardium and laparoscopic forceps inserted through 7th ICS were used and displaced the caudal lung lobes for better examination of diaphragm. However, pain was frequently observed during examination through ventral port.

Scharner *et al*. (2013) reported that the cow exhibited the discomfort by shifting back and forth when the endoscope was advanced cranially in the 8th ICS. Further, they suggested that satisfactory examination of the intrapleural structures were achieved through 9th ICS with port located at the level of ventral margin of the tuber coxa.

Peroni *et al.* (2001) suggested that thoracic structures were well evaluated when port placement was made at 10th and 12th ICS of horse because ribs associated with these spaces had less soft tissue and muscle coverage and ribs were not firmly attached to the sternum as they were more cranial however, cranial and caudal movement of telescope was well tolerated in horses without any complications.

In group I, thoracoscopic examination was found suitable through dorsal port at 9th and 10th ICS, whereas, 9th ICS was more convenient, because 10th ICS resulted in limited movement of telescope in the ventral and caudal direction, due to closer proximity to the diaphragm. In group II thoracoscopic examination of structures through ventral ports at 7th and 8th ICS were allowed close examination in the cranioventral portion of thorax.

4.9 Termination of procedure

In both the groups after completion of thoracoscopic examinations, a standardized pattern for the termination of procedure was applied i.e. initially, the telescope was moved in a dorsocranial direction followed by dorsal, caudal and finally towards the ventral direction (Scharner *et al*., 2013) to examine the complications if any. At the end of examination of hemithorax, air was slowly evacuated by the suction unit @80 to 120 mm Hg to re-establish negative pressure in to the pleural space. Michaux *et al.* (2014) used suction unit @80 to 120 mm Hg to resolve pneumothorax in cattle after thoracoscopy. They found mild pneumothorax after 24 hours of thoracoscopy but it resolved after few days without any significant change. In present study no incidence of pneumothorax was observed.

The telescope was removed from the port just before the lung came into contact with the scope and this technique was found suitable for complete lung reinflation on the basis of normal breathing pattern without thirst to air, then the telescope and cannula were removed. Cruciate skin sutures were deployed as suggested by Michaux *et al.* (2014) and no air leakage was found in animal from the both groups.

Anderson and Jean (2008) experienced that placement of suction tube in the hemithorax improved respiratory effort. Relave *et al.* (2008) used a surgical suction unit for rapid aspiration of pneumothorax for termination of procedure in horse for thoracoscopic lung biopsy.

Pollock and Russell (2015) reported that simple cruciate skin suture allowed complete closure of the skin without any leakage after thoracoscopy. Whereas, Isakow *et al*. (2000) experienced the best suture with 3-0 polydioxanone in a cruciate pattern in the muscle and subcutaneous layer and staples were used in the skin.

4.10 Parameters

4.10.1 Port placement

a) Ease of port placement

In all the animals of group I, placement of dorsal port in the 9th ICS, 15 cm ventral to transverse process of thoracic vertebra allowed for easy manipulation of the telescope in all directions. Thoracoscopic examination of the intrapleural structures were found suitable and best achieved through the 9th ICS, similar observations in cattle were noted by Scharner *et al*. (2013). However, placement of the dorsal port in the 10th ICS resulted limited movement of the telescope in the caudal and ventral direction due to its closer proximity to the diaphragm due to this restriction in manipulation of telescope and was found difficult these findings are in accordance with Michaux *et al.* (2014).

Klohnen and Peroni (2000) suggested that thoracoscopic structures were easily evaluated through port 10th and 12th ICS in horses because caudal ribs were distracted without damaging the equipment. Villalobos *et al*. (2017) noticed that higher pain score was observed with rigid scope through dorsal port and suggested that highest visualisation was found with combination of flexible scope through dorsal port. In present study the rigid scope was found suitable, however, denting on the scope was observed.

In group II animal, placement of ventral port in the 7th ICS and 8th ICS, 30-35 cm ventral to transverse process of thoracic vertebra allowed

closer examination of structures in the cranioventral portion of the hemithorax, however, signs of pain were exhibited by the animals and excessive pressure on the scope leaded to denting. Port placement in the 7th ICS allowed easy manipulation of telescope dorsally and ventrally, however, manipulation of telescope in cranially and caudally was difficult and patient discomfort was observed, similar findings were noted by Peroni *et al*. (2000) and Peroni *et al*. (2001). Placement of port in the 8th ICS in left and right hemithorax was difficult because 8th rib was a last sternal rib and restriction was found during advancing the telescope cranially with discomfort to animals as reported by Scharner *et al*. (2013). Lansdowne *et al.*, (2005) reported that bleeding was found from intercostal artery at 8th ICS during cannula insertion and it was not possible to ligate through port then they converted thoracoscopy in to thoracotomy in contrast to these observations no hemorrhages was found at any of the port placement during study in both the groups.

The 7th ICS when compared with the 8th ICS, from 30 cm ventral to transverse process of thoracic vertebrae was found easier and suitable for better examination of anatomical structures from both right and left hemithorax in group II animals.

b) <u>Ease of approaching thoracic organs</u>

In animals of group I, thoracic structures viz. pleural surface of ribs, intercostal muscle, aorta and aortic arch, sympathetic trunk, aortic hiatus, azygous vein, costocervical vein, thoracic esophagus, dorsal branch of vagus nerve, pulmonary ligament, diaphragm, caudal and cranial lung lobe, intercostal nerve bundle, mediastinal lymph nodes were visualized and easily approached through dorsal port located at 9th and 10th ICS, 15 cm ventral to transverse process of thoracic vertebra in both left and right hemithorax. Whereas, cranial mediastinum and cranial lung lobe were approached only in

left hemithorax and middle lung lobe was approached in right hemithorax through both dorsal port located at 9th and 10th ICS, similar findings were noted by Michaux *et al.* (2014).

In group II animals pleural surface of ribs, intercostal muscle, aorta and aortic arch, sympathetic trunk, aortic hiatus, azygous vein, costocervical vein, thoracic esophagus, dorsal branch of vagus nerve, pulmonary ligament, diaphragm, caudal lung lobe, intercostal nerve bundle, mediastinal lymph nodes were visualized and approached through ventral port located at 7th and 8th ICS, 30-35 cm ventral to transverse process of thoracic vertebra in both left and right hemithorax. Whereas, cranial mediastinum and cranial lung lobe was approached in left hemithorax and middle lung lobe was approached in right hemithorax through both 7th and 8th ICS of ventral port as stated by Michaux *et al.*(2014).

c) <u>Anatomical structures observed</u>

All the structures observed during the examination of the left and right hemithorax of all animals from both group I and II were summarized in table 4.1 and 4.2.

Table 4.1: Details of the anatomical structures observed from group I animals

Sr. No.	Anatomical structures visible	Dorsal port (n=06)			
		Left hemithorax		Right hemithorax	
		9th ICS	10th ICS	9th ICS	10th ICS
1.	Pleural surface of ribs	6	6	6	6
2.	Intercostal muscle	6	6	6	6
3.	Aorta and aortic arch	6	6	6	6
4.	Sympathetic trunk	6	6	6	6
5.	Aortic hiatus	6	6	6	6
6.	Azygous vein	6	6	6	6
7.	Costocervical vein	6	6	6	6
8.	Costovertebral joint	6	6	6	6
9.	Cranial mediastinum	6	6	0	0

10.	Oesophagus	6	6	6	6
11.	Dorsal branch of vagus nerve	6	6	6	6
12.	Pulmonary ligament	6	6	6	6
13.	Diaphragm	6	6	6	6
14.	Caudal lung lobe	6	6	6	6
15.	Cranial lung lobe	6	6	0	0
16.	Middle lung lobe	0	0	6	6
17.	Intercostal nerve bundle	6	6	6	6
18.	Mediastinal lymph nodes	6	6	6	6

In group I animals, the telescope was inserted through dorsal port of left hemithorax at 9^{th} and 10^{th} ICS 15 cm ventral to transverse process of thoracic vertebra. The anatomical structures observed were similar to the structures observed in the right hemithorax (Table 4.1) except cranial mediastinum and cranial lung lobe. Further, middle lung lobe was observed in the right hemithorax only (Table 4.1).

The aorta was located by directing the telescope medially and aorta was the first structure identified (Plate 4.10) and it was the landmark for navigation purpose (Michaux *et al.*, 2014). Dorsal to the aorta, the sympathetic trunk was visualized as a white filamentous band coursing cranially to caudally and several mediastinal lymph nodes look like a dark red structure between the sympathetic trunk and aorta (Plate 4.11).

As the left lung lobes collapsed, the aortic arch, left azygos vein crossing over the aorta and esophagus were detected. The esophagus was a flaccid purple structure ventral to the aorta and the swallowing act of cattle helped to verify its location, similar anatomical structures were located into the thoracic cavity by Michaux *et al.* (2014) and Scharner *et al*. (2013). Telescope directed medially and cranially helped to detect the dorsal branch of the vagus nerve (flat white band, Plate 4.12).

While moving the telescope cranially, the aortic groove was located on the collapsed lung while directing the telescope toward the parietal pleura, the costocervical vein was observed cranial to the aortic arch further more costovertebral

joint was also observed. When the dorsal port located in the 9th ICS telescope advanced cranially after the aortic arch, cranial portion of the esophagus was observed (Plate 4.13) these findings are in agreement with Michaux *et al.* (2014).

The telescope was then directed caudally, the tendinous and muscular portions of the diaphragm was noticed (Plate 4.14 and 4.15). The rotation of telescope laterally allowed the observation of the proximal parts of 3rd-12th ribs, intercostal muscle and neuromuscular bundles on the caudal aspect of each rib was visualized (Scharner *et al*., 2013).

The left caudal lung lobe and the caudal portion of the left cranial lung lobe (Plate 4.16) were observed with the telescope directed ventrally. Whereas, Isakow *et al*. (2000) reported that left cranial lung lobe was visualized at 4th ICS in dogs.

The thoracoscopic examination of the right hemithorax was performed in similar manner and the structures observed were noted in table 4.1 (Plate 4.17). As compared to the thoracoscopic examination of left hemithorax, the pulmonary ligament was more prominent in the right hemithorax, whereas, the aortic arch was less prominent because of its right to left orientation toward to the left aortic vasa vasorum.

The right azygous vein had more ramification than the left azygous vein. The costocervical trunk, which appeared as a pulsating, white tubular structure travelling in a craniocaudal direction, was observed (Plate 4.18 and 4.19).

The esophagus was difficult to locate in the right hemithorax as stated by Michaux *et al.* (2014), however, in the present study it was easily found in the left as well as right hemithorax of group I animals. The telescope when directed ventrally, the right caudal lung lobe, middle lung lobe and caudal portion of the right lung lobe (Plate 4.20 and 4.21) was observed.

However, the cranial portion of the right cranial lung lobe and the accessory lung lobe could not be identified. In general, anatomical structures within the mediastinum were easier to identified and observed during left thoracoscopy than right thoracoscopy, with the exception of the pericardium, which was easier to identify in right hemithorax.

Table 4.2: Details of the anatomical structures observed from group II animals

Sr. No.	Anatomical structures visible	Ventral port (n=06)			
		Left hemithorax		Right hemithorax	
		7th ICS	8th ICS	7th ICS	8th ICS
1.	Pleural surface of ribs	6	6	6	6
2.	Intercostal muscle	6	6	6	6
3.	Aorta and aortic arch	6	6	6	6
4.	Sympathetic trunk	6	6	6	6
5.	Aortic hiatus	6	6	6	6
6.	Azygous vein	6	6	6	6
7.	Costocervical vein	6	6	6	6
8.	Costovertebral joint	6	6	6	6
9.	Cranial mediastinum	6	6	0	0
10.	Thoracic esophagus	6	6	6	6
11.	Dorsal branch of vagus nerve	6	6	6	6
12.	Pulmonary ligament	6	6	6	6
13.	Hiatal and costal diaphragm	6	6	6	6
14.	Caudal lung lobe	6	6	6	6
15.	Cranial lung lobe	6	6	6	6
16.	Middle lung lobe	0	0	6	6
17.	Intercostal nerve	6	6	6	6
18.	Mediastinal lymph nodes	6	6	6	6

In the group II, the telescope was inserted through ventral port of left hemithorax at 7th and 8th ICS, 30-35 cm ventral to transverse process of thoracic vertebra. The structures visible through the ventral port of left hemithorax were almost same as that of the examination through dorsal port. The only advantage of thoracoscopic examination of the left hemithorax through the ventral port when

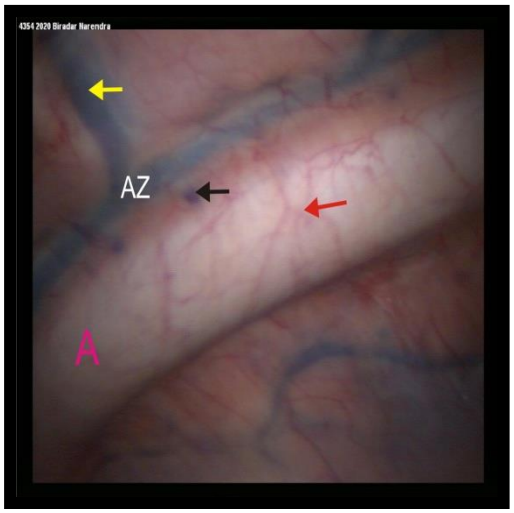


Plate 4.10: Thoracoscopic view of the dorso medial region of left hemithorax of animal from group I showing aorta (A) with its vasa vasorum (red arrow), azygous vein (AZ), dorsal intercostal vein (yellow arrow), lymph node (black arrow)

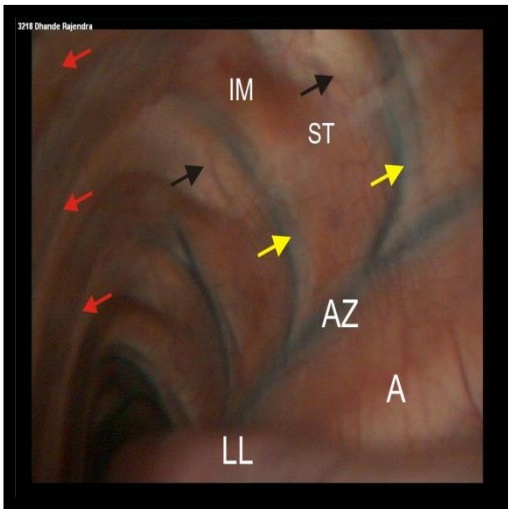


Plate 4.11: Thoracoscopic view of the cranio dorsal region of left hemithorax of animal from group I showing aorta (A), azygous vein (AZ), Collapsed left lung (LL), intercostal muscle (IM), sympathetic trunk (ST) costovertebral joint (black arrow), ribs (red arrow), dorsal intercostal vein (yellow arrow)

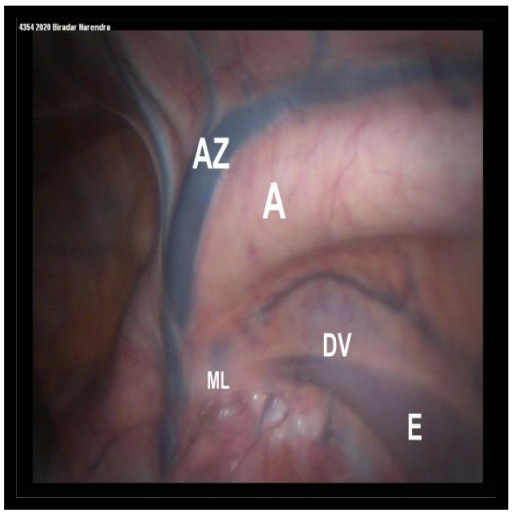


Plate 4.12: Thoracoscopic view of the cranio medial region of left hemithorax of animal from group II showing azygous vein (AZ) Mediastinal lymph node (ML), dorsal vagus nerve (DV), esophagus (E), aorta (A)

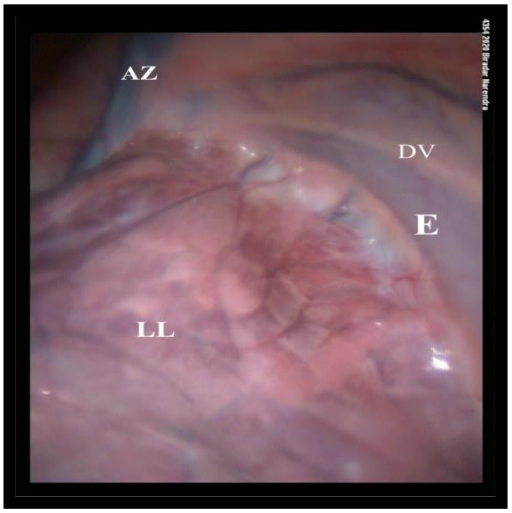


Plate 4.13: Thoracoscopic view of cranio-dorsal region of left hemithorax of animal from group II showing left collapse lung (LL), esophagus (E), dorsal vagus nerve (DV) and azygous vein (AZ).

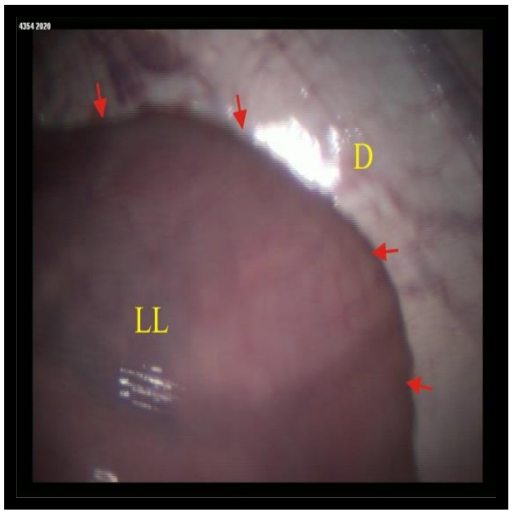


Plate 4.14: Thoracoscopic view of caudo-ventral region of left hemithorax of animal in group II showing caudal left lung lobe (LL), diaphragm (D) and acute margins of left caudal lung lobe (red arrow).

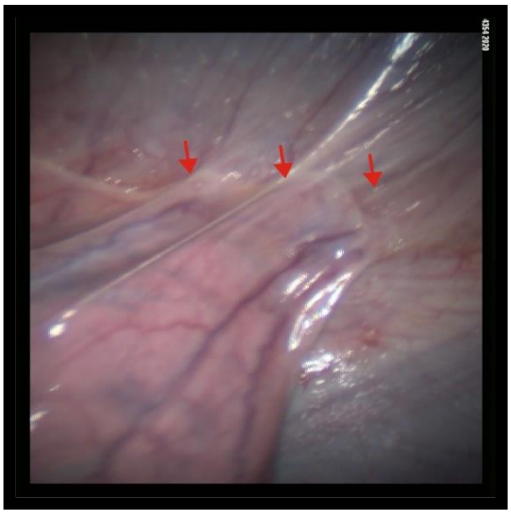


Plate 4.15: Thoracoscopic view of dorso-caudal region of left hemithorax of animal in group I showing pulmonary ligament (red arrow).

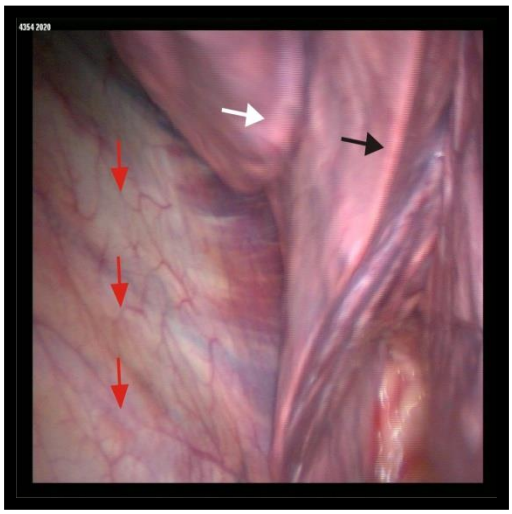


Plate 4.16: Thoracoscopic view of caudo-ventral region of left hemithorax of animal in group II showing margin of caudal lung lobe (black arrow), left cranial lung lobe (white arrow), distal part of ribs (red arrow)

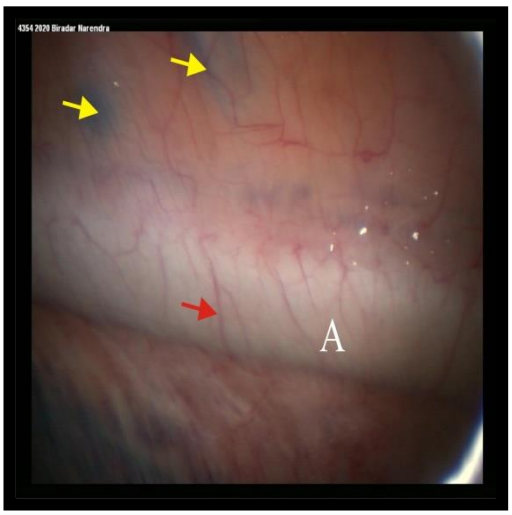


Plate 4.17: Thoracoscopic view of dorso-medial region of right hemithorax of animal in group I showing aorta (A) with its vasa vasorum (red arrow) and lymph nodes (yellow arrow).

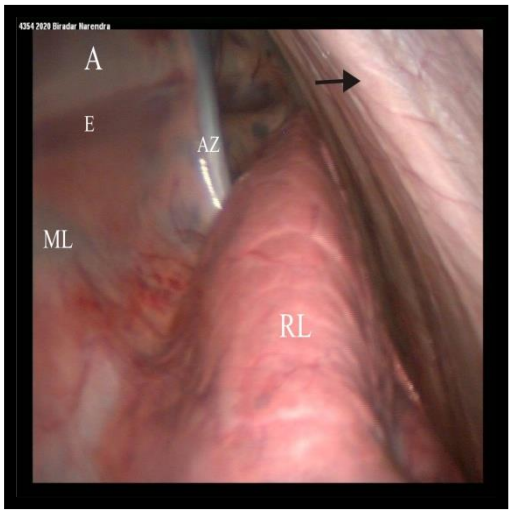


Plate 4.18: Thoracoscopic view of dorso-cranial region of right hemithorax of animal in group I showing aorta (A), esophagus (E), mediastinal lymph nodes (ML), azygous vein (AZ), right lung (RL) and proximal surface of ribs (black arrow).

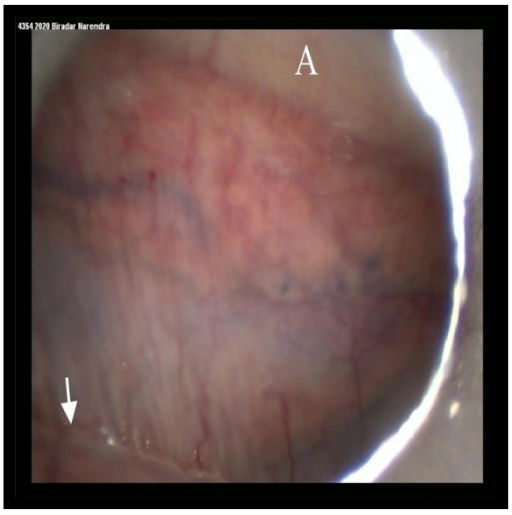


Plate 4.19: Thoracoscopic view of dorso-medial region of right hemithorax of animal in group II showing aorta (A) and pulmonary ligament (white arrow).

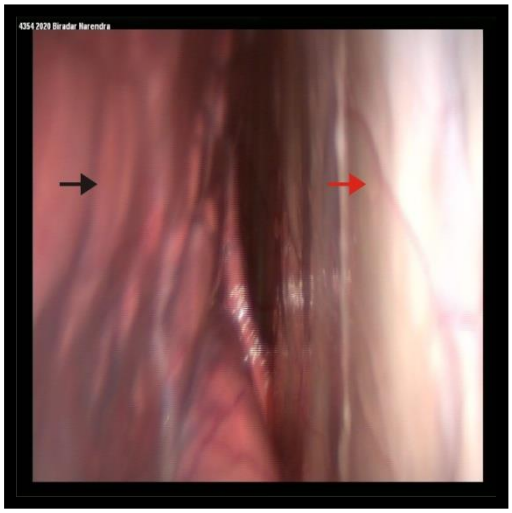


Plate 4.20: Thoracoscopic view of ventro-medial region of right hemithorax of animal in group II showing right middle lung lobe (black arrow) and ribs (red arrow).

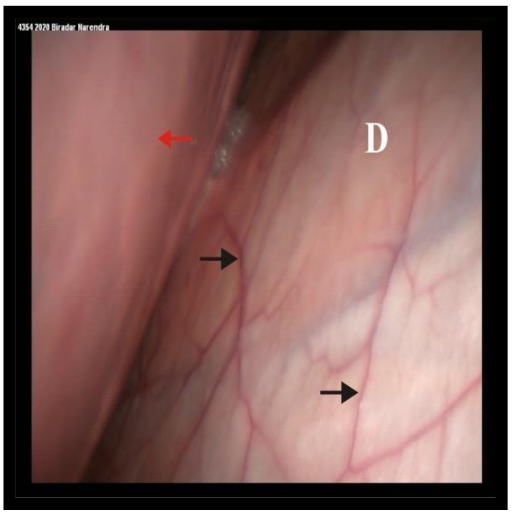


Plate 4.21: Thoracoscopic view of ventro-caudal region of right hemithorax of animal in group II showing diaphragm (D), phrenic veins (black arrow) and caudal lung lobe (red arrow)

compared with dorsal port, it was allowed closer evaluation of some structures such as the cranial portion of the esophagus and thoracic duct. MacPhail *et al*. (2001) recommended that port placement near costochondral joint at 7th ICS was helpful for retraction of left cranial lung lobe in left hemithorax in dogs.

Similar, to the left hemithorax, thoracoscopic examination of the right hemithorax through a ventral port had few advantages as pericardium and esophagus was easier to observe through the right ventral port than the right dorsal port (Michaux *et al.,* 2014). Similarly, in horse the findings of anatomical structures during thoracoscopies were reported by Peroni *et al*. (2000) and Peroni *et al*. (2001) with the exception of structures located in the mediastinum. However, the heart was more easily observed with thoracoscopy from the right hemithorax in group II animals.

Anderson and Jean (2008) stated that exposure of caudal lung lobes and mediastinum was done by making incision into the pleural space through 7th, 8th or 9th ICS, similarly, in present study caudal lung lobe was easily approached in both group I and II through dorsally 9th and 10th ICS and ventrally 7th and 8th port.

Table 4.3 Findings in thoracoscopy in all animals of group I and II

Sr. No.	Breed	Sex	Clinical findings in thoracoscopy
Group I			
1.	Deoni	Female	Pneumonia
2.	Holstein Friesen	Female	Lung consolidation
3.	Red Kandhari	Male	Lung consolidation
4.	Khillar	Male	Hydrothorax
5.	Non-Descript	Female	Pneumonia
6.	Deoni	Male	Hydrothorax
Group II			
1.	Non-Descript	Male	Lung consolidation
2.	Non-Descript	Male	Pneumonia
3.	Deoni	Male	Lung consolidation
4.	Red Kandhari	Male	Pneumonia
5.	Non-Descript	Female	Pneumonia
6.	Deoni	Female	Lung consolidation

4.10.2 Physiological parameters

Physiological parameters from group I and group II animals at 15 min before procedure, during procedure at 10 min (after 10th ICS from group I and 8th ICS from group II animals) and 24 hrs after procedure with the help of multipara patient monitoring unit were recorded.

a) Heart rate (beats/min)

The heart rate (beats/min) recorded at different time intervals in both hemithorax as well as in both groups were presented in table 4.4 and 4.5.

Table 4.4: Mean±SE of Heart rate (beats/min) for group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hrs of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hrs of thoracoscopy
Gr - I/ Dorsal	64.50± 2.93	71.66± 3.05	65.16± 2.93	65.16± 2.85	74.83± 3.25**	66.50± 2.98*
Gr - II/ Ventral	69.16± 2.76	77.50± 2.68	70.00± 2.73	70.33± 2.96*	78.16± 2.82	71.00± 3.00

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group.

Mean heart rate before 15 min of sedation were 64.50±2.93and 65.16±2.85 beats/min from left and right hemithorax of group I respectively and from group II it was 69.16±2.76 and 70.33±2.96 beats/min (Fig. 4.1) respectively which showed significant increase in right ventral hemithorax when compared between the group which might be because of preexisting severe disease conditions from group II animals. Further, there was no significant increase in heart rate before 15 min of sedation when compared within the groups I and II.

The mean heart rate during thoracoscopy at 10 min from left hemithorax of group I was 71.66±3.05 and 74.83±3.25 beats/min which was significantly increased when compared between the group whereas, from group II it was non-significantly increased 77.50±2.68 and 78.16±2.82 beats/min respectively. The heart rate after 24

hrs of thoracoscopy were (65.16±2.93 and 70.00±2.73 beats/min from left hemithorax of group I and II) and (66.50±2.98 and 71.00±3.00 beats/min from right hemithorax of Group I and II) of 24 hrs of thoracoscopy. However, the significant increase (66.50±2.98 beats/min) in heart rate was observed in right hemithorax of group I when compared between the groups.

Bohaychuk-Preuss *et al.* (2017) recorded non-significant increase in heart rate along with increased intrapleural insufflation of carbon dioxide pressure during thoracoscopy in horses under general anaesthesia.

Table 4.5: Mean±SE of Heart rate (beats/min) irrespective to left and right hemithorax of group I and group II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy
Gr – I	64.83±1.95	73.25±2.17	65.83±2.00
Gr – II	69.75±1.93	77.83±1.85	70.50±1.94

The mean heart rate before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy in group I and II were 64.83±1.953, 73.25±2.17 and 65.83±2.00 beats/min and 69.75±1.93, 77.83±1.858 and 70.50±1.94 beats/min (Table 4.5) respectively showed non-significant change when compared between the group.

Faunt *et al*. (1998) noticed significant increase in heart rate during diagnostic thoracoscopy in dog with nitrous oxide insufflated pleural cavity anaesthetized with ketamine-diazepam-isoflurane anaesthesia, whereas, Pigatto *et al*. (2008) observed initial increased heart rate after production of pneumothorax with room air. Cantwell *et al.* (2000) also noticed increase in the heart rate during thoracoscopy in dog with one lung ventilation.

In contrast, Daly *et al.* (2002) and Wen *et al.* (2013) noticed significant decrease in heart rate during thoracoscopy in dog anaesthetized with acepromazine-thiopental-isoflurane combination and insufflated with carbon dioxide in pleural cavity and during subxyphoid thoracoscopic lung lobectomy in dog under isoflurane

maintained anaesthesia. Michaux *et al.* (2014) found non-significant changes in heart rate before, during and after the thoracoscopy in cattle.

b) <u>Respiration rate (breaths/min)</u>

Respiration rate (breaths/min) recorded at different time intervals in both hemithorax as well as in both the groups were presented in table 4.6 and 4.7 (Fig 4.2).

Table 4.6: Mean±SE of Respiration rate (breaths/min) for group I and II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy
Gr - I/ Dorsal	26.50± 2.07	33.66± 2.31	27.33± 2.07	27.83± 1.72^{b}*	35.83± 2.13^{a}**	27.66± 1.97^{b}
Gr - II / Ventral	31.16± 2.71^{b}	42.33± 2.82^{a}	31.66± 2.99^{b}	32.16± 2.91^{b}*	43.00± 2.78^{a}	32.83± 2.79^{b}

The superscripts with different means of alphabets indicate that significance between different intervals of group. ** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group.

In group I mean respiratory rate of left hemithorax before 15 min sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 26.50±2.07, 33.66±2.31 and 27.33±2.07 (breaths/min) respectively which showed non-significant change within group. Whereas, in right hemithorax of group I mean respiratory rate were 27.83±1.72, 35.83±2.13 and 27.66±1.97 (breaths/min) respectively (Table 4.6) which was statistically found significant increase within group during thoracoscopy at 10 min of and returned to base value after 24 hrs of thoracoscopy.

The mean respiratory rate of left and right hemithorax before 15 min of sedation from group I was 26.50±2.07 and 27.83±1.72 (breaths/min) respectively which showed significantly increased between the groups, whereas, during thoracoscopy at 10 min it was 33.66±2.31 and 35.83±2.13 (breaths/min) respectively showed highly significant increase and after 24 hrs of thoracoscopy it was27.33±2.07 and 27.66±1.97 (breaths/min) respectively.

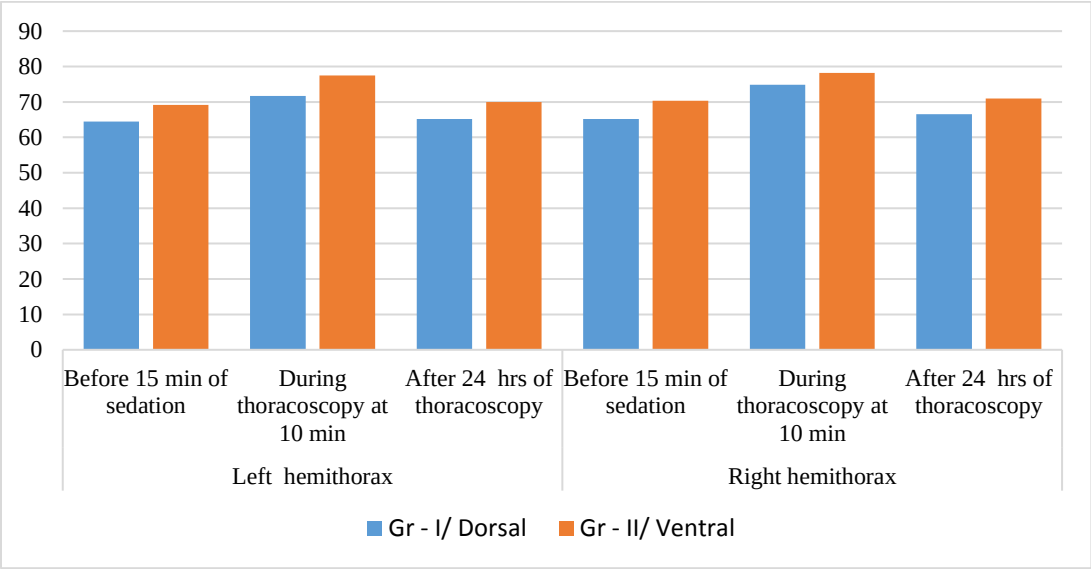


Fig. 4.1: Mean Heart rate (beats/min) for group I and group II

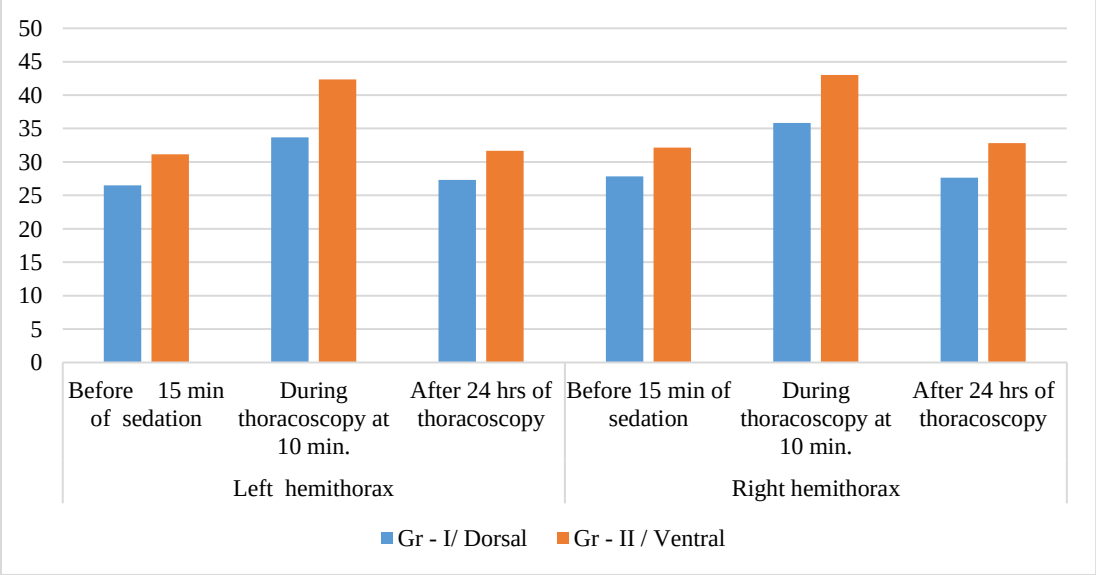


Fig. 4.2: Mean Respiration rate (breaths/min) for group I and II

In group II mean respiratory rate of left hemithorax before 15 min sedation, during thoracoscopy at 10 min and after 24 hrs thoracoscopy were 31.16±2.71, 42.33±2.82 and 31.66±2.99 (breaths/min) whereas, mean respiratory rate of right hemithorax 32.16±2.91, 43.00±2.78 and 32.83±2.79 (breaths/min) respectively which showed significant increase of respiratory rate during thoracoscopy at 10 minute and returned base values.

In group II, respiratory rate before 15 min of sedation from left and right hemithorax was 31.16±2.71 and 32.16±2.91 (breaths/min) respectively, which showed significantly increased between the groups, whereas, during thoracoscopy at 10 min it was 42.33±2.82 and 43.00±2.78 (breaths/min) which showed non-significant increased respiratory rate and after 24 hrs of thoracoscopy it was 31.66±2.99 and 32.83±2.79 (breaths/min) which showed non-significant increase in respiratory rate.

The significant increase in the respiratory rate in right hemithorax from group I and II was similar to the findings of Michaux *et al.* (2014) they reported that significant increase of respiration rate in second procedure regardless of hemithorax examination during thoracoscopy in cattle was intensely observed. It might be due to stress which produced by walking of animals from resting place to operation theater.

Table 4.7: Mean±SE of Respiration rate (breaths/min) irrespective to left and right hemithorax of group I and group II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy
Gr – I	27.16±1.30	34.75±1.53	27.50±1.36
Gr – II	31.66±1.94	42.66±1.89**	32.25±1.96

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group.

Mean respiratory rate before 15 min of sedation of both hemithorax of group I and group II animals were 27.16±1.30 and 31.66±1.94 (breaths/min) respectively. Whereas, during thoracoscopy at 10 min of both left and right hemithorax of group I

and group II were 34.75±1.53 and 42.66±1.89 (breaths/min) respectively (Table 4.7). Statistically mean respiratory rate during thoracoscopy at 10 min increased highly significant in group II and after 24 hrs of thoracoscopy it was 27.50±1.36 and 32.25±1.96 (breaths/min) respectively found non-significant between the groups. The significant increase in respiratory rate at 10 min during thoracoscopy might be because of the evident of pain lead to cardiorespiratory alterations.

c) Haemoglobin oxygen saturation (SpO_2%)

Haemoglobin oxygen saturation (%) recorded at different time intervals in both hemithorax as well as in both groups were presented in table 4.8 and 4.9

Table 4.8: Mean ±SE of Haemoglobin oxygen saturation (%) for group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy
Gr – I	98.16± 0.30^{a}	97.00± 0.25^{b}	98.00± 0.25^{a}	98.16± 0.30^{a}	97.16± 0.30^{b}	98.16± 0.16^{a}
Gr – II	98.00± 0.36	97.00± 0.25	98.00± 0.36	98.33± 0.33^{a}	96.83± 0.40^{b}	98.16± 0.30^{a}

The superscripts with different means of alphabets indicate that significance between different intervals of group.

Mean SpO_2 before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy of left hemithorax in animals of group I were 98.16±0.30, 97.00±0.25 and 98.00±0.25 (%) respectively showed significant decrease within group.

Whereas, change in mean value of SpO_2 in group II in left hemithorax before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 98.00±0.36, 97.00±0.25 and 98.00±0.36 (%) (Fig. 4.3) respectively found non-significantly decreased.

In group I and II mean SpO_2 of right hemithorax before 15 min sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 98.16±0.30, 97.16±0.30 and 98.16±0.16 (%) and 98.33±0.33, 96.83±0.40 and 98.16±0.30 (%) respectively which showed significant decrease of Haemoglobin in oxygen saturation. Whereas, between the left and right hemithorax there were no any significant decrease was noted.

Table 4.9: Mean±SE of Haemoglobin oxygen saturation (%) irrespective to left and right hemithorax of group I and group II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy
Gr - I	98.16±0.20	97.08±0.19	98.08±0.14
Gr - II	98.16±0.24	96.91±0.22	98.08±0.22

Mean SpO_2 of group I and group II before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 98.16±0.20, 97.08±0.19 and 98.08±0.14 (%) and 98.16±0.24, 96.91±0.22 and 98.08±0.22 (%) Table 4.9) found non-significant.

In contrast to the present study Dupre *et al*. (1999) reported significant decrease of SpO2 in dogs under CO_2 insufflation during thoracoscopic pericardectomy without pulmonary exclusion. However, Michaux *et al.* (2014) noted decrease in SpO_2 after induction of pneumothorax regardless of hemithorax during the thoracoscopic procedures.

4.10.3 Biochemical parameters

a) Aspartate aminotransferase (AST)

The mean aspartate aminotransferase level at different intervals in both hemithorax as well as in group I and group II were given in table 4.10 and 4.11.

Table 4.10: Mean±SE of Aspartate aminotransferase (IU/L) level in left and right hemithorax for group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hr of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hr of thoracoscopy
Gr – I	168.7± 3.90	175.85± 3.04	170.01± 3.62	170.78± 3.36*	175.45± 3.13	172.56± 2.72*
Gr – II	163.63± 6.04	171.33± 5.74	164.96± 5.98	165.16± 6.28	173.48± 5.97*	166.46± 6.24

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group

In group I the mean AST of left hemithorax before 15 min of sedation, during thoracoscopy and after 24 hr of thoracoscopy were 168.70±3.90, 175.85±3.04 and 170.01±3.62 (IU/L) respectively and the mean AST of right hemithorax before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy were 170.78±3.36, 175.45±3.13 and 172.56±2.72 (IU/L) (Fig. 4.4) respectively showed non-significant increase of AST during thoracoscopy.

In group II the mean AST of left hemithorax before 15 min of sedation, during thoracoscopy and after 24 hr of thoracoscopy were 163.63±6.042, 171.33±5.74 and 164.96±5.98 (IU/L) respectively. The mean AST of right hemithorax before 15 min of sedation, during thoracoscopy and after 24 hr of thoracoscopy were 165.16±6.28, 173.48±5.97 and 166.46±6.24 (IU/L) respectively there were non-significant change were found.

The mean of AST before 15 min of sedation in left and right hemithorax of group I were 168.7±3.90 and 170.78±3.36 (IU/L) respectively. The significant increase of AST was observed in right hemithorax before 15 min of sedation. Whereas, non-significant change was noted in the mean of AST in both left and right hemithorax of group II animals.

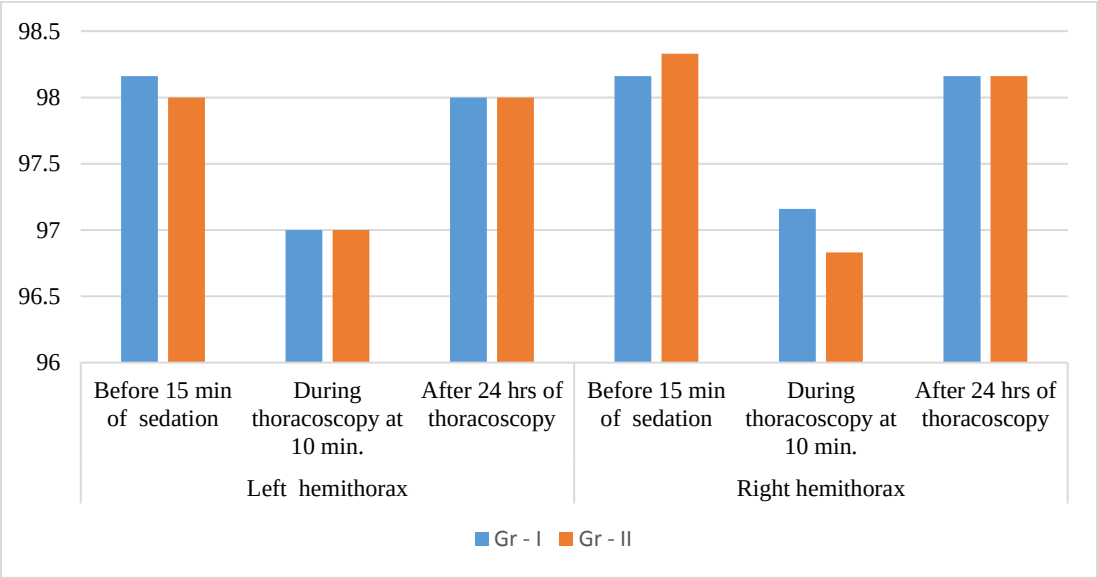


Fig. 4.3: Mean Haemoglobin oxygen saturation (%) for group I and group II

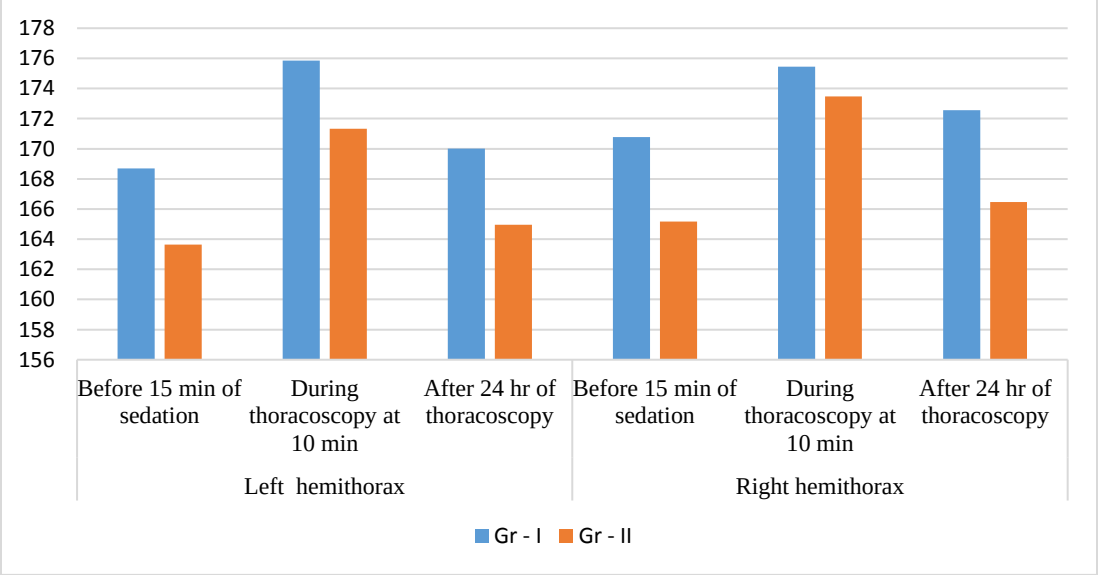


Fig. 4.4: Mean Aspartate aminotransferase (IU/L) level in left and right hemithorax for group I and group II

The mean of AST during the thoracoscopy at 10 min in right hemithorax (175.45±3.13 IU/L) was noted non-significant increase over the mean of AST in left hemithorax (175.45±3.13 IU/L) in group I.

In group II mean AST during thoracoscopy at 10 min of left and right hemithorax were 171.33±5.74 and 173.48±5.97 (IU/L) observed significant increase in right hemithorax. After 24 hr of thoracoscopy mean of AST in left and right hemithorax in group I were 170.01±3.62 and 172.56±2.72 (IU/L) showed significant increase in right hemithorax.

In group II mean AST after 24 hr of thoracoscopy of left and right hemithorax were 164.96±5.98 and 166.46±6.24 (IU/L) respectively noted non-significant change.

Table 4.11: Mean±SE of Aspartate aminotransferase (IU/L) level irrespective to left and right hemithorax of group I and group II

Parameter/Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hr of thoracoscopy
Gr - I	169.74±2.47	175.65±2.08	171.29±2.19
Gr - II	164.40±4.16	172.40±3.96	165.71±4.12

The mean AST before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 169.74±2.47, 175.65±2.08 and 171.29±2.19 (IU/L) and 164.40±4.16, 172.40±3.96 and 165.71±4.12 (IU/L) respectively (Table 4.11) showed non-significant change when compared between the group.

Dhumeaux and Haudiquet (2009) noticed no alterations in AST values during thoracoscopic assisted lung resection in dog. Similar findings have been reported by Bakhtiari *et al*. (2006) and Vishwanath and Ranganath (2012).

b) Alanine aminotransferase (ALT)

The mean alanine aminotransferase level at different interval in group I and group II was given in table 4.12 and 4.13.

Table 4.12: Mean±SE of Alanine aminotransferase (IU/L) level in left and right hemithorax for group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hrs of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hrs of thoracoscopy
Gr – I	50.55± 1.43	53.98± 1.45	51.43± 1.51**	51.83± 1.45**	56.76± 1.48**	52.75± 1.46**
Gr - II	49.73± 1.17	52.08± 1.30	50.02± 1.32	50.23± 1.17	53.7± 1.26**	50.58± 1.03

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group

The mean ALT before sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy of group I and II were 50.55±1.43, 53.98±1.45 and 51.43±1.51 (IU/L) and 49.73±1.17, 52.08±1.30 and 50.02±1.32 (IU/L) respectively observed non-significant change when compared within the group.

Mean ALT before sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy of group I and II were 49.73±1.17, 52.08±1.30 and 50.02±1.32 (IU/L) and 50.23±1.17, 53.7±1.26 and 50.58±1.03 (IU/L) (Fig. 4.5) respectively showed non-significant change in thoracoscopy.

Mean ALT before 15 min of sedation were 50.55±1.43 and 49.73±1.17 (IU/L) from left hemithorax of group I and II respectively and 51.83±1.45 and 50.23±1.17 (IU/L) from right hemithorax respectively which showed significant increase in right ventral hemithorax of group I when compared within the group.

Mean ALT of group I and II during thoracoscopy at 10 min were 53.98±1.45 and 52.08±1.30 (IU/L) from left hemithorax respectively and 56.76±1.48 and

53.7±1.26 (IU/L) from right hemithorax respectively which showed highly significant increases in right ventral hemithorax of group I when compared within the groups.

Mean ALT of group I and II after 24 hrs of thoracoscopy were 51.43±1.51 and 52.75±1.46 (IU/L) from left hemithorax respectively and 50.02±1.32 and 50.58±1.03 (IU/L) from right hemithorax respectively which showed highly significant increases in right hemithorax of group I when compared between the groups.

Table 4.13: Mean±SE of Alanine aminotransferase (IU/L) level irrespective to left and right hemithorax of group I and group II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hrs of thoracoscopy
Gr – I	51.19± 0.99	55.37± 1.07	52.09± 1.02
Gr – II	49.98± 0.79	52.89± 0.90	50.30± 0.80

The mean ALT before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 51.19±0.99, 55.37±1.07 and 52.09±1.02 IU/L (Table 4.13) and 49.98±0.79, 52.89±0.90 and 50.30±0.80 (IU/L) respectively showed non-significant change when compared between the group. Dhumeaux and Haudiquet (2009) noticed no abnormalities in ALT values during thoracoscopic assisted lung resection in dog.

c) <u>Alkaline phosphatase (ALKP)</u>

The mean alkaline phosphatase level at different interval in group I and group II was given in table 4.14 and 4.15 (Fig. 4.6).

Table 4.14: Mean±SE of alkaline phosphatase (IU/L) level in left and right hemithorax of group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hrs of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hrs of thoracoscopy
Gr – I	80.43± 1.07[b]	85.28± 1.34[a]	81.2± 0.94[b]	81.35± 0.95[b*]	86.233± 0.811[a]	81.95± 1.03[b]
Gr - II	81.13± 1.30	84.81± 1.43	81.53± 1.34	82.1± 1.52*	86.96± 1.72**	82.88± 1.47*

The superscripts with different means of alphabets indicate that significance between different intervals of group.
** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group

The mean ALKP of left hemithorax and right hemithorax before 15 min sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I were 80.43±1.07, 85.28±1.34 and 81.2±0.94 (IU/L) and 81.35±0.95, 86.23±0.81 and 81.95±1.03 (IU/L) respectively showed significant increased within group during thoracoscopy at 10 min in left and right hemithorax. After 24 hrs of thoracoscopy mean ALKP was came to mean level of before 15 min of sedation.

In group II the mean ALKP of left and right hemithorax before 15 min sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 81.13±1.34, 84.81±1.43 and 81.53±1.34 (IU/L) and 82.1±1.52, 86.96±1.72 and 82.88±1.47 (IU/L) respectively showed non-significant increase during the thoracoscopy at 10 min.

In group I mean ALKP before 15 min of sedation of left hemithorax and right hemithorax were 80.43±1.07 and 81.35±0.95 (IU/L) showed significant increase in right hemithorax. Whereas, non-significant change was observed in mean ALKP during thoracoscopy and after 24 hrs of thoracoscopy of left hemithorax 85.283±1.34 and 86.23±0.81 (IU/L) and right hemithorax 81.2±0.94 and 81.95±1.03 (IU/L)

In group II mean ALKP of right hemithorax before 15 min of sedation and after 24 hr of thoracoscopy were 82.1±1.52 and 82.88±1.47 (IU/L) respectively found significantly increase than the mean AKLP of left hemithorax 81.13±1.34 and 81.53±1.34 IU/L. Whereas, mean ALKP during thoracoscopy at 10 min in right

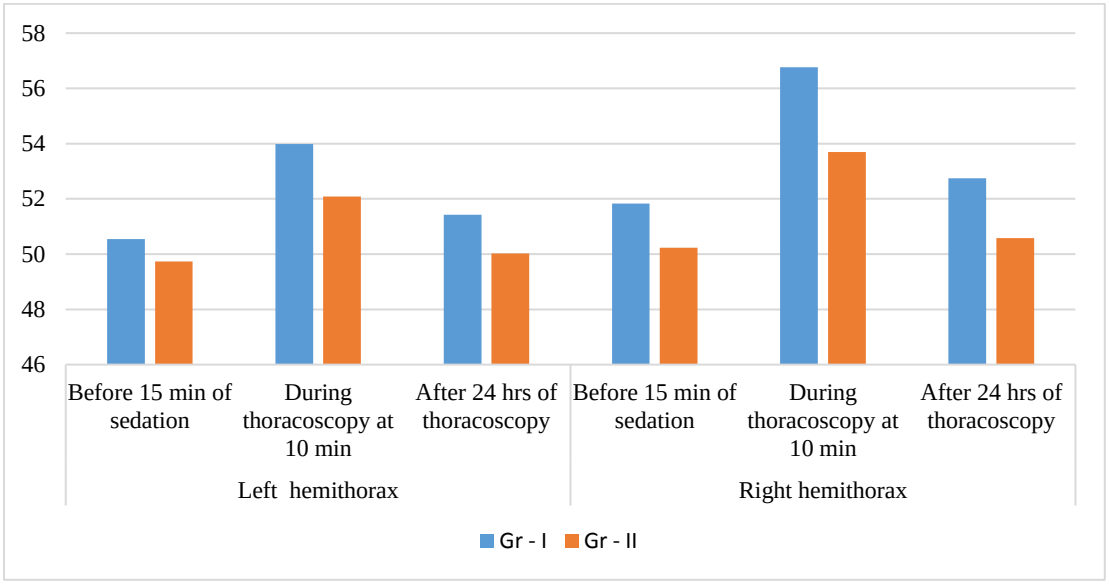


Fig. 4.5: Mean Alanine aminotransferase (IU/L) level in left and right hemithorax for group I and group II

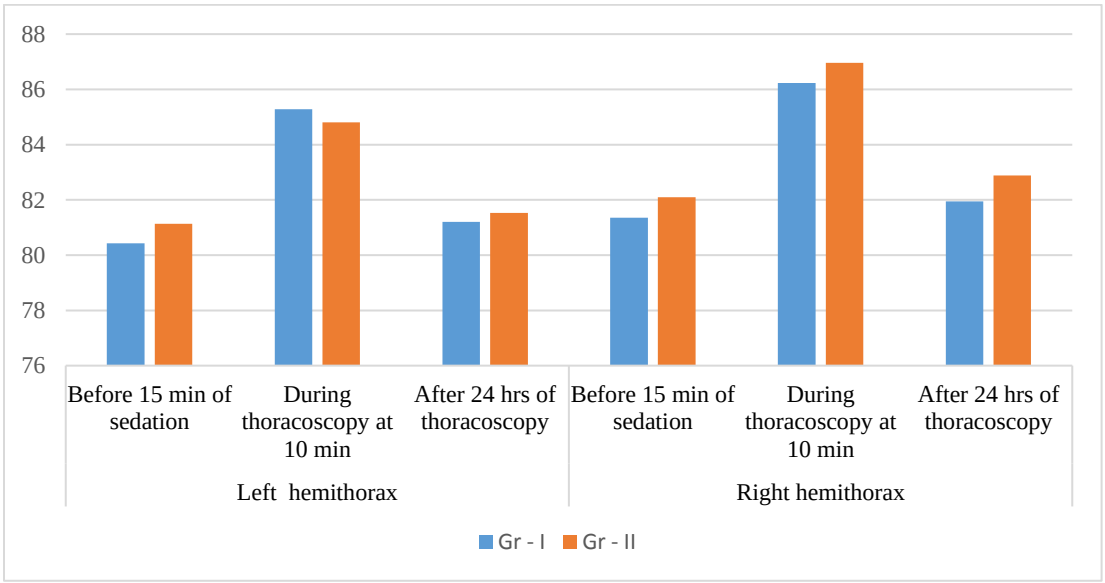


Fig. 4.6: Mean alkaline phosphatase (IU/L) level in left and right hemithorax of group I and group II

hemithorax was 86.96±1.72 (IU/L) found increase highly significant as compared to mean ALKP of left hemithorax.

Table 4.15: Mean±SE of alkaline phosphatase (IU/L) irrespective to left and right hemithorax of group I and group II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hr of thoracoscopy
Gr – I	80.89±0.69	85.75± 6.97	81.57±0.67
Gr – II	81.61±0.97	85.89±1.11	82.20±0.97

The mean ALKP before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 80.89± 0.69, 85.75± 6.97 and 81.57± 0.67 IU/L and 81.61± 0.97, 85.89± 1.11 and 82.20± 0.97 IU/L (Table 4.15) respectively showed non-significant change when compared between the group. As the values of ALKP returned to the base line values after 24 hrs of thoracoscopy, the possibilities of pathological change in the hepatic or renal injury could therefore be ruled out, further, there is no clinical relevance.

d) <u>Blood urea nitrogen (BUN)</u>

The mean blood urea nitrogen (BUN) level at different interval in group I and group II was given in table 4.16 and 4.17.

Table 4.16: Mean±SE of blood urea nitrogen (mg/dL) level in left and right hemithorax for group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hr of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hr of thoracoscopy
Gr – I	35.91± 1.27	37.45± 1.36	37.23± 1.25	37.83± 1.302*	39.13± 1.23*	38.25± 1.12**
Gr - II	39.28± 0.64	40.41± 0.80	39.5± 0.63	39.62± 0.76	41.1± 0.76*	39.43± 0.97

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group

The mean BUN of left and right hemithorax during 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I were 35.91±1.27 37.45±1.36 and 37.23±1.25 (mg/dL) and 37.83±1.30, 39.13±1.23 and 38.25± 1.12 (mg/dL) respectively whereas, mean BUN of group showed non-significant increase during thoracoscopy at 10 min. whereas, in group II 39.28±0.648, 40.41±0.806 and 39.5±0.63 (mg/dL) and 39.62±0.76, 41.1±0.76 and 39.43±0.97 (mg/dL) (Fig. 4.7) showed non-significant increase during thoracoscopy at 10 min.

In group I mean BUN before 15 min of sedation in left and right hemithorax were 35.91±1.27 and 37.83±1.30 observed significant increase of mean BUN in right hemithorax. Whereas, in group II mean BUN non-significant change was observed in left 39.28±0.64 (mg/dL) and right 39.62±0.76 (mg/dL) before 15 min of sedation.

In group I mean BUN of left and right hemithorax during thoracoscopy at 10 min were 37.45±1.36 and 39.13±1.23 respectively whereas, in group II 40.41±0.806 and 41.1±0.76 showed significant increase of mean BUN during thoracoscopy at 10 min in right hemithorax of both groups.

In group I mean BUN in right hemithorax 38.25±1.12 (mg/dL) was observed highly significant increase as compared with left hemithorax 37.23±1.25 (mg/dL). In group II mean BUN in left 39.5±0.63 (mg/dL) and right hemithorax 39.43±0.97 (mg/dL) were noted non-significant change.

Table 4.17: Mean ±SE of blood urea nitrogen (mg/dL) level irrespective to left and right hemithorax of group I and group II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hr of thoracoscopy
Gr – I	36.87± 0.91	38.29±0.91	37.74±0.81
Gr – II	39.45± 0.47*	40.75±0.54*	39.46±0.55

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group

The mean BUN before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 36.87±0.91, 38.29±0.91and

37.74±0.81 (mg/dL) and 39.45±0.47, 40.75±0.54 and 39.46±0.55 mg/dL (Table 4.17) respectively showed significant increase in mean BUN before 15 min of sedation and during thoracoscopy at 10 min in group II when compared between the group.

Dhumeaux and Haudiquet (2009) reported non-significant changes in BUN during thoracoscopic assisted lung resection in dog, whereas, Wormser *et al*. (2014) reported increase in BUN value post-surgery in one cat during thoracoscopic lung surgery.

e) <u>Serum creatinine</u>

The mean serum creatininelevel at different interval in group I and group II was given in table 4.18 and 4.19 (Fig. 4.8).

Table 4.18: Mean±SE of serum creatinine (mg/dL) level in left and right hemithorax for group I and group II

Parameter/ Group	Left hemithorax			Right hemithorax		
	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hr of thoracoscopy	Before 15 min of sedation	During thoracoscopy at 10 min	After 24 hr of thoracoscopy
Gr - I	2.11± 0.17	2.33± 0.15	2.13± 0.19	2.21± 0.16	2.48± 0.14*	2.26± 0.14*
Gr - II	1.88± 0.11	2.15± 0.11	1.97± 0.11	1.98± 0.10*	2.33± 0.09*	2.15± 0.10**

** Indicates significance at 1% level and * indicates significance at 5% level for comparison between values of a group

The mean serum creatinine of left and right hemithorax during 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I were 2.11±0.17, 2.33±0.15 and 2.13±0.19 (mg/dL) and 2.21±0.16, 2.48±0.14 and 2.26±0.14 (mg/dL) respectively whereas, mean BUN of group showed non-significant increase during thoracoscopy at 10 min. whereas, in group II 1.88±0.11, 2.15±0.11 and 1.97±0.11 (mg/dL) and 1.98±0.10, 2.33±0.09 and 2.15±0.10 (mg/dL) showed non-significant increase during thoracoscopy at 10 min.

In group I Mean serum creatinine before 15 min of sedation in left and right hemithorax were 2.11±0.17 (mg/dL) and 2.21±0.16 (mg/dL) observed non-significant change in mean serum creatinine. In group II significant change was observed in right 1.98±0.10 (mg/dL) as compared with left 1.88±0.11 (mg/dL) before 15 min of sedation.

Mean serum creatinine during thoracoscopy at 10 min of left hemithorax in group I and II were 2.33±0.15 and 2.15±0.11 (mg/dL) respectively and right hemithorax were 2.48±0.14 and 2.33±0.09 (mg/dL) respectively showed significant increase in serum creatinine during thoracoscopy of right hemithorax in both group I and II.

Mean serum creatinine after 24 hours of thoracoscopy of left hemithorax in group I and II were 2.13±0.19 and 1.97±0.11 (mg/dL) respectively and right hemithorax 2.26±0.14 and 2.15±0.10 (mg/dL) respectively showed significant increase in serum creatinine after 24 hours of thoracoscopy in both left whereas, highly significant in right hemithorax.

Table 4.19: Mean ±SE of serum creatinine (mg/dL) level irrespective to left and right hemithorax of group I and II

Parameter/ Group	Before 15 min of sedation	During thoracoscopy at 10 min.	After 24 hr of thoracoscopy
Gr – I	2.16±0.11	2.41±0.10	2.20±0.11
Gr – II	0.26±0.07	0.26±0.07	2.06±0.07

The mean serum creatinine before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 2.16± 0.11, 2.41± 0.10 and 2.20± 0.11 (mg/dL) and 0.26± 0.07, 0.26± 0.07 and 2.06± 0.07 mg/dL (Table 4.19) respectively showed non-significant change when compared between the group. Gaikwad (2019) reported no significant difference in the serum creatinine level during anaesthesia and thoracoscopy in dogs.

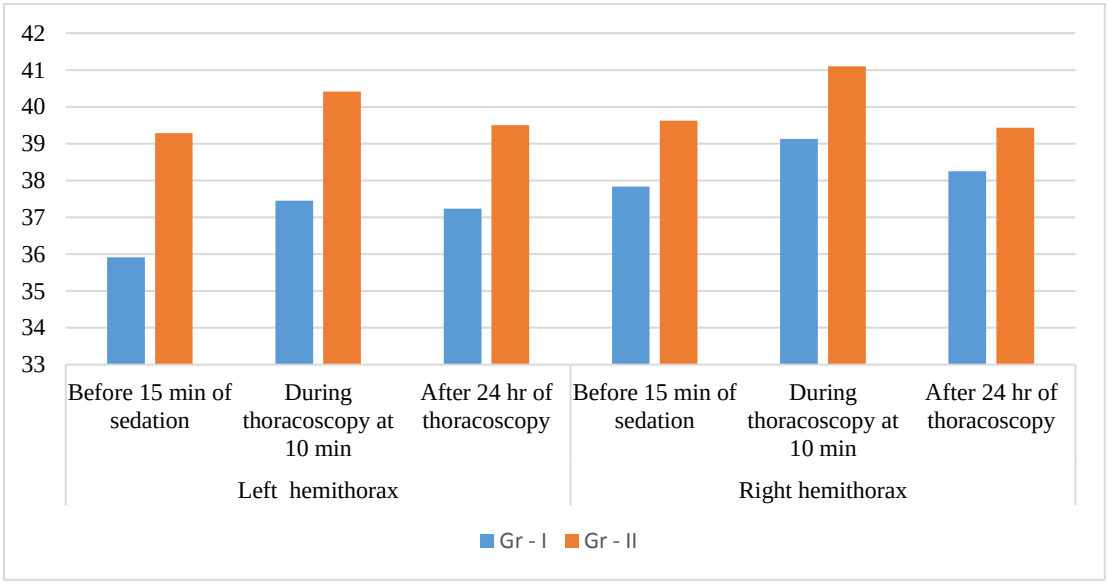


Fig. 4.7: Mean blood urea nitrogen (mg/dL) level in left and right hemithorax for group I and group II

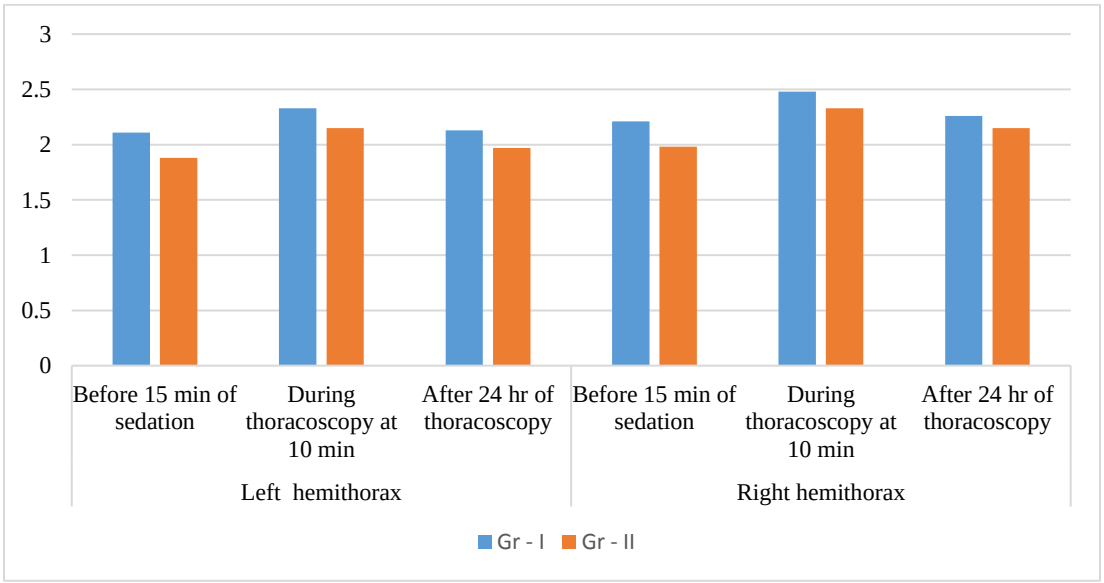


Fig. 4.8: Mean serum creatinine (mg/dL) level in left and right hemithorax for group I and group II

4.10.4 Peri-operative/post-operative complications

a) <u>Subcutaneous emphysema</u>

In the present study, the subcutaneous emphysema was not evident except in one animal at ventral port at 8th ICS of right hemithorax from group II, however, minor swelling and local inflammation at the site of surgical wound was noticed in all the animals of both groups whereas, it resolved after two days without any intervention. Peroni *et al*. (2001) noticed that peri-incisional post-operative subcutaneous emphysema was occurred in horses due to large and deep incision at port site. Scharner *et al*. (2013) and Michaux *et al*. (2014) reported that no emphysema was found postoperatively in cattle.

b) <u>Discomfort to the animals</u>

In group I one animal showed weight shifting during thoracoscopic examination of right hemithorax at 10th ICS because of short distance of diaphragm from 10th ICS (Scharner *et al*. 2013).

In group II almost all the animals were showed discomfort during thoracoscopy examination in both 7th and 8th ICS. The non-descript cow was showed weight shifting during examination of left hemithorax through 8th ICS when scope was moved caudal to cranial because telescope was distracted the more rigidly fixed cranial thoracic ribs.

Similar, findings was noted by Klohnen and Peroni (2000) and Peroni *et al*. (2001) in horses at 8th ICS. Villalobos *et al.* (2017) stated that risk of lung laceration was higher with ventral port and lower with dorsal port and also, suggested moderated discomfort in all calves.

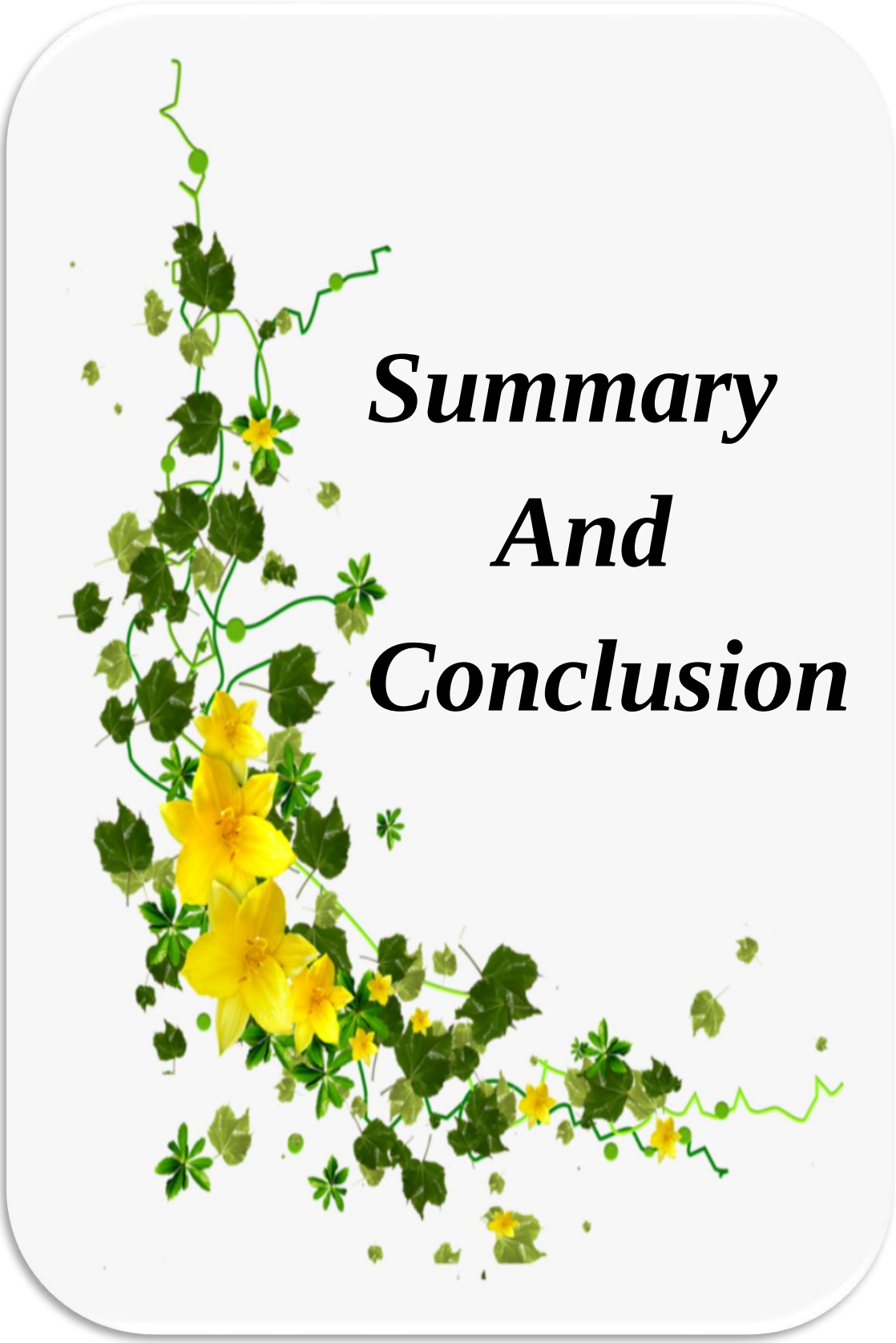
c) Complications

Two animals from group I was died after thoracoscopy procedures however, the death of animals was evident by the preexisting life threatening condition (Theileriosis). In contrast to these findings Boutin *et al.* (1993) stated that thoracoscopy was one of the safest pneumological examinations with mortality rate of 0.09% in humans whereas, Krasna *et al*. (1996) reported there were no deaths found during thoracoscopic examination procedure in human patients.

However, Jackson *et al.* (1999) reported traction of phrenic nerve, laceration of a lung lobe and intra operative bleeding in dogs. Walsh *et al*., (1999) reported that fewer wound complications, less post-operative pain and rapid return to normalcy and Radlinsky *et al*. (2002) stated that pulmonary trauma was caused by aggressive manipulation of instruments not under direct visualization in dog during thoracoscopy.

Furthermore, Relave *et al*. (2008) reported that intercostal hemorrhages, in present study minute blood clots in pleural spaces were found in two animals each from both group I and II whereas, no significant complication was noted. Post operatively, Brisson *et al*. (2010) and Alwen *et al*. (2015) observed portal site metastasis after diagnostic thoracoscopy in dogs. Pollock and Russell (2015) noticed residual pneumothorax, infection, pain, respiratory distress and lung lacerations during thoracoscopic diagnosis of lymphosarcoma in horse. Whereas, Villalobos *et al.* (2017) stated that the adverse event included hemorrhage and trauma to adjacent structures within the thoracic cavity after thoracoscopy.

The complications viz, pneumothorax, pneumonia, pleuritis, lung collapse, lung lacerations, post-operative air leak etc. were not found in any animal of group I and II animal.



Summary And Conclusion

5. SUMMARY AND CONCLUSION

The clinical study entitled "Evaluation of port placement approaches for thoracoscopic examination in cattle" was undertaken on Twelve clinical cases referred to the Department of Surgery and Radiology, College of Veterinary and Animal Sciences, Udgir.

Twelve clinical cases of cattle with history of chronic cough, anorexia with respiratory problem, dyspnea, exercise intolerance, labored breathing and nasal discharge were included in the study. These animals were randomly divided into two equal groups for thoracoscopy based on the placement of port, in group I animals port was created dorsally in 9^{th} and 10^{th} intercostal space of right and left hemithorax and in group II placement of port was created ventrally in 7^{th} and 8^{th} intercostal space of right and left hemithorax.

The thoracoscopy was carried out to evaluate the different port placement approaches for carrying out thoracoscopic examination with respect to anatomical structures and to study the physio-biochemical parameters in cattle undergoing thoracoscopy were evaluated in this study.

All the animals (group I and II) incorporated in the study from cattle were subjected for radiographic examinations in right lateral recumbency of thorax before and 24 hrs after thoracoscopy to evaluate thoracic abnormalities and pneumothorax. In all the animals of both groups showed mild to moderate lung consolidation during pre-operative radiographic examination.

In group I two animal, showed widely spread homogenous increased density of lung field specially in the ventral thorax and perivascular infiltration with loss of vascular markings and the cardiac shadow was indistinct and diaphragmatic line was hazy in preoperatively radiographs that indicated the hydrothorax and it was confirmed during thoracoscopy.

Post thoracoscopic radiographic examination was carried out in all the animals of group I and II and no incidence of pneumothorax was observed. The complications viz, pneumothorax, pneumonia, pleuritis, lung, collapse, lung lacerations, post-operative air leak etc were not found in any animal.

Before thoracoscopy, animals of both group I and II were prepared for thoracoscopy by fasting for at least 24 hours and water was withheld for 12-18 hrs. After thoracoscopic examinations of left hemithorax, the feed was allowed to the animal for 12 hr and again feed was withheld for 12 hr before right hemithorax examination, this method found suitable for thoracoscopy and no any complications were noted before and during procedure.

All the animals from both the groups (100%) were well responded to standing sedation with Inj. butorphanol @ 0.05 mg/Kg b.wt. IV. In present study no signs of anxiety or restlessness and increased respiratory rate except in one (16.66%) animal from group II was noticed. Further, sedation along with local anaesthesia was well tolerated by the all the animals for standing thoracoscopy in both the hemithorax.

The surgical site was prepared ascetically by scrubbing and shaving extending caudally from the caudal border of scapula to the 13^{th} rib and ventrally from dorsal midline to the level of the elbow joint from left and right hemithorax. All port sites were marked by applying sterile piece of surgical tape with label viz. (7^{th} ICS, 8^{th} ICS, 9^{th} ICS and 10^{th} ICS).

Dorsal port site at 9^{th} and 10^{th} ICS in group I and ventral port sites at 7^{th} and 8^{th} ICS in group II were anesthetized by using an 18 G, 1.5 inch needle to infiltrate 2% lignocaine HCl (15-20 mL) locally into the subcutaneous, muscular and pleural tissues of the selected ICS. One bullock from group II which had very thick body wall an 18 G, 1.5 inch needle was not sufficient to inject the anesthesia up to the plural tissues hence, 18 G 6 inch long spinal needle was used to infiltrate 2% lignocaine HCl and intercostal nerve was anesthetized. Lignocaine HCl was found

sufficient to provide adequate analgesia in entire procedure of thoracoscopy in both the groups.

The thoracoscopic procedures were carried out in standing position of all the animals of group I and II, and were restrained in travis for safety of instrument, surgeons and also to restrict the unnecessary movement of animals during thoracoscopy. Further, no any complications were noticed in thoracoscopic examination and were well tolerated by all the animals of group I and II.

Standardization of port placement was done by dividing the thorax in four region viz. left dorsal, right dorsal, left ventral and right ventral. Accordingly, dorsal port placement was created at the 15 cm ventral to transverse process of thoracic vertebra in 9^{th} and 10^{th} intercostal space of left hemithorax and right hemithorax. In both the procedures of left and right thoracoscopy the 24 hrs interval was maintained to minimize the effect of procedure on cardiovascular and pulmonary functions in animals of group I and II. Whereas, in group II animals the port placement was created at 30-35 cm ventral to transverse process of thoracic vertebra in 7^{th} and 8^{th} intercostal space of left hemithorax and right hemithorax similarly, as per group I, 24 hrs interval was maintained in both the procedures of left and right thoracoscopy.

Thoracoscopic examination was carried in group I and group II animals, after local analgesia, in the selected intercostal space through which scope was introduced. A one cm skin incision along with subcutaneous tissue and a portion of the underlying intercostal muscle layers were also incised. A nine cm long stainless steel teat cannula with a blunt end was inserted into the incision at the cranial aspect of the caudal rib to avoid trauma to the neuromuscular bundle. The teat cannula was inserted until it entered the pleural cavity as determined by the whistling sound of air passing through the cannula into the pleural cavity. After sound of air was completely stopped, teat cannula was replaced with 15 cm long 11 mm diameter trocar cannula unit. A 57 cm, 0^0 rigid telescopes with diameter 10 mm was introduced into pleural

cavity through cannula. The telescope was connected to a video camera and optic fiber cable for transmission of light and data was recorded.

Thoracoscopic examinations from group I animals were started through left dorsal hemithorax 15 cm ventral to transverse process of thoracic vertebra in 9^{th} and followed by 10^{th} ICS, all visible structures were identified and noted, whereas, contralateral thoracoscopic examination was performed in the same manner after 24 hrs of initial procedure in the 9^{th} and 10^{th} ICS.

In group II animals, the ventral ports were created through left ventral hemithorax, 30-35 cm ventral to transverse process of thoracic vertebra in7^{th} and 8^{th} ICS, all visible structures were identified and noted and similar procedures were repeated on the right hemithorax after 24 hrs. In group I and II animals, after examination of dorsal and ventral port the procedures were recorded and saved on the advanced image and data archiving system in DICOM format.

In all the animals, of both groups at the end of the procedure the cranial port site wound was sutured by cruciate technique and while removing the scope from the caudal port site suction was applied @ 80 to 120 mm Hg to resolve the pneumothorax the telescope was removed from the port just before the lung came into contact with the scope and surgical wound was sutured with cruciate technique by using sterilized nylon. Each animal from group I and II were shifted to separate IPD ward within 15 minutes after procedure under observation and complications if any were recorded.

Postoperatively all the animals from group I and II were administered with broad spectrum antibiotic Inj. Cefoperazone and sulbactum @ 10 mg/kg IM and Inj. Meloxicam @ 0.5 mg/kg IM once daily for five days. The surgical wound was dressed daily with povidone iodine and applied povidone iodine ointment. Clinical and routine observations of operated cases were noted and complications were recorded.

In all the animals of group I placement of dorsal port in the 9th ICS 15 cm ventral to transverse process of thoracic vertebra allowed for easy manipulation of the telescope in all directions. Thoracoscopic examination of the intrapleural structures were found suitable and best achieved through the 9th ICS.

Placement of the dorsal port in the 10th ICS resulted that limited movement of the telescope in the caudal and ventral direction due to its closer proximity to the diaphragm due to this restriction manipulation of telescope was found difficult.

In group II animal placement of ventral port in the 7th ICS and 8th ICS 30-35 cm ventral to transverse process of thoracic vertebra allowed closer examination of structures in the cranioventral portion of the hemithorax, however, signs of pain were exhibited by the animals. Port placement in the 7th ICS allowed easy manipulation of telescope dorsally and ventrally however, manipulation of telescope in cranially and caudally was difficult and patient discomfort was observed.

Placement of port in the 8th ICS in left and right hemithorax was difficult because 8th rib was a last sternal rib and restriction was found during advancing the telescope cranially with discomfort to animals. The 7th ICS when compared with the 8th ICS, from 30 cm ventral to transverse process of thoracic vertebrae was found easier and suitable for better examination of anatomical structures from both right and left hemithorax in group II animals.

In animals of group I, thoracic structures viz. pleural surface of ribs, intercostal muscle, aorta and aortic arch, sympathetic trunk, aortic hiatus, azygous vein, costocervical vein, thoracic esophagus, dorsal branch of vagus nerve, pulmonary ligament, diaphragm, caudal and cranial lung lobe, intercostal nerve bundle, mediastinal lymph nodes were visualised and easily approached through dorsal port located at 9th and 10th ICS 15 cm ventral to transverse process of thoracic vertebra in both left and right hemithorax. Whereas, cranial mediastinum and cranial lung lobe were approached only in left hemithorax and middle lung lobe was approached in right hemithorax through both dorsal port located at 9th and 10th ICS.

In group II animals, pleural surface of ribs, intercostal muscle, aorta and aortic arch, sympathetic trunk, aortic hiatus, azygous vein, costocervical vein, thoracic esophagus, dorsal branch of vagus nerve, pulmonary ligament, diaphragm, caudal lung lobe, intercostal nerve bundle, mediastinal lymph nodes were visualized and approached through ventral port located at 7^{th} and 8^{th} ICS 30-35 cm ventral to transverse process of thoracic vertebra in both left and right hemithorax. Whereas, cranial mediastinum and cranial lung lobe was approached in left hemithorax and middle lung lobe was approached in right hemithorax through both 7^{th} and 8^{th} ICS of ventral port.

The mean heart rate before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy in group I and II were 64.83±1.953, 73.25±2.17 and 65.83±2.00 beats/min and 69.75±1.93, 77.83±1.858 and 70.50±1.94 beats/min respectively showed non-significant change when compared between the group.

Mean respiratory rate before 15 min of sedation of both hemithorax of group I and group II animals were 27.16±1.30 and 31.66±1.94 (breaths/min) respectively. Whereas, during thoracoscopy at 10 min of both left and right hemithorax of group I and group II were 34.75±1.53 and 42.66±1.89 (breaths/min) respectively. Statistically mean respiratory rate during thoracoscopy at 10 min increased highly significant in group II and after 24 hrs of thoracoscopy it was 27.50±1.36 and 32.25±1.96 (breaths/min) respectively found non-significant between the groups. The significant increase in respiratory rate at 10 min during thoracoscopy might be because of the evident of pain lead to cardiorespiratory alterations.

Mean SpO_2 of group I and group II before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 98.16±0.20, 97.08±0.19 and 98.08±0.14 (%) and 98.16±0.24, 96.91±0.22 and 98.08±0.22 (%) found non-significant.

The mean AST before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 169.74±2.47, 175.65±2.08 and

171.29±2.19 (IU/L) and 164.40±4.16, 172.40±3.96 and 165.71±4.12 (IU/L) respectively showed non-significant change when compared between the group.

The mean ALT before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 51.19±0.99, 55.37±1.07 and 52.09±1.02 IU/L and 49.98±0.79, 52.89±0.90 and 50.30±0.80 (IU/L) respectively showed non-significant change when compared between the group.

The mean ALKP before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 80.89± 0.69, 85.75± 6.97 and 81.57± 0.67 IU/L and 81.61± 0.97, 85.89± 1.11 and 82.20± 0.97 IU/L respectively showed non-significant change when compared between the group. As the values of ALKP returned to the base line values after 24 hrs of thoracoscopy, the possibilities of pathological change in the hepatic or renal injury could therefore be ruled out.

The mean BUN before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 36.87±0.91, 38.29±0.91and 37.74±0.81 (mg/dL) and 39.45±0.47, 40.75±0.54 and 39.46±0.55 mg/dL respectively showed significant increase in mean BUN before 15 min of sedation and during thoracoscopy at 10 min in group II when compared between the group.

The mean serum creatinine before 15 min of sedation, during thoracoscopy at 10 min and after 24 hr of thoracoscopy in group I and II were 2.16± 0.11, 2.41± 0.10 and 2.20± 0.11 (mg/dL) and 0.26± 0.07, 0.26± 0.07 and 2.06± 0.07 mg/dL respectively showed non-significant change when compared between the group.

The subcutaneous emphysema was not evident except in one animal at ventral port at 8th ICS of right hemithorax from group II, however, minor swelling and local inflammation at the site of surgical wound was noticed in all the animals of both groups whereas, it resolved after two days without any intervention.

In group I one animal showed weight shifting during thoracoscopic examination of right hemithorax at 10^{th} ICS because of short distance of diaphragm from 10^{th} ICS. In group II almost all the animals were showed discomfort during thoracoscopy examination in both 7^{th} and 8^{th} ICS. The non-descript cow was showed weight shifting during examination of left hemithorax through 8^{th} ICS when scope was moved caudal to cranial because telescope was distracted the more rigidly fixed cranial thoracic ribs. Two animals of group I died after thoracoscopy procedures however, the death of animals was evident by the preexisting life threatening conditions.

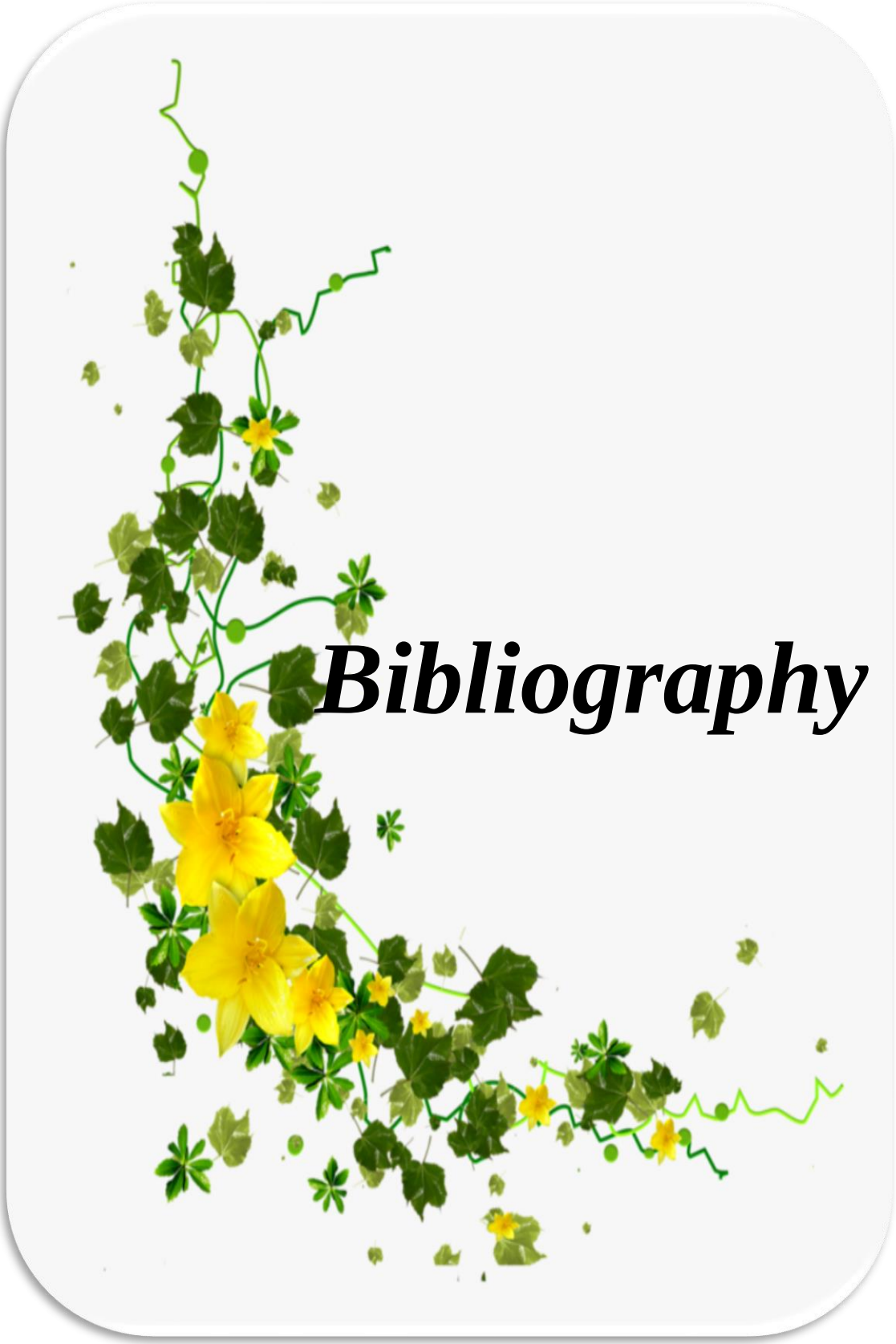
The complications viz, pneumothorax, pneumonia, pleuritis, lung collapse, lung lacerations, post-operative air leak etc. were not found in any animal of group I and II animal.

CONCLUSIONS

On the basis of study of the clinical research entitled "Evaluation of port placement approaches for thoracoscopic examination in cattle" the following conclusions were drawn:

1. The 0^0 rigid telescope, provided natural perspective to organ orientation and well suitable for thoracoscopy in cattle.
2. The 175 W xenon light was adequate for thoracoscopic examination and documentation in cattle.
3. Standing thoracoscopy was well tolerated in cattle without major complications.
4. Standing thoracoscopy provided good visualization of the dorsal and lateral structures of the thorax.
5. The lignocaine HCl was found sufficient to provide adequate analgesia in entire procedure of thoracoscopy

6. Stainless steel blunt end teat cannula was found suitable for passive lung collapse and was found suitable for thoracoscopic examination of both hemithorax in cattle.
7. Thoracoscopic examination was minimally invasive method and it helped to explore thoracic structures and obtained pleural fluids.
8. Radiographic examination was found suitable for diagnosis of hydrothorax in cattle.
9. During thoracoscopy dorsal port (approximately 15 cm ventral to transverse process of thoracic vertebra) at 9^{th} ICS and ventral port (approximately 30-35 cm ventral to transverse process of thoracic vertebra) at 7^{th} ICS were more suitable for examination of thorax.



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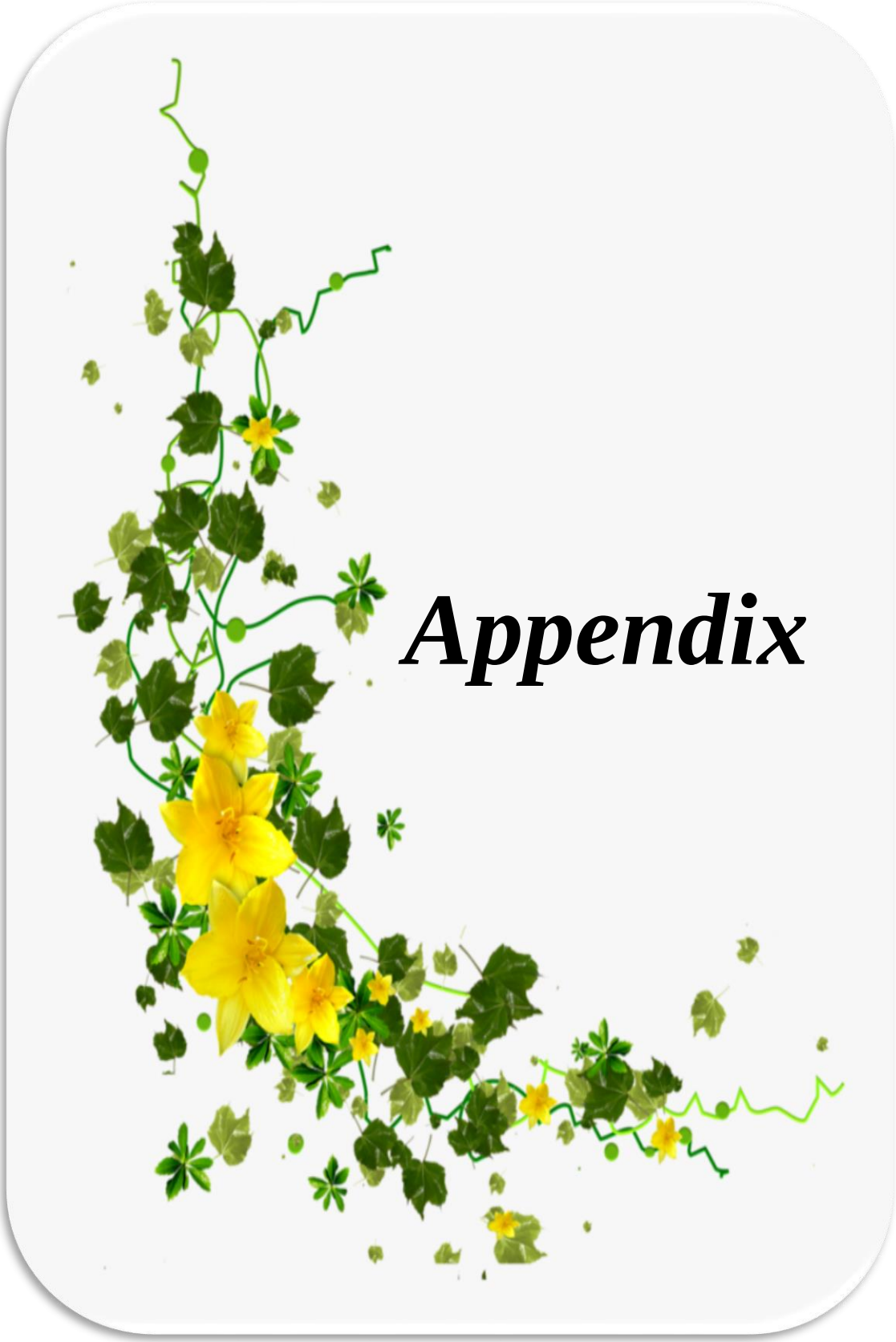

Appendix

APPENDIX

Analysis for Heart rate (Beats/min) dorsal port left hemithorax Group I

Treatment means

Sr. No	Average
Treatment 1	64.500
Treatment 2	71.667
Treatment 3	65.167

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	188.111	94.056	1.773	0.204
Error	15	795.667	53.044	-	-
Total	17	-	-	-	-

Coefficient of Variation = 10.852

Treatments found to be Non-Significant

Analysis for Heart rate (Beats/min) dorsal port right hemithorax Group I

Treatment means

Sr. No	Average
Treatment 1	65.167
Treatment 2	74.833
Treatment 3	66.500

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	329.333	164.667	2.979	0.081
Error	15	829.167	55.278	-	-
Total	17	-	-	-	-

Coefficient of Variation = 10.801

Treatments found to be Non-Significant

Analysis for Heart rate (Beats/min) ventral port left hemithorax

Treatment means

Sr. No	Average
Treatment 1	69.167
Treatment 2	77.500
Treatment 3	70.000

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	252.778	126.389	2.837	0.090
Error	15	668.333	44.556	-	-
Total	17	-	-	-	-

Coefficient of Variation = 9.242

Treatments found to be Non-Significant

Analysis for Heart rate (Beats/min) ventral port right hemithorax

Treatment means

Sr. No	Average
Treatment 1	70.333
Treatment 2	78.167
Treatment 3	71.000

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	226.333	113.167	2.198	0.145
Error	15	772.167	51.478	-	-
Total	17	-	-	-	-

Coefficient of Variation = 9.806

Treatments found to be Non-Significant

Samples are not significantly different

Paired T test

Sample 1 heart rate during thoracoscopy at 10 min dorsal port left thorax of group I

Number of Observations	6
Average	71.667
Standard Deviation	7.474
Variance	55.867

Sample 2 Heart rate during thoracoscopy at 10 min dorsal port right thorax group I

Number of Observations	6
Average	74.833
Standard Deviation	7.960
Variance	63.367

Test results

T - Statistic	:	-5.270
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 Heart rate before 15 min of sedation left thorax ventral port group II

Number of Observations	6
Average	69.167
Standard Deviation	6.765
Variance	45.767

Sample 2 Heart rate before 15 min of sedation right thorax ventral port group II

Number of Observations	6
Average	70.333
Standard Deviation	7.257
Variance	52.667

Test results

T – Statistic	:	-3.796
T - Table (0.05)	:	2.571

T - Table (0.01) : 4.032

Sample are significantly different at 5% level of significance

Sample 1 heart rate during thoracoscopy at 10 min ventral port left thorax in group II

Number of Observations	6
Average	77.500
Standard Deviation	6.565
Variance	43.100

Sample 2 heart rate during thoracoscopy at 10 min ventral port right thorax in group II

Number of Observations	6
Average	78.167
Standard Deviation	6.911
Variance	47.767

Test results

T - Statistic	:	-2.000
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not significantly different

Two sample test

Sample 1 before 15 min of sedation in group I

Number of Observations	12
Average	64.833
Standard Deviation	6.767
Variance	45.788

Sample 2 before 15 min of sedation in group II

Number of Observations	12
Average	69.750
Standard Deviation	6.717
Variance	45.114

Test results

T – Statistic	:	-1.786
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 during thoracoscopy at 10 min in group I

Number of Observations	12
Average	73.250
Standard Deviation	7.545
Variance	56.932

Sample 2 during thoracoscopy at 10 min in group II

Number of Observations	12
Average	77.833
Standard Deviation	6.436
Variance	41.424

Test results

T - Statistic	:	-1.601
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 After 24 hrs of thoracoscopy in group I

Number of Observations	12
Average	65.833
Standard Deviation	6.952
Variance	48.333

Sample After 24 hrs of thoracoscopy in group II

Number of Observations	12
Average	70.500
Standard Deviation	6.722
Variance	45.182

Test results

T - Statistic	:	-1.672
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

ANOVA OF RESPIRATORY RATE

Analysis for Respiration rate (breaths/min) dorsal port left thorax

Treatment means

Sr. No	Average
Treatment 1	26.500
Treatment 2	33.667
Treatment 3	27.333

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	184.333	92.167	3.290	0.065
Error	15	420.167	28.011	-	-
Total	17	-	-	-	-

Coefficient of Variation = 18.146

Treatments found to be Non-Significant

Analysis for Respiration rate (breaths/min) dorsal port right thorax

Treatment means

Sr. No	Average
Treatment 1	27.833
Treatment 2	35.833
Treatment 3	27.667

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	261.444	130.722	5.717	0.014
Error	15	343.000	22.867	-	-
Total	17	-	-	-	-

Coefficient of Variation = 15.707

Treatments found Significant at 5% level of Significance CD(0.05)= 5.883

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 2	T 1	T 3
Treatment Average	35.833	27.833	27.667
Critical Difference (CD) Compared	a	b	b

Analysis for Respiration rate (breaths/min) ventral port left thorax

Treatment means

Sr. No	Average
Treatment 1	31.167
Treatment 2	42.333
Treatment 3	31.667

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	477.444	238.722	4.778	0.025
Error	15	749.500	49.967	-	-
Total	17	-	-	-	-

Coefficient of Variation = 20.164

Treatments found Significant at 5% level of Significance CD(0.05)= 8.697

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 2	T 3	T 1
Treatment Average	42.333	31.667	31.167
Critical Difference (CD) Compared	a	b	b

Analysis for Respiration rate (breaths/min) ventral port right thorax

Treatment means

Sr. No	Average
Treatment 1	32.167
Treatment 2	43.000
Treatment 3	32.833

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	442.333	221.167	4.597	0.028
Error	15	721.667	48.111	-	-
Total	17	-	-	-	-

Coefficient of Variation = 19.267

Treatments found Significant at 5% level of Significance CD(0.05)= 8.534

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 2	T 3	T 1
Treatment Average	43.000	32.833	32.167
Critical Difference (CD) Compared	a	b	b

Paired T test

Sample 1 before 15 min of sedation in left hemithorax of group I

Number of Observations	6
Average	26.500
Standard Deviation	5.089
Variance	25.900

Sample 2 before 15 min of sedation in right hemithorax of group I

Number of Observations	6
Average	27.833
Standard Deviation	4.215
Variance	17.767

Test results

T - Statistic	:	-2.697
T - Table (0.05)	:	2.571

T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 during thoracoscopy at 10 min in left hemithorax of group I

Number of Observations	6
Average	33.667
Standard Deviation	5.680
Variance	32.267

Sample 2 during thoracoscopy at 10 min in right hemithorax of group II

Number of Observations	6
Average	35.833
Standard Deviation	5.231
Variance	27.367

Test results

T - Statistic	:	-7.050
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 before 15 min of sedation in left hemithorax of group I

Number of Observations	6
Average	31.167
Standard Deviation	6.940
Variance	48.167

Sample 2 before 15 min of sedation in right hemithorax of group II

Number of Observations	6
Average	32.167
Standard Deviation	7.139
Variance	50.967

Test results

T - Statistic	:	-2.739
T - Table (0.05)	:	2.571

T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 during thoracoscopy at 10 min in left hemithorax of group I

Number of Observations	6
Average	42.333
Standard Deviation	6.919
Variance	47.867

Sample 2 during thoracoscopy at 10 min in right hemithorax of group II

Number of Observations	6
Average	43.000
Standard Deviation	6.812
Variance	46.400

Test results

T - Statistic	:	-2.000
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not significantly different

Sample 1 respiratory rate after 24hr of thoracoscopy in left hemithorax in group I

Number of Observations	6
Average	31.667
Standard Deviation	7.339
Variance	53.867

Sample 2 respiratory rate after 24hr of thoracoscopy in right hemithorax in group II

Number of Observations	6
Average	32.833
Standard Deviation	6.853
Variance	46.967

Test results

T - Statistic	:	-2.150

T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not significantly different

Two sample test

Sample 1 respiratory rate before 15 min of sedation in group I

Number of Observations	12
Average	27.167
Standard Deviation	4.509
Variance	20.333

Sample 2 respiratory rate before 15 min of sedation in group II

Number of Observations	12
Average	31.667
Standard Deviation	6.733
Variance	45.333

Test results

T - Statistic	:	-1.924
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 respiratory rate during thoracoscopy at 10 min in group I

Number of Observations	12
Average	34.750
Standard Deviation	5.328
Variance	28.386

Sample 2 respiratory rate during thoracoscopy at 10 min in group II

Number of Observations	12
Average	42.667
Standard Deviation	6.555
Variance	42.970

Test results		
T - Statistic	:	-3.247
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are significantly different at both 5% and 1% level of significance

Sample 1 respiratory rate after 24 hrs of thoracoscopy in group I

Number of Observations	12
Average	27.50
Standard Deviation	4.73
Variance	22.45

Sample 2 respiratory rate after 24 hrs of thoracoscopy in group II

Number of Observations	12
Average	32.25
Standard Deviation	6.79
Variance	46.20

Test results		
T - Statistic	:	-1.98
T - Table (0.05)	:	2.07
T - Table (0.01)	:	2.81

Samples are not significantly different

Analysis for SpO2 (%) dorsal port left thorax

Treatment means

Sr. No	Average
Treatment 1	98.167
Treatment 2	97.000
Treatment 3	98.000

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	4.778	2.389	5.244	0.019
Error	15	6.833	0.456	-	-
Total	17	-	-	-	-

Coefficient of Variation = 0.691

Treatments found Significant at 5% level of Significance CD(0.05)= 0.830

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 1	T 3	T 2
Treatment Average	98.167	98.000	97.000
Critical Difference (CD) Compared	a	a	b

Analysis for SpO2 (%) dorsal port right thorax

Treatment means

Sr. No	Average
Treatment 1	98.167
Treatment 2	97.167
Treatment 3	98.167

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	4.000	2.000	4.615	0.027
Error	15	6.500	0.433	-	-
Total	17	-	-	-	-

Coefficient of Variation = 0.673

Treatments found Significant at 5% level of Significance CD(0.05)= 0.810

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 1	T 3	T 2
Treatment Average	98.167	98.167	97.167
Critical Difference (CD) Compared	a	a	b

Analysis for SpO2 (%) ventral port left thorax

Treatment means

Sr. No	Average
Treatment 1	98.000
Treatment 2	97.000
Treatment 3	98.000

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	4.000	2.000	3.000	0.080
Error	15	10.000	0.667	-	-
Total	17	-	-	-	-

Coefficient of Variation = 0.836

Treatments found to be Non-Significant

Analysis for SpO2 (%) ventral port right thorax

Treatment means

Sr. No	**Average**
Treatment 1	98.333
Treatment 2	96.833
Treatment 3	98.167

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	8.111	4.056	5.530	0.016
Error	15	11.000	0.733	-	-
Total	17	-	-	-	-

Coefficient of Variation = 0.876

Treatments found Significant at 5% level of Significance CD(0.05)= 1.054

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 1	T 3	T 2
Treatment Average	98.333	98.167	96.833
Critical Difference (CD) Compared	a	a	b

Sample 1 SpO2 before 15 min of sedation in group I

Number of Observations	12
Average	98.167
Standard Deviation	0.718
Variance	0.515

Sample 2 SpO2 before 15 min of sedation in group II

Number of Observations	12
Average	98.167
Standard Deviation	0.835
Variance	0.697

Test results

T - Statistic	:	0.000
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 SpO2 during thoracoscopy at 10 min in group I

Number of Observations	12
Average	97.083
Standard Deviation	0.669
Variance	0.447

Sample 2 SpO2 during thoracoscopy at 10 min in group II

Number of Observations	12
Average	96.917
Standard Deviation	0.793
Variance	0.629

Test results		
T - Statistic	:	0.557
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 SpO2 after 24 hrs of thoracoscopy in group I

Number of Observations	12
Average	98.083
Standard Deviation	0.515
Variance	0.265

Sample 2 SpO2 after 24 hrs of thoracoscopy in group II

Number of Observations	12
Average	98.083
Standard Deviation	0.793
Variance	0.629

Test results		
T - Statistic	:	0.000
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Analysis for AST of dorsal port left thorax group I

Treatment means

Sr. No	Average
Treatment 1	168.700
Treatment 2	175.850
Treatment 3	170.017

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	173.768	86.884	1.154	0.342
Error	15	1128.923	75.262	-	-
Total	17	-	-	-	-

Coefficient of Variation = 5.058

Treatments found to be Non-Significant

Analysis for AST of dorsal port right thorax group I

Treatment means

Sr. No	Average
Treatment 1	170.783
Treatment 2	175.450
Treatment 3	172.567

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	66.543	33.272	0.583	0.571
Error	15	856.397	57.093	-	-
Total	17	-	-	-	-

Coefficient of Variation = 4.369

Treatments found to be Non-Significant

Analysis for AST of ventral port left thorax group II

Treatment means

Sr. No	Average
Treatment 1	163.633
Treatment 2	171.333
Treatment 3	164.967

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	203.204	101.602	0.482	0.627
Error	15	3159.840	210.656	-	-
Total	17	-	-	-	-

Coefficient of Variation = 8.710

Treatments found to be Non-Significant

Analysis for AST of ventral port right thorax group II

Treatment means

Sr. No	Average
Treatment 1	165.167
Treatment 2	173.483
Treatment 3	166.467

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	240.181	120.091	0.526	0.602
Error	15	3425.075	228.338	-	-
Total	17	-	-	-	-

Coefficient of Variation = 8.975

Treatments found to be Non-Significant

Sample 1 AST before 15 min of sedation in left hemithorax of group I

Number of Observations	6
Average	168.700
Standard Deviation	9.565
Variance	91.480

Sample 2 AST before 15 min of sedation in right hemithorax of group I

Number of Observations	6
Average	170.783

Standard Deviation		8.239
Variance		67.878
Test results		
T - Statistic	:	-2.724
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 AST during thoracoscopy at 10 min in left hemithorax of group I

Number of Observations	6
Average	175.850
Standard Deviation	7.455
Variance	55.579

Sample 2 AST during thoracoscopy at 10 min in right hemithorax of group I

Number of Observations	6
Average	175.450
Standard Deviation	7.673
Variance	58.875

Test results		
T - Statistic	:	0.513
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not Significantly different

Sample 1 before 15 min of sedation in left hemithorax of group II

Number of Observations	6
Average	163.633
Standard Deviation	14.799
Variance	218.999

Sample 2 before 15 min of sedation in right hemithorax of group II

Number of Observations	6

Average	165.167
Standard Deviation	15.384
Variance	236.671

Test results

T - Statistic	:	-1.862
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not Significantly different

Sample 1 AST during thoracoscopy in left hemithorax of group II

Number of Observations	6
Average	171.333
Standard Deviation	14.083
Variance	198.339

Sample 2 during thoracoscopy in right hemithorax of group II

Number of Observations	6
Average	173.483
Standard Deviation	14.645
Variance	214.470

Test results

T - Statistic	:	-3.476
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 AST after 24 hrs of thoracoscopy in left hemithorax of group II

Number of Observations	6
Average	164.967
Standard Deviation	14.650
Variance	214.631

Sample 2 AST after 24 hrs of thoracoscopy in right hemithorax in group II

Number of Observations	6

Average	166.467
Standard Deviation	15.293
Variance	233.875

Test results

T - Statistic	:	-2.225
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are non-significantly different

Two sample test

Sample 1 AST before 15 min of sedation in group I

Number of Observations	12
Average	169.742
Standard Deviation	8.580
Variance	73.619

Sample 2 AST before 15 min of sedation in group II

Number of Observations	12
Average	164.400
Standard Deviation	14.414
Variance	207.764

Test Results

T - Statistic	:	1.103

Cochran and Cox corrected T Table values

T - Table (0.05)	:	2.201
T - Table (0.01)	:	3.106

Samples are not significantly different

Sample 1 AST during thoracoscopy at 10 min in group I

Number of Observations	12
Average	175.650
Standard Deviation	7.216
Variance	52.068

Sample 2 AST during thoracoscopy at 10 min in group II

Number of Observations	12
Average	172.408
Standard Deviation	13.744
Variance	188.901

Test Results

T - Statistic	:	0.723

Cochran and Cox corrected T Table values

T - Table (0.05)	:	2.201
T - Table (0.01)	:	3.106

Samples are not significantly different

Sample 1 AST after 24 hr of thoracoscopy in group I

Number of Observations	12
Average	171.292
Standard Deviation	7.602
Variance	57.797

Sample 2 AST after 24 hr of thoracoscopy in group I

Number of Observations	12
Average	165.717
Standard Deviation	14.300
Variance	204.480

Test Results

T - Statistic	:	1.192

Cochran and Cox corrected T Table values

T - Table (0.05)	:	2.201
T - Table (0.01)	:	3.106

Samples are not significantly different

Analysis for ALT (IU/L) Dorsal port left thorax

Treatment means

Sr. No	Average
Treatment 1	50.550
Treatment 2	53.983
Treatment 3	51.433

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	38.141	19.071	1.472	0.261
Error	15	194.357	12.957	-	-
Total	17	-	-	-	-

Coefficient of Variation = 6.924

Treatments found to be Non-Significant

Analysis for ALT (IU/L) Dorsal port right thorax

Treatment means

Sr. No	Average
Treatment 1	51.833
Treatment 2	56.767
Treatment 3	52.750

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	82.623	41.312	3.192	0.070
Error	15	194.122	12.941	-	-
Total	17	-	-	-	-

Coefficient of Variation = 6.689

Treatments found to be Non-Significant

Analysis for ALT (IU/L) ventral port left thorax

Treatment means

Sr. No	Average
Treatment 1	49.733
Treatment 2	52.083
Treatment 3	50.020

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	19.724	9.862	1.018	0.385
Error	15	145.290	9.686	-	-
Total	17	-	-	-	-

Coefficient of Variation = 6.149

Treatments found to be Non-Significant

Analysis for ALT (IU/L) ventral port right thorax

Treatment means

Sr. No	Average
Treatment 1	50.233
Treatment 2	53.700
Treatment 3	50.583

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	43.708	21.854	2.690	0.100
Error	15	121.862	8.124	-	-
Total	17	-	-	-	-

Coefficient of Variation = 5.534

Treatments found to be Non-Significant

Paired T test

Sample 1 ALT before 15 min of sedation in left hemithorax of group I

Number of Observations	6
Average	50.550
Standard Deviation	3.524
Variance	12.419

Sample 2 ALT before 15 min of sedation in right hemithorax of group I

Number of Observations	6
Average	51.833
Standard Deviation	3.571
Variance	12.755

Test results

T - Statistic	:	-8.868
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 ALT during thoracoscopy at 10 min in left hemithorax of group I

Number of Observations	6
Average	53.983
Standard Deviation	3.572
Variance	12.758

Sample 2 ALT during thoracoscopy at 10 min in right hemithorax of group I

Number of Observations	6
Average	56.767
Standard Deviation	3.627
Variance	13.155

Test results

T - Statistic	:	-8.819
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 ALT after 24 hr of thoracoscopy in left hemithorax in group I

Number of Observations	6
Average	51.433
Standard Deviation	3.701
Variance	13.695

Sample 2 ALT after 24 hr of thoracoscopy in right hemithorax in group I

Number of Observations	6
Average	52.750
Standard Deviation	3.594
Variance	12.915

Test results

T - Statistic	:	-6.672
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 ALT before 15 min of sedation in left hemithorax in group II

Number of Observations	6
Average	49.733
Standard Deviation	2.889
Variance	8.347

Sample 2 ALT before 15 min of sedation in right hemithorax in group II

Number of Observations	6
Average	50.233
Standard Deviation	2.872
Variance	8.251

Test results

T - Statistic	:	-1.705
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not significantly different

Sample 1 ALT before 15 min of sedation of group I

Number of Observations	12

Average	51.192
Standard Deviation	3.448
Variance	11.892

Sample 2 ALT before 15 min of sedation of group II

Number of Observations	12
Average	49.983
Standard Deviation	2.759
Variance	7.612

Test results

T - Statistic	:	0.948
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 ALT during 10 min of thoracoscopy of group I

Number of Observations	12
Average	55.375
Standard Deviation	3.727
Variance	13.891

Sample 2 ALT during 10 min of thoracoscopy of group II

Number of Observations	12
Average	52.892
Standard Deviation	3.122
Variance	9.744

Test results

T - Statistic	:	1.769
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 ALT after 24 hr of thoracoscopy of group I

Number of Observations	12
Average	52.092

Standard Deviation	3.545
Variance	12.568
Sample 2 ALT after 24 hr of thoracoscopy of group II	
Number of Observations	12
Average	50.302
Standard Deviation	2.792
Variance	7.797

Test results

T - Statistic	:	1.374
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Analysis for ALKP (IU/L) dorsal port left thorax group I

Treatment means

Sr. No	Average
Treatment 1	80.433
Treatment 2	85.283
Treatment 3	81.200

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	81.568	40.784	5.291	0.018
Error	15	115.622	7.708	-	-
Total	17	-	-	-	-

Coefficient of Variation = 3.373

Treatments found Significant at 5% level of Significance CD(0.05)= 3.416

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 2	T 3	T 1
Treatment Average	85.283	81.200	80.433
Critical Difference (CD) Compared	a	b	b

Analysis for ALKP (IU/L) dorsal port right thorax group I

Treatment means

Sr. No	Average
Treatment 1	81.350
Treatment 2	86.233
Treatment 3	81.950

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	85.108	42.554	8.073	0.004
Error	15	79.063	5.271	-	-
Total	17	-	-	-	-

Coefficient of Variation = 2.760

Treatments found Significant at 1% and 5% level of significance
CD(0.01) = 3.906 CD(0.05) = 2.825

Comparison of Treatment Means with Critical Difference (0.05)

Treatment No.	T 2	T 3	T 1
Treatment Average	86.233	81.950	81.350
Critical Difference (CD) Compared	a	b	b

Analysis for ALKP (IU/L) ventral port left thorax group I

Treatment means

Sr. No	Average
Treatment 1	81.133
Treatment 2	84.817
Treatment 3	81.533

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	49.014	24.507	2.161	0.150
Error	15	170.115	11.341	-	-
Total	17	-	-	-	-

Coefficient of Variation = 4.082

Treatments found to be Non-Significant

Analysis for ALKP (IU/L) ventral port right thorax group I

Treatment means

Sr. No	Average
Treatment 1	82.100
Treatment 2	86.967
Treatment 3	82.883

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	81.943	40.972	2.742	0.097
Error	15	224.102	14.940	-	-
Total	17	-	-	-	-

Coefficient of Variation = 4.602

Treatments found to be Non-Significant

Sample 1 ALKP during thoracoscopy at 10 min in group I

Number of Observations	12
Average	85.758
Standard Deviation	2.641
Variance	6.977

Sample 2 ALKP during thoracoscopy at 10 min in group II

Number of Observations	12
Average	85.892
Standard Deviation	3.878
Variance	15.039

Test results		
T - Statistic	:	-0.098
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 ALKP before 15 min of sedation in left hemithorax of group I

Number of Observations	6
Average	80.433
Standard Deviation	2.633
Variance	6.931

Sample 2 ALKP before 15 min of sedation in right hemithorax of group I

Number of Observations	6
Average	81.350
Standard Deviation	2.329
Variance	5.423

Test results		
T - Statistic	:	-3.887
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 ALKP at 10 min of thoracoscopy in left hemithorax of group I

Number of Observations	6
Average	85.283
Standard Deviation	3.296
Variance	10.862

Sample 2 ALKP at 10 min of thoracoscopy in right hemithorax of group I

Number of Observations	6
Average	86.233
Standard Deviation	1.987
Variance	3.947

Test results		
T - Statistic	:	-1.000

T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not significantly different

Sample 1 ALKP after 24 hr of thoracoscopy in left hemithorax of group I

Number of Observations	6
Average	81.200
Standard Deviation	2.309
Variance	5.332

Sample 2 ALKP after 24 hr of thoracoscopy in right hemithorax of group I

Number of Observations	6
Average	81.950
Standard Deviation	2.538
Variance	6.443

Test results

T - Statistic	:	-1.359
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are not significantly different

Sample 1 ALKP before 15 min of sedation in left hemithorax of group II

Number of Observations	6
Average	81.133
Standard Deviation	3.290
Variance	10.827

Sample 2 ALKP before 15 min of sedation in right hemithorax of group II

Number of Observations	6
Average	82.100
Standard Deviation	3.728
Variance	13.900

Test results

T - Statistic	:	-2.656
T - Table (0.05)	:	2.571

T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 ALKP at 10 min of thoracoscopy in left hemithorax of group II

Number of Observations	6
Average	84.817
Standard Deviation	3.518
Variance	12.378

Sample 2 ALKP at 10 min of thoracoscopy in right hemithorax of group II

Number of Observations	6
Average	86.967
Standard Deviation	4.235
Variance	17.935

Test results

T - Statistic	:	-4.284
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 ALKP after 24 hr of thoracoscopy in left hemithorax of group II

Number of Observations	6
Average	81.533
Standard Deviation	3.289
Variance	10.819

Sample 2 ALKP after 24 hr of thoracoscopy in right hemithorax of group II

Number of Observations	6
Average	82.883
Standard Deviation	3.604
Variance	12.986

Test results

T - Statistic	:	-2.574
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Two sample test

Sample 1 ALKP before 15 min of sedation in group I

Number of Observations	12
Average	80.892
Standard Deviation	2.418
Variance	5.844

Sample 2 ALKP before 15 min of sedation in group II

Number of Observations	12
Average	81.617
Standard Deviation	3.390
Variance	11.494

Test results

T - Statistic	:	-0.603
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 ALKP during thoracoscopy at 10 min in group I

Number of Observations	12
Average	85.758
Standard Deviation	2.641
Variance	6.977

Sample 2 ALKP during thoracoscopy at 10 min in group II

Number of Observations	12
Average	85.892
Standard Deviation	3.878
Variance	15.039

Test results

T - Statistic	:	-0.098
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 ALKP after 24 hr thoracoscopy in group I

Number of Observations	12
Average	81.575
Standard Deviation	2.346
Variance	5.506

Sample 2 ALKP after 24 hr thoracoscopy in group I

Number of Observations	12
Average	82.208
Standard Deviation	3.364
Variance	11.317

Test results

T - Statistic	:	-0.535
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

<u>Analysis for (BUN) (mg/dL) dorsal port left thorax group I</u>

Treatment means

Sr. No	Average
Treatment 1	35.917
Treatment 2	37.450
Treatment 3	37.233

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	8.263	4.132	0.409	0.671
Error	15	151.517	10.101	-	-
Total	17	-	-	-	-

Coefficient of Variation = 8.621

Treatments found to be Non-Significant

Samples are not significantly different

Analysis for (BUN) (mg/dL) dorsal port right thorax group I

Treatment means

Sr. No	Average
Treatment 1	37.833
Treatment 2	39.133
Treatment 3	38.250

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	5.288	2.644	0.294	0.750
Error	15	134.962	8.997	-	-
Total	17	-	-	-	-

Coefficient of Variation = 7.810

Treatments found to be Non-Significant

Analysis for (BUN) (mg/dL) ventral port left thorax group II

Treatment means

Sr. No	Average
Treatment 1	39.283
Treatment 2	40.417
Treatment 3	39.500

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	4.343	2.172	0.736	0.496
Error	15	44.277	2.952	-	-
Total	17	-	-	-	-

Coefficient of Variation = 4.324

Treatments found to be Non-Significant

Analysis for (BUN) (mg/dL) ventral port right thorax group I

Treatment means

Sr. No	Average
Treatment 1	39.620
Treatment 2	41.100
Treatment 3	39.433

Anova Table

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	10.006	5.003	1.186	0.333
Error	15	63.277	4.218	-	-
Total	17	-	-	-	-

Coefficient of Variation = 5.128

Treatments found to be Non-Significant

Sample 1 BUN before 15 min of sedation in left hemithorax of group I

Number of Observations	6
Average	35.917
Standard Deviation	3.122
Variance	9.750

Sample 2 BUN before 15 min of sedation in right hemithorax of group I

Number of Observations	6
Average	37.833
Standard Deviation	3.190
Variance	10.175

Test results

T - Statistic	:	**-3.983**
T - Table (0.05)	:	**2.571**
T - Table (0.01)	:	**4.032**

Sample are significantly different at 5% level of significance

Sample 1 BUN during thoracoscopy at 10 min in left hemithorax of group I

Number of Observations	6
Average	37.450
Standard Deviation	3.339
Variance	11.147

Sample 2 BUN during thoracoscopy at 10 min in right hemithorax of group I

Number of Observations	6
Average	39.133
Standard Deviation	3.033
Variance	9.199

Test results

T - Statistic	:	-2.984
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 BUN before 15 min of sedation in left hemithorax of group II

Number of Observations	6
Average	39.283
Standard Deviation	1.587
Variance	2.518

Sample 2 BUN before 15 min of sedation in right hemithorax of group II

Number of Observations	6
Average	39.620
Standard Deviation	1.862
Variance	3.469

Test results

T - Statistic	:	-1.900
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are non-significantly different

Sample 1 BUN during thoracoscopy at 10 min in left hemithorax of group II

Number of Observations	6
Average	40.417
Standard Deviation	1.973
Variance	3.894

Sample 2 BUN during thoracoscopy at 10 min in right hemithorax of group II

Number of Observations	6
Average	41.100
Standard Deviation	1.881
Variance	3.540

Test results

T - Statistic	:	-3.089
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 BUN after 24 hr of thoracoscopy in left hemithorax of group II

Number of Observations	6
Average	39.500
Standard Deviation	1.563
Variance	2.444

Sample 2 BUN after 24 hr of thoracoscopy in right hemithorax of group II

Number of Observations	6
Average	39.433
Standard Deviation	2.376
Variance	5.647

Test results

T - Statistic	:	0.132
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are non-significantly different

Two sample test

Sample 1 BUN before 15 min of sedation in group I

Number of Observations	12
Average	36.875
Standard Deviation	3.171
Variance	10.058

Sample 2 BUN before 15 min of sedation in group II

Number of Observations	12
Average	39.452
Standard Deviation	1.659
Variance	2.752

Test results

T - Statistic	:	-2.494
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Sample are significantly different at 5% level of significance

Sample 1 BUN during thoracoscopy at 10 min in group I

Number of Observations	12
Average	38.292
Standard Deviation	3.166
Variance	10.021

Sample 2 BUN during thoracoscopy at 10 min in group II

Number of Observations	12
Average	40.758
Standard Deviation	1.873
Variance	3.506

Test results

T - Statistic	:	-2.323
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Sample are significantly different at 5% level of significance

Sample 1 BUN after 24 hr of thoracoscopy in group I

Number of Observations	12

Average	37.742
Standard Deviation	2.832
Variance	8.021

Sample 2 BUN after 24 hr of thoracoscopy in group II

Number of Observations	12
Average	39.467
Standard Deviation	1.918
Variance	3.679

Test results

T - Statistic	:	-1.747
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are non-significantly different

<u>Analysis for Serum creatinine: (mg/dL) left thorax dorsal port</u>

Treatment means

Sr. No	Average
Treatment 1	2.117
Treatment 2	2.333
Treatment 3	2.133

Anova

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F cal	F prob
Treatments	2	0.174	0.087	0.478	0.629
Error	15	2.735	0.182	-	-
Total	17	-	-	-	-

Coefficient of Variation = 19.458

Treatments found to be Non-Significant
Samples are not Significantly different

Sample 1 Serum creatinine during thoracoscopy at 10 min in left hemithorax of group I

Number of Observations	6
Average	2.333
Standard Deviation	0.388
Variance	0.151

Sample 2 Serum creatinine during thoracoscopy at 10 min in right hemithorax of group I

Number of Observations	6
Average	2.487
Standard Deviation	0.355
Variance	0.126

Test results

T - Statistic	:	-3.861
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 Serum creatinine after 24 hr of thoracoscopy in left hemithorax of group I

Number of Observations	6
Average	2.133
Standard Deviation	0.468
Variance	0.219

Sample 2 Serum creatinine after 24 hr of thoracoscopy in right hemithorax of group I

Number of Observations	6
Average	2.268
Standard Deviation	0.364
Variance	0.132

Test results

T - Statistic	:	-2.599
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 Serum creatinine before 15 min of sedation in left hemithorax of group II

Number of Observations	6
Average	1.883
Standard Deviation	0.286
Variance	0.082

Sample 2 Serum creatinine before 15 min of sedation in right hemithorax of group II

Number of Observations	6
Average	1.980
Standard Deviation	0.247
Variance	0.061

Test results

T - Statistic	:	-2.825
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 Serum creatinine during thoracoscopy at 10 min in left hemithorax of group II

Number of Observations	6
Average	2.150
Standard Deviation	0.274
Variance	0.075

Sample 2 Serum creatinine during thoracoscopy at 10 min in right hemithorax of group II

Number of Observations	6
Average	2.333
Standard Deviation	0.242
Variance	0.059

Test results

T - Statistic	:	-2.607
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Sample are significantly different at 5% level of significance

Sample 1 Serum creatinine after 24 hr of thoracoscopy in left hemithorax of group II

Number of Observations	6
Average	1.975
Standard Deviation	0.289
Variance	0.084

Sample 2 Serum creatinine after 24 hr of thoracoscopy in right hemithorax of group II

Number of Observations	6
Average	2.153
Standard Deviation	0.251
Variance	0.063

Test results

T - Statistic	:	-4.330
T - Table (0.05)	:	2.571
T - Table (0.01)	:	4.032

Samples are significantly different at both 5% and 1% level of significance

Sample 1 Serum creatinine before 15 min of sedation in group I

Number of Observations	12
Average	2.165
Standard Deviation	0.394
Variance	0.155

Sample 2 Serum creatinine before 15 min of sedation in group II

Number of Observations	12
Average	1.932
Standard Deviation	0.260
Variance	0.067

Test results

T - Statistic	:	1.713
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are not significantly different

Sample 1 Serum creatinine during thoracoscopy at 10 min in group I

Number of Observations	12
Average	2.410
Standard Deviation	0.363
Variance	0.132

Sample 2 Serum creatinine during thoracoscopy at 10 min in group II

Number of Observations	12
Average	2.242
Standard Deviation	0.264
Variance	0.070

Test results

T - Statistic	:	1.300
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are non-significantly different

Sample 1 Serum creatinine after 24 hr of thoracoscopy in group I

Number of Observations	12
Average	2.201
Standard Deviation	0.406
Variance	0.165

Sample 2 Serum creatinine after 24 hr of thoracoscopy in group II

Number of Observations	12
Average	2.064
Standard Deviation	0.275
Variance	0.075

Test results

T - Statistic	:	0.966
T - Table (0.05)	:	2.074
T - Table (0.01)	:	2.819

Samples are non-significantly different

Vitae

VITA

The author, Mr. Suraj Santosh Borakhede was born on 26th September, 1995 at muktainagar, Taluka. Muktainagar, Dist. Jalgaon (Maharashtra). He has passed scholarship examination in fourth as well as seventh standard conducted by Government of Maharashtra. He passed his secondary school certificate examination (SSC) with first class in the year 2011 from J. E. School, Muktainagar, Dist. Jalgaon.

He passed his Higher Secondary Certificate (HSC) examination in the year 2013 from Mahatma Gandhi Mahavidyalaya, Ahmedpur, Dist. Latur. For pursuing further education, he joined Collage of Veterinary and Animal Sciences, Parbhani and earned his B.V.Sc and A.H. degree in the year 2018

He has completed his course work for Master Degree from discipline Veterinary Surgery and Radiology from Collage of Veterinary and Animal Sciences, Udgir, under Maharashtra Animal and Fishery Science University. Nagpur.

Thesis Abstract

THESIS ABSTRACT

a)	Title of thesis (in capital letters)	:	**"EVALUATION OF PORT PLACEMENT APPROCHES FOR THORACOSCOPIC EXAMINATION IN CATTLE"**
b)	Full name of student	:	**BORAKHEDE SURAJ SANTOSH**
c)	Name and address of major advisor	:	**Dr. S.S. PITLAWAR** **Assistant Professor** Department of Veterinary Surgery and Radiology, Collage of Veterinary and Animal Sciences, Udgir
d)	Degree to be awarded	:	**Master of Veterinary Science**
e)	Year of award of degree	:	2021
f)	Major subject	:	VETERINARY SURGERY AND RADIOLOGY
g)	Total number of pages in the thesis	:	93
h)	Number of words in the abstract	:	290
i)	Signature of student	:	Borakhede
j)	Signature, Name and Address of forwarding authority	:	**Dr. S.S. PITLAWAR,** SECTIONAL HEAD Department of Surgery & Radiology College of Veterinary & Animal Sciences UDGIR-413517 Dist. Latur (M.S.) Sectional Head Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences. Udgir

प्रबंध सारांश

प्रबंध शिर्षक	:	गाय वर्गीय प्राण्यांमध्ये दुर्बीण परीक्षणा करिता दुर्बीण छातीत टाकण्यासाठी स्थळ निश्चिती चा अभ्यास.
विद्यार्थाचे पूर्ण नाव	:	डॉ. बोराखेडे सुरज संतोष
मार्गदर्शक	:	डॉ. एस. एस. पिटलावार सहाय्यक प्राध्यापक, पशुशल्यचिकित्सा व क्ष- किरणाशास्त्र विभाग पशुवैद्यक व पशुविज्ञान महाविद्यालय, उदगीर, जि. लातूर - ४१३५१७.
संबंधित पदव्युतर पदवी	:	एम. व्ही. एस. सी.
पदवीदानाचे वर्ष	:	२०२१
मुख्य विषय	:	पशुवैधयकीय शस्त्रक्रिया व क्ष- किरणाशास्त्र
प्रबंधाची एकूण पाने	:	९३
सारांशचे एकूण शब्द	:	२९१
विद्यार्थाची स्वाक्षरी	:	Borakher
विभाग प्रमुख	:	डॉ. एस. एस. पिटलावार विभागप्रमुख पशुवैधयकीय शस्त्रक्रिया व क्ष- किरणाशास्त्र विभाग पशुवैद्यक व पशुविज्ञान महाविद्यालय, उदगीर.

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सारांश

रुग्णालयात दाखल होणाऱ्या गाय वर्गीय प्राण्यांमध्ये दुर्बीण परीक्षणा करिता दुर्बीण छातीत टाकण्यासाठी स्थळ निश्चिती चा अभ्यास करण्यात आला. सदर गाय वर्गीय बारा रुग्ण दोन समान गटात विभागण्यात आले असून गट क्रमांक १ मध्ये दुर्बीण छातीत टाकण्याची जागा ही१५ सेंटिमीटर छातीच्या मणक्याच्या खालील बाजूपासून नवव्या व दहाव्या छाती मधली बरगड्या मध्ये निश्चित करण्यात आली व गट क्रमांक दोन मधील जनावरांमध्ये दुर्बीण छातीत टाकण्याची जागा ही ३०-३५ सेमी छातीच्या मणक्याच्या खालील बाजूस सातव्या व आठव्या छातीच्या मधील बरगड्या मध्ये टाकण्याचे निश्चित करण्यात आले दोन्ही गटांतील जनावरांची दुर्बीण परीक्षणा अगोदर व २४ तास परीक्षणानंतर क्ष-किरण तपासणी करण्यात आली. दुर्बीण परीक्षण अगोदर २४ तास चारा व १२ ते १८ तास अगोदर पाणी बंद करण्यात आले. जनावरांचे दुर्बीण परीक्षण उभ्या स्थितीतच इंजेक्शन ब्युटोर्फेनोल ०.०२ मिली ग्राम प्रति किलो या दराने देऊन उभे ठेवण्यात आले व दुर्बीण छातीत टाकण्याच्या ठिकाणची जागा लिग्नोकेन २% या औषधाच्या प्रभावाखाली बधीर करण्यात आले. निष्क्रिय फुफूस कोसळण्याची प्रक्रियाही स्तनाच्या कॅनुला द्वारे करण्यात आले सदर कॅनुला व ५७ सेंटिमीटर लांब शून्य अंश असलेली दुर्बिण द्वारे परीक्षण करीत असताना प्रत्येक अवयव ओळखण्यात आला व त्याच्या नोंदी ठेवण्यात आल्या निरीक्षणाअंती पुढील बाजूचे छिद्र क्रूशीएट या पद्धतीने बंद केले व नंतर शोषण यंत्राद्वारे फुफूस पडद्यातील हवा शोषून मागील छिद्रसुद्धा बंद करण्यात आले. परीक्षण कालावधीतील हृदयाची ठोके, रक्तजल ऑक्सिजन पातळी, एएसटी, एलटी, एएलकेपी आणि रक्तजल क्रिएटिनिन यामध्ये कोणतेही महत्त्वाचे व परिणामकारक बदल दिसून आले नाही तथापि श्वसन दर हा अधिक परिणामकारक रित्या वाढलेला तर रक्त युरिया नायट्रोजन सुद्धा परिणामकारक बदलेले दिसून आले. परीक्षणानंतर सर्व जनावरांमध्ये प्रतिजैविके व वेदनाशामके पाच दिवसांकरिता देण्यात आले . दुर्बीण परीक्षणणा दरम्यान छातीतील अवयवांचे निरीक्षण हे वरच्या छिद्रातून म्हणजेच नव्या बरगडी दरम्यान व खालच्या छिद्रातून म्हणजे सातवा बरगडी दरम्यान परीक्षांना अंती चांगल्या पद्धतीने दिसून आले छातीच्या खालच्या भागातील परीक्षण हे वरच्या भागातील परीक्षणा पेक्षा अधिक जवळचे दिसून आले परंतु जनावरांसाठी वेदनादायक होते.