OBSERVATIONS ON

Experimental Thoraco-Pericardiotomy in Buffalo Calves as A Treatment of Traumatic Pericarditis

THESIS

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CERTIFICATE

Certified that Shri Jayadevappa, S.M., U.P. College of Veterinary Science and Animal Husbandry, Mathura, a candidate for M.V.Sc. Final Examination of 1971 in SURGERY has been working under my supervision during the session and that the accompanying thesis entitled "OBSERVATIONS ON EXPERIMENTAL THORACO-PERICARDIOTOMY IN BUFFALO CALVES AS A TREATMENT OF TRAUMATIC PERICARDITIS" which he is submitting is his genuine work.

Dated : April __,1971.

A. J. Angelo.

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J.S.M.

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draughtability and productivity of the animals in a very deceptive way.

Extra thoracic cases of traumatism are comparatively easier to diagnose (by exploratory laparotomy and rumenotomy) and treat. But intrathoracic cases of traumatism, as for example; traumatic pericarditis is difficult both to diagnose and treat. Though no authentic statistics is available on the incidence of traumatic cases in our country, it will not be wrong to presume that the incidence is pretty significant and adversely affects our agricultural economy.

Perusal of available literature shows that no systematic survey on the incidence, mortality and morbidity of traumatic diseases has been carried out in our country nor any method undertaken experimentally or otherwise, to standardise measures for surgical intervention in such cases. Though no definite reason can be attributed for this deficiency, yet it appears that some of the reasons are :-

1. Deceptive nature of the disease,
2. Late revelation of the symptoms which makes treatment almost like 'fighting a loosing battle' and
3. Lack of known standard surgical technique

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INTRODUCTION

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In view of the importance of animals in our agricultural operations and also to make the "GREEN REVOLUTION" a success, an effective remedy for these traumatic maladies need be found out.

With this inspiration, an attempt has been made to standardise the surgical technique for performing thoraco-pericardiotomy and thoraco-pericardiectomy experimentally in buffalo calves - keeping in view the fact that the thoracic anatomy of buffaloes simulate that of cattle.

The parameters studied are pre and post-operative :-

1. Temperature, Pulse and Respiration,
2. Fortnightly body weight,
3. Haemogram besides radiography of thorax.

The results of the observations are embodied in this humble thesis.

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REVIEW OF LITERATURE

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REVIEW OF LITERATURE

Moussu (1914) described a surgical technique for draining the pericardium through a puncture from the direction of the xiphoid cartilage in cattle.

Barie and Lebert (1915) recorded a case of pericarditis in man treated by periostiotomy who died later on.

Boidin (1916) treated a case of suppurative pericarditis in man by puncture and pericardiostomy which terminating in death.

Gibson (1916) recorded at post-mortem a case of traumatic pericarditis in a camel.

Robey (1917) successfully treated a human patient suffering from purulent pericarditis by resection of the fourth and fifth cartilages.

Williamson (1917) recorded a case of pericardiotomy performed under local anaesthesia in man.

Pugh (1925) performed radical operation for traumatic pericarditis in cattle. He used Morphine subcutaneously as a premedicant and cocaine infiltration

along the line of incision as anaesthetic. With the animal on the right lateral recumbency the rib was exposed for about eight inches caudally. It was then resected by sawing through and disarticulated at the costochondral junction. A trocar and canula was inserted into the pericardium to ascertain the nature of the contained fluid which was completely evacuated. The pericardial cavity was flushed with normal saline through a rubber tube. The wound was lightly plugged with boric gauze and the whole operation site covered with a clean towel. Post-operative treatment consisted of pericardial sac flushing and wound dressing. Out of three animals so treated only one survived.

Barker (1926) diagnosed a case of traumatic pericarditis in a Jersey cow at post-mortem examination. The pericardium was enormously engorged and thickened and a piece of wire six inches long was recovered.

Hudson (1927) performed thoracotomy and pericardiotomy in a cow by following the technique of Pugh (1925). He, however, could not locate the foreign body and the animal died on the ninth post-operative day from secondary haemorrhage.

Blackwell (1933) recorded a case of suppurative pericarditis at post-mortem examination in a heifer.

Stephens (1944) treated a case of traumatic pericarditis in a five year old cow. Anaesthesia was induced by giving chloral hydrate solution intravenously and maintained with chloroform. The fifth rib was resected and thoracic cavity exposed. The pericardium was found adherent to the sixth rib over a diffuse area which was difficult to break and the wound was closed. Though the animal recovered satisfactorily, it was destroyed after sometime. post-mortem examination revealed adherence of reticulum to the diaphragm and abscess between the heart and diaphragm.

Cassells (1946) performed pericardiotomy in a one year old heifer. He employed six ounces of 1 : 8 solution of chloral hydrate by intravenous route and maintained anaesthesia with chloroform administered by an open mask. A 'T' shaped incision was made. Both the incisions were six inches long, the vertical one being over the rib. The resulting triangular skin flap was reflected from the thoracic wall and a three inch piece of the exposed rib was removed with a hack saw blade. The heart was exposed, the pericardium incised, reflected from the heart and the wound was

closed. The animal recovered but the symptoms relapsed after four weeks. Seven weeks post-operatively the animal was slaughtered.

Zayanchkovski (1946) cited 20 cases recommended for emergency slaughter out of which nine cases were positive for traumatic pericarditis and reticulitis.

Kalchschmidt (1950) performed pericardiotomy in a number of animals suffering from traumatic pericarditis and claimed a good percentage of recovery. He further opined that early surgical treatment has decided advantage over conservative treatment in which only 22.6 per cent of 681 cases recovered.

Guard (1951) suggested thoracotomy and pericardiotomy through left fifth rib resection under local anaesthesia with the animal standing. The heart sac was irrigated with warm sterile solution on the fourth day after surgery. He further stated to have experimentally explored the heart sac of healthy young cattle with complete recoveries and no losses.

Blood and Hutchins (1955) recorded the result of conservative treatment in 22 cases of traumatic pericarditis in cattle and observed that Sulphamezathine and Penicillin reduced the mortality rate.

Munster (1956) successfully treated a bovine suffering from traumatic pericarditis.

Jennings and McIntyre (1957) treated a three-year-old Ayreshire cow suspected for traumatic pericarditis. Anaesthesia was induced with 4.7 grams of of Thiopentone sodium intravenously. Intubation was carried out with one and a quarter inch endotracheal tube which was connected to a closed circle absorber apparatus. Ether was used to maintain surgical anaesthesia. With the animal on the right lateral recumbency a 20 centimetre vertical incision was made on the midline of the fifth rib, the periosteum was reflected, the rib was resected with an embryotome wire about 15 centimetre from the costochondral junction. The rib was then broken away from the sternum at the costochondral joint. The thorax was opened, the pericardium incised partially and the fibrous adhesion between the pericardium and the epicardium was revealed. As much of the pericardium as possible was removed with a large curved Mayo's scissors although the right side of the heart could not be reached where the pericardium hung loosely. The parietal pleura and periosteum were repaired separately and the recovery was uneventful.

Horney (1960) suggested a technique for the surgical drainage of the bovine pericardial sac.

Little (1964) undertook pericardiostomy in a six-year-old cow suffering from traumatic pericarditis. Anaesthesia was achieved by three per cent procaine in a line block over the anterior edge of the fifth rib and deep into the intercostal muscles anterior and posterior to that rib. An eight inch skin incision commencing three inch dorsal to the sternal attachment on the fifth rib was made ventrodorsally. Intercostal muscles on both edges of the rib were detached, a three inch curved needle threaded with a wire saw was carried around the rib seven inches above its sternal attachment and the rib resected. The periosteum was not separated from the rib and failing to disarticulate the rib at the sternal attachment a second wire cut was made four inches distal to the first and the piece of the rib removed. The parietal and mediastinal pleura were incised separately. The pericardium was then entered and spongy yellow fibrin contents of the pericardial cavity were removed by digital manipulation. Following this the sac was flushed with normal saline and the pericardium was sutured to the cut edges of the serratus ventralis muscle with simple interrupted sutures using catgut.

The cow was eventually slaughtered on account of complications.

Frank (1964) described the surgical technique to provide access to the pericardial sac in the treatment of traumatic pericarditis. Anaesthesia for the operation was obtained by infiltration of the skin and subcutaneous tissue over the fifth rib. Tissues anterior and posterior to the edges of the rib to be removed were also infiltrated, as well as the medial surface. A cutaneous incision commencing about one inch below the costochondral articulation upward was made for a distance of six inches. After careful dissection of the soft tissues the rib was exposed and the pleura closely attached to the medial side of the rib separated by careful blunt dissection with the fingers. A piece of obstetrical wire saw was passed between the pleura and the rib to resect out the rib at the upper end of the incision. This piece of rib was then bent outward until it disarticulated at the costochondral articulation. The pleura was incised by making a small opening which was gradually enlarged so that the air entered slowly the pleural cavity without embrassing the functioning of the lung. The pericardial sac was freely opened and complete drainage

established. The after care was same as for infected cavity, irrigation with antiseptic solution and removal of all purulent exudate.

Berge and Westhues (1965) described a technique for partial resection of the rib for surgical treatment of costal fistula. They stated that it was impossible to remove the periosteum completely in this condition.

Fisher and Pirie (1965) made detailed investigations of 13 cows with traumatic pericarditis. They suggested pericardial drainage by performing thoracotomy through right thoracic wall due to obvious reasons.

Pettit (1965) gave a good account on the principles of thoracic surgery in animals. The different approaches suggested by him are, lateral intercostal, subperiosteal rib resection, intercostal by partial stripping of the rib periosteum, transternal and longitudinal and median strenotomy. He laid special emphasis on efficient positive pressure respiration.

Kohli et al. (1966) gave a clinico-pathological account of traumatic reticulo-pericarditis in buffalo calves following experimental studies.

Donawick et al. (1969) gave a detailed account of anaesthesia and ventilation in experimental thoracotomy in the calf. They opined that large tidal high volume pressure (30 to 33 cm. of water) controlled ventilation with inhalation anaesthesia was necessary to provide adequate oxygenation during thoracotomy in the calf. No mechanical damage was observed in the lungs of calves ventilated with continuous high pressure ventilation. They further observed that small tidal volume low pressure ventilation even with 100 per cent oxygen resulted in hypoxaemia, hypercapnia, atelectasis and increased alveolar arterial oxygen gradient.

DeMoor et al. (1969) recorded a case of thoracic repair of diaphragmatic hernia in an 18 month old heifer. Premedication consisted of 30 milligrams atropine intramuscularly. Anaesthesia was induced with 30 grams intravenous chloral hydrate. Intubation was performed and the tracheal tube was connected to a closed circle system apparatus. Artificial respiration was maintained throughout the operation by means of a mechanical intermittent positive - negative breathing device. Thoracotomy was performed on the right thoracic wall by giving a 25 centimetre

incision. The pleura and periosteum were repaired, the thoracic incision was closed, and the drainage tube was anchored to the skin. The skin incision was repaired by vertical mattress suture. Recovery was uneventful.

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SURGICAL ANATOMY

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THE THORAX

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SURGICAL ANATOMY OF THE THORAX

Before describing the materials and methods, it would be pertinent to describe in brief the anatomy of the bovine thorax with particular reference to regional anatomy.

THORACIC CAVITY

The thoracic cavity of the bovine is bounded, dorsally by the thoracic vertebrae and muscles, laterally by the ribs and intercostal muscles, ventrally by sternum, the cartilages of sternal ribs and muscles connected with these and posteriorly by the diaphragm (Sisson and Grossman, 1955).

PLEURAE

In situ a serous membrane known as pleura covers each lung and lines the walls of the thoracic cavity. The pleurae are divided into three parts : the parietal, the mediastinal and the visceral or pulmonary.

The parietal pleura is attached to the thoracic wall by the endothoracic fascia on each side and it is again divided into costal and diaphragmatic pleura.

stinal space and is in part in apposition with the opposite sac. The part which is adherent to the pericardium is termed as pericardiac pleura. The visceral or pulmonary pleura is the reflection from the mediastinum upon the corresponding lung.

It is closely attached to the surfaces of the lungs by the endothoracic fascia. Hence the separation of the visceral pleura from the lung is difficult without tearing lung tissue (Sisson and Grossman, 1955).

The mediastinum is the space between the two mediastinal pleurae and complete. It encloses all the organs in the thorax except lungs, caudal vena cava and right phrenic nerve (Sisson and Grossman, 1955).

The line along which the costal pleura passes from the lateral wall to the diaphragm is known as diaphragmatic line of pleural reflection. In bovines the line extends from the ventral end of the eighth rib in a very slight curve upward and backward so that it reaches the 12th rib about six inches from its vertebral end and it may extend to the last rib at lateral border of the longissimus muscle or may

not quite reach to the 12th rib. This line is important for demarcating the thoracic cavity (Sisson and Grossman, 1955).

LUNGS

The lungs occupy the greater part of the thoracic cavity. At the hilus of each are bronchus, pulmonary artery, pulmonary veins, bronchial artery, pulmonary nerves and the pulmonary lymph vessels.

The left lung (Fig. 1) presents three lobes namely apical, cardiac and diaphragmatic. The right lung (Fig. 2) presents four lobes namely the apical, cardiac, diaphragmatic and intermediate. The apical lobe is much larger and is usually subdivided into anterior and posterior parts by a deep fissure. The diaphragmatic lobe is the largest and has the form of three sided pyramid with its base resting on the diaphragm. The cardiac lobe is prismatic and forms the posterior margin of the cardiac notch; its long axis corresponds to the fifth rib. The apical lobe of the left lung is small and pointed. The apical lobe ofthe right lung occupies the space infront of the pericardium. On the left side the cardiac notch leaves the greater part of the pericardium.

in contact with the chest wall as far back as the fourth intercostal space. On the right side the lung may cover the pericardium so that the later has no contact with the lateral wall of the thorax. But in many cases there is a small cardiac notch at the ventral part of the fourth rib and adjacent intercostal spaces (Sisson and Grossman, 1955).

PERICARDIUM

The pericardium is the fibro-serous sac which encloses the heart and in part the large blood vessels entering and leaving the organ. It consists of fibrous and serous layers. The fibrous layer is thin strong and inelastic. It is attached dorsally to the large vessels at the base of the heart and ventrally to the sternum between facets for the sixth costal cartilages by two fibrous bands the sterno-pericardiac ligaments. These are embodied in the mass of fat about the apex of the pericardium on the floor of the thorax.

The serous layer is surrounded by the fibrous pericardium and contains liquor pericardii. It consists of two parts, the parietal and visceral, the former lines the fibrous layer to which it is closely attached

and the later covers the heart and large blood vessels respectively (Sisson and Grossman, 1955).

INNERVATION OF THE THORACIC WALL :

A. The thoraco-dorsal nerve

This nerve arises medial to the axillary nerve and passes upward and backward across the subscapularis muscle to ramify in the latissimus dorsi muscle.

B. The long thoracic nerve

This nerve arises from the anterior end of the brachial plexus gives off (usually) three branches to the serratus ventralis at the junction of its cervical and thoracic parts and passes backward across the surface of the serratus thoracis to which it is distributed.

C. The external thoracic nerve

This nerve arises by a common trunk with the ulnar nerve and its branches innervate the cutaneous muscle and skin of the abdominal wall as far back as the flank region. It gives off branches to the deep pectoral muscle and anastomose with the perforating branches of the intercostal nerves.

D. Thoracic spinal nerves

The thoracic nerves number 13 on either side. Each nerve divides into a smaller dorsal and a larger ventral branch. The ventral branches or the inter costal nerves join the sympathetic system, through the rami communicates. These supply the intercostal muscles and give perforating branches. The ventral branch of the first thoracic nerve joins the brachial plexus. The perforating branches of the two to six intercostal nerves emerge through the spaces between the costal cartilages to supply the pectoral muscles. The two to eight intercostal nerves supply branches to transverse thoracis muscle. The succeeding ones give branches to the diaphragm, transverse and internal oblique muscles and finally ramify in the rectus abdominis muscle (Sisson and Grossman, 1955).

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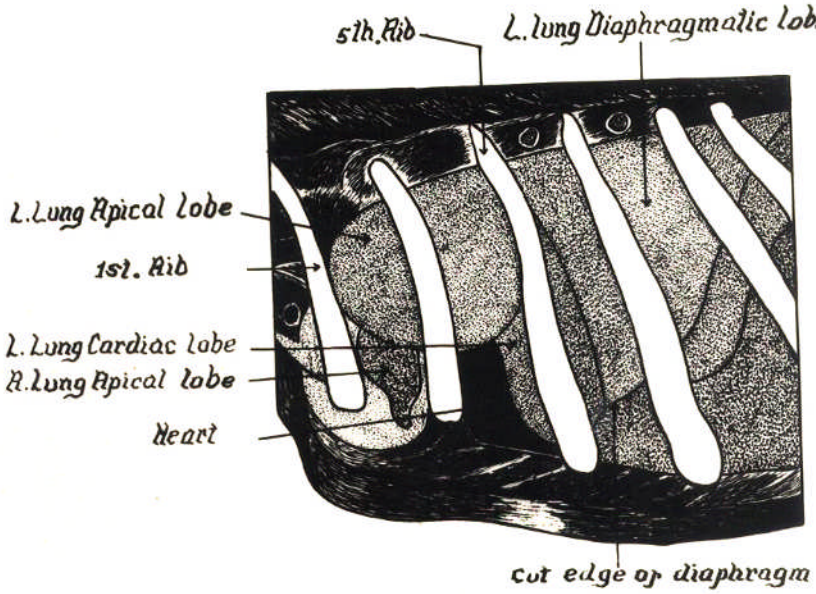
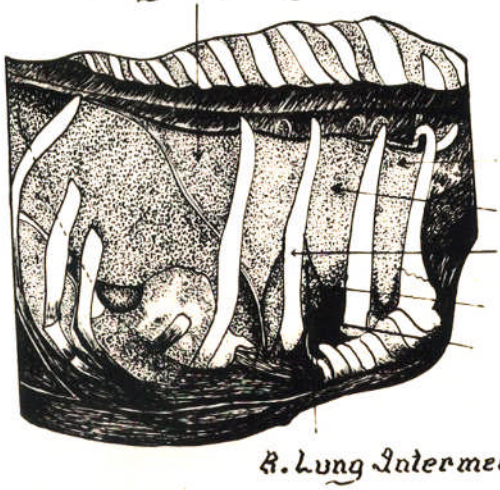


(FROM SISSON & GROSSMAN)

Fig. 1 - Diagramatic representation of the thoracic viscera of cow - lateral view (left side)



(FROM SISSON & GROSSMAN)

Fig. 2. Diagramatic representation of the thoracic viscera of Cow - Lateral view (Right Side)

MATERIALS AND METHODS

Animals found harbouring worms were dewormed with specific anthelmenthics. All the observations made were recorded. From above observations, the animals were found apparently healthy and free from any systemic disease.

METHOD

PRE-OPERATIVE PREPARATION

The animal was fasted for 24 hours and only water was allowed. The day preceding the actual operation, the operative site on the entire lateral aspect of the thorax (on the side to be operated upon) was thoroughly shaved from the vertebral border to the costochondral junction, scrubbed and washed with soap and luke warm water, dried and painted with Mercurochrome in spirit. The entire area was protected with an improvised protective jacket made up of Markin cloth. The animal was returned to a room provided with sufficient paddy straw bedding.

On the day of operation, the operative site was again thoroughly scrubbed with lukewarm cetrimide lotion, washed, dried and Tincture Iodine applied. A fresh protective bandage was applied and the animal was taken to the operation theatre.

PRE-MEDICATION AND ANAESTHESIA

The animal was premedicated 30 minutes prior to operation depending on the body weight with 20 to 30 milligrams of Triflupromazine hydrochloride (Siquil, Squibb) and Promethazine hydrochloride (Phenergan, M&B) 125 milligrams intramuscularly. Anaesthesia was effected by blocking the fourth, fifth and sixth intercostal nerves by following the technique of Westhues and Fritsch (1964). The caudal border of the particular rib to be resected (fifth rib) was palpated at its junction of upper and middle thirds, a needle approximately five centimeter long was inserted perpendicularly at the posterior costal margin and the point directed down as close as possible to this caudal border. To be immediately adjacent to the rib, the needle was first inserted on the rib itself and then maintaining direct contact the point of the needle passed over its posterior border. At this point when the needle was pushed further through the musculature, whistling sounds were heard indicating the passage of the air. The needle was then gradually withdrawn until no further inspiration of air took place. At this stage the needle point was lying subpleurally and the first injection of 10 ml. three per cent procaine hydrochloride was made while withdraw-

ing the needle gradually. Finally subcutaneous infiltration of another five ml. of three per cent procaine hydrochloride was made over the lateral surface of the particular rib. Likewise local anaesthesia of the preceding and following intercostal nerves was obtained.

INSTRUMENTS USED (FIG. 3)

1. Bard-Parker handle (No.4) with blade (No.22)
2. Alli's tissue forceps
3. Artery forceps (Curved and straight)
4. Mayo's scissors(Curved and straight)
5. Periosteal elevator and Rugine combined - Alexander's
6. Wire saw
7. Rib cutter
8. Dissection forceps-rat toothed
9. Lung forceps-Duval's
10. Lung retractor
11. Mathue's needle holder
12. Needle holder-Thomson Walkers
13. 20 c.c. L.L.syringe and needles
14. Rib retractor
15. Traumatic and atraumatic needles with cotton thread
16. Drainage tube (polythene)

SURGICAL TECHNIQUE

The entire surgical procedure was carried out with the animal in the standing position with the foreleg of the operative side drawn forward. The proposed line of incision was marked (Fig. 4) and a cutaneous incision extending from the middle of the rib at the junction of its proximal and middle third extending downwards upto the costochondral junction was made. The skin edges were reflected and the underlying muscles likewise split and separated till the lateral surface of the rib was visible (Fig. 5). Now corresponding to the skin incision, another incision was made on the periosteum of the rib in its middle starting from proximal to the distal commissure of the cutaneous incision. This incision on the periosteum was joined by two transverse incisions proximally and distally. With the help of a periosteal elevator the periosteum was reflected in two halves. Now with a curved mosquito haemostat a rent was created between the naked posterior border of the rib and the periosteum on the medial aspect till the point of the haemostat emerged at the anterior naked border of the rib. The haemostat was then played up and down till the medial periosteum was completely reflected. With the help of an embryotome

wire the rib was resected at the proximal and distal commissure of the wound. Following this, the intact medial periosteum was clearly visible (Fig. 6). Haemorrhage was controlled either by forci-pressure or ligation or by both.

Now, with the help of a knife a half inch incision was made on the periosteum at the proximal commissure including the lining pleura to allow gradual entrance of atmospheric air into the chest cavity to cause gradual collapse of the lung of that side to avoid respiratory embarassment. About 10 minutes after the first stab wound the periosteal and pleural incision was increased to the entire length of the wound. Rib retractors were applied for clear visibility of the thoracic cavity and also to provide sufficient room for surgical manoeuvres. The lung was retracted with lung forceps and lung retractor for the clear visibility of the heart (Fig. 7). With the help of Alli's tissue forceps a portion of the pericardium was grasped at the base of the heart and snipped with a pair of scissors. Through this opening on the pericardium 10 inch polythene tube (8 mm.O.D.) was introduced into the pericardial cavity upto the apex of the heart (Fig. 8) when some pericardial fluid readily escaped through the tube. The tube was

applying a loose knot at the proximal commissure of the thoracic wound. The other end of the tube remained outside the thoracic cavity through which normal saline under pressure was passed for the purpose of irrigation of the pericardial cavity. The thoracic cavity was flushed with luke warm normal saline, mopped up with sterile sponges and insufflated with 30 grams of Hostacycline water soluble powder (Hoechst). The pleura and periosteum were repaired by interrupted sutures using cotton thread. The muscles were repaired by interrupted sutures using cotton thread. The skin incision was repaired by mattress suture leaving about an inch area at the distal commissure of the wound through which the tube passed out (Fig.9). At the free end of the tube a small piece of rubber tube and a pinch-cock was applied to prevent ascending contamination. The skin incision was painted with Tincture Iodine, a sterile protective jacket was applied and the animal returned to the recovery room.

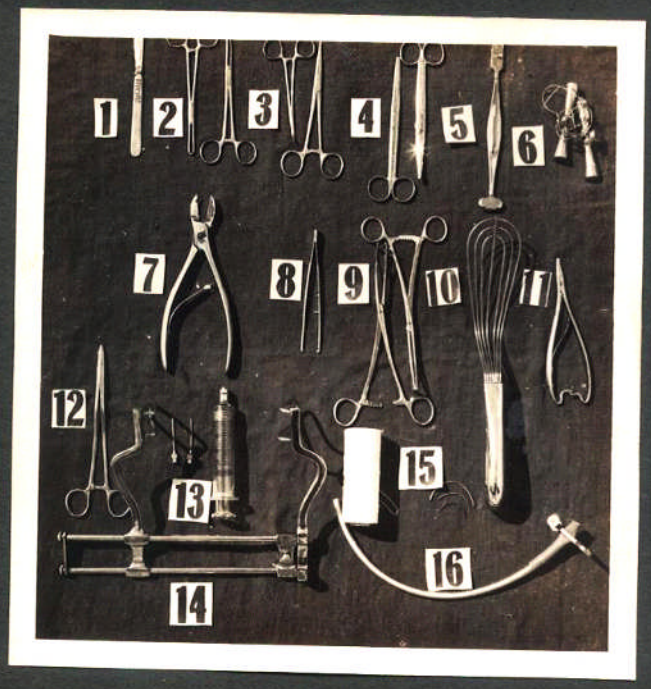
In four animals PERICARDIECTOMY was undertaken (Table-1). The incision on the pericardium at the base of the heart was extended down to the apex and joined by two transverse incisions at the base of the heart proximally. Now with the fingers as much of the pericardium as possible was stripped off the heart

leaving small portion of it on the opposite side which was not easily accessible.

TABLE - I

DETAILS OF THORACO-PERICARDIOTOMY AND THORACO-PERICARDI-ECTOMY PERFORMED

Buff. calf No.	Surgical approach	Rib resected	Results
1	Left lateral thoraco Pericardiotomy	5th	Discharged after post-operative observations.
2	-do-	"	Sacrificed on 62nd day for autopsical examination.
3	-do-	"	Discharged after post-operative observations.
4	-do-	"	Sacrificed on 62nd day for autopsical examination.
5	Right lateral thoraco Pericardiotomy	"	Died on 12th post-operativ day of acute tympanites.
6	-do-	"	Sacrificed on 62nd day for autopsical examination.
7	-do-	"	-do-
8	-do-	"	Died on 12th post-operativ day of acute tympanites.
9	Right lateral thoraco Pericardiectomy	"	Discharged after post-operative observations.
10	-do-	"	Sacrificed on 62nd day for autopsical examination.
11	-do-	"	Discharged after post-operative observations.
12	-do-	"	Sacrificed on 62nd day for autopsical examination.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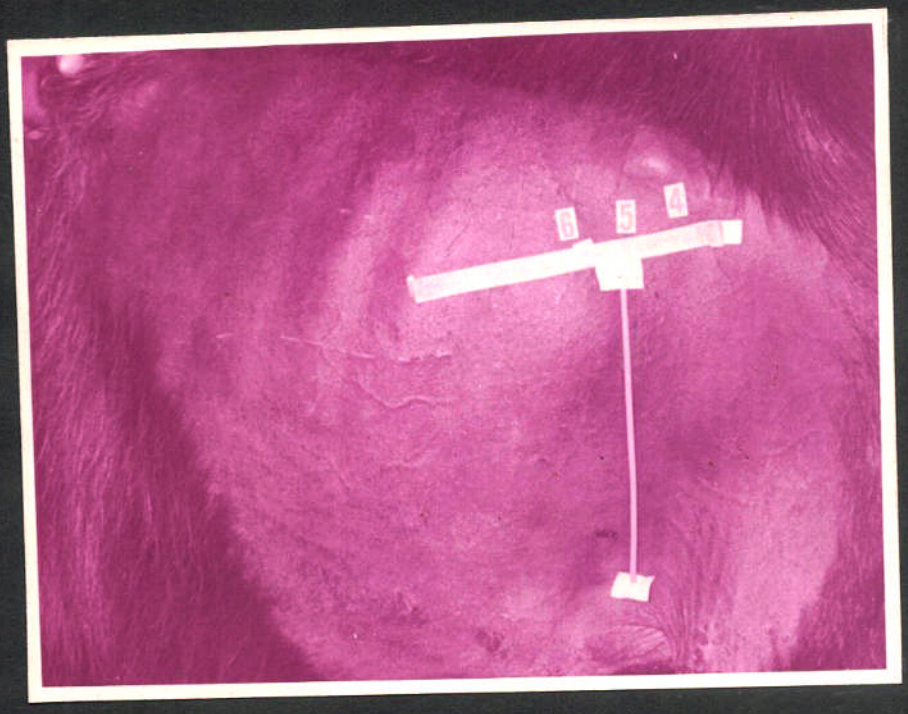
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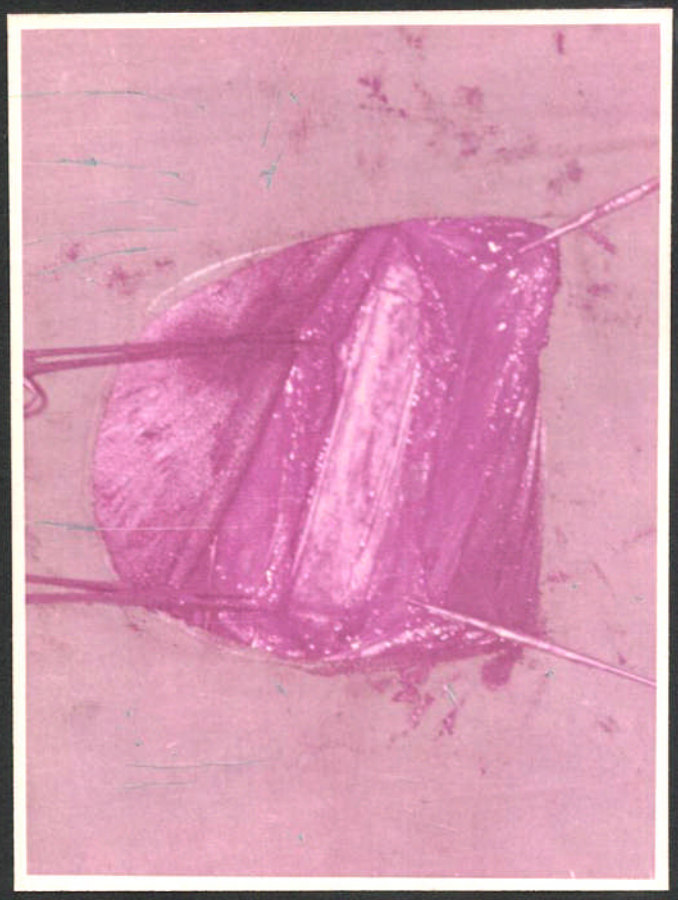

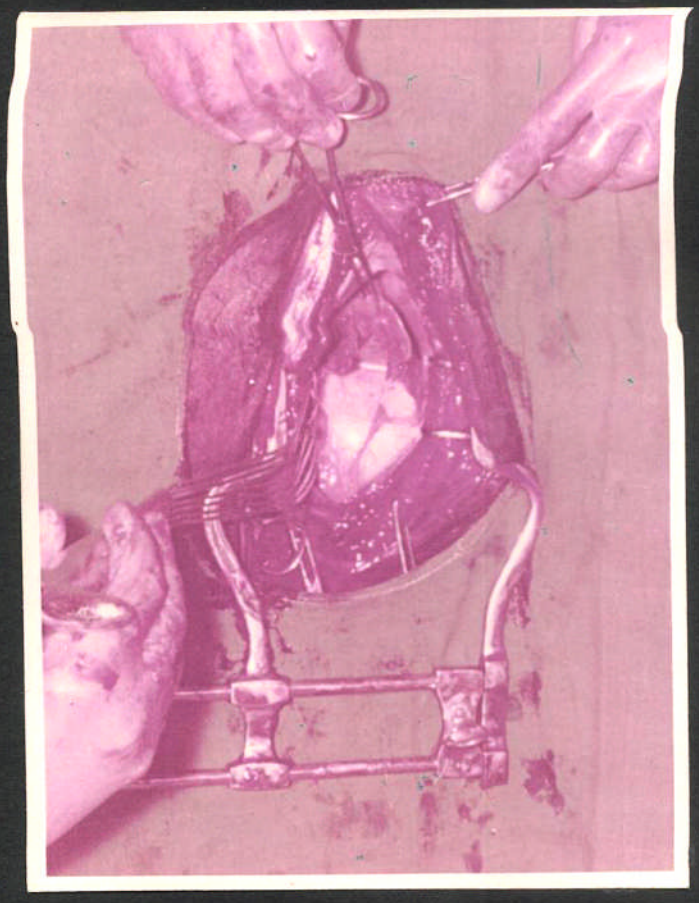

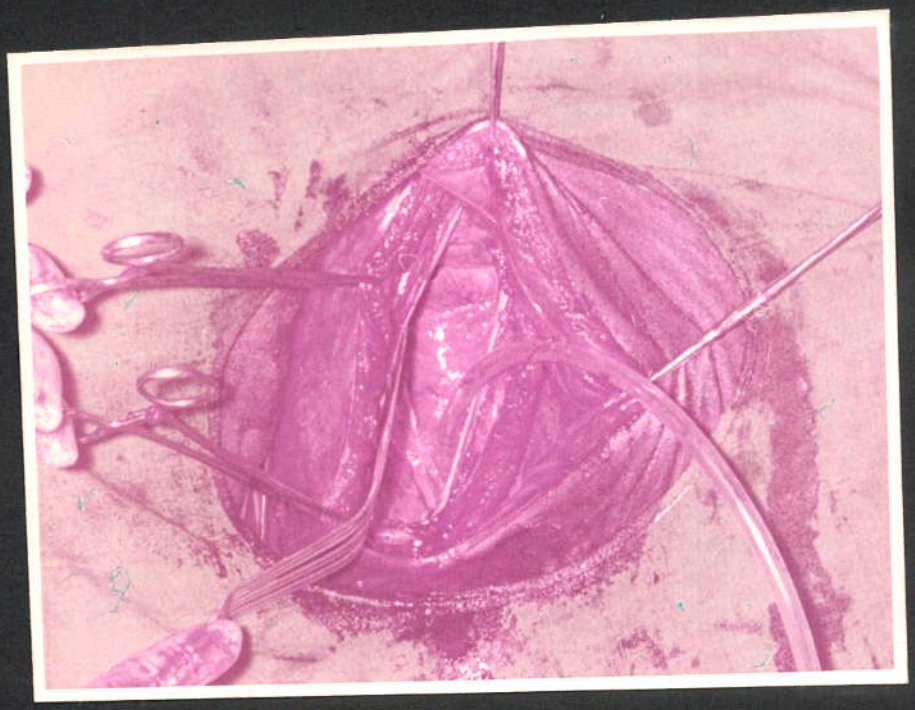

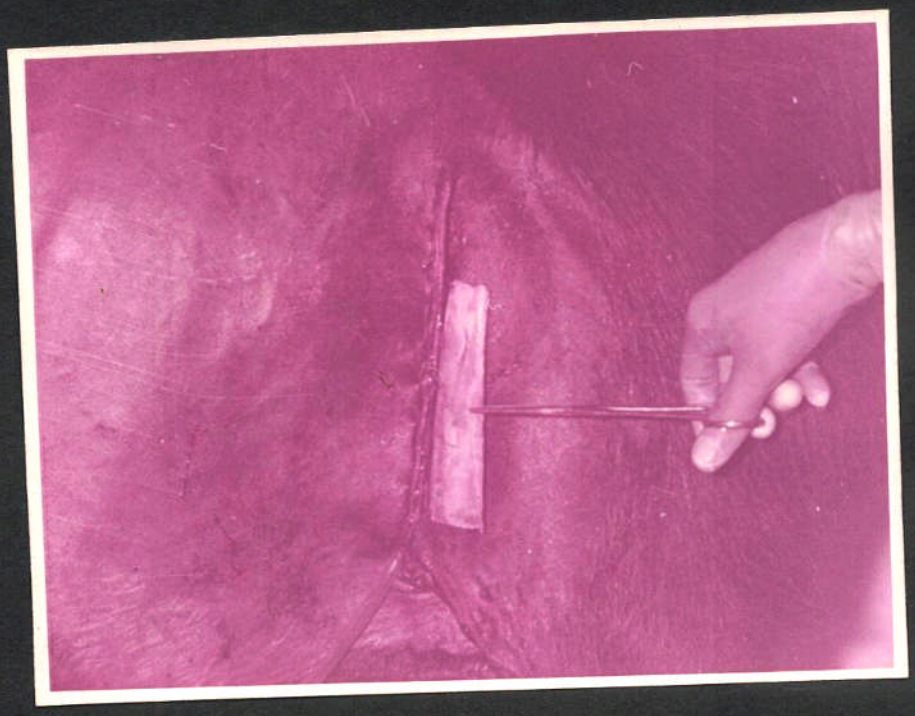

POST-OPERATIVE CARE AND TREATMENT

1. The pericardial sac was irrigated daily with sterile luke warm normal saline for seven days.

2. The cutaneous wound was cleaned with sterile saline gauze and dressed with carbolized vaseline.

3. Omnamycin (8;1 Hoechst) was given intramuscularly for five days.

The drainage tube was removed on the seventh day and the skin sutures on the 10th day post-operatively

POST-OPERATIVE OBSERVATIONS

The following observations were made :-

1. Haemogram - The blood was collected on the third, sixth and tenth post-operative days for
   - Total erythrocyte count,
   - Total leucocyte count,
   - Differential leucocyte count,
   - Haemoglobin and
   - Packed cell volume.

2. Body weight - Fortnightly body weight of animals was recorded after taking the average of three consecutive days body weight in the morning before allowing food and water.

3. Average of morning and evening temperature, pulse and respirations for 10 days.

4. Radiograph of the thorax on the seventh day.

5. Post-mortem examination after voluntary sacrifice on 62nd post-operative day.

RADIOGRAPHY OF THE THORAX

A Radiograph of thorax was taken on the seventh day post-operatively to ascertain the position of the drainage tube left in situ, by adopting the following technique.

The animals was tranquillized 30 minute prior to Radiography with 20 to 30 mg of Siquil depending on the body weight. The animal was restrained in the standing position with the operated side facing the X-Ray tube. With the fore-leg drawn forward a lateral exposure was made. The film was then processed in the usual way for examination and record.

HAEMATOLOGY

Blood samples of experimental animals were obtained on third, sixth and 10th pre and post-operative days to determine the significant changes, if any.

COLLECTION OF SAMPLES

Blood samples were collected from the jugular vein of the animals. Each time, 5 ml. of blood was drawn with sterile, clean, dry syringe and needle and placed in test tubes containing 0.5 ml. of double oxalate anticoagulant. This anticoagulant was prepared as follows:-

0.8 grams of potassium oxalate and 1.2 grams of ammonium oxalate were dissolved in 100 ml. of distilled water and from this solution, 0.5 ml. was pipetted into test tubes and the anticoagulant was evaporated to dryness in a hot air oven.

TECHNIQUE OF BLOOD EXAMINATION

The following techniques were employed in the examination of the blood samples:-

1. Preparation for staining and examination of the blood smears

Grease free slides were used for preparing the blood smears from the oxalated blood. These smears were stained with 'Leishman's stain' for differential leucocyte count. The Leishman's stain was prepared as follows:-

Powdered Leishman's stain	0.5 g.
Glycerin	5.0 ml.
Absolute methyl alcohol	300.0 ml.

were taken into a 500 ml. Pyrex flask and heated just below the boiling point. Then it was cooled to room temperature and filtered. The dried blood smears were covered with Leishman's stain and allowed to stand for one minute. Then equal amount of buffered distilled water was added, mixed with the stain and allowed to stand for 15 minutes. Finally the slides were washed under running tap water and then dried before examining the blood films under oil immersion.

2. Determining the Packed cell volume

The Packed cell volume was determined by using Wintrobe haematocrit tubes. One ml. of oxalated blood was pipetted into the haematocrit tube and this tube

was placed in a centrifuge at 3000 r.p.m. for half an hour. The packed cell volume was noted in percentage.

3. Enumerating the total erythrocytes

The erythrocyte diluting fluid was prepared as follows:-

Three grams of Sodium citrate was dissolved in 100 ml. of distilled water and to this one ml. of formalin and 0.6 gm. of water soluble yellowish eosin were added and filtered.

The oxalated blood was drawn into the erythrocyte diluting pipette to the 0.5 mark and then the pipette was filled to the '101' mark with diluting fluid. The number of cells counted in the five small squares of the improved Neubauer ruling chamber were multiplied by 10,000 to obtain the total erythrocytes per cubic millimetre.

4. Enumerating the total leucocytes

The leucocyte diluting fluid was prepared as follows:-

Two ml. of glacial acetic acid and one ml. of gentian violet were added to 100 ml. of distilled water and filtered.

The oxalated blood was drawn into leucocyte diluting pipette to the 0.5 mark and then the pipette was filled upto the 11 mark with diluting fluid. The number of cells counted in the four corner squares of the improved Neubauer ruling chamber were multiplied by 50 to obtain the total leucocytes per cubic millimeter.

5. Evaluation of Haemoglobin

The haemoglobin concentration in grams per 100 ml. of blood was determined by the Sahli's standard haemometer. A measured quantity of oxalated blood was treated with N/10 Hcl for the conversion of haemoglobin to acid haematin and the resulting colour was compared with the standard.

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RESULTS AND DISCUSSION

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ANAESTHESIA :

Triflupromazine hydrochloride ('Siquil', Squibb) in doses of 20 to 30 milligrams and promethazine hydrochloride ('Phenergan', M&B) 125 milligrams by intramuscular injections as tranquillizer and anti-histaminic followed by nerve block (4th, 5th and 6th intercostal nerves) with freshly prepared three per cent procaine hydrochloride solution were found effective and satisfactory. The administration of additional increments of local anaesthetic during the operation was not required nor muscle relaxants used. The animals were apparently unmindful about the surgical intervention.

Pugh (1925) and Hudson (1927) performed thoraco-pericardiotomy under local anaesthesia in the lateral recumbency. Stephens (1944); Cassells (1946); Jennings and McIntyre (1957); Donawick *et al.* (1969) and DeMoor *et al.* (1969) performed thoracotomy under general anaesthesia with or without positive pressure ventilation.

In the present study, the operations were performed under local anaesthesia with the animal in

the standing position with following advantages :-

1. Reaction of the animal was easily accessible throughout the operation.
2. No intubation and positive pressure ventilation was required.
3. The thoracic cavity on the operated side was easily visible with or without artificial light with the lung and heart in the normal disposition.

Under lateral recumbency the lung on the unoperated side being below, is under pressure and hence unable to inflate to its full. In such event a hypoxaemic condition is likely to prevail (more so when only one lung is functioning on exposure of thoracic cavity) and give rise to respiratory acidosis and alter the acid-base balance of the body. To avoid this sort of derangement in the pulmonary gaseous exchange, the operation when possible should be undertaken in the standing position so that the functional lung on the unoperated side can function to its full. Besides, the reaction of the animal to the manipulation of thoracic organs is more easily appreciable when the operation is conducted in the

standing position. Guard (1951) has also recommended thoracotomy and pericardiotomy in bovines in the standing position.

Local anaesthesia has the following advantages over general anaesthesia :-

1. Sophisticated, costly and special equipments are not required.
2. The need of an anaesthetist is done away with.
3. The operation can be performed under field condition and in comparatively less equipped hospitals.
4. No extra care and attention is required as in recovery period with general anaesthesia.

SURGICAL TECHNIQUE :

Different authors have advocated different approaches and techniques. Moussu (1914) suggested draining of the pericardium in the cattle through a puncture from the direction of the xiphoid cartilage. Left lateral fifth rib resection has been advocated by Pugh (1925), Hudson (1927), Guard (1951), Jennings and McIntyre (1957) and Rajendran and Mohammed (1969) whereas Fisher and Pirie (1965) have suggested pericardial drainage by performing thoracotomy through

right thoracic wall. DeMoor et al. (1969) preferred right lateral thoracotomy for repair of diaphragmatic hernia in a heifer.

In the present study it has been found that it is easier to perform pericardiotomy and establish pericardial drainage through right thoracic approach because, the pericardium comparatively loosely covers the heart on this side. This finding is in agreement with Fisher and Pirie (1965). Besides this, on the right side opposite to the fourth rib and following intercostal spaces the lung presents a cardiac notch through which the heart is easily visible and palpable without retracting the lungs. This pliability and looseness of the pericardium on the right side is probably due to the fact that the right ventricle is thinner than the left ventricle.

Pugh (1925) after flushing the pericardial cavity with normal saline through a canula and rubber tube, left the thoracic wound unsutured and lightly plugged with boric gauze. Jennings and McIntyre (1957) removed as much of the pericardium as possible. The parietal pleura and periosteum were repaired together and the thoracic wound conventionally. Little (1964) removed spongy yellow fibrin contents from the

pericardial cavity, flushed the cavity with normal saline and sutured the lips of the pericardium to the cut edges of the serratus ventralis muscle with interrupted sutures using catgut. Frank (1964) freely opened the pericardial sac and established complete drainage. Post-operative treatment given by him was same as for infected cavity. DeMoor et al. (1969) repaired thoracotomy wound by suturing together periosteum and intercostal muscles of the resected rib and the skin in the conventional way. Rajendran and Mohammed (1969) closed the pericardial incision by interrupted sutures and fixed a 10 inch fenestrated rubber tube for drainage at the lower end of the incision. The pleura and periosteum were repaired together and the thoracic wound conventionally. The drainage tube was anchored to the skin.

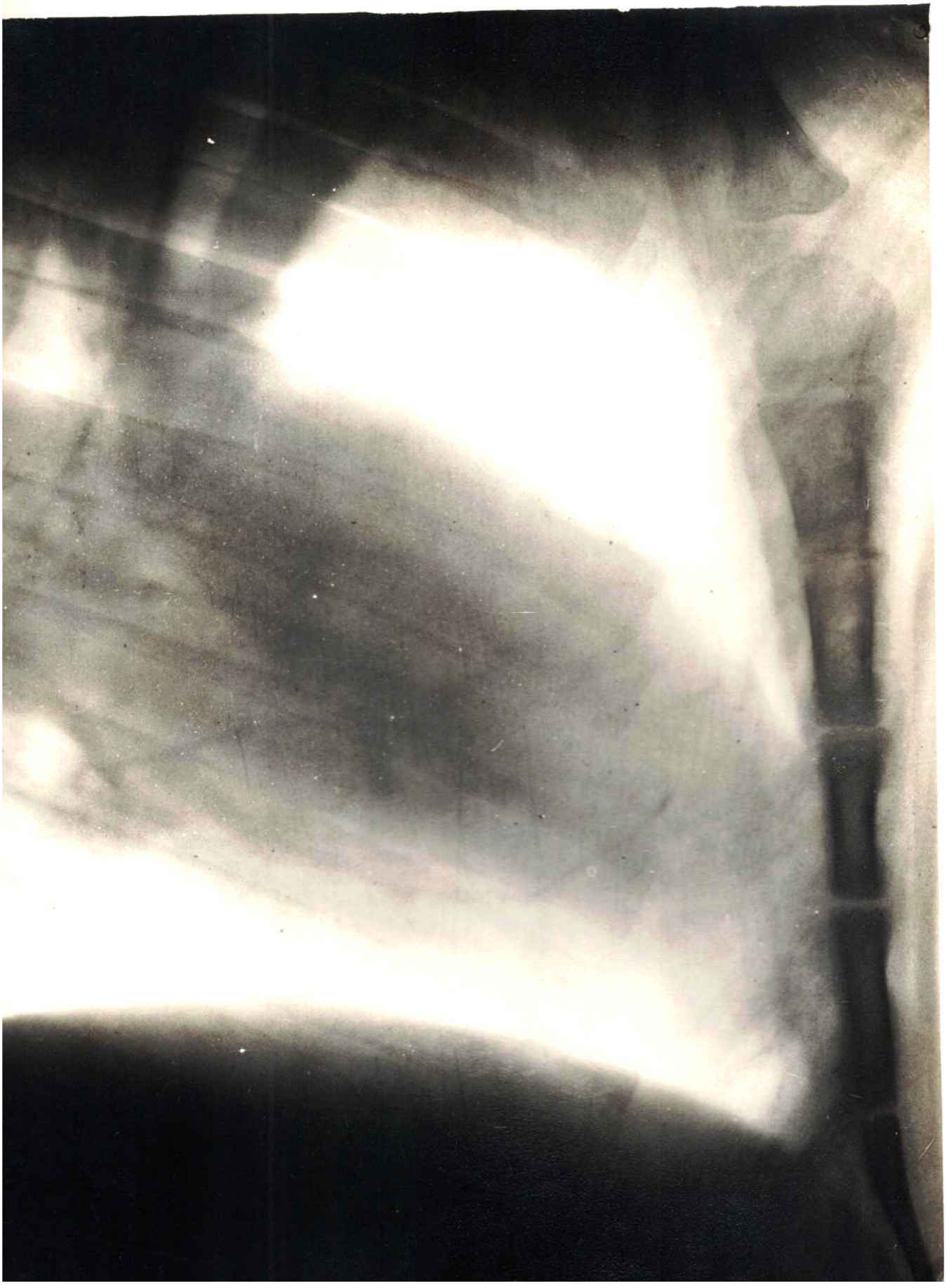
In this study approximately an half inch incision was made in the pericardium at the base of the heart through which a drainage tube was inserted upto the apex of the heart. This incision being just sufficient to permit entrance of the tube did not require repair. Anchoring was done by passing a threaded needle through the tube at the level of the periosteum near the upper commissure of the thoracotomy wound and fixing the tube with the periosteum.

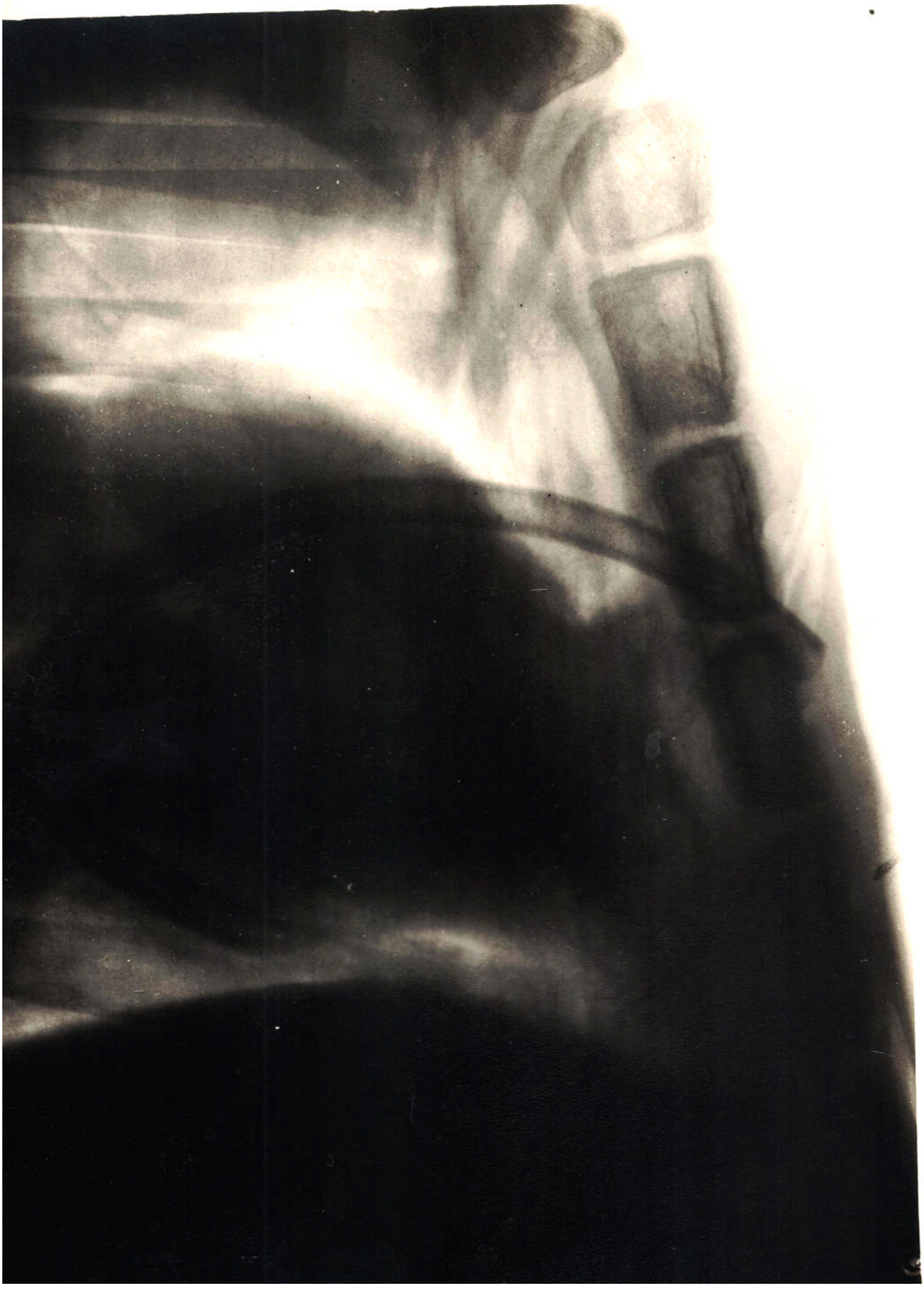
The pleura and periosteum were repaired together with interrupted sutures and likewise the muscles and skin separately using cotton thread. The free end of the drainage tube over the skin was protected with improvised jacket made out of markin cloth. In all but two cases, first intention healing was achieved.

Daily irrigation of the pericardial sac with luke warm normal saline solution followed by introduction of antibiotic solution gave satisfactory results as is evident from the graphs showing temperature, pulse and respiration and haemogram. Guard (1951) has also stated that he had experimentally explored the pericardial sac of healthy young cattle with complete recoveries and no losses.

RADIOGRAPHY OF THE THORAX

On the seventh post-operative day radiography of the thorax was undertaken in four experimental animals to demonstrate and ascertain the position of the drainage tube within the pericardial sac (Fig. 10).





PHYSIOLOGICAL REACTIONS

As is evident from the graphs (1 to 12) showing pre and post-operative temperature, pulse and respiration, the temperature of all animals remained normal post-operatively considering the normal range for this species between 100 - 102°F. Maintenance of normal body temperature post-operatively indicates absence of infection and satisfactory aseptic technique - the key to successful surgery.

Rate of pulse and respiration per unit time showed an increase post-operatively. This increase appears to be compensatory in nature. After thoraco-pericardiotomy operation, the animal is left with only one functional lung but the oxygen requirement of the body remains the same. So, in order to cope with the normal body requirement for oxygen there is an augmentation of respiratory function probably as a result of stimulation of the respiratory centre by blood containing more carbondioxide per unit volume. It has been correctly said that, "Carbondioxide is a stimulant par excellence of respiration". The increased pulse rate could also be explained likewise.

HAEMOGRAM

The mean haematological values obtained for buffaloes by Gautam and Buttar (1965) are as follows :-

Item	No. of Buffaloes	Mean value
Erythrocytes	104	6.5 ± 0.10 m/cmm
Haemoglobin	104	11.52 ± 0.18 gms/100 ml.
PCV	104	36.03 ± 0.43 per cent
MCV	104	55.60 ± 0.53 cubic microns
MCH	104	17.71 ± 0.21 micro-micrograms
MCHC	104	31.8 ± 0.4 per cent
ESR	104	48.8 ± 1.3 mm.fall in 1 hour
Leucocytes	104	11.32 ± 0.27 thousands per cmm.
Neutrophils	104	33.0 ± 0.83 per cent
Lymphocytes	104	58.6 ± 0.88 per cent
Monocytes	104	4.0 ± 0.15 per cent
Eosinophils	104	3.7 ± 0.24 per cent
Basophils	104	0.70 ± 0.05 per cent
Clotting time	79	5.5 minutes

The mean values obtained in this study (Table-2) compare favourably with those of Gautam and Buttar (1965), Kehar and Murthy (1951), Simon and Jacob (1961) and Netke and Shukla (1962).

It is apparent from Table-2 that there is a fall in P.C.V. and T.E.C. in the post-operative period. Schalm (1965) has stated that the P.C.V. is a function of erythrocyte size and number of cells per unit volume. It,therefore appears that the fall in P.C.V. observed in this study is due to a fall in T.E.C. Again, the same factor, that is decrease in total R.B.C. also explains the slight fall in the post-operative haemoglobin value observed in this investigation. Bild (1955) has stated that haemoglobin loss is common in many surgical conditions which are stress situations. He has further observed, "in general it may be stated that often a tentative fall in body weight and occasionally a haemoglobin deficit accompanies stress".

Boddie (1964) has stated that inflammation is the normal response of trauma or bacterial infection and the polymorphonuclear neutrophilic cells are actively involved in the defensive mechanism of the body. Therefore the most common change in the white cell picture is an increase, both in proportion and in the absolute numbers of leucocytes.

Krishnamurthy (1970) has also observed a fall in P.C.V.,R.B.C. and leucocytosis post-operatively.

Contrary to these - Schalm (1965) has stated, "it is well known in clinical medicine that the bovine does not respond to infections with leucocytosis of the magnitude commonly found in the canines and felines. A shift in neutrophils to 50 per cent or above with occurrence of a few bands is considered indicative of stress reaction, to bacterial infection with or without a significant increase in total count, or a distinct left shift without significant neutrophilia or leucocytosis".

Leucocytosis observed in the present investigation appears to be due to surgical trauma and may be explained in the light of the above facts.

The differential leucocyte count in the post-operative period shows slight neutrophilia. This may be explained as the organisation of defensive mechanism of the body to avert stress.

Neutrophilia and eosinopenia observed in this study is due to post-operative stress reaction. Schalm (1965) has stated that the eosinophil disappears from the circulation during the stress. However, contrary to this, Boddie (1964) has observed that as the proportion of eosinophils in normal animals

may be so low as to be practically non-existant it is obviously impossible to describe as eosinopenia.

It is evident from Table-2 that there is no appreciable difference in the haematological values of the pre and post-operative periods, suggesting that the animals stood the ordeal of surgery satisfactorily.

Details of abbreviations and the unit of measurements or value for each blood factor used in Table-2.

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Blood entity	Expressed in
Haemoglobin (Hb.)	Grams per 100 ml. of blood
Packed cell volume (P.C.V.)	Volume per cent
Total erythrocytes count (T.E.C.)	Millions per cubic millimeter of blood
Total leucocyte count (T.L.C.)	Thousands per cubic millimeter of blood
Differential leucocyte count (D.L.C.)	Per cent
Neutrophils (N)	Per cent
Lymphocytes (L)	Per cent
Monocytes (M)	Per cent
Eosinophils (E)	Per cent

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TABLE - 2

PRE AND POST-OPERATIVE AVERAGE BLOOD VALUES OF THE EXPERIMENTAL ANIMALS

Buff. Calf No.		Hb.	P.C.V.	T.E.C.	T.L.C.	Differential leucocyte count			
						L	N	M	E
1	2		3	4	5	6	7	8	9
1	Pre	13.2	35.4	6.9	11500	62.1	28.4	4.3	6.2
	Post	12.5	30.6	6.0	13946	54.6	38.2	5.0	4.2
2	Pre	12.3	33.6	5.8	10856	60.6	30.2	3.3	5.7
	Post	11.7	28.3	5.1	12723	50.2	42.3	4.2	3.3
3	Pre	12.6	35.7	6.6	12342	58.1	32.2	3.0	6.7
	Post	12.0	30.6	5.8	13320	52.3	37.3	5.2	5.2
4	Pre	13.0	37.3	5.3	10978	63.3	27.2	3.5	6.0
	Post	12.4	29.4	4.8	15303	56.4	36.2	2.6	4.8
5	Pre	11.6	34.2	5.0	9987	57.4	33.7	1.7	7.2
	Post	10.8	27.2	4.6	12260	50.3	39.3	5.1	6.2
6	Pre	13.5	38.5	6.2	15036	66.5	25.3	2.6	5.6
	Post	13.0	30.5	5.4	18640	56.2	34.5	4.6	4.7

continued

Table-2(continued)

1	2	3	4	5	6	7	8	9
7	Pre 14.0	40.0	6.1	14320	65.0	32.0	2.0	1.0
	Post 13.4	34.7	5.9	14626	59.6	38.8	1.6	-
8	Pre 15.2	42.1	6.6	12876	60.7	31.2	3.0	6.0
	Post 14.2	37.8	5.7	16424	60.1	30.6	4.3	6.7
9	Pre 12.6	33.4	5.5	9700	59.5	30.4	3.4	6.7
	Post 12.0	28.6	5.0	11780	58.7	34.2	4.2	3.3
10	Pre 13.7	36.7	5.6	11020	61.7	29.6	3.0	5.7
	Post 12.5	27.7	4.9	13940	60.2	31.8	4.5	3.5
11	Pre 13.1	34.8	6.0	12996	60.4	32.2	0.8	6.6
	Post 12.7	30.0	5.5	13870	60.0	34.8	1.6	3.6
12	Pre 14.0	39.8	7.2	13346	64.2	30.8	2.6	2.4
	Post 13.5	34.3	6.2	15920	60.3	36.6	2.4	1.0

Note - Each figure denotes the average of the readings taken on 3rd, 6th and 10th pre and post-operative days.

BODY WEIGHT

Body weight of the experimental animals (Table-3) showed slight decrease post-operatively which was not statistically significant. By about 60th post-operative day, their body weight either increased or reached their respective pre-operative values. This fact suggests that the operation did not have detrimental effect on their health.

Inspite of the fact that there was no significant derangement or disturbance in the normal physiological functions of the experimental animals after thoraco-pericardiotomy and thoraco-pericardiectomy, yet it remains to be seen how the draught animals subjected to this surgical intervention would fare at the plough or in the cart. It also remains to be seen if the collapsed lung could be revived to function normally after removal of the drainage tube, by removing the atmospheric air from the thoracic cavity with the help of suction apparatus as is done in canines.

TABLE - 3

BODY WEIGHT OF THE EXPERIMENTAL ANIMALS

Buff. Calf No.	Pre-operative body weight (pounds)	Post-operative fortnightly body weight (pounds)					
		I	II	III	IV	V	VI
1	187.0	184.2	186.4	187.8	188.6	189.2	189.7
2	165.0	162.3	160.0	162.6	163.4	-	-
3	242.2	240.7	242.3	243.8	243.8	244.1	244.9
4	160.6	159.2	160.7	162.6	162.7	-	-
5	176.0	-	-	-	-	-	-
6	209.0	207.4	209.6	211.0	211.2	-	-
7	200.0	199.2	201.7	202.6	202.5	-	-
8	198.0	-	-	-	-	-	-
9	165.0	163.2	164.8	166.2	166.9	167.0	167.2
10	176.0	173.7	174.7	176.2	176.9	-	-
11	209.0	208.2	209.7	210.7	211.0	211.6	211.6
12	176.0	174.4	175.8	176.9	178.0	-	-

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5	176.0	-	-	-	-	-	-
6	209.0	207.4	209.6	211.0	211.2	-	-
7	200.0	199.2	201.7	202.6	202.5	-	-
8	198.0	-	-	-	-	-	-
9	165.0	163.2	164.8	166.2	166.9	167.0	167.2
10	176.0	173.7	174.7	176.2	176.9	-	-
11	209.0	208.2	209.7	210.7	211.0	211.6	211.6
12	176.0	174.4	175.8	176.9	178.0	-	-

POST-MORTEM EXAMINATION

Two animals from each group viz. right and left lateral thoraco-pericardiotomy and pericardiectomy (Table-1) were randomly selected and sacrificed for autopsical examination of the thoracic cavity on the 62nd post-operative day. In one animal of the right lateral group, some adhesions between pericardium and the cardiac lobe were noticed. No other significant pathological change could be observed. The healing of the thoracic wounds were technically perfect.

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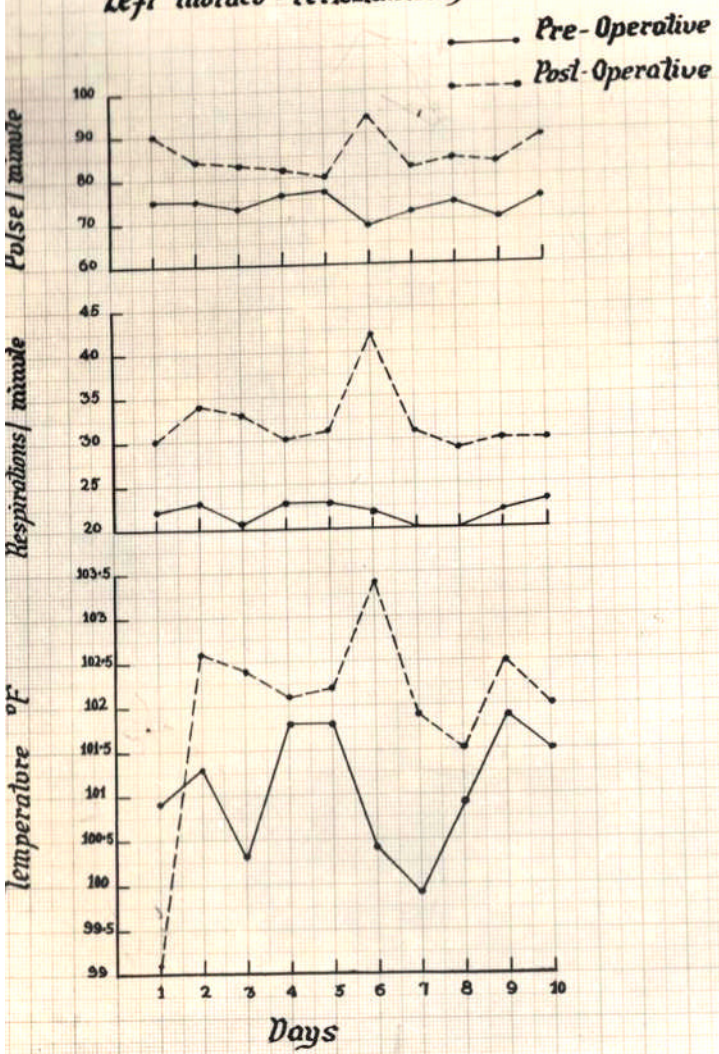
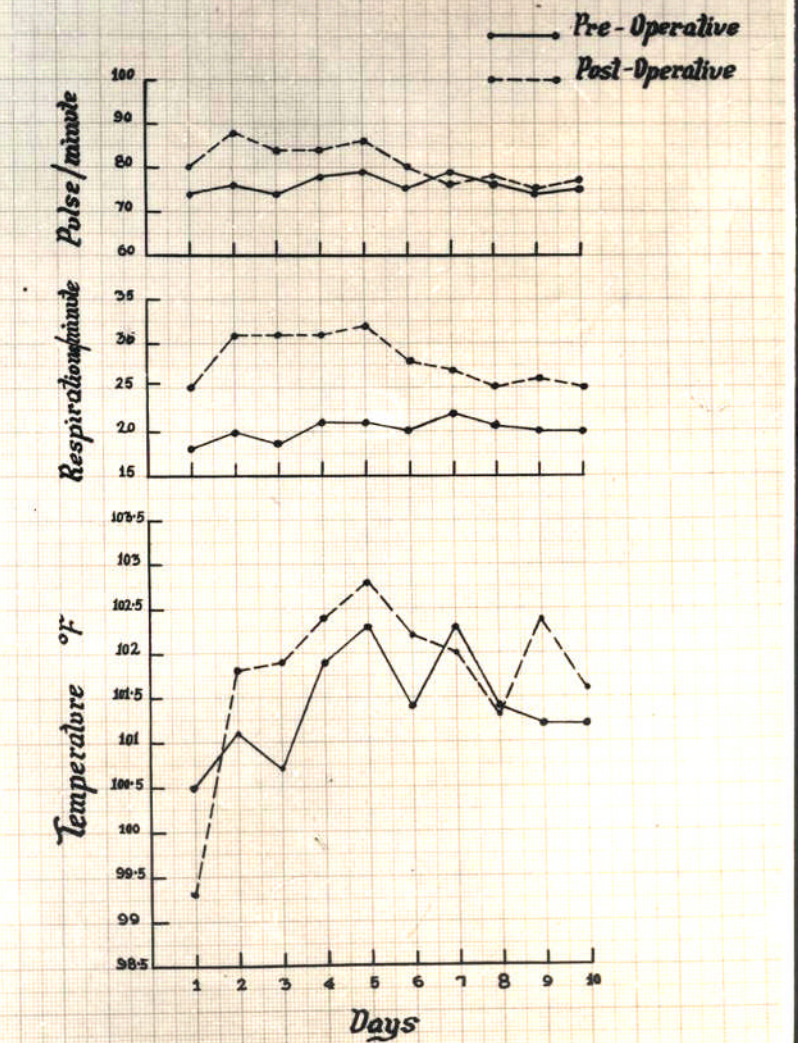
Graph-2. Buffalo Calf 2, Sex-Male

Left thoraco-Pericardiotomy



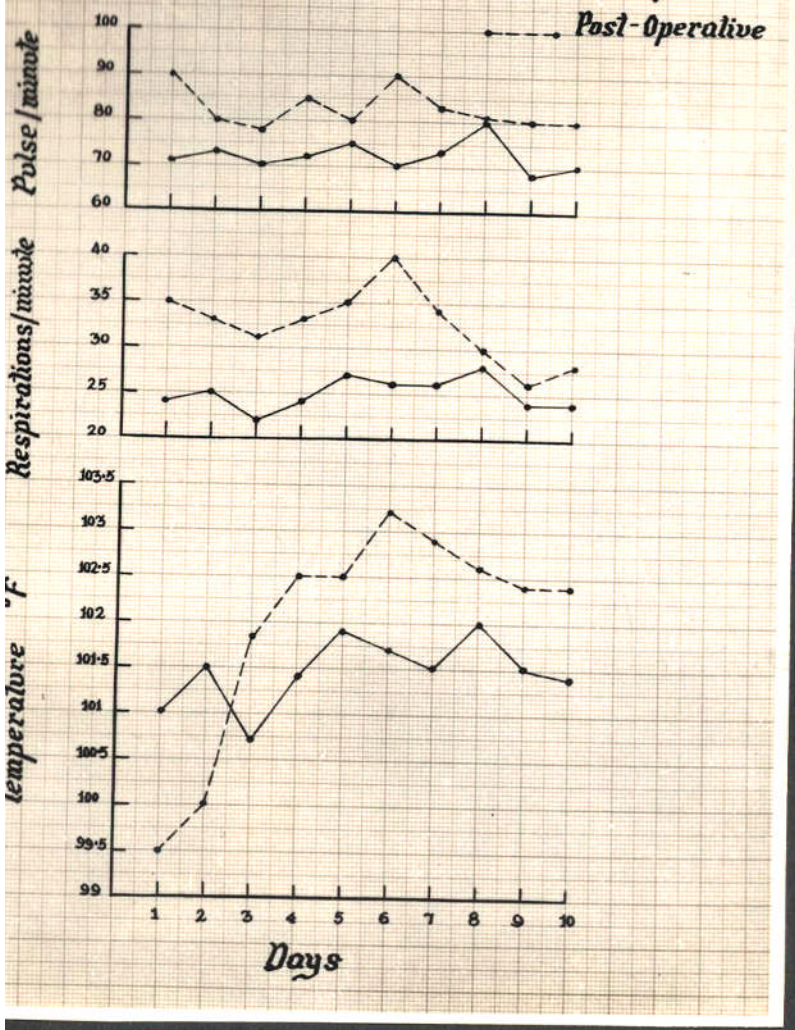
Graph-1. Buffalo Calf 1, Sex - Male

Left thoraco-Pericardiotomy



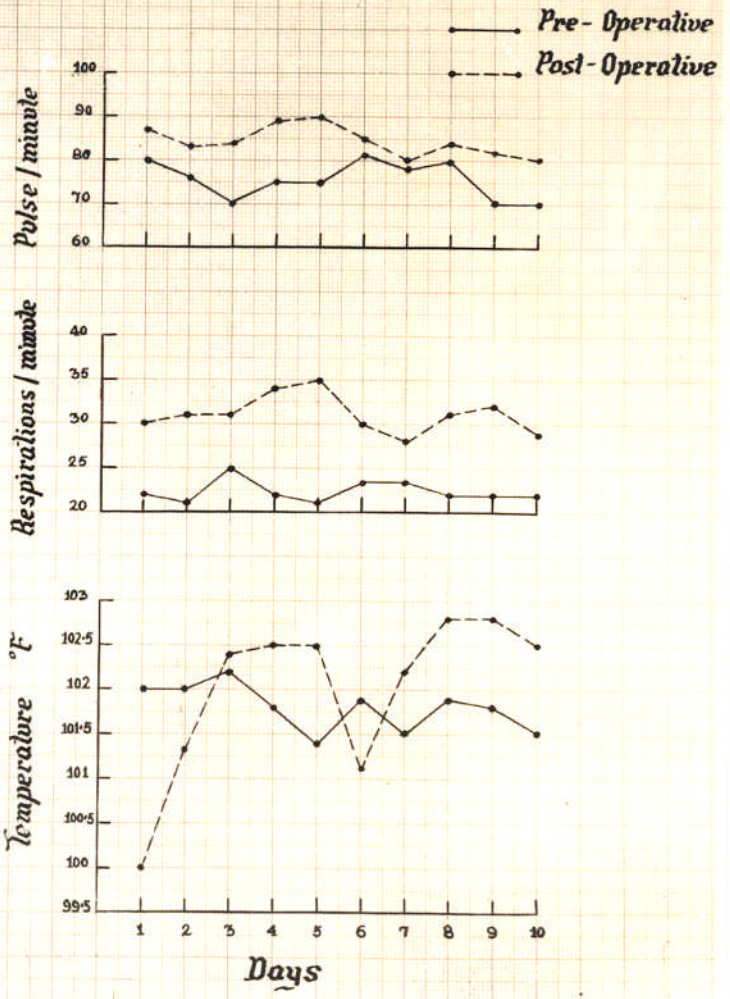
Graph-4 . Buffalo Calf - 4 , Sex-Male

Left thoraco - Pericardiotomy

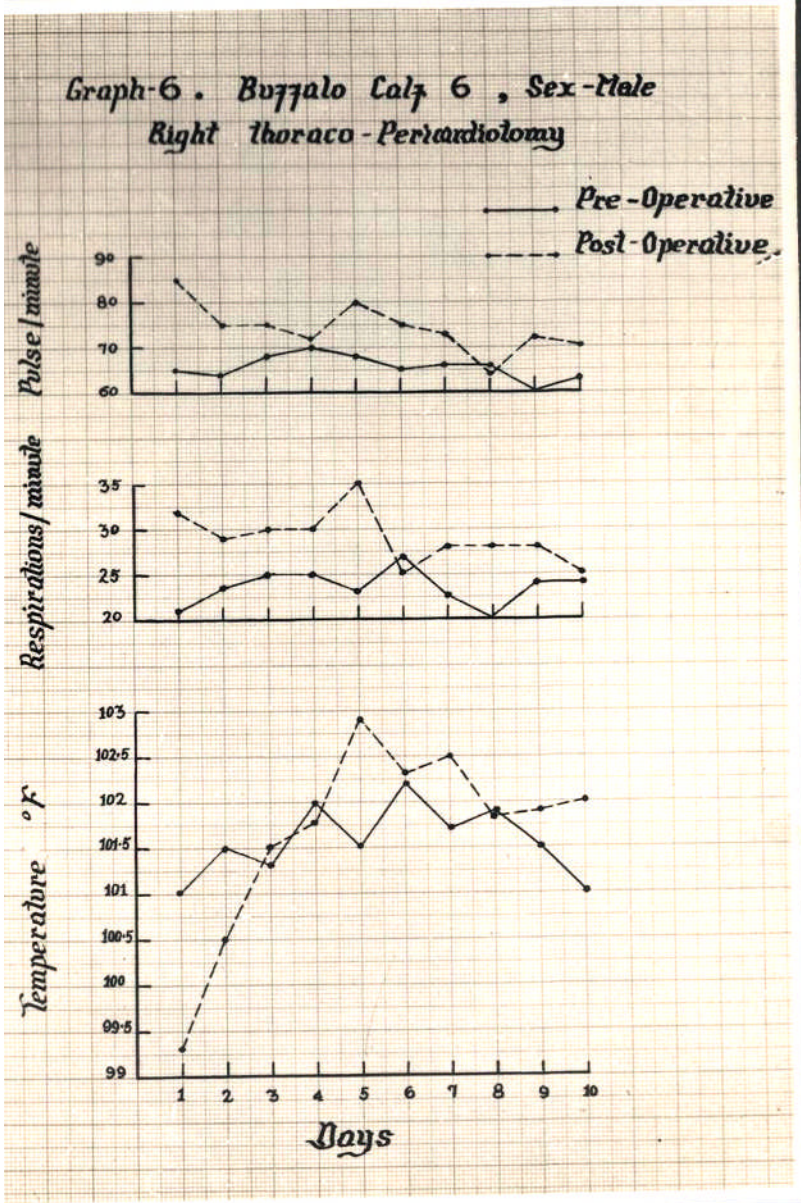


Graph-3 . Buffalo Calf - 3 , Sex-Male

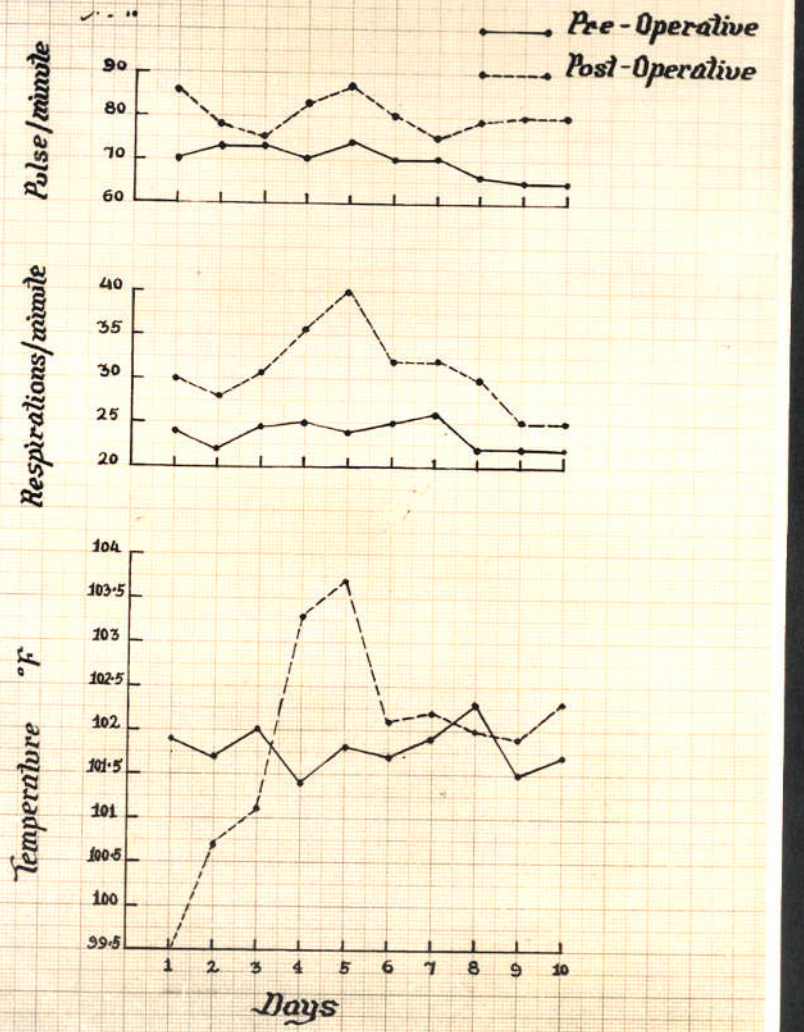
Left thoraco - Pericardiotomy



Graph-6 . Buffalo Calf 6 , Sex-Male
Right thoraco-Pericardiotomy

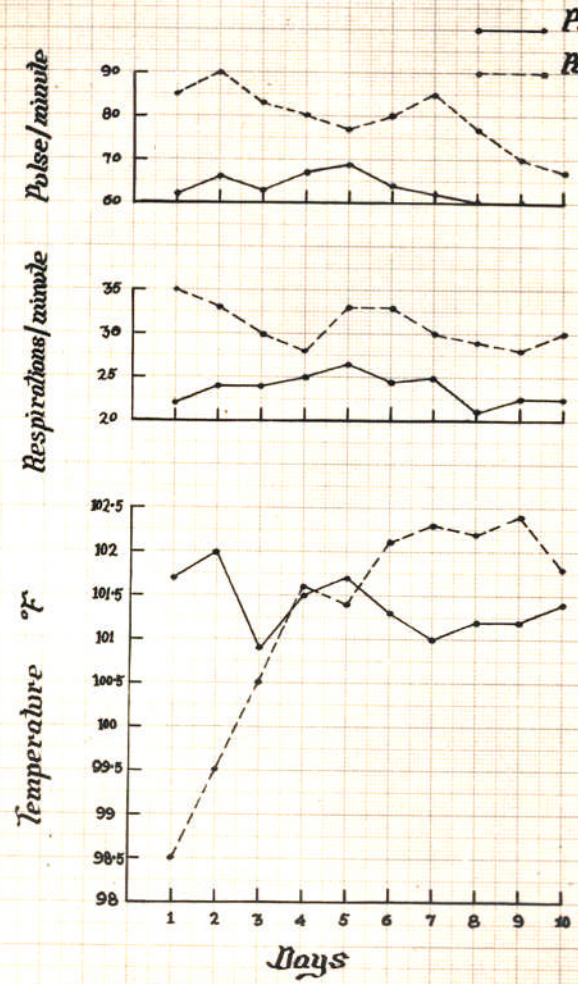


Graph-5 . Buffalo Calf-5 , Sex-Male
Left thoraco - Pericardiotomy



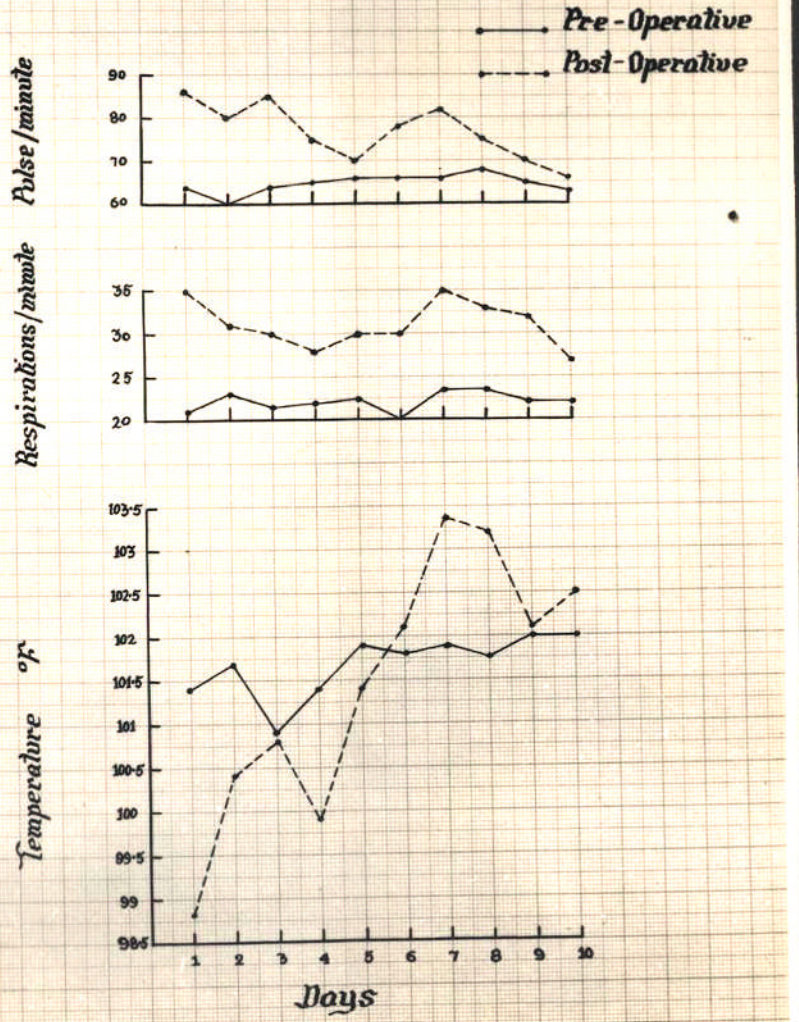
Graph-8. Buffalo Calf 8, Sex-Male

Right thoraco-Pericardiotomy

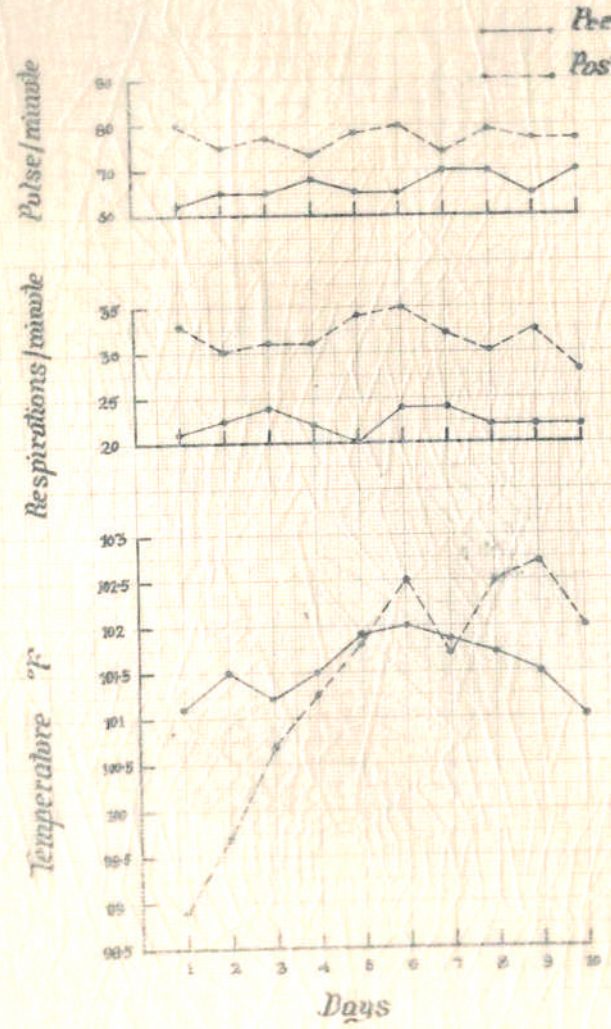


Graph-7. Buffalo Calf-7, Sex-Male

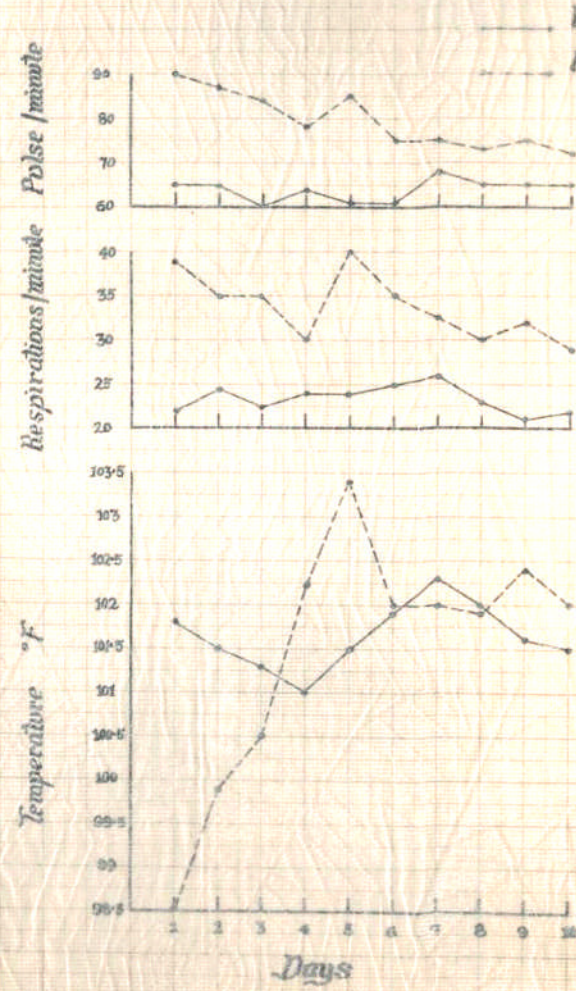
Right thoraco-Pericardiotomy



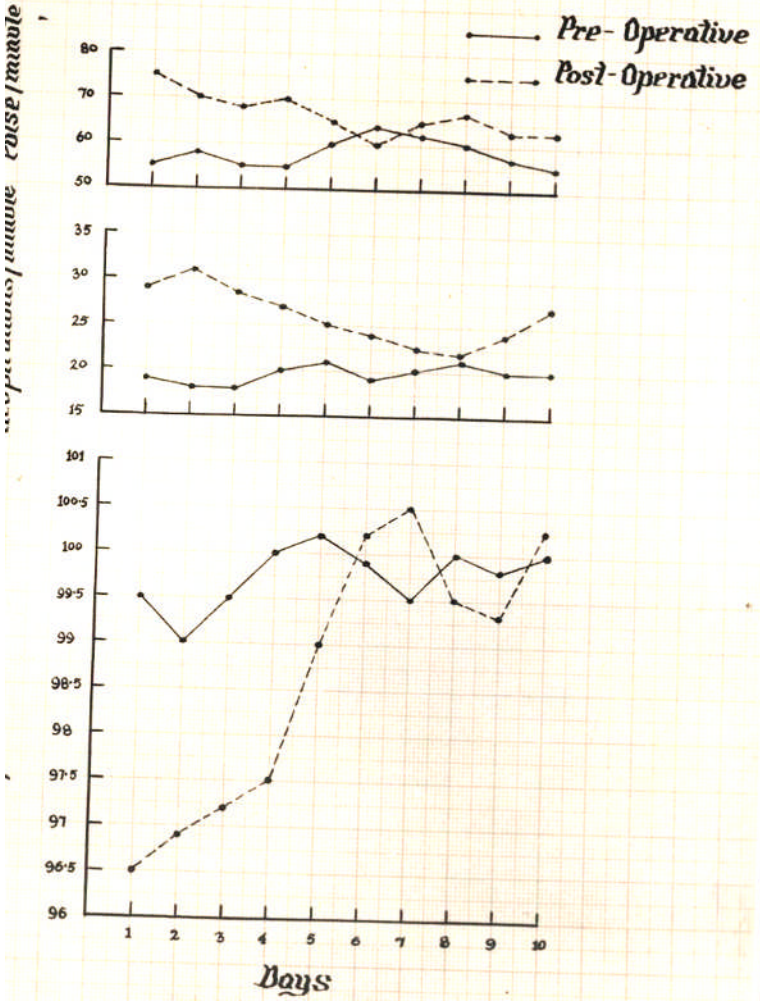
Graph -10 . Buzzalo Calz -10 , Sex-Male
Right Thoraco-Pericardiectomy



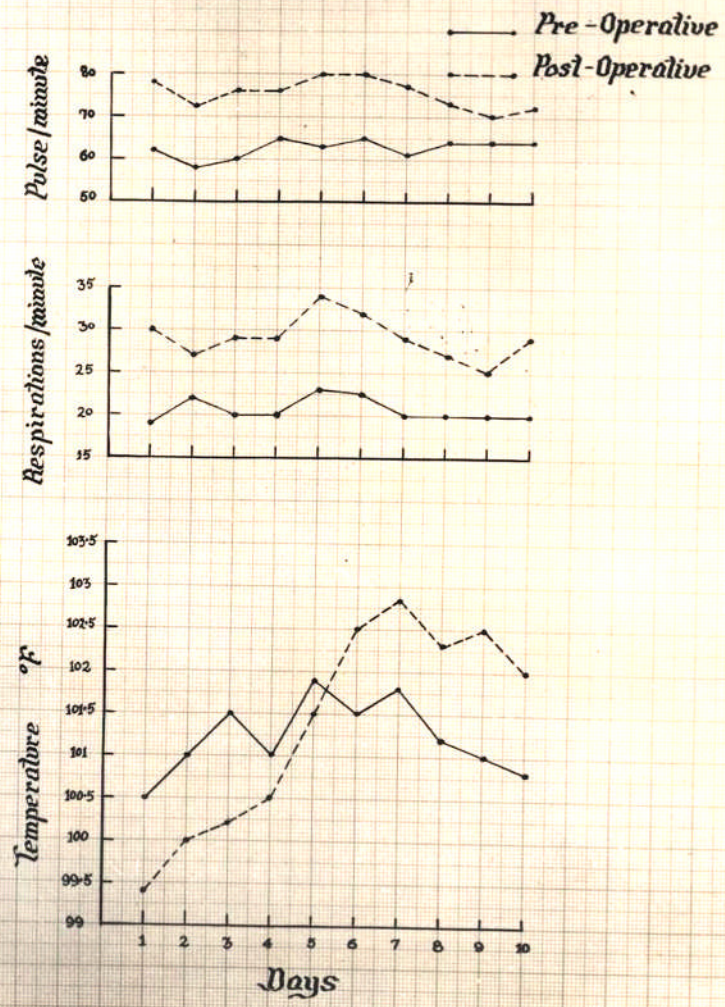
Graph-9 . Buzzalo Calz. - 9 , Sex-Male
Right Thoraco-Pericardiectomy



Graph-12 . Buffalo Calf - 12 , Sex-Male
Right thoraco - Pericardiectomy



Graph-11 . Buffalo Calf 11 , Sex-Male
Right thoraco - Pericardiectomy



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SUMMARY

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SUMMARY

1. Technique of thoraco-pericardiotomy and thoraco-pericardiectomy in buffalo calves has been described.

2. The indications and different techniques of the operation have been reviewed and discussed.

3. Radiography of the thorax has been performed to demonstrate the indwelling pericardial drainage tube.

4. Twelve animals were operated upon out of which two animals died of acute frothy tympanites on the 12th post-operative day.

5. No significant post-operative complications has been observed in any animals.

6. Pre and Post-operative temperature, pulse and respiration and haematological values have been recorded and compared. Post-operative rise in pulse rate and respiration has been discussed.

7. Pre and post-operative body weights have been recorded. A slight decrease in the body weight

upto the 60th post-operative day has been observed after which it either increased or reached the pre-operative level.

8. Six animals randomly selected were sacrificed and autopsied. Only one animal showed some adhesions between pericardium and the cardiac lobe of lung.

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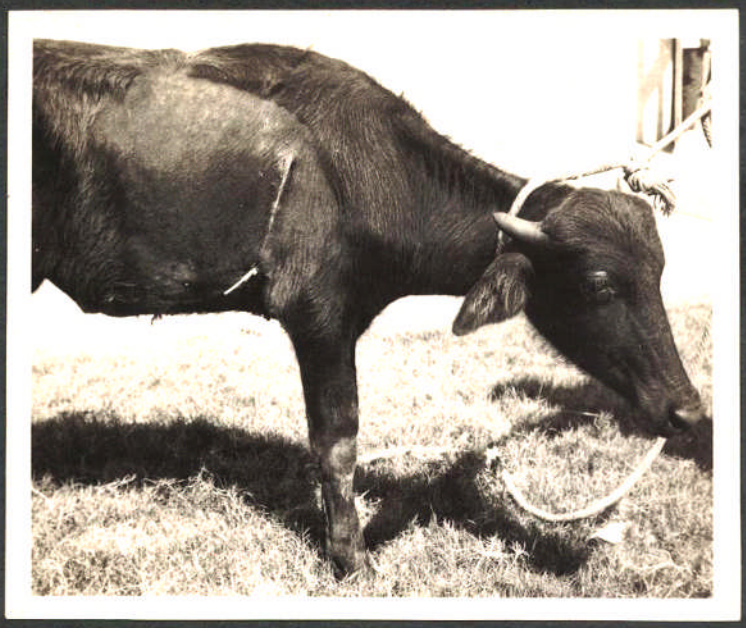

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