

**Management of Different Surgical procedures in Small and Large animals:  
OIE Compliant CPD Module for Veterinarians and Para Veterinarians**

**Submitted to: Ethiopian Veterinary Association (EVA)**



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## **PREFACE**

Veterinary surgery is a branch of medical science which deals with partial or complete treatment of disease through manual or operative procedure. It is not only science but also an art and it requires a firm foundation and working knowledge of anatomy, pathology and diagnostic medicine. Veterinary Surgery, like human surgery, is of ancient origin but of relatively recent development as a science. Especially, since World War II the development of Veterinary Surgery has been dramatic. In the short space of 25 years, Veterinary Surgery has achieved a level of sophistication equivalent in most way to that of human surgery. Even if Veterinary Surgery is one of the oldest forms of medicine; it was introduced and opened lately in Ethiopia and hence, scarcity of documentations on surgical operations in different animals is the main challenge.

Moreover, a survey with the main objectives of assessing the status of competence of veterinarians and veterinary paraprofessionals in Ethiopia with identification of possible causes has been conducted since September 2014 by the Ethiopian Veterinary Association (EVA). The results of this study suggested that there is a critical lack of competence in technical skills among the professionals including in surgical techniques/procedures. Among the reasons identified as responsible for the problem were deficient initial training at veterinary schools and lack of continuing professional development (CPD) after graduation. This training material was therefore prepared with the aim of serving as an input in CPD trainings in veterinary surgery and to provide relevant information that will boost Vets and paravets' knowledge, skill and confidence to practice surgery in different animals with or without supervisors.

A concise, well written, practical and relevant manual is vital for development of veterinarians in their profession. For easy comprehension, this CPD module has been included nineteen different surgical procedures comprises surgical affections of head and neck, abdominal and pelvic regions. Major surgical conditions like dehorning in cattle; cropping of ear, extirpation of eye; tracheotomy; esophagotomy; rumenotomy; Gastrotomy; enterotomy; urethrotomy; castration and spaying were addressed by this manual. Each surgical exercise comprises indication, site of operation, control and anesthesia, surgical technique of operation and postoperative cares. This manual was prepared based on the available and accessible literatures and experiences of the authors.

**The authors**

## **1. COURSE INTRODUCTION**

**1.1. Course Title:** Management of different Surgical procedures in Small and Large animals: OIE Compliant CPD Module for Veterinarians and Para Veterinarians

**1.2. Course code:** TBA (To Be Allocated)

**1.3. Credit Points:** TBA (To Be Allocated)

**1.4. Target trainees:** Veterinarians and Para Veterinarians are eligible to be considered for this module training. Moreover, female professionals will be encouraged to take the course.

## **2. MODULE FORMAT**

### **2.1. Module Description**

The veterinary competences are dynamic and development does not stop after graduation. All veterinarians should regularly update their competences to stay engaged in the new developments in the veterinary field by participating in postgraduate education. Maintaining skill and knowledge related to profession is also called continuing professional development (CPD) or Life Long Learning (LLL). In Ethiopia, the authors believed that there is no knowledge dearth among Veterinary graduates. However, there is a deficit on skill and attitudes of field veterinarians towards practicing different surgical procedures in animals. This CPD Module will be a compilation of scholarly and practical knowledge in the field of veterinary surgery to cater the needs of practicing veterinarians and fresh graduates who intend to practice surgery. The contents will be contributed by experienced surgeons and academicians in different areas include their practical experience and tips for the field veterinarians, paravets and for the beginners. Surgical affections of head region will be practically described in the beginning. Management of common surgical conditions like urinary calculi, castration, caesarean section and ovariohysterectomy will be detailed. Some of the emergency procedures like tracheostomy, oesophagotomy, rumenotomy, intestinal anastomosis, repair of hernias and atresia ani etc. will be described in detail with the use of quality photographs. Common affections of eye are also described for the benefit of field vets. Overall, this CPD module will be a very useful publication for all practicing veterinarians and fresh veterinary graduates.

### **2.2. Module Duration**

This module will be delivered in 50 hours training. The training will possess 18 hours of lectures (online or face to face), 32 hours of practical sessions and two way communications (discussions).

## 2.3. Objectives

### General Objective:

- ✿ To deliver a course that will enable the trainees to practice major surgical procedures in both small and large animals with minimum guidance of mentors at their clinical setting.

### Specific Objectives:-

- Describe surgical anatomy and full surgical procedure of different surgical affections in small and large animals.
- Explain emergency surgical procedures like trachotomy, esophagotomy etc. and how they can treat at field condition.
- Introduce and adopt new surgical advancements and describe how to perform surgical procedures effectively and efficiently at their clinical settings.

## 2.4. Learning Outcomes

At the end of the module, candidates should be able to:

- ✕ Prepare the animal for surgical procedures.
- ✕ Perform major surgical procedures both in small and animals
- ✕ Explain the difference between elective and emergency surgery and able to treat at field condition
- ✕ Handle and treat any surgical procedures in different species of animals with confidence
- ✕ Explain to a farmer about which organs will be operated and possible consequences of the surgery
- ✕ Minimize his/her shortcomings and improve his/her skill, knowledge and attitude towards different surgical procedures.
- ✕ Recognise the moral responsibility to provide adequate levels of care and facilities for particular surgical procedures
- ✕ Perform post-operative care to his/her patients.

## 2.5. Learning Approach

Content were developed and will be delivered according to established international standards for text to read, images to view, videos to watch, audio clips to hear, or tasks to attempt. Based on the nature of the session, the content will be delivered by the following approaches:-

- **Lecture:** Lectures involve the use of PowerPoint presentations supplied by numerous clinical surgical cases useful to the description of various diseases. In addition, to improve the understanding, presentations are accompanied by numerous images and videos.
- **Practical lessons:** The practical lessons are carried out by dividing the learners in to four groups, to form groups of about 25 learners. The practical lessons are carried out using real clinical cases in the present of the patient in the clinic or operating room or alternatively PowerPoint video presentations will be used for group discussion of the cases.
- **Open discussion on a problem:** question and discussion during lectures and practical sessions will be included.
- **Undertaking an applied study /learning by doing/** to targeted at enabling a practitioner to address a real time problem with guidance from the mentor will be employed.
- **Case studies:** cases will be presented from the learners experiences or from the presenter and reflections and feedbacks will be included.
- For those with low internet bandwidth, CPD modules will have options to be consulted off-line and PDF companion guide.

## **2.6.Measurement of Learning**

Formative and summative measurement techniques will be employed. Presenting a broad spread of cases, reflective case reports, answer question, journal critique/journal club presentation (pass/fail), quizzes, group and individual assignment, and checklists will be used to measure the competence level of the learners. Learners will also provide with feedback, in the appropriate language(s), on their responses to support learning.



### **3. MODULE CONTENTS**

#### **3.1. Dehorning in Cattle**

##### **Indications:**

- ✿ Squamous cell carcinoma of the horn
- ✿ Fracture of the horn
- ✿ Avulsion of the horn
- ✿ Irreparable wound at the base of the horn
- ✿ Misdirected/ overgrown horn

##### **Site of operation:**

- ✿ The skin about 1.5 to 2 inches around the base of the horn is prepared aseptically prior to the operation. The objective of this operation is to destroy completely or remove the horn secreting tissue.

##### **Surgical Anatomy:**

- ✿ The horn is actually the cornual process of frontal bone. The hollow interior of the horn consists of irregular spaces which are continuation of frontal sinuses. The horn substance is thicker towards its apex where it is almost solid.
- ✿ The nerve supply to the horn is by cornual nerve. The cornual nerve is a branch of lachrymal nerve which itself is a branch of ophthalmic nerve that again is a branch of fifth cranial nerve the trigiminal (CLOT).
- ✿ The blood supply to the horn is through the cornual artery, which is a superficial branch of temporal artery. The cornual artery bifurcates into rostral and caudal branches to encircle the base of horn.

##### **Special instruments:**

- ✿ Gigli wire saw
- ✿ Bone chisels and osteotome
- ✿ Bone rongeur and bone cutter

##### **Control:**

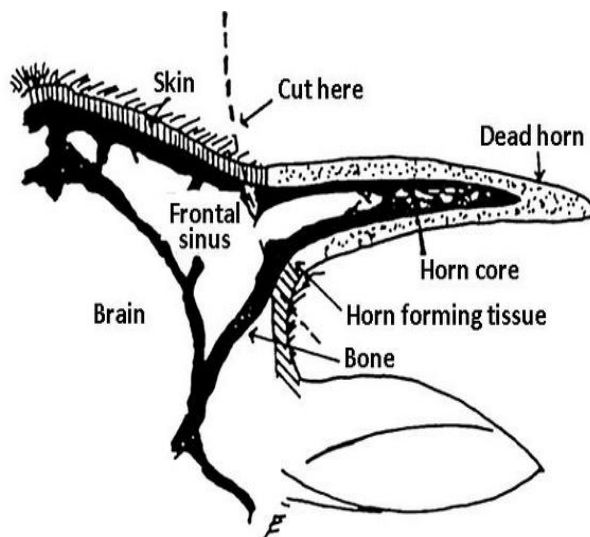
- ✿ Standing or Lateral recumbency with the affected horn upwards

### Anaesthetic technique:

- ✿ Cornual nerve block

### Surgical procedures:

- ✿ One incision is taken towards the poll and another incision of 2-3 cms is taken towards the frontal ridge.
- ✿ These incisions are joined together by taking incision on anterior and posterior side of the horn at the junction of the base of the horn and skin
- ✿ The skin on both sides is reflected to form a flap
- ✿ The exposed horn is then cut close to its base either using a saw or an obstetrical wire
- ✿ Hemorrhage is arrested by pressure hemostasis or by ligating the cornual artery
- ✿ If horn amputation is indicated following horn cancer, complete growth along with affected part of frontal bone should be chiseled out and wound is curetted.
- ✿ Frontal sinus is also irrigated to flush out all cancerous tissue
- ✿ The skin flaps are apposed together with interrupted sutures using nonabsorbable suture material
- ✿ A protective bandage must be applied
- ✿ If closure is difficult:
  - ✓ Special tension suture (N-F-F-N)
  - ✓ Relaxation incision
  - ✓ Undermining (blunt dissection)



**Figure 1:** Site of operation for dehorning

**Source:** Armistead (2008)



**Figure 2:** Horn removal by horn shear

**Post operative care:**

- ✿ Regular antiseptic dressing and a course of antibiotics.

### 3.2. Ear Cropping In Dogs

#### Indications:

- ✿ To improve the appearance of the animal.

#### Control and Anaesthesia:

- ✿ The animal is controlled in sternal recumbency after proper premedication and general anaesthesia.

#### Site of Operation:

- ✿ Lateral border of ear flap.

#### General Guidelines:

- ✿ After folding the ear flap with slight traction, the medial edge of flap is made to touch the medial angle of the eye. It makes the tip of the cropped ear.
- ✿ To make 3/4 crop, the ear flap is folded in half and the point at which the fold occurs is marked. The flap is held erect and the tip is folded down to the previously marked half way point. This point where this fold occurs will become the tip of cropped ear.

#### Note:

- ✿ *The cropped ear should conform to the standard for the breed, the prevailing style and characteristics of individual dog.*
- ✿ *In large breeds, ears should be cropped between 9 to 12 weeks of age. In small breeds, ears are trimmed when the dogs are 4 to 6 months old.*

#### Surgical Technique:

- ✿ The ear clamp is applied from the upper to lower points of a flattened ear flap so as to adjust the flap to the desired shape. A concave curve can be made by pulling ear flap laterally through the clamp and convex curve the pulling ear flap medially or area to be cropped is demarcated.
- ✿ Lateral portion of ear flap is excised by cutting along the clamp leaving the clamp in place or on the line of demarcation on the medial side.
- ✿ The bleeding from the cut surface of cropped surface is controlled by using electro-cautery or with sponges/ligatures.

- ✿ The auricle ear cartilage is trimmed with scissors at the base of ear flap.
- ✿ The upper 2/3 of earflap is closed skin to skin with simple continuous sutures of 3-0 to 4-0 silk.  
The lower portion of incision is sutured with simple interrupted sutures. Care should be taken to avoid folding or puckering of skin edges.
- ✿ The second ear is cropped in a similar manner as the first.

#### **Post-Operative Care:**

- ✿ The ear flaps should be bandaged over the head for first 48 hours and sedative/analgesic is given to the animal.
- ✿ Scratching of ears should be prevented to avoid disruption of suture line, if needed light bandaging of ear flap to the head may be done.
- ✿ Antibiotics should be given for 4 to 5 days.
- ✿ Sutures should be removed 8th to 10th post-operative day or after complete healing.



**Figure 3:** Ear cropping in dog



**Figure 4:** Postoperative management of ear

**Source:** Free range, 2017

### 3.3. Extirpation Of Eyeball In Goats

#### Indications

- ✿ Irreparable injury to eye ball
- ✿ Orbital abscess
- ✿ Painful intractable glaucoma.
- ✿ Extensive ocular tumors/ cancer
- ✿ Rupture of the eye

#### Surgical Anatomy

- ✿ The eye ball is situated in the anterior part of the orbital cavity. It is protected in front by the upper and lower eye lids, bulbar and palpebral conjunctiva and its middle by the complete orbital ring. It is related behind to the fascia bulbi, fat and ocular muscles.
- ✿ The eye ball consists of three tunics, the fibrous tunic; sclera and cornea; the vascular tunic; choroids, ciliary body, the iris; and the nervous tunic: retina, within which three refractive media, the aqueous humour, the lens substance and vitreous humour are enclosed.
- ✿ The third eye lid or membrana nictitans is situated at the anteromedial angle of the eye.
- ✿ The movement of eye lids are governed by orbicularis oculi and levator palpebrae superioris muscles.
- ✿ The movement of the eye ball is controlled by four straight, two oblique and a retractor muscles.
  - ☛ The straight muscles which are band like arise close together around the optic foramina and end into the sclera. They are designated according to their position as rectus dorsalis, rectus ventralis, rectus medialis and rectus lateralis. These straight muscles rotate the eye ball about the transverse axis.
  - ☛ The oblique dorsalis superior which is the longest and narrowest of the ocular muscles, arises near the ethmoidal foramina and inserts into the sclera between dorsal and lateral recti. It rotates the eye ball about the longitudinal axis and raises the lateral end of the pupil.
  - ☛ The oblique ventralis, a wide and shorter muscle arises from the middle of the orbit behind the lacrimal fossa and inserts into the sclera beneath the rectus lateralis. It lowers the lateral end of the pupil.
  - ☛ The retractor oculi entirely surrounds the optic nerve. It arises from the optic foramina and inserts into the sclera behind the recti. It draws the whole eye ball backwards.

- ✿ The arteries of the vascular tunic come from the ciliary branches of the ophthalmic artery while the eye lids and conjunctiva is supplied by the facial arteries. Venous drainage is by satellite veins.
- ✿ Sensory innervation is by the branches of ophthalmic and maxillary nerves while motor innervation is by facial, oculomotor and sympathetic nerves.

### **Site of Operation**

- ✿ Between eye ball and orbital rim through the skin of both eye lids about half cm from the border.

### **Control and Anaesthesia**

- ✿ The animal is controlled in lateral recumbency with the affected side up.
- ✿ Analgesia at the site of operation is achieved by auriculopalpebral and retrobulbar nerve blocks or by infiltration of local anaesthetic into upper and lower eye lids and deeper tissues at the site of incision, in case sedative or tranquilizers are used.

### **Surgical Technique**

- ✿ The upper and lower eye lids are sutured together with a continuous suture leaving the suture ends at least 15-20 cm long for grasping and applying traction during the operative procedure.
- ✿ An incision completely encircling the eye lids is made approximately 1/2 cm from the margin of the lids.
- ✿ The incision is extended around the entire circumference of the lid margin between the orbital rim and eye ball by blunt dissection taking care that conjunctiva is not punctured.
- ✿ Haemorrhage is carefully controlled either by ligation or forcipressure.
- ✿ Conjunctiva from the lids back to its attachment to the orbit is separated leaving its attachment to the border of the lids. The dissection is carried out back to the point of insertion of the conjunctiva to the orbit.
- ✿ All the muscles of the eye are incised with scissors and finally the optic nerve is cut. Before cutting, the optic vessels are ligated firmly in order to control the haemorrhage.
- ✿ All the periorbital fat is left in place.
- ✿ The haemorrhage is controlled with gauze pressure temporarily packed up inside the orbital cavity. All the blood clots are removed from the cavity.
- ✿ Temporary pack is removed and a 70-80 cm long piece of bandage impregnated in antiseptic lotion is inserted into the orbital cavity. Outer skin edges of the lids are sutured with interrupted

sutures in order to close the wound leaving a little portion of impregnated gauze outside towards the inner canthus.



**Figure 5:** Elliptical skin incision to encircle the eye lids

**Source:** Harvey *et al.* (1990)

### **Post Operative Care**

- ✿ A pressure bandage should be tied for about 24 hours after the Operation.
- ✿ A 15-20 cm piece of impregnated bandage should be removed and changed at daily basis for 5 and 7 days.
- ✿ A course of antibiotics should be administered for 4-5 days or till the healing is complete.
- ✿ The sutures of the lids should be removed 8 to 10 days after the operation or after the healing is complete.



### **3.4. Tracheostomy in Animals**

#### **Indications**

- ✿ Upper respiratory tract obstruction
- ✿ Stenosis of trachea
- ✿ Dyspnea with hemorrhagic septicemia
- ✿ Collapsed or fractured tracheal rings
- ✿ Snake bites and
- ✿ Oedema of larynx

#### **Surgical Anatomy**

- ✿ Trachea is a musculo-membrano-cartilagenous tube extending from the larynx to the hilus of the lungs. It occupies a median position in the ventral aspect of the neck.
- ✿ It is composed of incomplete cartilaginous rings, which helps to keep the trachea permanently open. In ruminants these rings are 45 to 60 in number. These rings are enclosed and connected by fibroelastic membrane and constitute the tracheal annular ligament.
- ✿ The cervical part of the trachea is related dorsally to the longus coli muscle and oesophagus and laterally to the thyroid gland, the carotid artery, the jugular vein, the vagus, sympathetic and recurrent laryngeal nerves, the tracheal lymph duct and cervical lymph gland.
- ✿ The sternocephalicus muscle converges from below to above and crosses the trachea obliquely, passing from the ventral surface, forward its sides and diverging to reach the angle of jaws. The left-over area of trachea is covered only with skin, subcutaneous tissue and areolar tissue between the two halves of sternothyroideus muscles which lie on the ventral surface.
- ✿ The branches of common carotid artery supply the trachea and the nerve supply is by vagus and sympathetic nerves.

#### **Site of Operation**

- ✿ Ventral midline incision at the junction between the upper and the middle one third of the neck region

#### **Control and Anaesthesia**

- ✿ The animal is positioned in lateral recumbency with neck extended.
- ✿ Head is kept in lower position to prevent aspiration of fluids.

- ✿ The anaesthesia is local linear infiltration analgesia at the site of incision.

### **Surgical Technique**

- ✿ A skin incision is made between fourth to sixth tracheal rings
- ✿ Paired bellies are displaced laterally and loose areolar tissue is cleared to expose the ring of trachea
- ✿ For tracheostomy, a stab incision is made through the annular ligament, connecting the two adjacent rings, the incision is extended on either side to provide adequate space for placement of tracheostomy tube
- ✿ Plastic, rubber or metal tube will serve the purpose in emergency
- ✿ If tracheostomy tube is expected to remain in position for prolonged period then an elliptical piece of cartilage is removed from cranial and caudal tracheal rings adjacent to annular ligament incision
- ✿ The piece of cartilage removed should not be more than half of both tracheal rings
- ✿ A self retaining metallic tracheostomy tube is then introduced through the window
- ✿ The subcutaneous tissue and bellies of the muscles are sutured by using chromic catgut no. 1 and skin is sutured by taking 2-3 interrupted sutures.



**Figure 6:** Tracheostomy tube placement

**Source:** Vygonvet (2019)

## **Post Operative Care**

- ✿ The tube is cleaned daily for first few days.
- ✿ The opening of tracheostomy tube should be covered with gauze to prevent entrance of any foreign material.
- ✿ The course of antibiotics for 5 days must be completed.
- ✿ Daily/alternate day antiseptic dressing of wound till complete healing when sutures are removed (normally 8-12 days after operation).

### 3.5. Cervical Esophagotomy in Goat

#### Indications

- ✿ Oesophageal obstruction
- ✿ Stenosis of oesophagus
- ✿ Tumor of the oesophagus
- ✿ Oesophageal perforation

#### Surgical Anatomy

- ✿ The oesophagus is three to three and half feet long in medium sized animals and is comparatively small in dogs. It connects pharynx and the stomach.
- ✿ The whole length of oesophagus is divided into cervical, thoracic and abdominal part in horses and dogs the abdominal part is absent in dogs.
- ✿ The average diameter is approximately one to two inches and is musculomembrane tube.
- ✿ In cervical area it is almost in dorsal position at origin and passes gradually to left side of the trachea at the level of about 4th cervical vertebrae. Thereafter it occupies the left position of trachea upto 3rd thoracic vertebrae. In the thoracic region it is median in position and enters the abdominal cavity through hiatus oesophagus and terminates at the cardia of the stomach.
- ✿ As the oesophagus crosses to left side of the trachea it is accompanied by longus coli and longus capitis muscles dorsally, left carotid artery, vagosympathetic trunk, jugular vein and recurrent laryngeal nerve laterally. Overlying the oesophagus are skin, cervical fascia, cervical panniculus muscle and the omohyoideus muscle, which crosses the jugular furrow obliquely from below upward, forward and inward towards the median line.
- ✿ Its wall is composed of fibrous sheath, the tunica adventitia, the muscular coat, the submucous and mucous coat. In cervical area the oesophageal wall is thicker.
- ✿ The oesophagus is supplied by branches of carotid, brachio-oesophageal and gastric arteries.
- ✿ The nerve supply to oesophagus is by vagus, glosso-pharyngeal and sympathetic nerves.

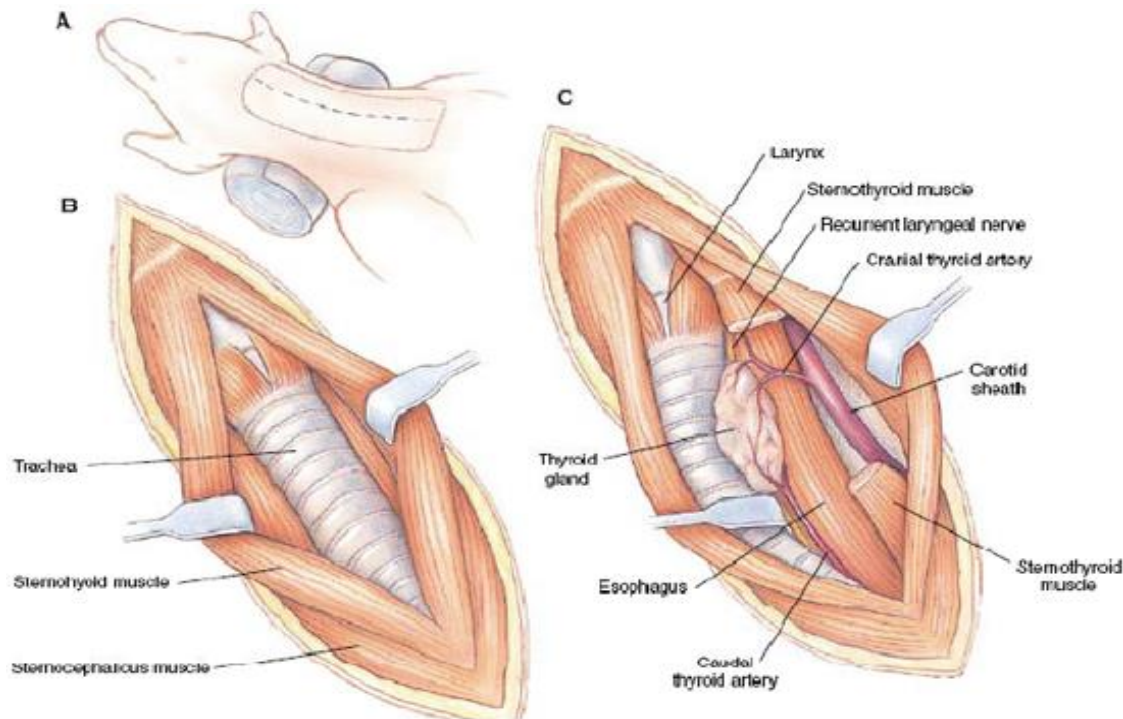
#### Site of Operation

- ✿ At the level of obstruction or lesion
- ✿ At upper or lower border of irregular furrow

#### Control and Anaesthesia

- ✿ The position of animal is right lateral recumbency.

- ✿ Anaesthesia is by local infiltration analgesia at the site of operation.



**Figure 7:** Surgical anatomy of esophagus

**Source:** Fossum (2009)

### Surgical Technique

- ✿ An incision about 3-4 cm is made along the superior border of jugular furrow cutting through the skin and cervical cutaneous fascia
- ✿ Sharp scissors or scalpel should not be used for cutting the muscles since it can cause accidental injury to carotid artery, jugular vein or the vagus nerve or the recurrent laryngeal nerve
- ✿ The jugular vein is retracted by separating it from the brachiocephalicus muscle to encounter the sterno-occipitalis muscle which is pushed downwards.
- ✿ Dissect the muscle bluntly
- ✿ The oesophagus is situated adjacent to the trachea. Oesophagus can be recognized as characteristic pink color
- ✿ It is exposed by tenaculum or curved artery forcep
- ✿ The wall of the oesophagus is incised on healthier part longitudinally over the desired length to get into the lumen and the obstruction is relieved

- ✿ The mucous membrane and submucosa is sutured by simple interrupted/ continuous lock-stitch suture pattern
- ✿ The overlying muscle and skin are sutured separately only if conditions are suitable for primary healing

### **Post Operative Care**

- ✿ Do not allow solid food for few days and intravenous feeding is done twice daily.
- ✿ A course of antibiotics is to be completed (4-5 days)
- ✿ Antiseptic dressing of the wound should be carried until healing is complete or when sutures are removed after 8-12 days.

### **Important Consideration/ Remarks**

- ✿ Check hemorrhage during surgery
- ✿ If oesophagus is empty it is recognized by passing a stomach tube.
- ✿ During dissection, prevent damage to recurrent laryngeal nerve.
- ✿ Suturing only oesophagus and leaving the skin wound open is the procedure of choice because:
  - ✓ It favors early closure of oesophageal wound
  - ✓ It prevents escape of alimentary matter during swallowing.
  - ✓ It permits drainage of any material, if present.

### 3.6. Laparotomy (Coeliotomy) In Bovine

#### Indications:

- ✿ Rumenotomy
- ✿ Enterotomy/Enterectomy
- ✿ Splenectomy
- ✿ Cystotomy/Cystorrhaphy
- ✿ Abomasopexy
- ✿ Hysterectomy (Cesarean section)
- ✿ Exploratory purposes

#### Surgical Anatomy:

- ✿ The abdominal cavity is limited anteriorly by the diaphragm and posteriorly by the pelvic inlet. The lateral wall is formed by three abdominal muscles namely obliques abdominis externus, obliques abdominis internus and transverse abdominis. The ventral wall is formed by rectus abdominis and aponeurosis of all the abdominal muscles. The dorsal wall is limited by lumbar vertebrae and their transverse processes.
- ✿ The external obliques abdominis is the most superficial and originates from middle portion of third to twelfth ribs and also from the entire lumbar area of thoracolumbar fascia. It courses mainly caudoventrally and inserts on the linea-alba and prepubic tendon by its aponeurotic portions. The caudal most portion of this muscle thickens and form inguinal ligament. The fibres of obliques abdominis internus are cranioventral that is at the right angle to that of obliques abdominis externus. This muscle originates from the thoraco-lumbar fascia and the cranial iliac spine. It inserts along the costal arch to the lateral border of rectus abdominis.
- ✿ The transverse abdominis is the deepest of all the abdominal muscles and lies just out side the transverse fascia. It originates from the medial side of costal arch as cranial as the xiphoid cartilage and the transverses thoracic. Its lumbar part originates from thoraco-lumbar fascia. Its fibers course transversely to attach to an aponeurosis, which passes deep to the rectus abdominis to join linea-alba.
- ✿ The rectus abdominis lies longitudinally arising by broad flat tendon over the sternal costal cartilage and insert on the prepubic tendon. The transverse fascia covers the inner most surface of these abdominal muscles. The parietal peritoneum lies beneath it.
- ✿ The nerve supply to the abdominal wall is by the various branches of thirteenth thoracic, first, second and third lumbar spinal nerves.

- ✿ The blood supply to the abdominal wall is through:

1. Cranial & caudal epigastric vessels.
2. External pudic artery
3. Deep circumflex iliac artery
4. Cranial abdominal artery
5. Lumbar arteries

### **Site of Operation:**

- ✿ It may be one of the following depending upon the purpose of opening the abdomen and the topography of the organ(s) to be manipulated-
- ✿ Incision through ventral abdominal wall
  - Median incision (Cranial or caudal)
  - Para-median incision (Cranial or caudal)
  - Para-rectal incision (Cranial or caudal)
  - Trans-rectal incision (Cranial or caudal)
- ✿ Incisions through para-lumbar fossa (3.5 cms ventral to transverse process of lumbar vertebra)
  - Mid upper flank incision
  - Upper paracostal incision
  - Caudal upper flank incision
- ✿ Incision medial/parallel to thigh
  - Lower flank incision
  - Ventrolateral incision

### **Control:**

- ✿ Standing position for incisions through paralumbar fossa
- ✿ Lateral recumbency for incisions in lower flank
- ✿ Dorsal recumbency for incisions through ventral abdominal wall

### **Anaesthetic Technique:**

- ✿ Para-vertebral analgesia
- ✿ Field block by inverted L
- ✿ Linear infiltration



**Surgical Procedure:**

- ✿ A 10-25 cm long incision depending upon the need for available spaces for maneuverability is made in the skin at the proposed operation site wherever practicable.
- ✿ Dissect the underlying muscles if present along the direction of their fibers.
- ✿ Otherwise the underlying muscles or linea-alba may be incised along the direction of skin incision.
- ✿ A groove director is then passed through the small cut in the peritoneum and the incision is enlarged using scissors.
- ✿ After the desired work, the abdominal layer may be closed in different layers. The peritoneum and transverse abdominis muscle may be sutured together with absorbable sutures.
- ✿ The other muscles are sutured separately with absorbable 2-3 number sutures.
- ✿ Then the skin is sutured with simple interrupted, horizontal or vertical mattress suture pattern with non-absorbable suture materials.
- ✿ In median incisions where peritoneum is adhered to the linea-alba, these two can be sutured together with interrupted sutures or lock stitch pattern. Then subcutaneous and skin sutures should be applied preferably with non-absorbable sutures.

**Post Operative Care:**

- ✿ Routine antibiotic therapy
- ✿ If the incision is made in ventral abdomen the animal should be fed with easily digestible food and in less quantity for about two weeks.

**Remarks:**

- ✿ In larger animals such as cattle, the incision on ventral aspect of abdomen should be avoided if possible.

### **3.7. Rumenotomy in Goat**

#### **Indications:**

- ✿ Traumatic reticuloperitonitis (removal of metallic and non-metallic foreign bodies from rumen and reticulum)
- ✿ Persistent ruminal impaction
- ✿ Frothy bloat
- ✿ Removal of toxic feed in poisoning
- ✿ Rumen Acidosis/Alkalosis and Atony of the rumen (Replacement of cud)
- ✿ Rumen fistula for nutrition experiment.
- ✿ For diagnosis

#### **Surgical Anatomy:**

- ✿ The rumen occupies almost whole left half and some ventral right half of abdominal cavity. The rumen extends from 7<sup>th</sup>-8<sup>th</sup> intercostal space to pelvic inlet. The rumen is opened through its dorsal sac.
- ✿ The structures to be divided in rumenotomy include skin subcutaneous fascia, external oblique muscle, internal oblique muscle, transverse abdominal muscle, peritoneum and the ruminal wall.
- ✿ The nerve supply to the left paralumbar fossa is mainly by thirteenth thoracic, first and second lumbar spinal nerves. The third lumbar spinal nerve also supplies a small cutaneous branch in the caudal aspect of paralumbar fossa.
- ✿ The blood supply to the site is by phrenico- abdominal and deep circumflex-iliac vessels. However, no major vessel is located at the site of incision.

#### **Site of Operation:**

- ✿ Rumenotomy is done through an incision in the left flank in the para-lumbar fossa and the site of incision is equidistant from tuber coxae and last rib beginning 5cm ventral to the lumbar transverse process, due to the voluminous abdomen and incision parallel to the last rib is preferred to provide an easy access to the rumen.

#### **Special Instruments:**

- ✿ Rumenotomy set (Weingarth set or Mc'limtoch set)
- ✿ Suction pump

- ✿ Hose pipe
- ✿ Siphoning tube (with a diameter of at least 3” to 4”)

### **Control**

- ✿ The animal should be controlled in standing position.

### **Anaesthetic Technique:**

- ✿ Para-vertebral nerve block
- ✿ Inverted ‘L’ regional nerve block
- ✿ Linear nerve block

### **Surgical Procedure:**

- ✿ An 10-15 cms long vertical skin incision starting about 3-4 cms below the transverse process of the lumbar vertebral is made.
- ✿ The abdominal muscles and peritoneum are also incised corresponding to the skin incision.
- ✿ The Weingarth’s ring is now fixed to the abdominal wall with the help of screw fixed at dorsal aspect of incisional wound.
- ✿ The rumen is now exteriorized and fixed in the Weingarth set with the help of two strong tissue forceps placed at dorsal and ventral aspect at least 12 cms apart.
- ✿ The forceps are now hooked tightly into the frame (ring) of rumenotomy set. Thick gauze should always be used to cover the grasping edges of the tissue forceps before applying then on rumen to minimize trauma.
- ✿ In case of non-availability of rumenotomy set, the rumen can be fixed by the help of Allis/Babcock forceps or two strong stay sutures.
- ✿ Now abdominal wound is packed tightly by surgical shrouds all around the exteriorized rumen to prevent entry of ruminal contents in to the abdominal cavity during its removal later.
- ✿ The exposed part of the rumen is now incised for about 8-10 cms. Initially a small incision is made on the rumen and this is extended enough to permit easy access by hand into the rumen and reticulum and rumen hooks are applied into the cut edges and hooked into ring. About 6-10 such hooks are applied to the exposed rumen.
- ✿ The ruminal content of approximately 50 % is taken out and the rumen and reticulum are examined for any foreign material. If any, the foreign bodies are removed.

- ✿ The ruminal cut edge are thoroughly cleaned after removal of hooks and sutured by a double row of continuous Lembert and Cushing using absorbable suture material.
- ✿ Change the pair of glove after suturing the rumen and the abdominal wound is again cleaned. The shrouds are also discarded and fresh sterilized shrouds are used to drape the animal.
- ✿ The abdominal wound is sutured in a routine manner.



**Figure 8:** Surgical incision and fixing of rumen with Weingarth set

Source: Namakkal (2019).

#### **Post Operative Care:**

- ✿ The animal should be kept on light diet for about two weeks post surgery.

#### **Remarks:**

- ✿ The instruments, which get contaminated during removal of ruminal contents, should be discarded immediately.
- ✿ The surgeon should scrub his hands freshly to close incisional wound.
- ✿ The ruminal hooks should be counted before and after their application to avoid inadvertent leaving of any of those into the rumen in case of accidental dropping.

### **3.8. Gastrotomy in Dog**

#### **Indications:**

- ✿ Foreign body in the stomach
- ✿ Chronic gastric ulcers
- ✿ Neoplasms, rupture or necrosis of stomach
- ✿ Gastric dilatation or volvulus

#### ***Surgical Anatomy***

- ✿ Stomach of dog lies largely in a transverse position more to the left of the median plane. It forms an extensive concavity in the caudal surface of the liver.
- ✿ The greater curvature is convex and extends from the cardia to the pylorus and is attached by the greater omentum.
- ✿ Stomach wall consists of serosa, muscularis (inner circular and outer longitudinal layers), submucosa and mucosa.
- ✿ The main arteries to the stomach are the left and right gastric arteries, running along the lesser curvature while the left and right gastroepiploic arteries are found running along the greater curvature. In addition, terminal part of splenic artery supplies a portion of the fundus of the stomach. The veins go to the gastrosplenic and gastroduodenal veins.
- ✿ The nerve fibers to the stomach comes from the vagus and celiac plexus.
- ✿ The structures to be cut in cranial midventral abdominal incision include skin, subcutaneous, fascia, linea-alba, fat filled falciform ligament extending from the xiphoid process in which the cranial deep epigastric vessels will be encountered.

#### **Site of operation**

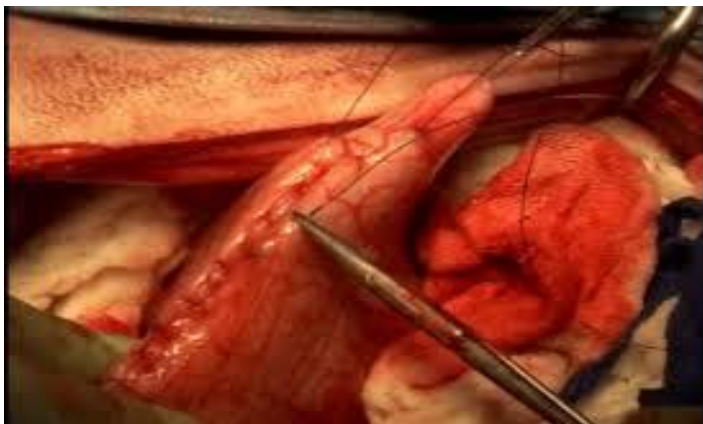
- ✿ Cranial midline incision behind xiphoid cartilage or left para-costal incision or parallel to left cranial midline.

#### **Control and Anesthesia**

- ✿ The animal is controlled in dorsal recumbency after proper premedication. The general anesthesia is induced by intravenous route.

## Surgical Technique

- ✿ An incision 8-10 cm long on cranial midline behind the xiphoid cartilage towards the umbilicus or an incision parallel to the left cranial midline is made
- ✿ The fat filled faciform ligament is excised after ligating the cranial deep epigastric vessels through ventral midline incision. It will facilitate visualization and closure of the cranial abdomen.
- ✿ The stomach is recognized and is exteriorized with the help of two fingers.
- ✿ Sterile gauze sponges or towels are applied around the stomach and the abdominal cavity is packed off to prevent contamination from stomach contents.
- ✿ Two stay sutures 4-5 cm apart going up to the submucosa or muscularis are placed on relatively less vascular area. Half way between greater and lesser curvatures of the stomach is comparatively less vascular.
- ✿ The stomach is incised between two stay sutures. After incising the stomach the gastric mucosa bulges out from the incision.
- ✿ The lumen is explored and foreign body, if any, is removed with the help of forceps. The instruments which have come in contact with contents or mucosa should be discarded.
- ✿ After removing the foreign body the gastric wound edges are wiped off with sterile gauze.
- ✿ The gastric incision is closed by double row of Lembert sutures or Cushing sutures using atraumatic needle and chromic catgut size 1-0.
- ✿ It is advisable to change the pair of gloves after suturing the stomach.
- ✿ The stomach after suturing is replaced in the abdomen. Gauze sponges or towels are removed and abdominal incision is closed in the usual manner.



**Figure 9:** Closing a gastrotomy by 2 layers

### ***Post-operative care***

- ✿ The animal should be kept on soft and liquid diet for three or four days and small volumes of food for 10 days.
- ✿ A course of antibiotic may be given.
- ✿ Fluid and other medications are administered, if needed.
- ✿ The skin sutures should be dressed on alternate days, if needed. The skin sutures are removed on 8<sup>th</sup> to 10<sup>th</sup> post-operative days or after the healing is complete.

### 3.9. Enterotomy in Dog

#### Indications:

- ✿ Intestinal foreign bodies
- ✿ Intestinal Intussusception
- ✿ Intestinal Volvulus
- ✿ Intestinal Torsion
- ✿ Intestinal Strangulation
- ✿ Intestinal Neoplasm
- ✿ Intestinal Gangrene
- ✿ Intestinal Perforating wounds

#### Surgical Anatomy:

- ✿ The intestinal wall is composed of serosa, muscularis, sub mucosa and mucosa. In which sub-mucosa is most dense and have more suture-holding capability.
- ✿ The small intestine of an average sized adult dog is about 4 meters long. It is clearly divided into a fixed and a mesenteric part. The fixed part, termed as duodenum, is the shortest portion, which starts at the pylorus and passes caudally and dorsally. Near the pelvis it turns medially and passes cranially along the medial side of left kidney, bends ventrally to join jejunum.
- ✿ The mesenteric part is arbitrarily divided into jejunum and ileum which are suspended by a double fold of peritoneum termed as mesentery. The jejunum, which is the longest part of small intestine, is composed of six to eight coils which take up the space between the stomach and liver on one side and the pelvic inlet on the other.
- ✿ The difference between jejunum and ileum is not discernible grossly although there are distinct differences in the mucosa of dog.
- ✿ The large intestine averages about 60-70 cms and composed of caecum, colon and rectum. In dogs caecum exist only as a blind end diverticulum of the proximal portion of colon.
- ✿ The colon is attached to the sub-lumbar region by mesentery 'the mesocolon'. The colon has three parts; ascending, transverse and descending part.
- ✿ The ascending part passes cranial along the medial surface of cranial part of duodenum until it reaches pyloric part of stomach, here it turns to the left and crosses the median plane forming transverse colon. The last part of the descending colon passes caudally along the medial border of the left kidney to join rectum.



- ✿ The nerve supplies to the intestines are from vagus and celiac plexus. The blood supplies are from the branches of celiac and anterior mesenteric arteries.

#### **Special instruments:**

- ✿ Crushing intestinal clamps
- ✿ Non-crushing (Such as doyen) intestinal clamps.

#### **Site of operation:**

- ✿ Midline, cranial to the umbilicus

#### **Control:**

- ✿ Dorsal recumbency for ventral midline incision
- ✿ Left lateral recumbency for right flank incision

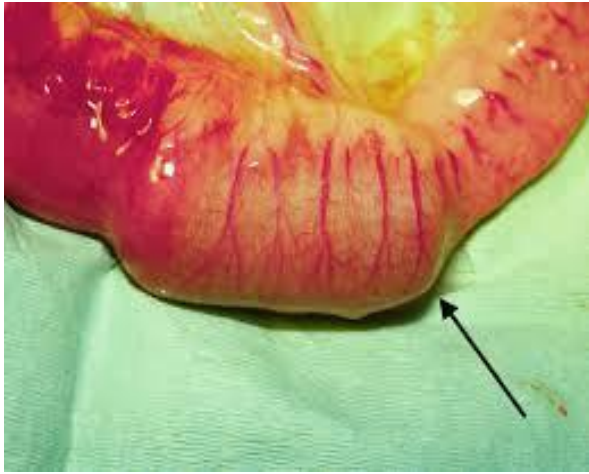
#### **Anesthesia:**

- ✿ Sedative with local anesthesia or General Anesthesia depending on the patient's behavior

#### **Surgical Procedure**

- ✿ Take 5-6 cm long incision on midline.
- ✿ Gently remove the intestinal loop containing foreign body.
- ✿ Pack the abdominal wound with sterile gauze.
- ✿ Milk out the intestinal content away from the foreign body (enterotomy site).
- ✿ Apply two intestinal forceps or assistant fingers, one at proximal and another at distal to the foreign body.
- ✿ Take an incision over one end of foreign body on healthy tissue on the antimesenteric side.
- ✿ Clean the intestinal content and remove foreign body with forceps.
- ✿ Clean again the intestinal wound and suture the intestine with continuous Cushing or Lembert suture or double row of Lembert sutures.
- ✿ Use chromic catgut size 3-0 or 4-0 and atraumatic needle for suturing.

- ✿ Remove abdominal packs and change the instruments.
- ✿ Close the abdomen with simple interrupted sutures using chromic catgut size 1-0.
- ✿ Suture subcutaneous and skin in routine manner.
- ✿ If intestine is necrosed at the site of obstruction perform end to end anastomosis.



**Figure 10:** Intestinal obstruction



**Figure 11:** Suturing of intestinal wall

**Source:** Bebhuck *et al.* (2019)

### Post-operative Care

- ✿ Give soft or liquid feed for 5 days.
- ✿ Administer parenteral antibiotic for 5 days after surgery.
- ✿ Remove the skin sutures after 8 to 10 days or after complete healing.

### **3.10. Ovariohysterectomy in Bitch**

#### **Indications:**

- ✿ Prevention of estrus and problem associated with bloody discharge, attraction of male dogs, accidental mating, pregnancy and unwanted puppies.
- ✿ Treatment of metritis, pyometra, endometrial hyperplasia (CPC), neoplasia, injury, neglected dystocia and congenital abnormalities.
- ✿ Hyperplasia and neoplasia of mammary gland.

#### **Age and Time:**

- ✿ Though operation can be done at almost any age and at any phase of reproductive cycle, it is best performed either before puberty or during anoestrus. Some prefer to wait until the animal has passed through one heat period.
- ✿ Six to eight months of age is generally considered best.
- ✿ The surgery may be most hazardous during estrus or pregnancy and in old obese female.
- ✿ Most favourable time to spay a mature bitch is 3 to 4 months after estrus. After whelping, the operation should be done about 6-8 weeks, as soon as the puppies have weaned and lactation has ceased.

#### **Surgical Anatomy :**

- ✿ Ovaries lie close to the caudal pole of the corresponding kidney, ventral to the 4th lumbar vertebra, and half way between last rib and the crest of the ilium. The ovary is completely enclosed by the bursa and is attached to cranial end of the uterine horn by ovarian ligament continuous with its suspensory ligament of ovary. Ovaries receive the blood supply through ovarian artery and vein. The uterus has a very short body and extremely long narrow horns. Broad ligament is attached to the anterior part of vagina.

#### **Surgical Site :**

- ✿ Ventral midline abdominal incision, beginning over the umbilicus and extending caudally for 6-8 cms.

### **Preparation, Control and Anaesthesia:**

- ✿ Food is withheld for at least 8-12 hours before the operation.
- ✿ The animal is controlled in dorsal recumbency. The operation table may be slightly tilted so as to allow the abdominal viscera to move forward.
- ✿ After proper premedication, the general anaesthesia is achieved by using parenteral or inhalant anaesthetic.
- ✿ After the animal has been anaesthetized, the ventral wall of the abdomen is prepared for surgery.

### **Surgical Technique:**

- ✿ A 6-8 cm long midline incision is made on the ventral aspect of the abdomen beginning over the umbilicus and extended caudally.
- ✿ Skin, Subcutaneous tissue, linea alba, falciform ligament and peritoneum are incised.
- ✿ An ovariectomy hook or index finger can be passed to locate the uterine horn by taking the urinary bladder as landmark. Uterus is withdrawn and followed to the ovary.
- ✿ No definite sequence is required for excising the ovaries and uterus, but it is convenient to remove the left ovary then right ovary and finally the body of uterus.
- ✿ The ovarian bursa is clamped across by artery forceps. The ovary is grasped between thumb and index finger and withdrawn for ligation.
- ✿ The suspensory ligament of the ovary is ruptured by traction and ovary is withdrawn from the abdomen.
- ✿ Application of three artery forceps facilitates the ligature procedure for ovarian pedicle. A double ligature with chromic catgut size 1-0 is used to ligate ovarian pedicle. The attachment between the ligature and the ovary is then severed. The severed stump should be checked carefully for haemorrhage before returning to the abdomen.
- ✿ After removing one ovary, the other ovary is located and removed in a similar manner. The broad ligament is then severed.
- ✿ The body of the uterus is withdrawn from the abdomen. The uterine vessels are ligated on each side and cut. Transfixation double ligature is used to encompass the entire cervix. The uterus is severed just cranial to the ligatures.
- ✿ Uterine stump is checked carefully for haemorrhage and returned into the abdomen. Care should be taken to remove as much uterine body as possible.
- ✿ Abdominal incision is closed in the usual manner.



**Figure 12:** Ovariohysterectomy in small animals

**Source:** Fossum (1997)

**Post Operative Care :**

- ✿ The operative site should be checked for swelling or discharge.
- ✿ Operative incision should be dressed with betadine.
- ✿ The patient should receive antibiotics and analgesics for seven and three days respectively.
- ✿ Exercise should be restricted for 10-12 days.
- ✿ Liquid diet should be given for the first 3-6 days and the patient should be observed for proper urination and defecation.
- ✿ Cutaneous sutures should be removed after 8-10 days of operation or after complete healing.

### 3.11. Cesarean Section in Cow

#### Indications

##### ⚙ Maternal reasons

- ✓ Uterine torsion
- ✓ Inadequate cervical dilation
- ✓ Uterine inertia
- ✓ Uterine rupture
- ✓ Prepubic tendon ruptures
- ✓ Hydrops amnion /Allantiois
- ✓ Vaginal constriction-congenital /Trauma induced
- ✓ Feto-pelvic disproportion (FPD) which may be due to;
  - Fetal over size
  - Pelvic fractures
  - Immature heifers
  - Abnormal pelvic conformation.

##### ⚙ Fetal reasons

- ✓ Fetal oversize
- ✓ Fetal monsters
- ✓ Fetal malposition
- ✓ Emphysematous fetus.

#### Control

- ⚙ Operation is performed in properly restrained cow
  - ◆ In standing position
- ⚙ This is most convenient and relatively complication free
  - ◆ In recumbent position
- ⚙ If surgery is prolonged, there will be development of ruminal tympany and abdominal pressure and regurgitation of ruminal content, which may cause respiratory trouble.

#### Anesthesia

- ⚙ Linear infiltration- Standing procedures
- ⚙ Inverted 'L' block - Standing procedures
- ⚙ Paravertebral block - Standing procedures

## Surgical technique

### 1. Standing paralumbar fossa coeliotomy

- ✿ The abdominal cavity can be approached via a standing paralumbar fossa coeliotomy on the right or left side of the abdomen.
  - ◆ **The rule of thumb**
    - ➡ The rule of thumb is the rumen is easier to manipulate than the rest of the intestinal tract. In most instances it is easier to deal with the rumen on the left side of the abdomen than manipulating around the intestinal segments of the right side.
    - ➡ The incision should be made in the caudal third of the fossa to facilitate exteriorization of the uterus. The coeliotomy should be large enough so that delivery of the fetus is more easily accomplished.
    - ➡ If the right side is elected, the incision should not extend too far ventrally so that there will be no problem with intestines prolapsing out of the surgical incision.
- ✿ A sharp skin incision 30-40 cm long is made in the skin starting 10 cm below the lumbar transverse process and continued through the subcutaneous tissue as well as the internal and external abdominal oblique muscles.
- ✿ The peritoneum and transverses abdominus are tented with forceps and incised with scissors. A finger should be inserted into the abdomen, and the peritoneum should be “swept” for any adhesions before the incision is extended.
- ✿ Note:
  - 📌 The right flank approach
    - ✓ Very useful when torsion of uterus is present. It helps correction of torsion in standing position.
    - ✓ But it is very difficult to bring the uterus at the site of incision.
    - ✓ Abdominal contamination with uterine content is more likely when uterus itself is infected due to various conditions like dead and infected fetus in the uterus.
    - ✓ A large part of the intestine may be expelled through the site of incision and it makes very difficult to reset the intestine in the abdominal cavity.
  - 📌 The left flank approach
    - ✓ A large full rumen stands in the way to bring the uterus from the right side of the abdominal cavity to the left.
    - ✓ Advantageous in that small intestine does not get chance to come out through the site of incision as rumen blocks the passage.

## 2. Ventral midline coeliotomy

📌 Restrain and position the animal in dorsal recumbency

- Cattle restrained in this position suffer from cardiovascular and respiratory compromise. Therefore, it is ideal to complete surgery as quickly as possible.

⚙️ A 40 cm skin incision is made starting at the udder and extended toward the xiphoid.

⚙️ The subcutaneous tissues and linea alba are sharply incised.

⚙️ The peritoneum is tented and incised with scissors.

⚙️ Rotate the cow to one side so that the uterus delivers more easily.

⚙️ **Note:**

### ☛ Advantage

- Very useful for beef cattle or fractious range cattle that may not tolerate a standing flank laparotomy
- Helps for easy manipulation of uterine horn with less risk of contaminating the abdomen. This is a great advantage when uterus is infected.

### ☛ Disadvantage

- In this abdominal area, the abdominal wall is comparatively less thick and it is composed largely of fibrous tissue tunics and herniation after operation is more common.
- Restraint and positioning of adult cattle in dorsal recumbency for a ventral midline approach can be labor intensive.

## 3. Paramedian coeliotomy

⚙️ This also requires restraint in dorsal recumbency.

⚙️ It is a multiple layer incision in the caudal abdomen, which may result in more hemorrhage and a poor holding layer for closure.

⚙️ **Disadvantage:**

- In dairy there is large amount of ventral vasculature and udder that may be in the way.
  - ✓ To avoid incising a major vessel, it is advisable to trace the vasculature with a marker while the cow is standing and the vessels are distended with blood. A major transverse vein often runs across the abdomen just cranial to the udder and may be inadvertently incised if the incision is made too caudally.
  - ✓ Restraint and positioning of adult cattle in dorsal recumbency can be labor intensive.



✿ **Advantage:**

- ✓ This procedure offers very few advantages and is rarely recommended.

**4. Ventrolateral coeliotomy:**

- ✿ The cow is restrained in lateral recumbency and the upper hind leg is elevated and secured.
- ✿ The skin incision is made parallel to the superficial mammary vein.
  - Tracing the vein or marking it with an indelible pen marker before the animal is cast will prevent inadvertent incision of the vessel because it is no longer prominently distended with blood after casting.
- ✿ Sharp incision is continued through the subcutaneous tissues and abdominal oblique muscles, which are mostly aponeurotic at this level.
- ✿ The transverse abdominis muscle and peritoneum are tented and incised in the same direction as the incision.
- ✿ **Advantage:**
  - ➡ It allows excellent exteriorization of the uterus and it is good for a cow with an emphysematous fetus.
- ✿ **Disadvantage:**
  - ➡ Since the incision is long, closure requires multiple layers and restraining the animal is difficult, it is time consuming.
  - ➡ Furthermore, the surgery must be performed by the surgeon kneeling beside the cow so the incision is close to the ground, increasing chances of postoperative wound infection.

**5. Left oblique coeliotomy**

- ✿ A left oblique coeliotomy was described for a standing cesarean section.
- ✿ The skin incision begins 8 to 10 cm cranial and 8-10 cm ventral to the cranial most aspect of the tuber coxae and extends cranioventrally at a 45° angle to end 3 cm caudal to the last rib.
- ✿ Subcutaneous tissues and the external abdominal oblique muscle are sharply incised.
- ✿ The internal oblique and transverse abdominal muscles are opened along the direction of their fibers, and the peritoneum is tented and incised.
- ✿ **Advantage:**
  - Better exteriorization of the gravid uterus than in a paralumbar fossa coeliotomy.
  - Muscles in this region are stretched easily and contamination of abdominal cavity by uterine fluid is very less.
- ✿ **Disadvantage:**
  - Control of small intestine in site is very difficult on the right side approach.



**Figure 13:** Surgical site preparation for CS



**Figure 14:** Administration of Inverted L anesthesia for CS



**Figure 15:** Left oblique coeliotomy for CS



**Figure 16:** Delivery of the calf

**Source: Tilahun Bekele (Dr.)**

### **Delivering the Calf**

- ✿ Once entry into the abdomen is accomplished by coeliotomy, the position and condition of the calf should be determined.
- ✿ Then the surgeon should attempt to manipulate a limb of the calf with intact uterus to the incision and the uterus is exteriorized
- ✿ Now hysterotomy is made outside the abdomen between the cotyledons without injuring them. If the uterus could not be exteriorized it may be incised inside the abdomen but, the incised uterine

edges should be lifted after delivery to avoid contamination of the peritoneum with the uterine contents

- ✿ After the removal of calf with outside assistance, the placental detachment if complete, it is best removed at surgery itself. If the placenta is not detached, it is replaced into the uterus and broad spectrum antibiotic pessaries are placed in the uterus
- ✿ Now check for another calf in the uterus and also for any uterine tear
- ✿ The surgeon's preference dictates the manner in which the uterus is closed. A popular choice is double row of inversion -- Cushing followed by Lembert, using catgut No 2 chromic, after cleaning the uterine wound edges with sterile saline
- ✿ If the indication of C.S is for uterine torsion, after closure of the uterus, it must be reduced back to the original position and confirmed by an assistant introducing a hand through vagina
- ✿ Injection of oxytocin 50-60 units, parenterally or into the wall of healthy uterus hastens involution
- ✿ The muscle layers and the peritoneum are closed by lock stitch followed by simple continuous or continuous lock stitch using No. 2 or 3 chromic catgut
- ✿ The skin incision closed by horizontal mattress or cross mattress or simple interrupted pattern.
- ✿ Post operatively or during the operation saline solution given, to take care of shock and hypoglycemia.

#### **Post-operative care in caesarean section**

- ✿ Parenteral broad spectrum antibiotics given for 5 days
- ✿ The skin sutures removed on the 8<sup>th</sup> or 10<sup>th</sup> post-operative day.
- ✿ Oxytocin to encourage uterine involution 20 IU QID until membranes are passed out or 24 hours
- ✿ The cow monitored for the expulsion of placenta intact
- ✿ Analgesics and antibiotics continued for 3 to 7 days
- ✿ Exercise and udder care and appropriate wound care are important

### **3.12. Amputation of Tail**

#### **Indications:**

- ✿ Tail gangrene
- ✿ Complicated fractures of coccygeal vertebra
- ✿ Malignant tumors of the tail
- ✿ Irreparable injury to the tail.

#### **Surgical anatomy:**

- ✿ The skeletal framework of tail is made up of coccygeal vertebrae of which number varies with species to species.
- ✿ The paired muscles of the tail are enclosed in the strong coccygeal fascia, which is loosely attached at the root of the tail.
- ✿ Sacro-coccygeal dorsalis muscles lie on either side of the dorso-median aspect of the tail.
- ✿ Sacro-coccygeus lateralis muscles lie immediately lateral to dorsalis.
- ✿ Sacro-coccygeus ventralis lies on the ventral aspect of the sacrum and coccy.
- ✿ Inter transversalis caudae consists of muscles bundles and lies on the lateral aspect of the tail between sacro-coccygeus lateralis & ventralis.
- ✿ The blood supply to the tail is through the middle and lateral coccygeal arteries and nerve supply by coccygeal nerves.

#### **Site of Operation**

- ✿ Above the injury or seat of infection at the intervertebral articulation.

#### **Control & Anesthesia:**

- ✿ Large animal is controlled in standing or in recumbent position & small animal on the operation table in recumbent position.
- ✿ Anaesthesia is achieved by infiltrating local anaesthetic solution subcutaneously encircling the tail above the site of operation or by posterior epidural anesthesia.
- ✿ In uncontrollable animal sedative as tranquilizers may be required.

#### **Surgical Technique:**

- ✿ Tourniquet should be applied on the base of the tail.

- ✿ Two 'V' shaped flaps one on dorsal and the other on ventral side are made at the site of operation after palpating the articulation.
- ✿ Prominent vessels at the lateral and ventral aspect are identified and ligated proximal and distal to the proposed site of amputation.
- ✿ Intervertebral space is located by blunt dissection and the joint is disarticulated with the help of BP blade. The distal portion of the tail is then removed.
- ✿ Skin flaps are united by simple interrupted or interrupted mattress sutures.



**Figure 17:** “V” Surgical incision on the tail



**Figure 18:** Suturing of amputated tail

**Source:** Katica *et al.* (2018)

#### **Post-Operative Care:**

- ✿ Sutures are removed 7-8 days after surgery or after complete healing
- ✿ Daily antiseptic dressing is to be done.

### **3.13. Extripation of Anal Sac in Dog (Anal Sacculectomy)**

#### **Indications:**

- ✿ Recurrent episodes of anal sac impaction
- ✿ Ineffective medical therapy in recurrent anal sac infection
- ✿ Anal sac abscessation with or without fistulous tract
- ✿ Anal sac gland adeno-carcinoma.

#### **Site of Operation:**

- ✿ Linear incision (about 2cm long) lateral to the anal orifice.

#### **Control:**

- ✿ Ventral recumbency with hind parts raised

#### **Anesthesia:**

- ✿ General anaesthesia
- ✿ Linear infiltration along with tranquilizers
- ✿ Epidural analgesia

#### **Surgical Procedure:**

- ✿ The anus is packed off with sterile gauge to minimize the contamination at the site.
- ✿ The duct opening of one of the anal sacs is identified just under the anal orifice and a mosquito haemostate is pushed into the sac.
- ✿ The incision is made on the hairless skins of the perineal region over this distended area bounded by the haemostate in the sac.
- ✿ The sac is now grasped with forceps and is dissected sharply as well as bluntly by the curved metzembaum scissors from the surrounding tissue.
- ✿ The neck of the sac should be carefully dissected so that external sphincter muscle is not damaged.
- ✿ The duct is identified, isolated, ligated and transected.
- ✿ The subcutaneous tissue and the skin are sutured in the routine manner.
- ✿ The other anal sac is now removed in the same manner.





**Figure 19:** Infection of Anal sac



**Figure 20:** Extirpation of anal sac

**Source:** Hnilica and Patterson (2017)

**Post Operative Care:**

- ✿ Routine antibiotic therapy
- ✿ Prevention of self-mutilation by applying Elizabethan collar
- ✿ Stool softness and soft diet for at least 10days.

### 3.14. Urethrotomy in Bovines

#### Indications

- ✿ Urethral calculi
- ✿ Urethral necrosis
- ✿ Repair of ruptured urethra

#### Surgical Anatomy:

- ✿ The urethra of an adult bullock/bull is over a meter long and about one quarter of its length is taken up for the formation of 'S' shaped sigmoid flexure which present caudally and dorsally to the scrotum.
- ✿ The urethra is made of two parts, the pelvic and extra pelvic part.
- ✿ The pelvic part is about 10-12 cms long and is of small uniform caliber. The urethral lumen is kinked and narrow at the ischial arch.
- ✿ At the ischial arch the urethra passes between the bulbourethral glands, which open into the urethra under a fold of mucous membrane, and forms a blind pouch of about 1 cm deep on the dorsal wall of urethra. The extra pelvic part of urethra passes between the two crura of penis and runs along the groove on the ventral surface.
- ✿ It passes through the glans penis at the end and opens via external urethral orifice. The lumen of the extra pelvic part of urethra decreases gradually towards the external urethral orifice.
- ✿ The nerve supply to the various muscles of the penis is through the dorsal nerve of penis. This nerve is a branch of pudendal nerve, which arises from ventral branch of third sacral nerve mainly.
- ✿ The blood supply comes from the branches of internal pubic artery.

#### Site of Operation:

- ✿ **Post scrotal site:** About 3 inches behind the scrotum along the median line. This is used for removal of calculi at the sigmoid flexure.
- ✿ **Sub ischial site:** About 7-8 inches behind the scrotum along the median line. It is used for removal of calculi lodged in sub-ischial area.
- ✿ **Ischial site:** Incision is given on the midline just below sphincter ani and extended ventrally for obstruction at the neck of the bladder. It is used to remove calculi closed to ischial arch.

#### Control:

- ✿ For post scrotal and sub ischial site: Right lateral recumbency with left hind limb tied anteriorly.



- ✿ For ischial site: Standing position with tail tied towards one side.

#### **Anaesthetic Technique:**

- ✿ Linear infiltration of local analgesia
- ✿ Epidural anesthesia

#### **Surgical technique**

- ✿ An incision about 8-10cm long is made through the skin and sub cutis exactly on mid line in post-scrotal region.
- ✿ The areolar tissues are dissected to reveal penis. The tunic is separated and held retracted to expose the body of the penis.
- ✿ The penis is exteriorized by putting curved artery forcep below it.
- ✿ Palpate the urethra on the ventral aspect and incise it longitudinally along the exact midline following the location of calculi, if present.
- ✿ Remove the calculi and pass the appropriate size catheter towards bladder as well as penis.
- ✿ Suture the mucus membrane and muscles of urethra by continuous or interrupted suture, respectively, in two layers using atraumatic needle and chromic catgut size 2-0.
- ✿ Anchor the catheter with the skin of prepuce with non-absorbable suture material.
- ✿ The skin is sutured using interrupted sutures with non –absorbable suture material.
- ✿ If it is desired to keep the urethral opening patent (urethral fistulation), suture the urethral wound with corresponding edges of skin with non-absorbable suture material.

#### **Post –operative care**

- ✿ Apply sterile Vaseline all around the urethral orifice to protect the wound from excoriation due to dribbling or passing of urine.
- ✿ Dress the wound daily with non –irritant antiseptics and a course of antibiotic is given for 5 days parenterally.
- ✿ Catheter is removed after sutures are removed.

### **3.15. Penile Amputation in Cattle**

#### **Indications:**

- ✿ Irreparable injury to the penis
- ✿ Neoplasm
- ✿ Paralysis of penis
- ✿ Necrosis and severe adhesion

#### **Site of operation**

- ✿ Base of scrotum
  - ✓ Exteriorization of the penis is easier as the penis is more superficial at this site
  - ✓ After creating a fistula, urine soiling of the hind quarter is less likely

#### **Anesthesia and control**

- ✿ Dorsal or dorsolateral recumbency
- ✿ Local infiltration or high epidural analgesia

#### **Surgical Procedure**

- ✿ A 10-12 cm vertical incision is made over the median raphe starting at a point 15 cm dorsal to the scrotum (where the sigmoid flexure can be palpated) and ending at the dorsal limit of scrotum.
- ✿ Subcutaneous tissue is incised, bluntly dissected until the penis is grasped
- ✿ Exteriorization of the penis (by gentle traction) through the skin incision, the retractor penis muscle is then severed.
- ✿ The dorsal artery of the penis proximal to the point of amputation is ligated (include the vein).
- ✿ The penis is amputated (transected) 5-10 cm distal to the upper apex of the skin incision (1.2-2 cm in small ruminants) to leave a stump protruding from the dorsal commissure of skin incision.
- ✿ The urethra is identified and opened for a distance of 5 cm using scissors /groove director. Avoid cutting of the underlying vasculature layers (corpus cavernosus/ spongiosus muscles).
- ✿ The stump of the penis directed caudo-ventral to project it slightly from the skin incision to which it is anchored with a suture which passes through the tunica albuginea and corpus cavernosus.

- ✿ The stump should be of sufficient length to avoid enfolding of skin due to excessive tension and to reduce scalding of urine in to internal tissues/ medial aspect of the thigh.
- ✿ The incised edge of the urethra is apposed to the edge of skin incisions on each side.
- ✿ Incase of urethral rupture, drainage of urine from ventral abdominal floor by multiple small skin and underlying fascia incisions.



**Figure 21:** Infiltration of the Scrotal, Ventral Abdominal and Preputal Regions with Urine in a Case of Ruptured Urethra in a Calf

**Source:** Simpson and Streeter (2019).



**Figure 22:** Urination after penile amputation

### Postoperative care

- ✿ Antimicrobial therapy 5-7 days in case of urethral rupture.
- ✿ Application of sterile Vaseline to the skin ventral to the incision and on the medial surface of hind limbs to limit urine scald.
- ✿ Application of fly repellent.
- ✿ Suture removal 2 weeks after surgery.

### **3.16. Horse Castration (Gelding)**

#### **Indications**

- ✿ To render the animal docile.
- ✿ Malignant diseases or any irreparable injury of the gland.
- ✿ Enlarged prostate.
- ✿ Operation for scrotal hernia

#### **Surgical Anatomy:**

- ✿ The testes are contained into two distinct sacs inside the scrotum. These sacs are attached together by scrotal septum also known as mediastinum testes. The wall of the scrotum is composed of skin, tunica dartos, spermatic fascia and Tunica vaginalis parietalis.
- ✿ The tunica vaginalis is the peritoneal invagination that envelops the spermatic cord, the testes and the epididymis.
- ✿ The epididymis is attached to the dorsal lateral aspect of two testes, the head of epididymis pointing interiorly. The tail of epididymis is continuing to ductus deferens which is contained in spermatic cord.
- ✿ The spermatic cord infact has two distinct bundles namely anterior vascular bundle and posterior avascular bundle which contain the testicular artery, testicular vein (which joins the pampiniform plexus), testicular plexuses of autonomic nerves, lymphatic vessels and the ductus deferens respectively.
- ✿ The ductus deferens passes through the vaginal ring and within the abdominal cavity it terminates at the prostate gland by looping caudally and medially around each ureter.
- ✿ The nerve supply to testes is through the spermatic nerves, which are derived from the renal and mesenteric plexus. The branches of second and third lumbar spinal nerves supply the scrotum.
- ✿ The blood supply is by spermatic vessels to the testes and branches of external pudic vessels to the scrotum.

#### **Site:**

- ◆ Parallel to the median raphe on the scrotum or
- ◆ Circular incision on the tip of scrotum.

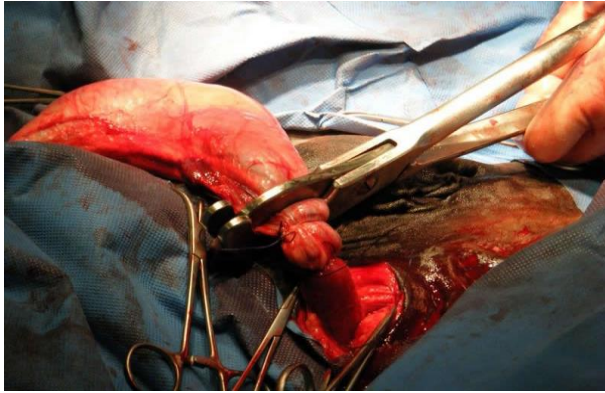
#### **Control and anesthesia**

- ✿ The horse should be in lateral recumbence.

- ✿ Upper hind limb forward to the shoulder region so that scrotum is well exposed.
- ✿ Chloral hydrate /xylazine/any other sedative or tranquilizer along with local anaesthetic on scrotal incision line followed by infiltration in the spermatic cord or give general anaesthesia with propofol.

### **Surgical Technique**

- ✿ Castration is performed through separate incisions for each testis, with incisions located 1cm from the median raphe.
- ✿ First the lower testis is grasped between thumb and forefingers
- ✿ Skin incision made for the length of the testis through the tunica dartos and scrotal fascia leaving the common vaginal tunic
- ✿ Pressure is exerted by the fingers, to extrude the testis with the common tunic
- ✿ Incise the common tunic over the cranial pole of the testis
- ✿ Continue the incision proximally, while hooking the tunic with finger to maintain tension and now the testis is released from the common tunic.
- ✿ Grasp the testis and strip off the s/c tissues from the common tunic as far proximally as possible using a sterile gauze sponge
- ✿ Penetrate the mesorchium digitally to separate the spermatic cord from the ductus deferens, common tunic and external cremaster muscle
- ✿ The musculofibrous portion of the spermatic cord (less vascular structures) are severed after ligation conveniently with the emasculators and the "crush" need only be applied for a short period of time
- ✿ The vascular bundle of the spermatic cord is ligated (Double ligation if needed) using chromic catgut No. 1 or 2 at the highest point accessible and emasculated distal to the ligatures to remove the testis.
- ✿ Keep the emasculator in the crushed position for 1 or 2 minutes depending on the size of the cord and then release carefully to avoid secondary hemorrhage. The other testicle also removed in a similar manner
- ✿ Apply sterile surgical gauze to facilitate drainage of serous fluids.



**Figure 23:** Surgical excision of testicle by emasculator

**Source:** Alamy pictures



**Figure 24:** Scrotal wound after removal of testicle

### **Postoperative Management**

- ✿ Following castration, horses should receive a tetanus toxoid booster (if vaccinations are current) or both tetanus toxoid and a tetanus antitoxin injection if the horse has never been vaccinated.
- ✿ Antibiotic coverage
- ✿ The horse should be confined and kept under close observation for the first 24 hours after surgery for hemorrhage, and then daily inspected for a week
- ✿ Uneventful healing is the usual result with good drainage and satisfactory exercise
- ✿ The horse should be forcibly exercised twice daily from the 2<sup>nd</sup> day, until healing
- ✿ It should be separated from the mares for a week.

### **3.17. Castration in Bull**

#### **Indications**

- ✿ Enlarged prostate
- ✿ To improve the meat quality
- ✿ Prevention of breeding nuisance
- ✿ To render the males more manageable (docile)

#### **Control and Anesthesia**

- ✿ No analgesic is used.
- ✿ Animal is controlled in recumbent position.

#### **Surgical Technique**

- ✿ The spermatic cord of each side is held outward against the scrotal skin and is crushed with Burdizzo castrator in such a way that the crush marks on either side do not coincide. Crush the cord without crushing the testicle. Then the testicle is pushed upward after removing the Burdizzo to prevent adhesion at the points crushed. Similarly the spermatic cord of other side is crushed. Apply Tincture of iodine on crushed area.

#### **Complication:-**

- ✿ If testicle is crushed, inflammatory swelling with infection (pus) occurs. If both crush marks coincide (In one line) then entire scrotum may slough off.

### 3.18. Castration in Dog

#### Indications

- ✿ Prevention of breeding of bitches
- ✿ Neoplastic growths or crushing injuries affecting the testicle.
- ✿ Enlarged prostate.
- ✿ Perineal hernia.
- ✿ To make animal more docile and domesticated.
- ✿ Control of stray dog population and ultimately rabies.

#### Control and Anesthesia

- ✿ General Anesthesia is used (Ketamine + xylazine combination)

#### Site:

There are three sites.

1. **Pre - scrotal site:** Midline in front of the scrotum.
2. Longitudinal incision on the ventral aspect of the scrotum, lateral and parallel to the median raphe on either side.
3. Longitudinal incision parallel to the median raphae on one side to remove that testicle and a second (through the same) on the mediastinum to remove the other testicle.

#### Surgical Technique

- ✿ **Prescrotal site:** One testis is pushed forward and brought under the skin, over the ventral aspect of sheath. An incision is taken over midline and testis is removed by pressing between thumb and forefinger. The cord is ligated and severed to remove the testis. Other testis is then removed through the same incision and skin wound is closed.
- ✿ Each testis is tensed against the skin of the scrotum and an incision is made antero-posteriorly parallel to the median raphe, cutting through the skin, dartos and Tunica vaginalis. The testicle slips out through the wound. The spermatic cord is then separated into the anterior vascular bundle and the posterior bundle containing the vas deferens. The posterior bundle is divided by scissors and a self-ligation portion of spermatic cord is done with vascular bundle. The vascular bundle is then divided to remove the testis. The skin wound is left open for drainage and is allowed to heal as open wound.
- ✿ After removal of one testis as in technique II, the other testicle is extracted through the same opening by making an incision through the median septum of the scrotum.

#### Post –operative care:

- ✿ Daily dressing of wound with antiseptic cream
- ✿ Parenteral antibiotic injection for 3-5 days.



- ### 3.19. Cat Castration - Surgical Technique

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- An anatomical illustration of the male reproductive system, showing the testis, epididymis, and associated structures. Labels with arrows point to the Pampiniform Plexus, Ductus Deferens, and Vaginal Tunic. A copyright notice for Dr. B. B. B. B. is visible in the bottom left corner.



**Source:** Fossum (1997)

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**ANNEX I: PRE, INTRA AND POSTOPERATIVE FOLLOW UP RECORDING FORMAT****Anaesthetic and Intra-Operative observations**

Group		Date		Name of Surgical Procedure			
Surgeon				Instrument Assistant			
Assistant Surgeon				Helper			
Animal	Sex	Wt.	Physical Status	PCV	Hb	TLC	DLC
Preanesthetics/ Other drugs				Anesthetic drugs			
Drugs	Dose	Route	Time	Drug	Dose	Route	Time

**Record of different Parameters**

Parameters	Before medication	After induction of anesthesia			
		5 min.	10 min.	20 min.	End
Temperature					
HR/min.					
RR/min.					
MM color					
Pulse Quality					
CRT					

Procedure start time:	Anesthesia induction time:
Procedure end time:	Anesthesia recovery time:
Total time of Procedure:	Total time of anesthesia:

**Any special intra-operative observation:****Remarks of instructor:****Signature:****Post operative observations**

Day 1		Treatment	Instructor
Appetite			
Temp.			
HR			
RR			
Exudate			
Incision Site			
Any other			
Day 2		Treatment	Instructor
Appetite			
Temp.			
HR			
RR			
Exudate			
Incision Site			
Any other			
Day 3		Treatment	Instructor
Appetite			
Temp.			
HR			
RR			
Exudate			
Incision Site			
Any other			
Day 4		Treatment	Instructor
Appetite			
Temp.			
HR			
RR			
Exudate			
Incision Site			
Any other			
Day 5		Treatment	Instructor

Appetite			
Temp.			
HR			
RR			
Exudate			
Incision Site			
Any other			

## ANNEX 2: SUMMARY OF COMMONLY USED ANESTHETICS AND THEIR DOSE

### Preanesthetics

Drug	Dose	Route of Administration	Note
Atropine	0.04mg/kg	IM/IV	Anticholinergics
Acepromazine Maleate	Dogs: 0.03-0.05mg/kg, Cats: 0.03-0.05mg/kg	IV or IM	Tranquilizers
Diazepam	0.1-0.5 mg/kg	IV	Tranquilizers
Xylazine	1.1mg/kg	IV/IM	Alpha-2-agonists/ Sedative
Morphine	0.2 – 0.5 mg/kg ( total dose not exceeding 10 mg )	I.M/I.V	Opioids (For cats it must be administered with caution because it may induce CNS stimulation)

### General Anesthetic Agents

Drug	Dose	Route of Administration	Note
Thiopentone sodium	20-30 mg/kg	IV	
Propofol	4-6 mg/kg	IV	
Ketamine hydrochloride	10 mg/kg	IM	

### Emergency Drugs

Drug	Concentration	Dose	Route of Administration
Atropine	0.54mg/ml	0.04mg/kg	IV
Epinephrine	1:1000 (1mg/ml)	0.01mg/kg	IV
Hetastarch		Dogs: 10-20ml/kg/day	IV
		Cats: 2-10 ml/kg/day	

### Reversal Drugs

Drug	Concentration	Dose	Route of	Note
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			<b>Administration</b>	
Yohimbine	2 mg/ml	0.1 mg/kg	IV, SC or IM	Cats who have received xylazine will generally be given 0.1ml IM immediately post Op.
Naloxone	0.4 mg/ml	0.02-0.04mg/kg	IV, SC or IM	
Atipamezole	5 mg/ml	0.1-0.4 mg/kg	IV/IM	Dose will usually be same Volume as Dexamedetomidine dose