TVET CERTIFICATE V in ANIMAL HEALTH

NECROPSY

ANHPN501

Perform Necropsy

Competence

Credits: 8

Learning hours: 80

Sector: AGRICULTURE AND FOOD PROCESSING

Sub-sector: ANIMAL HEALTH

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Purpose statement

This module describes the skills and knowledge required to perform Necropsy.

By the end of this module the participant will be able to:

- Identify necropsy equipment and tools
- Perform pre-necropsy evaluation
- Perform necropsy evaluation

Table of Contents

	mucous membranes	
	3.4 Appropriate positioning of the body according to animal species	
	3.5 Systematic carcass opening following different layers and internal organs	
	3.6 Proper examination of body cavities, viscera, red muscles, bones, joints and head by inspection, palpation, and incision	
	3.7 Proper sample collection according to the nature of sample and exams to be performed	
	3.8 Proper submission of sample according to the nature of sample and exams to be performed	
	3.9 Correct interpretation of necropsy findings	

LU & PC is linked in LO inside the content

Total Number of Pages: 62

GENERAL INTRODUCTION

Necropsy is the post-mortem evaluation of an animal. A thorough examination of a dead body involves the dissection and study of all the body systems. The term used in human medicine for the same procedure is autopsy. We often use the term autopsy with clients when we really mean necropsy, because autopsy is a familiar term to most people and does not require much explanation.

The purpose of necropsy is usually to determine a cause of death. However, in research studies necropsy is also used for data collection. Also, when there are large populations of animals to manage, an animal or animals may be chosen for necropsy procedure as a means to monitor the incidence or cause of disease within the group from which they came. This sacrificial procedure is a technique used in disease surveillance for research such as lab animal colonies, or commercial operations such as that for the poultry industry.

Reasons to necropsy an animal:

- Identification of disease.
- Indicate appropriate treatment of disease in a herd.
- Limit future losses.

- Improve understanding of disease effects on your animals.
- Enhance discussion of health maintenance programs with animal health specialists.

Necropsy is an important diagnostic technique that is often performed by veterinarians. Usually the role of the veterinary technician is to sterilize and set up instruments, assist in the necropsy procedure, record findings, and to process specimens. However, in some venues, the veterinary technician is responsible for actually performing the necropsy, or at least initiating the dissection. In order to be proficient at necropsy, you must be familiar with normal anatomy and use a standard technique in which the body systems are examined in a sequence so that nothing is overlooked. There is no absolute right or wrong way, just as long as it is standardized, methodical, and systematic. There are many techniques and order of operations used so that the necropsy technique will vary depending upon the prosector's training and preferences as well as the type of subject species. The body is evaluated by gross examination and microscopic examination.

This module is designed to acquire trainers and trainees the knowledge and technics to effectively perform necropsy on different domestic and wildlife animals. It contains three learning units that are complementary each other.

Learning Unit 1 –: Identify necropsy equipment and tools

LO 1.1 – Select Protective equipment

- Topic-1: Personal protective equipment (PPE) considerations

The phrase - personal protective equipment (PPE) refers to special clothing and equipment that places a barrier between an individual and a hazard.

Personal protective equipment serves two purposes in an animal health emergency:

- The protection of the responder against potentially harmful hazards, e.g., highly pathogenic avian influenza and;
- With appropriate use and decontamination/disposal, the prevention of the spread of hazards, e.g., foot-and mouth disease, between animals or locations.

Personal protective equipment (PPE) is intended to form a barrier between the person and the infectious agent. It may include:

- rubber boots

- splash-proof overalls (long sleeves with a hood) or cotton or disposable overalls with impervious or splash-proof apron
- disposable impermeable gloves (nitrile gloves recommended), double-gloved
- face shield or safety eyewear (to protect against facial splashing)
- a particulate respirator.

The PPE must be maintained, repaired or replaced so that it continues to minimise risk. This includes ensuring that it's clean and hygienic, and in good working order. You should also ensure, as far as is reasonably practical, that the PPE is used or worn by the worker or any other person at the workplace.

Using PPE

Always have adequate PPE available at all places where animals are examined. PPE supplies for repeat visits and for those assisting should be available.

Always remove PPE carefully to avoid contamination and perform hand hygiene during and after removing PPE. Decontaminate reusable PPE after use and don't reuse disposable PPE

- Topic 2: Environmental protective equipment (EPE)

Environmental Protection Equipment refers to equipment specialized on environmental pollution control including water pollution control equipment, air pollution control equipment, solid waste handling equipment and noise control equipment.

Examples: bone dust collector, cleaning disinfecting, fluid collector, storage container.

Importance of EPE

The importance of environmental protective equipment is:

- Remove Potential workplace hazards.
- Effective use of controls for reducing workplace exposures.
- Preventing needle stick, scalpel, and sharps injury for animals and personal.
- Emergency and evacuation procedures.

L O 1.2: Select cutting instruments

- Topic 1: Description of cutting instruments

The equipment used to perform the necropsy should be kept to a minimum, and be kept in clear view at all times. The basic necropsy instruments include necropsy knives (including sharpening stone or steel),

scalpel handles and disposable blades or disposable scalpels, scissors (small and large), and tissue forceps (several sizes, toothed forceps).

The dissection instruments should always be sharp to reduce operator fatigue and to minimize the damage of the specimens that may be collected. One should always keep in mind that “a dull knife is a dangerous knife”. There are some instruments specifically used at the necropsy exam to cut hard tissues and bone: boning knife, small and large shears, chisel and mallet, axe or hatchet, a handsaw, or an electric saw. The equipment required for necropsy depends on the size of the animal, but is not extensive.

A. Necropsy supplies

A.1. Necropsy cutting supplies

Necropsy cutting instruments are the following:

- Gloves
- Boots
- Coveralls
- Protective glasses
- Boning knife - 6"
- Steel - for sharpening
- Scissors
- Forceps
- Pruning shears (rib cutters or an Ax)
- Wire cutters

A.2. Sharpening cutting equipment

These sharpening cutting equipment vary according to the type of animal for which you are required to do necropsy. Among others, we can list: sharp knife and sharpening equip (steel/stone) tissue forceps and scissors, saw, cleaver, osteotome, shears,..

L.O 1.3: Select sampling equipment and tools

The need for application of different methodologies to disease diagnosis, genetic problems, and research requires some knowledge on different forms of collection and preservation tissue samples during necropsy, which will be dependent on the observed lesions and the subsequent sample analysis.

One of the most important features of all subsequent techniques is the tissue preservation, given that autolysis and bacterial growth can promote artifacts and misinterpretations. So, the sample must be fresh, being the ideal preservation dependent on the technique that will be performed.

Mindless sampling can lead to serious diagnostic errors. So, next we will describe some basic principles for sampling and delivering the material to the laboratory. The misinterpretation of a macroscopic lesion can lead to erroneous sampling of material that does not translate into a useful diagnostic.

The main criteria for the material of the sampling container/bag or device are outlined below:

- The material be inert with the odorous gas
- The material be odourless
- Material be of low permeability to prevent diffusion of odorant gas and outside environment across the material
- Opaque so as to prevent odorous gas from reacting/degrading with sunlight
- Impervious so as to
- Smooth surface

- Topic 1: Material for solid sample collection


- Sealable bag (Zip-lock bags)

- Plastic bottles
- Glass bottles

- Topic 2: Material for liquid samples collection



- Plastic wide mouth containers
- Needles and Syringes
- Blood and other liquid tubes
- Sealable bag (Zip-lock bags)

- Topic 3: Materials for labelling

Labeling only makes identification easier but it also helps in directing, giving out information and warning. The following is a list of seven label materials frequently used:.

1. Clear or White Polypropylene

Polypropylene is a substitute for vinyl and excellent for solvent resistance. It is also a cost effective in comparison with polyester labels. It's usually available in clear or white with a gloss or matte finish. It has great flexibility and clarity. The type of adhesive depends on the application type.

2. Static Cling Vinyl

Static cling vinyl is used to make window decals that do not require an adhesive. It uses static electricity to stick to a surface. It's normally used for glass, metal and other smooth and even surfaces. A common use is for (windshield) oil change labels. It can be printed with laser or thermal transfer (ribbon) printers.

3. Fluorescent and Foil Paper

Fluorescents can be brightly colored vinyl labels or those flood coated on synthetic material. Normally it is available in colors that stand out such as red, green, pink and orange. They are often used for safety labels because they alert people. Foil paper label material is available in both bright or dull, silver or gold. Both flourescent and foil types come with a permanent adhesive.

4. Litho, Semi-Gloss and High Gloss Paper

Litho paper is uncoated and matte. It's used in sheet fed laser printers, and computer pin fed shipping labels. Paper is often used through direct thermal label printers in offices for envelope labels. It comes with both permanent and removable adhesive. Semi-gloss paper and high gloss paper comes with rubber base adhesive and acrylic cold temperature adhesive. The later is used for food related labeling. Removable adhesive is also available for certain conditions.

Permanent marker

Alcohol-Proof Labeling Pen

Laboratory Markers Sample Pack

A sample pack of the three most commonly used and requested laboratory marking pens for histology and pathology laboratory use is now available. Each pen has different features for laboratory applications. This sample pack offers the opportunity to test one of each pen type first, to determine the best fit.

- Statmark Pen™: Histology/Cytology Marking Pen, resistant to formalin, ethanol isopropanol and xylene
- Moist Mark Plus™ Pen: Histology/Cytology Marking Pen, premium slide/cassette marker; writes smooth, dark and fine on all cassettes and slides

- Science Marker™: General Laboratory Marking Pen, fine tip, cryogenic marker, alcohol-resistant on most surfaces

L O 1.4: Select miscellaneous equipment and tools

- Topic.1: Diluting fixative and other reagents

Biopsy specimens should be submitted in 10 % neutral buffered formal saline. This is usually made up by diluting formalin (37-40% formaledhyde) at a ratio of 1 part formalin to 9 parts water. Buffering the solution will reduce histological artefacts, especially in blood- rich tissues such as spleen.

Formula for making up 1 litre of 10% neutral buffered formal saline:

Formalin (Formaldehyde 37-40% solution): 100 ml Water (distilled water is preferable): 900 ml Sodium dihydrogen phosphate dehydrate: 4.5 g Sodium Phosphate (anhydrous): 6.5 g

Remember that biopsy samples must be submitted in a minimum 10-times volume of neutral-buffered formalin.

- Topic.2: Photographic equipment

During necropsy, photographic and documents evidence are needed.

Photographic apparatus include:

- Cameras
- Projectors or projection-type viewers, or their details
- Photographic printing apparatus, or their details
- Combinations of cameras, projectors, or photographic printing apparatus with non-photographic non-optical apparatus

- Topic 3: Medical imaging equipment

Diagnostic Medical Imaging Equipment

Diagnostic Medical Imaging Equipment Diagnostic Medical Imaging is a common technique to visualize physical diagnosis among the clinical community. Techniques that fall under the medical imaging umbrella include:

- Radiography (X-rays)
- Magnetic resonance imaging (MRI)
- Computed tomography (CT)
- Fluoroscopy
- Ultrasound
- Echocardiography,

For diagnostic purposes, these systems are used to image the body to obtain a correct diagnosis and determine future care. Rapid advancements in technology and changes in health-care reform necessitate a mindful approach in order to end up with the correct system for your facility's needs.

- Topic 4: Material for body tag
  - Forceps, pliers or hammer instruments are used to pierce the skin in the required pattern, and a highly contrasting dye, ink or paste (eg. red, green or black for non-pigmented skin) for tattoo tagging method
  - Electro-vibrator systems or needles that both pierce the skin and inject the dye for tatooing
  - Single-use needle used for Passive Integrated Transponder (PIT) tags that are small, durable microchips that have no power supply. Tag marking must be conducted using sterile injectors and tag
  - Collars used for collar tagging
  - Leg bands used for bird tagging
  - Ear tags applicator used for ear tagging
  - Fur clippers used for fur clipping tagging method
  - Paints, Dyes and brush used for paint tagging
- Topic 5: Cleaning and sterilisation of sampling equipment

Cleaning is the removal of foreign material (e.g., soil, and organic material) from objects and is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is required before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes.

Sterilizing equipment is a vital element of modern medical care since patients come in contact with surgical tools, syringes and bandages all the time. To ensure the medical safety of your patients, medical practitioners and the environment, you must use medical equipment safely — this includes keeping them clean and sterilized.

Benefits of Sterilizing Medical Equipment

Some benefits of sterilizing medical equipment include:

- It eliminates pus, blood, foreign particles and dirt left behind that could lead to dangerous complications for the next patient requiring surgery where the medical practitioner uses the instrument.
- It decreases bioburden the number of non-sterilized bacteria living on a surface.
- It prevents the corrosion of expensive and highly precise tools that have delicate pivots and hinges.
- It removes the breeding ground for the surviving germs.
- It ensures the safe transport of equipment needing to be packed and assembled for sterilization or disinfection.

How to Sterilize Medical Equipment

To prevent HAIs from spreading, all hospitals must have a plan of attack. The germ warfare strategy of the hospital consists of a few processes done in this precise order:

- Cleaning: Cleaning must always come before high-level sterilization or disinfection.
- Disinfecting: This is the second step and can involve using liquid chemicals are used to kill non-spore forming bacteria.
- Sterilizing: You can employ several methods of sterilization to kill disease-causing microorganisms and eradicate transmissible agents, like bacteria and spores.

The level of sterilization or disinfection is dependent on how you intend to use the objects. Whether equipment requires high-level sterilization, low-level disinfection or high-level disinfection depends on where it falls in these three categories:

- Critical objects: An example includes surgical instruments that come in contact with sterile tissue.

- Semicritical objects: An example includes endoscopes that come in contact with mucous membranes.
- Noncritical objects: An example includes stethoscopes that come in contact with only intact skin.

Learning Unit-2: Perform pre-necropsy evaluation

LO 2.1 – Identify dead animal to be necropsied

Topic 1: Identification of the dead animal

A. Animal Owner Identification

The farmer`s full identification should contain the main information as follow:

- Farmer`s name
- Village, cell, sector and district
- Phone number if she/he has any
- Email address
- Age and sex
- Marital status
- Level of instruction

B. Identification of the dead animal

Proper identification of an animal is required prior to commencing examination. Some species have legally required forms of identification.

It is important that in our records you identify the animal as to species, age, sex, breed, brand, ear tags or other identification features, such as the colour and special markings. This is of particular importance in the case where the animals are insured or where court cases could follow.

- Topic 2 :Review clinical history of dead animal

Prior to examining the dead animal, a thorough history of the problem must be evaluated.

The more information provided about housing conditions, environment, management practices, and herd history, the more likely the pathologist will be able to derive a diagnosis.

The herd history should include: primary clinical signs, age, strain (or species), number affected, previous vaccinations, previous medications, recurrent animal diseases, feeding problems, feed consumption, production, body weights, and mortality pattern.

If the disease problem is in chicks, include the history on hatching and brooding procedures.

In most cases, a list of possible causes of the problem (differential diagnosis) can be developed following study of the complete history.

This will help your veterinarian create a whole picture of the cause of death:

- Start a written record of animal age, sex, production cycle, breed, and clinical signs prior to death, history of trauma or disease, etc.…
- Note where the animal died.
- Does it look like the animal just laid down and died or does it appear that the animal struggled.
- Note any blood from nose, mouth, rectum, vulva, etc.…
- Note if any other animals are affected, make note of their symptoms, age, location, etc.…
- Consider a feed analysis if you suspect nutritional problems.
- It may be useful to take pictures of your findings to later show your veterinarian.

L O 2.2 – Examine the necropsy request form

- Topic 1: Special organs or systems to examine with emphasis

Carefully note external abnormalities. Check orifices, genitals and mammary glands. Make note of any injuries, wounds, parasites. Unless you suspect anthrax or rabies lay back the skin

Organs or systems to examine

- Remove the udder in females and the genitals in males. Cut away the front leg by incision under the shoulder blade. Open the abdominal cavity by incision from sternum to pubes.
- Check and note whether there is peritoneal fluid in the cavity. Make note of amount and colour. Check absence or presence of fat and intestinal gas.
- Open the thoracic cavity along the diaphragm. Cut through the sternum at the centre point and saw through the upper ribs. Note whether there is fluid in the thoracic cavity and pericardial sack.
- Remove the 4 parts of the stomach in ruminants, or the stomach in non-ruminants and the spleen by cutting the oesphagus and small intestine. Before cutting, tie off the gullet and small intestine in 2 places and cut between them. This prevents gut contents from spilling into the area. Remove the rest of the alimentary canal, tying off at the rectum.
- Examine the liver in position. Make note of size, colour, shape, presence of cysts, texture etc. Note gall bladder and contents. Remove the liver and take tissue section for laboratory analysis.
- Remove and examine the kidneys. Note the amount of fat, size, consistency and colour.
- Examine the bladder and note amount and colour of urine.

- Remove the thoracic organs. The heart is removed by cutting through the large blood vessels suspending it. The lungs are removed by cutting the trachea. The heart sack is now cut open and any abnormalities noted. The lungs are examined for elasticity, colour, and texture, presence of froth or solidification.
- All other organs – tongue, pharynx, larynx, and oesophagus are removed and examined. Tissue sections may be taken for lab analysis.
- The head is sawed open and the brain and cavities of the head examined.
- Lymph nodes are examined throughout and abnormalities noted.

The organs receiving the most attention will be those related to the disease

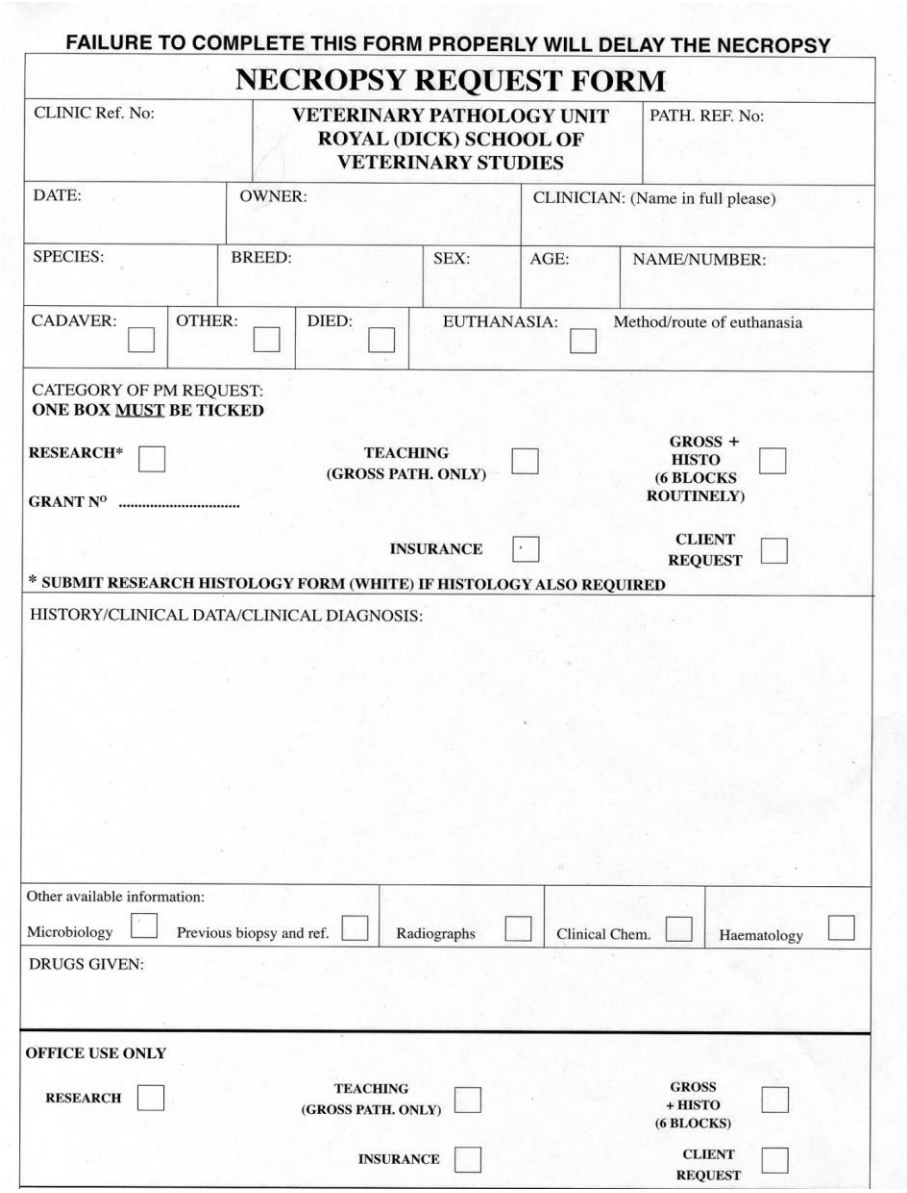
- Topic 2: Special requests

Prior to the necropsy, the contributor should fill out a necropsy requisition form, including animal's identification and clinical relevant data, as well as identification of the clinician and animal's owner. Written permission to perform the necropsy exam should always be assured.

The date is a fundamental item in the requisition form, usually being a legal prerequisite. The identification of the animals to be examined must include its name or number, species, breed, sex, and age, as well as the tattoo or electronic identification, if existent. Whenever possible, the date and time of animal's death should be established. In some situations, more than one animal is affected, and in this case, number and the affected species, mortality, and morbidity rates must be registered.

The clinical diagnosis or clinical suspicious and contact details referring to the health or environmental technician should also be referred. With regard to clinical data, the contributor should indicate: if the animal was euthanized, pointing out the methodology used; the medical reason for death or euthanasia; the total number of animals affected/dead; the clinical diagnosis; a complete clinical history, including a description of the clinical signs, in addition to the supplementary relevant information (if necessary, additional clinical information can be attached to the requisition form).

Necropsy request form



FAILURE TO COMPLETE THIS FORM PROPERLY WILL DELAY THE NECROPSY

NECROPSY REQUEST FORM

CLINIC Ref. No:	**VETERINARY PATHOLOGY UNIT ROYAL (DICK) SCHOOL OF VETERINARY STUDIES**	PATH. REF. No:

DATE:	OWNER:	CLINICIAN: (Name in full please)

SPECIES:	BREED:	SEX:	AGE:	NAME/NUMBER:

CADAVER: ☐	OTHER: ☐	DIED: ☐	EUTHANASIA: ☐ Method/route of euthanasia

CATEGORY OF PM REQUEST:
ONE BOX MUST BE TICKED

RESEARCH* ☐ **TEACHING (GROSS PATH. ONLY)** ☐ **GROSS + HISTO (6 BLOCKS ROUTINELY)** ☐

GRANT Nº .....

INSURANCE ☐ **CLIENT REQUEST** ☐

*** SUBMIT RESEARCH HISTOLOGY FORM (WHITE) IF HISTOLOGY ALSO REQUIRED**

HISTORY/CLINICAL DATA/CLINICAL DIAGNOSIS:

Other available information:

Microbiology ☐ Previous biopsy and ref. ☐ Radiographs ☐ Clinical Chem. ☐ Haematology ☐

DRUGS GIVEN:

OFFICE USE ONLY

RESEARCH ☐ **TEACHING (GROSS PATH. ONLY)** ☐ **GROSS + HISTO (6 BLOCKS)** ☐

INSURANCE ☐ **CLIENT REQUEST** ☐

L O 2.3 – Label the containers for sample collection

- Topic 1: Containers labelling

All labels should be written in indelible ink (e.g. sharpie) or pencil...no ball point pens. Minimum information on the label should include location of collection, date and unique specimen ID. To avoid confusion, abbreviate the month (i.e. MAR 5, 2000 not 3/5/00).

- Topic 2: Reagents (fixative) preparation

Formalin fixation allows pathologists to examine tissues under the microscope and diagnose disease:

- To ensure that enough formalin is present in the jar to allow for adequate fixation of the tissue, the ratio of formalin to tissue should be a minimum of 2 parts formalin to 1 part tissue by volume. All tissues from one animal can go into one jar. Label the jar.
- Ensure that tissue section is not too large to allow for adequate fixation. A piece of tissue should generally be no thicker than ~0.5 cm. If there is a lesion, make sure to take a portion of "normal tissue" adjacent to the lesion. This is crucial as many diseases are diagnosed based on microscopic examination of the "margin" between a normal and abnormal tissue. It is advisable to change the formalin once (say after 24 hours of fixation). This will result in better fixation and staining for microscopic analysis. Used formalin should be disposed of appropriately. Tissues in formalin should never be frozen.

Learning Unit- 3: Perform Necropsy Evaluation

LO 3.1– Identify post-mortem changes

- Topic 1: Post mortem scavenging

Scavengers are animals that consume dead organisms that have died from causes other than predation. While scavenging generally refers to carnivores feeding on carrion, it is also a herbivorous feeding behavior

Discovery of decomposed bodies in domestic setting is not an uncommon occurrence. However postmortem animal scavenging of their owner is not commonly reported but can occur when the main predisposing factors are social isolation, living with free pets in the house and a medical condition causing sudden death.

Outdoor postmortem animal scavenger modification is a common finding in corpses exposed to the natural surroundings. However indoor postmortem scavenging is not a common occurrence.

In cases of postmortem animal scavenging extensive soft tissue defects with notched/ crenated wound edges without signs of vitality have been noticed. In canine attacks, the characteristic feature is a “v” shaped or rhomboid punctured stabs adjacent to mutilations whereas in rodent attacks injuries have a

circular crater like hollow defect with distinct parallel cutaneous lacerations in the margins of damaged skin.

If the body has been scavenged up to the bones, tooth marks can be found on the bones. Bloodless injuries are usually indicative of postmortem injuries, except when advanced decomposition makes such determination questionable or impossible. To differentiate the injuries from antemortem injuries the edges of the injuries can be analyzed for the levels of histamine, serotonin and cathepsins.

Postmortem injuries show low levels of these inflammatory mediators and enzymes. However in cases of advance putrefaction and mummification such investigations will be futile.

Identifying postmortem scavenging is crucial in necropsy to differentiate the sources of injuries on the body.

- Topic 2: Rigor mortis

Rigor mortis

Rigor mortis is the shortening and contraction of muscles leading to stiffness of the cadaver. It is characterized in dead animal by hardening and contraction of all the voluntary and involuntary muscles arising from coagulation of the myosin of muscles by lactic acid produced from muscle glycogen due to lack of oxygen.

Rigor mortis occur in 3-8 hours after death and disappears after 24 h. in summer and 36-72 h. in winter.

Causes of rigor mortis:

- release of calcium ions
- depletion of ATP
- fusion of actins and myosin.

A few additional points may be helpful in interpreting the effects of rigor in other organs:

Cardiac muscle

Like skeletal muscle also undergoes post mortem rigor. This accounts for the commonly observed, relatively empty left ventricle associated with a seemingly distended right ventricle. The increased strength of the left side of the heart during the process of cardiac muscle rigor results in blood being forced back

through pulmonary and systemic vasculature into right heart chambers. Obviously, this occurs only if the blood has not coagulated.

Smooth muscle rigor

Is most apparent as unusual color patterns on the mucosa of tubular or hollow organs such as the GI tract and urinary bladder. The mucosal surface usually becomes corrugated with linear intervals of blanched and red discoloration. The pattern, sometimes called "zebra stripes," has often been considered a lesion by the inexperienced.

- Topic 3: Algor mortis

Algor mortis is the cooling of the body after death, The concept of estimating postmortem interval (PMI) using algor mortis is based on the premise that the body begins to cool upon death and the cessation of cellular activities that generate heat and maintain body temperature in life. After death, the body begins to lose heat to the environment and internal temperatures begin to drop.

The ‘‘rule of thumb,’’ which states that the body cools at a rate of 1^{o}C per hour after death, plus a factor of 3 hours. This can be expressed as:

Time of death (h)= 37(^{o}C) – rectal temperature (^{o}C) + 3.

Algor mortis affected by several key factors, including:

- Stability or fluctuation of the environmental temperature.
- The level and thickness of fur or similar covering materials.
- The thermal conductivity of the surface on which a body lies.
- Diseases or drugs which increase body temperature and thereby raise the starting temperature of the corpse at the time of death

- Topic 4: Livor mortis

Gravitational hypostasis (livor mortis)

The purple-red discoloration of the soft tissues due to postmortem gravity-dependent pooling of blood is livor mortis.

Livor mortis may be observed either externally in the skin and mucous membranes or internally in the abdominal or thoracic viscera, most notably the lung. Livor mortis must be distinguished from hemorrhage.

In livor mortis, the pooling of blood is entirely within dilated vascular channels, whereas hemorrhage is the escape of blood from the blood vessels and into the connective tissues or internal or external spaces.

Organs on the "down side" are darker than those of the contralateral side. Animals euthanized during surgery and in dorsal recumbency often show dark red dorsal lung lobes.

In the liver, gravitational settling of blood in addition to uneven compression of different lobes by gas distended segments of the GI tract or compression of the chest/diaphragm muscles undergoing rigor mortis result in a mottled pattern of the capsular surface. The so called "mottled pattern" of the liver commonly described in many autopsies is usually nothing more than a post mortem change.

- Topic 5: Post mortem clotting

Most of the blood clots observed at the autopsy are the "currant jelly" variety, which are dark red, soft and friable. They are red because fibrin in the clot has not contracted which results in squeezing the red blood cells out of the clot. Currant jelly clots are often molded to the shape of blood vessels or cardiac chambers in which they are found.

"Chicken fat" clots are also commonly seen during the autopsy. These clots are also soft and friable; however, the colour is pale tan/yellow. Chicken fat clots occur in animals that are in extremis for several hours prior to death. Sluggish blood flow results in ante-mortem clot formation with partial retraction of the loose fibrin aggregate. This results in extrusion of red blood cells and the resulting tan/yellow colour of these clots. Strictly speaking, chicken fat clots are ante-mortem but they usually have formed several hours prior to death in a moribund patient.

- Topic 6: Haemoglobin imbibition

Blood: Hemolysis occurs after death and behaves as a common dye in the cadaver. Various shades of pink or red stained aortic intima or endocardial surfaces of the heart chambers are commonly seen in animals that have been dead for several hours.

- Topic 7: Bile imbibition

Bile: Like hemoglobin, bile can also behave as a dye in the dead animal resulting in yellow or green staining of the liver, intestine in addition to the body wall and tissues adjacent to the gall bladder. This will lead to the condition called icterus.

- Topic 8: Pseudomelanosis

Enteric bacteria break down hemoglobin with the resultant formation of black pigment first seen in the large intestine. As these bacteria invade other portions of the cadaver, the same change is also observed in other locations. The liver, because of it direct communication to the GI tract through the biliary system, often shows blotchy areas of pseudomelanosis.

Green staining of the distal GI tract is also occasionally observed. This is a variation of pseudomelanosis however green, rather than black hemoglobin breakdown product is formed.

- Topic 9: Post-mortem decomposition (Autolysis)

Enzymes produced in the GI tract and pancreas are capable of degrading tissues after death. In the pancreas, digestion autolysis is often observed as poorly delineated, foci of hemorrhage in the pancreas.

Absence of fibrinous inflammation in these regions indicates that this change is not a result of acute pancreatitis however, microscopic tissue examination is necessary to confirm this observation. Digestion autolysis rapidly ensues in the mucosa of the upper GI tract aided, to a large extent, by bacterial action.

- Topic 10: Putrefaction

This represents the post-mortem rotting that eventually makes it impossible to gain useful information from an autopsy. The process begins soon after death (minutes) in the GI tract and rapidly spreads to the liver and biliary system. High ambient temperatures and prolonged retention of body heat in animals with a heavy hair coat accelerate this process. Large animals (over 500 pounds) cool slower than small animals simply due to the volume of tissue and the high specific heat properties of water.

To illustrate how rapidly this process can occur it may be helpful to remember that under certain conditions, enteric bacteria have been cultured from the heart and pulmonary blood vessels 1 hour after death.

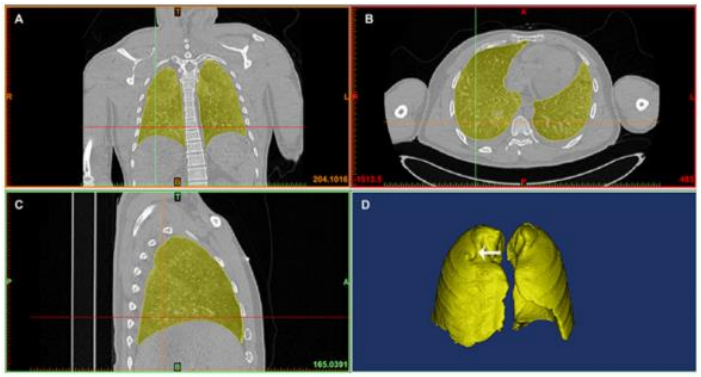
The signs of putrefaction are as follows:

- Abdomen distended with gas.
- Blood stained fluid from mouth and nostrils.
- Liquefaction of eye balls.
- Presence of obnoxious odour or smell.
- Bursting of the abdomen and thorax with protrusion of stomach and intestine through it or eversion of the rectum through the anus.

- Topic 11: Post-mortem emphysema (blotting)

Gas-forming enteric bacteria especially *Clostridia* species commonly invade tissues after death forming gas bubbles in the subcutis, lungs and liver. Crepitation is a term used to describe the crackling or "bubble wrap-like" sensation detected when these tissues are handled.

- Topic 12: Rib indentation



Sometimes, indentations from the ribs can be found on the surface of the lungs. Emaciated animal may also have more prominent indentation at the nape. Condition code 2

Pectus excavatum is an abnormal development of the rib cage in which the sternum (breastbone) grows inward, resulting in a noticeable and sometimes severe indentation of the chest wall.

- Topic 13: Post-mortem rupture and organ displacement

Rupture of organs and tissue due to accumulation of gasses in the tissue. Displacement of organs: it occur when the cadaver moved, this should be differentiated from torsion or volvulus.

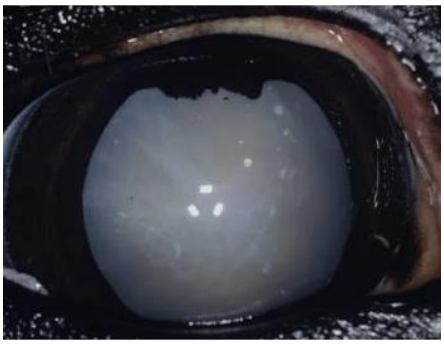
The traumatic diaphragmatic rupture with the liver displaced to the right hemithorax. Traumatic diaphragmatic rupture may occur after accidents, especially after lateral collisions.

Trauma to the kidney may result in:

- contusion of the kidney parenchyma
- tearing of the capsule and parenchyma, with bleeding
- subcapsular haematoma formation
- avulsion of the kidney from its pedicle

Abdominal trauma is an injury to the abdomen. Abdominal organs as the pancreas and the intestines, may be displaced or compressed against the spinal column. The liver, the most vulnerable abdominal organ to all forms of injury because of its size and location.

- Topic 14: Lens opacity



Cataract is defined as opacification (to become opaque) or clouding of the natural clear lens that results in visual problems, including blindness.

Abnormalities of the lens are frequently detected during the ophthalmic examination.

Cataract (opacity of the lens or its capsule) is the most common disorder of the lensthat occurs in domesticated animals. Abnormalities of the zonular fibers that normally hold the lens in position may occur, resulting in luxation of the lens from its normal position into the anterior chamber or into the vitreous humor.

Causes of lens opacity

Hereditary--A common causes of cataracts in dogs. Characteristic appearance/progression of breed-specific cataract.

Metabolic--Diabetes mellitus is the most common cause of metabolic cataract in dogs and is related to abnormal metabolism of glucose by the lens (does not occur in cats). These cataracts are always bilateral, and often form rapidly.

Hypocalcemia (e.g., due to hypoparathyroidism) can lead to cataracts with a characteristic appearance-multiple, punctuate subcapsular opacities.

Trauma--Perforating injury to the cornea and lens frequently induces cataract formation.

Nutritional--Unsuitable canine and feline milk replacers (arginine, tryptophan deficiency)

L O 3.2 – Describe lesions by types and systems

- Topic 1: Growth and differentiation defects

Cell growth: is the process of increase in size, resulting from the synthesis of specific tissue components. The term may he applied to populations, individuals, organs, cells, or even subcellular organelles such as mitochondria.

Cellular differentiation: is the process in which a cell changes from one cell type to another. Usually, the cell changes to a more specialized type. Differentiation occurs numerous times during the development of a multicellular organism as it changes from a simple zygote to a complex system of tissues and cell types. Differentiation continues in adulthood as adult stem cells divide and create fully differentiated daughter cells during tissue repair and during normal cell turnover.

Morphogenesis: Morphogenesis is the highly complex process of development of structural shape and form of organs, limbs, facial features, etc. from primitive cell masses during embryogenesis.

Regeneration: Regeneration enables cells or tissues destroyed by injury or disease to be replaced by functionally identical cells. These replaced 'daughter' cells are usually derived from a tissue reservoir of 'parent' stem cells

Disturbances of cell growth

Aabnormal cell growth ranges from complete absence of tissue development (agenesis) to totally unregulated growth (neoplasia).

Agenesis: complete failure of an organ / tissue to develop with no associated primordium

Aplasia: failure of an organ / tissue to grow due to failure of development of the primordium.

Hypoplasia; failure of an organ / tissue to reach its normal size (less severe than aplasia)

Dysplasia: in context of organ development, refers to abnormal organization of cells („abnormal growth") eg retinal dysplasia, hip dysplasia, renal dysplasia: in the context of mature tissue, it refers to disordered growth of cells.

- occurs primarily in epithelium; when severe can indicate neoplastic transformation.
- see loss of uniformity of the individual cells & architectural disorganization.

Metaplasia: a reversible change in which one adult cell type is replaced by another adult cell type.

- reflects the reprogramming of stem cells to differentiate along a new pathway.

- brought about by changes of soluble factors (cytokines, growth factors, ECM components) that affect tissue specific, differentiation genes.
- represents an adaptive substitution; where cells sensitive to stress are replaced by other cell types better able to withstand a new adverse environment.
- usually an orderly process & reversible (if persists can lead to cancer development).

Hamartoma: a benign tumor-like mass composed of an overgrowth of mature cells and tissues normally present in the affected part. Present at birth & probably results from an overgrowth of progenitor cells in the fetus.

Choristoma: a mass of histologically normal tissue in an abnormal location (ectopic rest)

- Topic 2: Disruptive defects (injuries)

Central nervous system injuries account for about half of deaths from trauma, and blood losses by about one-third. Hemorrhage is the most common cause of avoidable death in patients treated with trauma. Injuries to abdominal structures are an important source of bleeding and are pose special medical interest, since they present great practical difficulties for adequate diagnosis and eventual therapeutic approach, especially when there are other associated lesions. This is because almost half of the bleeding in the peritoneal cavity or retroperitoneum manifests itself with few or no symptoms.

We also included cases with trauma in other body regions, such as the head, limbs and thorax, as long as associated with abdominal trauma (AT) in the mechanism of death.

The abdominal organs most injured in the penetrating trauma were the liver and the intestines, and in blunt trauma, the liver and the spleen.

- Topic.3: Cardiovascular disturbances (defects)

Cardiac rhythm disturbances, sometimes known as heart rhythm disturbances or arrhythmias (uh-RITH-me-uhs), are abnormal or irregular heartbeats. These disturbances disrupt your heart's electrical signals and can cause your heart to beat too fast, too slowly, or in an abnormal way.

The heart beats through its own electrical conduction system that not only coordinates squeezing of the heart chambers, but also determines how fast or slow the heart beats.

A. Types of heart rhythm disturbances

The main types of heart rhythm disturbances include:

- Tachycardia: A fast heart rhythm (more than 100 beats per minute)
- Bradycardia: A slow heart rhythm (fewer than 60 beats per minute)
- Supraventricular arrhythmias: Abnormal rhythms that begin in the heart's upper chambers (atria)
- Ventricular arrhythmias: Arrhythmias that begin in the heart's lower chambers (ventricles)
- Bradyarrhythmias: Slow heart rhythms that usually are caused by a disease in the heart's conduction system

B. Causes and Symptoms of Cardiac Rhythm Disturbances

Symptoms of Cardiac Rhythm Disturbances

- Fatigue: Feeling easily tired
- Dizziness: Feeling faint, woozy, weak, or unsteady
- Lightheadedness: Unpleasant sensation of dizziness and/or a feeling that you may faint
- Sweating: Sweating more than usual without reason
- Fainting: Temporarily losing consciousness
- Shortness of breath: Feeling that you cannot get enough air
- Chest pain: Pain in your chest that is often worse with deep breathing, coughing, or laughing

Causes of Cardiac Rhythm Disturbances

Disturbances in your heart rhythm can be caused by many different environmental factors, as well as other health problems.

Environmental causes can include:

- Abuse of certain prescription or over-the-counter medicines
- High blood pressure or the presence of too much stress hormone (cortisol) in your bloodstream can lead to an arrhythmia because these conditions cause your heart to work too hard.

Other health conditions that can lead to arrhythmia in some animals include:

- Heart attack
- Coronary heart disease
- Heart failure
- Overactive or underactive thyroid gland (too much or too little thyroid hormone produced)
- Rheumatic heart disease
- Certain congenital heart defects (present at birth) can cause arrhythmias.

Congenital Heart Defects

Congenital heart defects are malformations that are present at birth. They may or may not have a disruptive effect on a person's circulatory system:

- **Aortic Valve Stenosis (AVS):** A valve from the heart to the body that does not properly open and close and may also leak blood. Pressure may build up inside the heart and cause damage.
- **Atrial Septal Defect (ASD):** A "hole" in the wall that separates the top two chambers of the heart. This defect allows oxygen-rich blood to leak into the oxygen-poor blood chambers in the heart.
- **Coarctation of the Aorta (CoA):** A narrowing of the major artery (the aorta) that carries blood to the body. This narrowing affects blood flow where the arteries branch out to carry blood along separate vessels to the upper and lower parts of the body
- **Complete Atrioventricular Canal defect (CAVC):** A large hole in center of the heart affecting all four chambers where they would normally be divided. When a heart is properly divided, the oxygen-rich blood from the lungs does not mix with the oxygen-poor blood from the body.
- **d-Transposition of the great arteries:** A heart in which the two main arteries carrying blood away from the heart are reversed. A normal blood pattern carries blood in a cycle: body-heart-lungs-heart-body.
- **Ebstein's Anomaly**: A malformed heart valve that does not properly close to keep the blood flow moving in the right direction. Blood may leak back from the lower to upper chambers on the right side of the heart.
- **l-transposition of the great arteries:** A heart in which the lower section is fully reversed. This malformation of the heart causes a reversal in the normal blood flow pattern because the right and left lower chambers of the heart are reversed.
- **Patent Ductus Arteriosis (PDA):** An unclosed hole in the aorta. Before a baby is born, the fetus's blood does not need to go to the lungs to get oxygenated. The ductus arteriosis is a hole that allows the blood to skip the circulation to the lungs.
- **Pulmonary Valve Stenosis:** A thickened or fused heart valve that does not fully open. The pulmonary valve allows blood to flow out of the heart, into the pulmonary artery and then to the lungs.
- **Single Ventricle Defects:** Rare disorders affecting one lower chamber of the heart. The chamber may be smaller, underdeveloped, or missing a valve.
- **Tetralogy of Fallot:** A heart defect that features four problems:
  - a hole between the lower chambers of the heart
  - an obstruction from the heart to the lungs

- The aorta (blood vessel) lies over over the hole in the lower chambers
- The muscle surrounding the lower right chamber becomes overly thickened

- **Total Anomalous Pulmonary Venous Connection (TAPVC):** A defect in the veins leading from the lungs to the heart. In TAPVC, the blood does not take the normal route from the lungs to the heart and out to the body.
- **Truncus Arteriosus:** When a person has one large artery instead of two separate ones to carry blood to the lungs and body. In a normal heart, the blood follow this cycle: body-heart-lungs-heart-body.
- **Ventricular Septal Defect (VSD):** VSD is a hole in the wall separating the two lower chambers of the heart. In normal development, the wall between the chambers closes before the fetus is born, so that by birth, oxygen-rich blood is kept from mixing with the oxygen-poor blood. When the hole does not close, it may cause higher pressure in the heart or reduced oxygen to the body.

Topic 4: Degenerative defects

Degenerative Skeletal Diseases (degenerative joint disease (DJD))

Fig.2. Bovine 2: the animal is standing up with legs straight (decreased hock curvature) and displaced forward; the abdomen is contracted due to joint pain.

Fig.1. Bovine 9: note the bilaterally increased volume of scapulo-humeral joints.

Degenerative pathology affecting the skeletal system is well recognized in all classes of animals, with significant overlap among the conditions recognized in standard veterinary models (canine, feline, and equine) and humans.

C. Clinical signs

The common clinical signs observed in both species were chronic lameness ranging from degree 2 to 4, stiff gait, postural changes, reluctance to walk, audible crackles during circumduction of the affected limb, prolonged recumbency and difficulty to stand up, and flexing the affected joints.

Additionally, weight loss, pressure sores and increased volume in the tuberosities of the joints were observed. Bovines showed abnormal posture characterized by straight legs that were displaced forward when the animal remained standing. The animals in the Animal Breeding Center, according to the responsible veterinarians, had low semen quality and lost their ability to mount for semen collection.

D. Types of Degenerative Skeletal Diseases

Degenerative arthropathies in the peripheral synovial joints are best characterized as osteoarthritis (OA). Degenerative arthropathy in the spine, generically termed spondylosis, includes OA of the synovial joints (facet, uncovertebral, atlantoaxial, and sacroiliac joints), degenerative disc disease (DDD) of the fibrocartilaginous intervertebral discs, and senescent changes in the attachments of the fibrous supporting structures (degenerative enthesopathy).

Osteoarthritis

Osteoarthritis refers to the pathologic failure of synovial joints characterized by the mechanical destruction of articular cartilage, with secondary changes in the subchondral bone (osteophytes, sclerosis, and eburnation).

Spondylosis

Spondylosis is a generic term that refers to degenerative arthropathy in the spine, including OA of the synovial joints (facet, uncovertebral, atlantoaxial, and sacroiliac joints), degenerative disc disease of the fibrocartilaginous intervertebral discs, and senescent changes in the attachments of the fibrous supporting structures (degenerative enthesopathy).

Degenerative Disc Disease

Degeneration of the fibrocartilaginous interbody joints likely begins in the nucleus pulposus of the disc, which desiccates with age. As the process progresses, radially oriented tears occur within the annulus fibrosis. Herniated nucleus material may extend through these defects, protrude beyond the confines of the disc, or even extrude through the longitudinal ligaments. Gas clefts or calcification may develop in the degenerating discs. Collapse of the disc is a relatively late manifestation. These morphologic changes each affect the biomechanics of the motion segment. Specifically, loss of disc height and turgidity (often combined with facet joint osteoarthritis) increase the load in the vertebral endplates, and predispose to segmental hypermobility. The response of the endplates is marginal bone proliferation, similar to the formation of osteophytosis in synovial joint osteoarthritis.

- Topic 5: Inflammation and repair

Inflammation is the body's mechanism for handling with agents that could damage it. In other words, inflammation is a protective response to rid the body of the cause of cell injury and the resultant necrotic cells that cell injury produces. Although the processes of acute and chronic inflammation are an important protective mechanism used by the body to deal with potentially damaging agents, they are potentially damaging to the body and must be closely regulated. The basic steps in acute inflammation allow white blood cells to move from the blood to the tissue location where they are required. Acute inflammation can resolve completely if the inciting agent is removed, or it can have one of several other sequelae, including chronic inflammation.

General Concepts of Acute and Chronic Inflammation

The body must undergo changes locally through vasodilation and increased vascular permeability in the area of the agent inciting the inflammatory reaction to allow white blood cells to accumulate. The white blood cells must then leave the blood vessel, cross the basement membrane, and be drawn to the area where they are needed. The process by which white blood cells are drawn to the area where they are needed is referred to as **chemotaxis.**

Acute inflammation has a rapid onset, lasts for minutes to days, and is characterized by exudation of fluid and protein from vessels and emigration of neutrophils. Acute inflammation is a protective process that is designed to rid the body of the inciting agent and set up the process of repair. Chronic inflammation has a longer time course (days to years) and involves different cell types than does acute inflammation (lymphocytes and macrophages versus neutrophils). Also, *in chronic inflammation, tissue repair coexists with tissue destruction.*

Principal signs of acute inflammation: Rubor (red discoloration), calor (heat), dolor (pain), tumor (mass effect), and loss of function.

Causes of acute inflammation: Infection, trauma, physical and chemical agents, necrosis, foreign bodies, and immune reactions.

Causes of acute inflammation: Infection, trauma, physical and chemical agents, necrosis, foreign bodies, and immune reactions.

Stages of acute inflammation:

Vasodilation (after a transient vasoconstriction)

- **How:** Vasodilation occurs through release of mediators from cells. These mediators include histamine, prostacyclin (PGI_2), and nitric oxide (NO).

- **Why:** Vasodilation increases the hydrostatic pressure by causing slowing (sludging) of blood flow. Sludging of blood also causes margination of leukocytes along the wall of the blood vessel.

Increased vascular permeability (increased leakiness of vessels)

- **How:** Increased vascular permeability occurs through release of mediators from cells. These mediators include histamine and leukotrienes C_4, D_4, and E_4.

- **Why:** Increased vascular permeability allows fluid to cross into the interstitial tissue, which increases protein levels in the interstitial tissue, thereby decreasing osmotic pressure in the blood ...

L O 3.3 – Examine external features

- Topic 1: Body condition assessment

A. Thinness

A.1. Severely Emaciated

The spinous processes show no fat cover, are very prominent and sharp. There are visible spaces between the vertebrae. The ribs and bone structure are visible with no fat cover; the tail head is very prominent. There is severe muscle loss in the shoulder, loin, and hind regions. There is no fat over muscle, or under skin. An animal with a score of one is life-threateningly thin.

A.2. Very Thin

There is more fat cover over the ribs and backbone, but space is still visible between the vertebrae. The tail head is less prominent, but there is still muscle loss. Overall, there is slightly more fat cover than in condition Score 1.

A.3. Thin

The spinous processes are still visible, but less sharp. There is less space between the vertebra, and more fat cover along the entire backbone. The loin muscle has more depth, but there is no obvious fat cover. The ribs and tail head are still visible, with more cover, and there is only slight muscle loss.

A.4. Slightly Thin

There are no spaces between the vertebra, and the spinous processes are no longer visible, but can be palpated with little pressure. The last 2 to 4 ribs and the hipbones are still visible. Fat covers the loin and shoulder, and the animal has no muscle loss, but is still flat.

B. Medium

B.1. Moderate or Average

Here is just the right amount of fat cover over the shoulders, ribs, loin, and tail head. The spinous processes can be palpated with a little pressure, and feel smooth to the touch. Only the last two ribs are visible, and the loin is filled. There is little fat in the brisket and over the hooks and pins.

B.2. Slightly Fleshy

The spine is palpated with moderate pressure, and the hindquarters have become slightly rounded. There is visible fat in the brisket and around the tail head. All ribs, the loins, shoulders, and fore ribs are covered with fat.

B.3. Fleshy

The entire animal appears smooth. The spine can be felt with significant pressure. There is fat that fills the brisket, flanks, and tail head. There is more fat cover over the shoulder, loins, and fore ribs.

C. Fatness (Obesity)

C.1. Fat (slightly Obese)

The animal appears square. The tail head is embedded in fat, and the flanks and brisket appear to be full.

C.2. Extremely Fat (Very Obese)

There is no visible bone structure or definition in the muscles. The spine cannot be felt. The brisket is filled with fat, and the neck appears shorter due to the deposition of fat. The loin, hip, and tail head have a rippled look due to the excess fat.

- Topic 2: Skin and hair coat

A. Abscess

An abscess is an enclosed localized collection of pus surrounded by inflamed tissue. Generally develops in response to infection, often forms when foreign bacteria (such as bacteria from the skin surface) are introduced beneath the skin - eg. Via injection, cuts, wounds etc.

Abscess Formation Abscesses often form for many reasons:

- Pushing dirt and bacteria in when injecting
- Using drugs that contain bacteria and dirt
- Missed hits
- Injecting certain drugs such as speedballs
- Skin popping or injecting into the muscle
- Poor hygiene

B. Wound

A wound is a type of injury which happens relatively quickly in which skin is torn, cut, or punctured (an open wound), or where blunt force trauma causes a contusion (a closed wound). In pathology, it specifically refers to a sharp injury which damages the epidermis of the skin.

B.1. Open wound

Open wounds can be classified according to the object that caused the wound:

- Incisions or incised wounds: caused by a clean, sharp-edged object such as a knife, razor, or glass splinter.

- Lacerations: irregular tear-like wounds caused by some blunt trauma. Lacerations and incisions may appear linear (regular) or stellate (irregular). The term laceration is commonly misused in reference to incisions.
- Abrasions: superficial wounds in which the topmost layer of the skin (the epidermis) is scraped off. Abrasions are often caused by a sliding fall onto a rough surface such as asphalt, tree bark or concrete.
- Avulsions: injuries in which a body structure is forcibly detached from its normal point of insertion. A type of amputation where the extremity is pulled off rather than cut off. When used in reference to skin avulsions, the term 'degloving' is also sometimes used as a synonym.
- Puncture wounds: caused by an object puncturing the skin, such as a splinter, nail or needle.
- Penetration wounds: caused by an object such as a knife entering and coming out from the skin.
- Gunshot wounds: caused by a bullet or similar projectile driving into or through the body. There may be two wounds, one at the site of entry and one at the site of exit, generally referred to as a "through-and-through.

B.2. Closed wound

Closed wounds have fewer categories, but are just as dangerous as open wounds:

- Hematomas (or blood tumor): caused by damage to a blood vessel that in turn causes blood to collect under the skin: **Hematomas that originate from internal blood vessel** pathology are petechiae, purpura, and ecchymosis. The different classifications are based on size. **Hematomas that originate from an external source of trauma** are contusions, also commonly called bruises.
- Crush injury: caused by a great or extreme amount of force applied over a long period of time.

C. Burns

Burn (burn) injury to tissues caused by contact with dry heat (fire), moist heat (steam or hot liquid), chemicals (e.g., corrosive substances), electricity (current or lightning), friction, or radiant and electromagnetic energy.

Types of burns

Burns are classified by the depth of injury as first-, second-, third-, or fourth-degree:

- First-degree burns: a burn that affects the epidermis only, causing erythema and in some cases mild edema, without vesiculation.

- Second-degree burns: a burn that affects the epidermis and the dermis, classified as superficial or deep according to the depth of injury. The superficial type involves the epidermis and the papillary dermis and is characterized by pain, edema, and the formation of blisters; it heals without scarring. The deep type extends into the reticular dermis, is pale and anesthetic, and results in scarring
- Third-degree burns : a burn that destroys both the epidermis and the dermis, often also involving the subcutaneous tissue
- Fourth-degree burns: a burn that extends deeply into the subcutaneous tissue, completely destroying the skin, subcutaneous fat, and underlying tendons, and sometimes involving muscle, fascia, or bone.

D. Ulcers

A local defect, or excavation, of the surface of an organ or tissue, which is produced by the sloughing of inflammatory necrotic tissue.

Types of ulcers

Ulcers are classified as follow:

- Penetrating ulcers: an ulcer that extends to involve the wall or substance of an adjacent organ
- Perforating ulcers an ulcer that involves the entire thickness of an organ, such as the foot, the stomach wall, or the intestinal wall, with openings both internally and externally.

E. Nodules

A small boss or node that is solid and can be detected by touch, on a radiograph of the lung, a discrete opacity less than 30 mm in diameter.

F. Tumor

It is swelling, one of the cardinal signs of inflammation; morbid enlargement or a new growth of tissue in which the multiplication of cells is uncontrolled and progressive; called also neoplasm.

Types of tumors

Tumors are classified as follow:

- Benign tumor: a tumor that lacks the properties of invasiveness and metastasis and is usually surrounded by a fibrous capsule; its cells also show a lesser degree of anaplasia than those of malignant tumors. Called also innocent tumor
- Malignant tumor: a tumor that has the properties of invasiveness and metastasis and that shows a greater degree of anaplasia than do benign tumors.
- Malignant mixed tumor: a type of malignant pleomorphic adenoma usually occurring in the salivary glands of older adults in one of two forms: in the first both epithelial and mesenchymal components are malignant and may metastasize (carcinosarcoma) and in the second a histologically benign appearance persists in both the primary tumor and metastatic foci. The term is sometimes used synonymously with carcinoma ex pleomorphicadenoma or with the more general term malignant pleomorphic adenoma.

- Topic 3: Body discharges

A. Pus

A liquid inflammation product made up of leukocytes, cellular debris, and a thin protein-rich fluid called liquor puris.

B. Blood

The fluid that circulates through the heart, arteries, capillaries, and veins, carrying nutriment and oxygen to the body cells. It consists of the plasma, a pale yellow liquid containing the microscopically visible formed elements of the blood: the erythrocytes, or red blood corpuscles; the leukocytes, or white blood corpuscles; and the platelets, or thrombocytes.

Defibrinated blood: whole blood from which fibrin was separated during the clotting process.

Laky blood: blood that has undergone laking and contains at least some lysed erythrocytes.

C. Urine

A liquid excrement consisting of water, salts, and urea which is made in the kidneys then released through the urethra and urine is evaluated as follow:

- Urine colour is an indicator for hydration.
- Urine pH is often influenced by diet.
- Urine smell indicates age of the urine and may indicate the presence of glucose and ketones.
- Urine turbidity may indicate urinary tract infection or obstruction.

- Urinalysis is the process of analysing and detecting chemicals excreted in urine.
- Physical characteristics of urine include colour, smell, pH, density and turbidity

D. Mucus

Mucus is a slippery aqueous secretion produced by, and covering, mucous membranes. It is typically produced from cells found in mucous glands, although it may also originate from mixed glands, which contain both serous and mucous cells. It is also a viscous colloid containing inorganic salts, antimicrobial enzymes immunoglobulins, and glycoproteins such as lactoferrin and mucins, which are produced by goblet cells in the mucous membranes and submucosal glands.

E. Saliva

The clear, alkaline, somewhat viscid secretion from the parotid, submaxillary, sublingual, and smaller mucous glands of the mouth. It serves to moisten and soften the food, keeps the mouth moist, and contains a-amylase, a digestive enzyme which converts starch into maltose. The saliva also contains mucin, serum albumin, globulin, leukocytes, epithelial debris, and potassium thiocyanate. Certain toxins frequently occur in it.

F. Tears

The watery secretion of the lacrimal glands which serves to moisten the conjunctiva; the secretion normal is slightly alkaline and saline. Also it is small, naturally formed, drop like masses of a gum or resin

- Topic 4: Mucous membrane

A. Icterus

The term icterus is used interchangeably with jaundice to refer to yellow discoloration of skin, mucous membranes, and sclerae caused by an accumulation of bilirubin pigment in plasma (hyperbilirubinemia) and tissues.

Bilirubin is an end product of hemoglobin metabolism. Icterus occurs when bilirubin formation exceeds hepatobiliary excretion. Three pathophysiologic mechanisms of hyperbilirubinemia and icterus are termed:

- **prehepatic:** which results from accelerated red blood cell destruction (hemolysis) and increased bilirubin production;
- **Hepatic:** which is caused by intrinsic hepatocellular disease and reduced hepatocyte uptake, conjugation, and secretion of bilirubin; and
- **posthepatic:** which is caused by extrahepatic cholestasis and disruption of bile flow through the extrahepatic biliary system

B. Congestion

Excessive or abnormal accumulation of fluid, as of blood in a part. There are two categories of congestion:

- **Active congestion:** accumulation of blood in a part because of dilatation of the lumen of its supplying blood vessels.
- **Chronic passive congestion :** long-term passive congestion of the liver, most often due to right heart failure, giving it a swollen and mottled appearance

C. Dehydration

Removal of water from a substance or the condition that results from excessive loss of body water. There are two categories of congestion:

- **Absolute dehydration**: water content below the normal or below a standard amount.
- **Relative dehydration**: dehydration resulting from increased osmotic pressure of the body fluids.

L O 3.4 – Open the carcass of the different animal species

- Topic 1: Recumbency (Positioning).

Begin with the animal placed on its left side; this places the rumen down making it much easier to visualize the abdominal organs.

- Topic 2: Examination of the mucous membranes

Examination of the visible mucous membranes is of great clinical importance as it reflects the general condition of the animal as well as certain disease conditions (e.g. jaundice in case of liver diseases). The visible mucous membranes are oral, nasal, conjunctival mucous membranes and vaginal mucous membrane in females. Changes in color may result from disturbance in oxidation process of the blood, disturbances in blood circulation or of certain other disease conditions.

Noticeable changes in mucous membranes include changes in color, presence of exudates and swelling.

A. Changes in color

The normal color of the visible mucous membranes varies between species. In general, different shades of pink (light pink, pink or rosy red) are considered normal depending on the species (please refer to your practical session tutor for details). The following changes occur in various diseases:

Anaemic mucous membranes:

- Blood loss anaemia.
- Parasitic infestations leading to haemolysis.
- Tumours or leucosis.
- Iron deficiency anemia.
- Long-standing infectious diseases.
- Exposure to X-rays and some medications.

Congested mucous membranes:

- High environmental temperatures and exercise.
- Any disease resulting in fever.
- Diseases of the heart, brain and its membranes.

Yellowish or icteric mucous membranes:

- Icterus of jaundice occurs due to increase of blood bilirubin concentration (blood parasites, leptospirosis, hepatitis, cholangitis, cholecystitis and cholangiohepatitis).
- Infectious anaemia and contagious pleuropheumonia of horses.
- Chronic gastric dilatation.

Cyanosed mucous membranes:

- Bluish discoloration of visible mucous membranes resulting from presence of reduced haemoglobin in blood capillaries.
- Myocarditis, pericarditis.
- Plant and mineral intoxications.

B. Swelling of mucous membranes

Inflammation of mucous membranes results in its swelling; in which case the mucous membranes may also be hot and tender (i.e. showing cardinal signs of inflammation).

Marked swelling of conjunctival mucous membranes is characteristic of equine influenza. A slight degree of swelling is noticed in contagious pleuropneumonia of horse and cattle plague, anthrax and fowl diphtheria.

C. Presence of exudate

Escape of serous fluid and fibrinogen from blood vessels, which also contains desquamated epithelial cells, leukocytes and erythrocytes.

- Topic 3: Incisions


Make the first incision under the animal's lower jaw. Place the tip of your knife under the skin and make a smooth cut along the neck. Make midventral incision with knife from chin to anus.

Surround the prepuce, scrotum/mammary gland, remove skin dorso-ventral, and remove skin at face, neck, thorax and abdomen. Cut the muscles and fascia in between scapula and body, remove fore legs. Raise hind legs, cut the coxofemoral ligament. Examine subcutaneous tissues, muscle, superficial lymph nodes (prescaular, prefemoral and suppramammary)

- Topic 4: Skinning

With your knife, free the skin from the body wall on the right side of the animal up to the spine, as far as possible. This is accomplished by cutting the connective tissue between the hide and the muscles of the animal. By cutting through the connective tissue you will be able to reflect the limbs without cutting through any more of the hide. Try not to make too many holes in the skin; the hide is the only part of the animal that can be salvaged by the rendering service. Also an intact hide makes it easy to close and remove the carcass after the necropsy is performed.

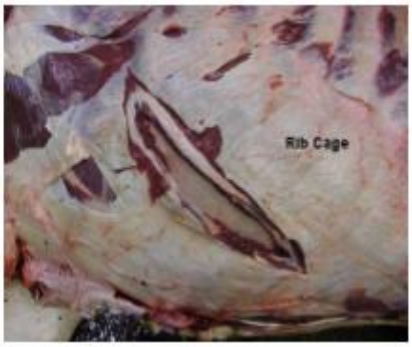
Reflect the right forelimb by cutting between the muscles of the shoulder and those of the body wall. There is a thin, clear to white connective tissue between the muscles. As you lift up on the forelimb you

will begin to see this connective tissue. Cut this connective tissue while pulling back on the limb. You should not have to cut through the hide on the limbs. After this is done the right forelimb should be at a right angle to the rest of the body.

Now lift the hindlimb up and cut through the muscle bellies toward the hip joint. Once you reach the joint you will see that it looks like a ball and socket. There is a small ligament connecting the ball to the socket. Cut through this ligament to allow the joint to come apart. Once you have done this, the hindlimb should also lay at a right angle to the body of the animal. Again you should not have to cut through the hide on the limbs to accomplish this task.

- Topic 5: Abdominal cavity opening

Carefully make an incision in the abdomen just behind the ribs. Try not to cut too deep in order to avoid penetrating the underlying forestomach and intestines.




Reverse the knife in your hand so that the tip of the knife points toward yourself. Insert your hand and the knife handle in the abdominal incision you previously created. Cut the abdominal wall along the rib, and then continue the cut from the original point of entry towards the udder.

You should now have an abdominal flap, that when folded down exposes the abdominal contents. Later this flap will serve to keep the organs contained within the carcass during removal of the animal.

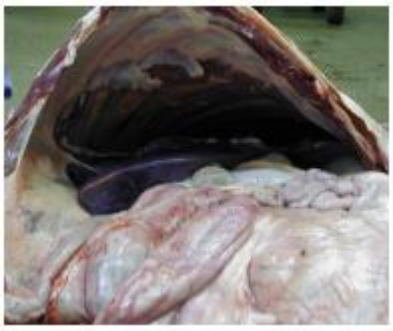
Examine the color, position and size of all of the organs. If you notice any fluid within the abdominal cavity, note the approximate amount and color of it.


The thick tissue covering the abdominal organs is called the Greater Omentum. This tissue acts as a "sling" for the abdominal organs. With one hand, grab the greater omentum towards the hip joint and cut it away from the body wall of the abdominal organs.

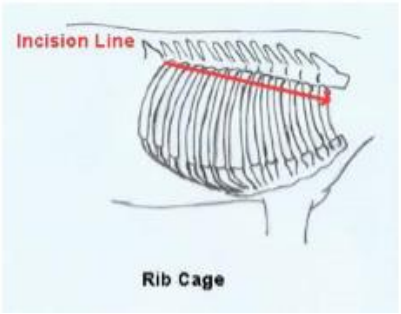
You should now be able to observe the abdominal organs. Examine the abdominal cavity for any adhesions, discoloration (i.e. black or bright red intestine) or masses.

- Topic 6: Thoracic cavity opening

Cut the entire right side of the diaphragm away from the rib cage. This allows for the first look into the chest cavity.



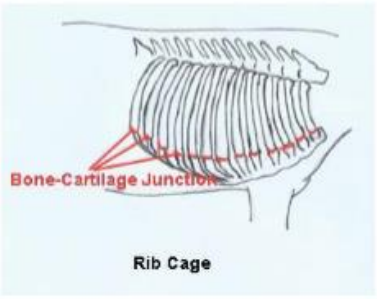
With your knife, cut the muscles covering the rib cage along the top of the rib cage, near where the ribs meet the spine.



With the rib (AKA bush) cutters or an ax, cut the ribs along the incision you just created in the muscle. There are 13 ribs that will need to be cut.

Lift up on the rib cage while cutting any tissue attaching the ribs at the incision site. Create a handle by cutting a hole in the muscles between the center of the ribs.

Push down on the ribs, fracturing them at the junction between bone and cartilage. This will create a tray that may be used as a cutting platform during the necropsy.



Now both the abdominal and chest cavities are exposed and can be examined for abnormalities. Any samples needed for culture (bacteria, virus, etc.…) should be taken now to decrease the amount of contamination of the sample.

For poultry dip the dead bird in antiseptic solution or in water to avoid feather contamination. Keep the birds on post-mortem table at vertebra column and look for any lesion or parasite on skin, then remove skin through a cut with the knife and with the help of fingers.

Expose thymus trachea, oesophagus in neck, break the coxo-femoral joint by lifting the legs, cut on lateral side of chest muscles. Lift the chest muscle dorsary and break bones at joints with thorax. Cut bone at both sides and remove muscles, bones, to expose thorax and abdomen.

- Topic 7: Viscera examination

A. Examination of the thoracic viscera

To remove the thoracic viscera, follow the step below:

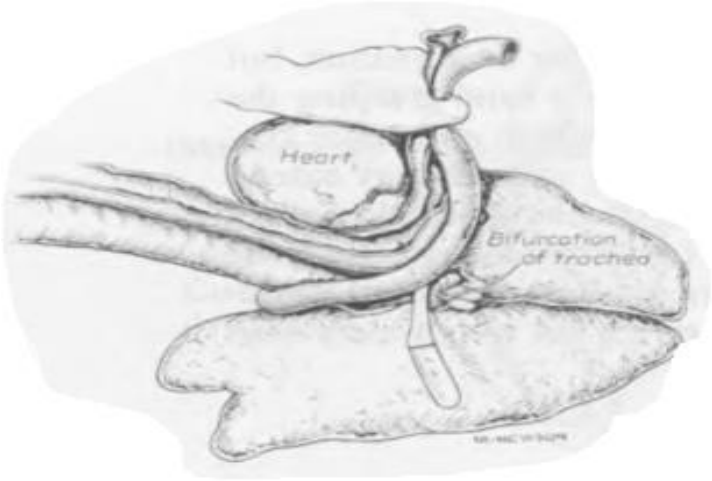
- Separate the mandibles at the symphysis.
- Cut along the lingual surface of both sides of the mandible.
- Loosen the tongue and pull it down between the rami.
- Disarticulate the hyoid bones; tongue, larynx, trachea and esophagus are dissected ventrally back to the thoracic inlet.

- Lift up viscera and detach heart and lungs from the body wall by cutting dorsal and ventral mediastinum. Include the aorta, post cava and esophagus back to about 2-3 cm anterior to the diaphragm.
- Sever and remove the thoracic viscera.

A.1. Examine thyroid, parathyroids, and thymus glands.

- Note size, shape, consistency, etc.
- Incise glands in large animals.
- Arrange the organs in approximately normal position.

A.2. Examine lungs



Follow the procedure below:

- Free the esophagus and the aorta from the dorsal caudal mediastinum to allow access to both bronchi. This is a commonly ignored step in the procedure, which allows unnecessary damage to the esophagus and aorta if not done.
- Leave the heart attached to the lung for best evaluation of the vessels involved and leave the lungs attached to the diaphragm to act as another third hand in pulling the oesophagus and trachea tight when cutting down each of them, and down the bronchi.
- Palpate the lungs gently and cut down the trachea and major bronchi and observe the cut ends of the pulmonary arteries for emboli. Incise the tracheobronchial lymph nodes. To cut down and examine the pulmonary arteries, it is best to turn the lungs over and cut from their ventral surfaces.

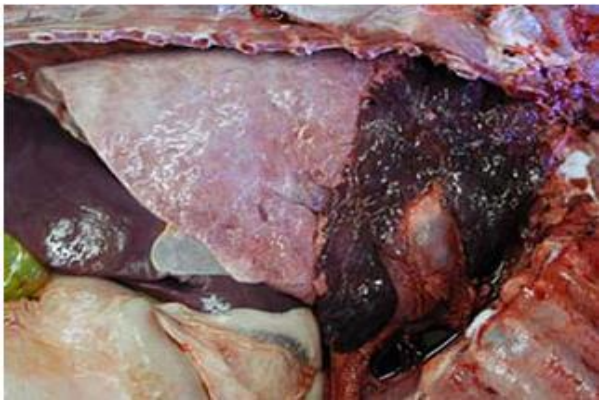
Note: Although shown isolated for better depiction in these drawings, it is wise to leave the heart attached to the lungs for the best orientation of major vessels and associated structures including malformations.

Lesions to be observed on the respiratory system are:

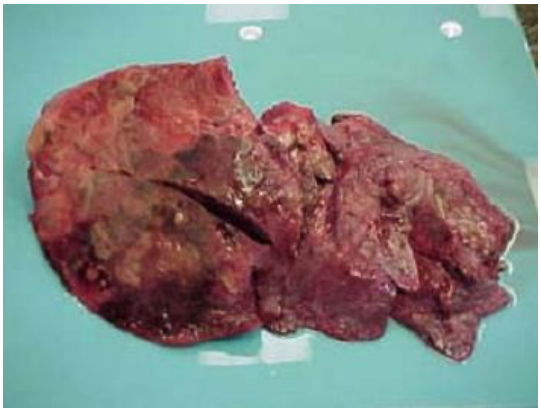
- Discharges from external nares

- Growth (granuloma/popy) in nasal passage if there is blood mixed nasal discharges.
- Trachea and bronchi: congestion, haemorrhage, presence of gaseous exudates, frothy exudates etc.
- Lungs: Congestion, consolidation, nodules, presence of exudates on cut surfaces, oedema, atelectasis, emphysema, hemorrhage, and necrosis.
- Mediastinal lymphnodes: oedema, hardening, calcification, congestion, hemorrhage.

Common lesions of the lungs



This is an example of bronchopneumonia. Notice how the bottom-front of the lung is darker than the rest of the lung. Usually this part of the lung will be heavier than the more normal, pink lung to the left. You will need to sample the darker tissue of this lung to find out the cause of the bronchopneumonia.

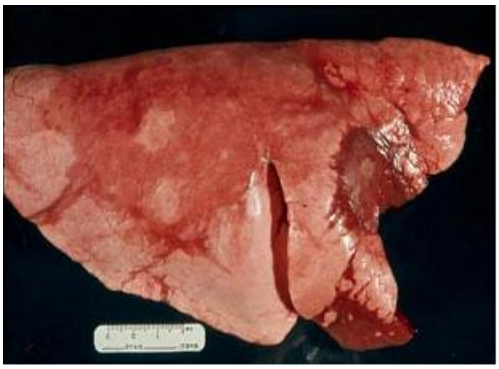


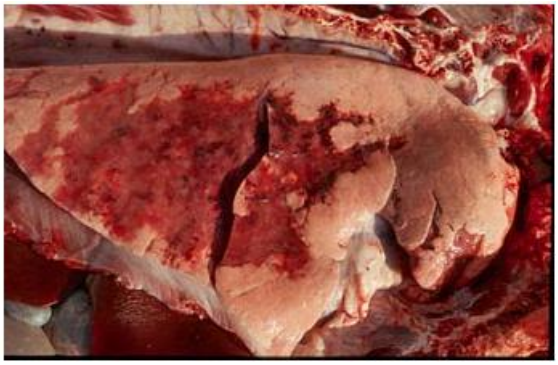
This is an example of chronic pneumonia. Notice how the lung looks darker (or redder) than normal pink lung tissue. This lung may be heavier than normal lung and will not have the "spongy" feel to it.

Here, one of the airways in the lung has been cut open. You can see feed-like material in the airway. This could be from the animal getting feedstuff in the airways during death or could have occurred prior to

death. Be sure to look closely at the surrounding tissue for any red and inflamed areas, or ulcers that may suggest that the feedstuff was there prior to death.

This is an example of an abscess in the lung. The white circles are the abscesses. When you cut into them they will either contain a runny yellow-white material or a cheese like material.





The above photos are of pneumonia. The red areas are the most affected and there may be some collapse of the lung in these areas.

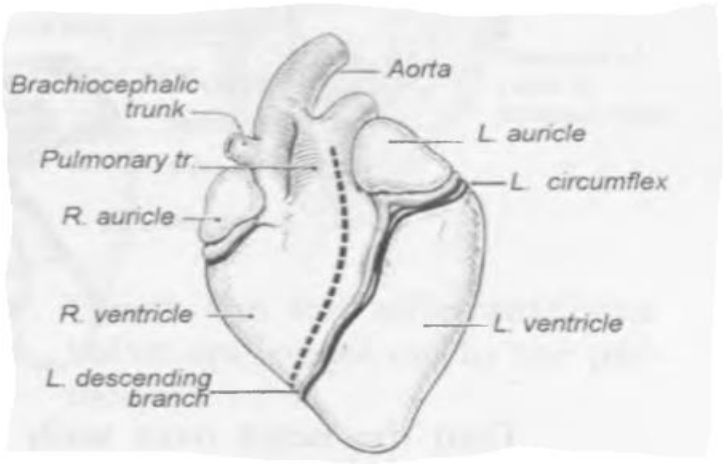
Common Lesions of the Trachea

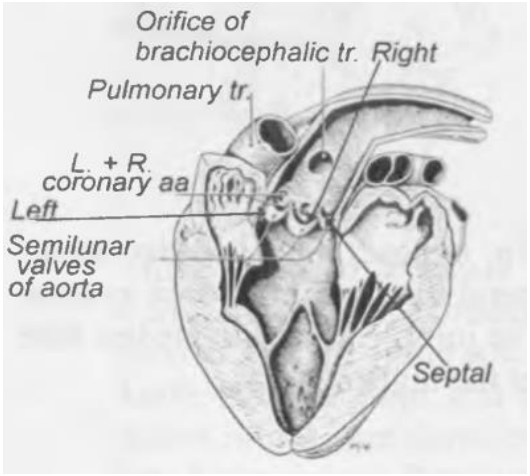
All of the photos above illustrate necrosis (dead tissue) of the larynx extending into the trachea. You may also see ulcers in this area.

A.3. Examine the heart

The heart should be weighed after examination, but before sections are taken. With a hand grasping the base of the heart, cut the pericardium and major vessels, the pulmonary artery, and aorta as they extend through the pericardium. All blood should be removed before weighing.

To open the right ventricle, hold the heart in your left hand, with the left side of heart towards you. Make the incision, starting at the pulmonary trunk, into the right ventricle, close to the inter-ventricular septum.





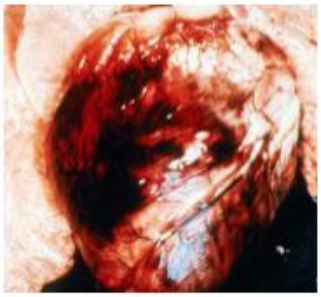
Procedure:

- Remove the heart from lungs at the level of large blood vessels.
- Observe any disproportion of parts (dilation, hypertrophy, anomalies) and alterations in shape. Note presence of normal adipose tissue.
- Open heart:
- Position the heart so that the right atraium faces the prosector. Cut through the right atrial free wall (including the auricle) horizontally. Examine the endocardium and vena cava. Examine the atrial side of the right A-V valve. Check for sufficiency of the valve and integrity of corda tendinea.
- Cut through the right A-V valve and wall of the right ventricle, keeping ghe incision near the septum. Continue the incision around the right ventricle through the pulmonic valve, and pulmonary artery. Examine for patent ductus arteriosus at this time.
- Open the left atrium and examine the same manner as the right atrium. Cut through the left A-V valve, incising the ventricle through the mid-portion of the free wall. Continue the incision to the apex. Make a horizontal incision in the ventricle approximately mid-way between the coronary groove and the apex, incising from the first cut to the septum. At the septum, cut upward through the aortic valve and aorta. This process should result in a small flap of left heart with aortic valve on one side and left A-V valve on the other.
- Examine vessels, valves and septa for anomalies.
- Examine endocardium and mycordium.

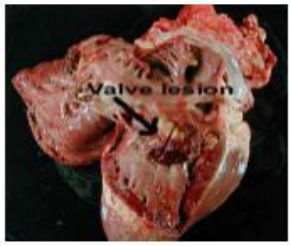
Lesion to be observed on the heart are the following:

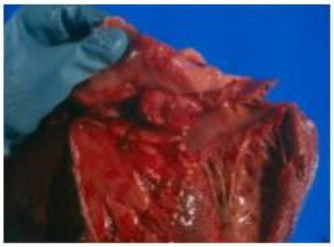
- Fluid, blood, pus in percardial sac
- Adhesions, fibrin, fibrosis
- Congestion, hemorrhage, necrotic foci
- Hardening of blood vessel, obstruction and Presence of parasites

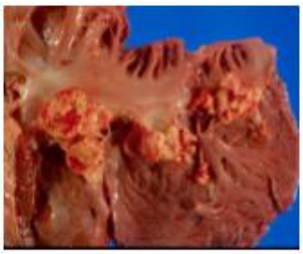
Common Heart Lesions



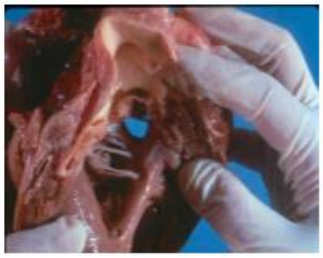
Notice the black areas of the heart. This is an indication of diseased or dead tissue.







Notice the "cauliflower" lesion on the walls of the hearts in these photos. This is a thrombus (blood clot adhered to a blood vessel or the heart) and is usually found on the valves of the heart.



The hearts in these photos each have a hole that is in the septum, middle wall of the heart, connecting the two sides of the heart.

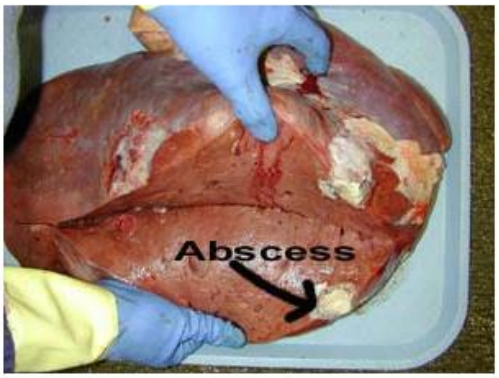
The following set of photographs depict an infection within the heart sac around the heart. In the photo to the left, the yellow material in the middle is surrounding the heart.

In the photos above, the heart sac has been opened and you can see that the heart is surrounded by fibrous material. This material is due to infection within the heart sac. This can be referred to as a "shaggy heart".

A.4. Remove and examine the liver

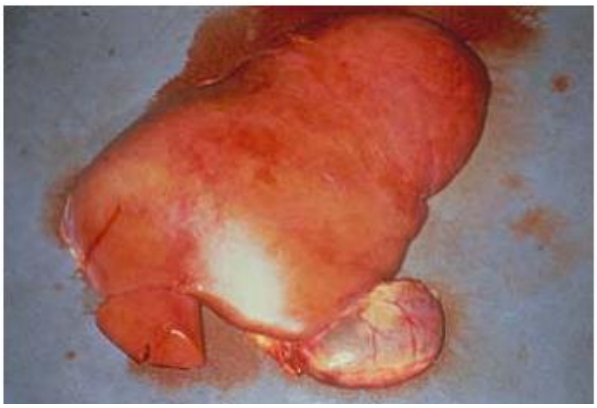
- Examine the peritoneal surface for fibrosis or adhesions.
- Free the liver from the diaphragm.
- Note the size, shape, weight, color and consistency.
- Open the gall bladder and the larger bile ducts. Examine for stones, inflammation, flukes, and thickening of wall.
- Palpate and incise the liver liberally from the abdominal surface. Look for necrosis, fibrosis, abscesses, etc.

Common lesion of the liver



Both of the above pictures are examples of liver abscesses. The abscesses are the yellow to white spots on the liver. Not all abscesses may be evident from the surface of the organ. It is important to cut into the organ to see if there is abnormal tissue or abscesses within the organ.

Note that this liver has a stripped appearance. This is an insignificant finding and is due to the animal laying on its side after death. The pressure against the rib cage forces the blood out and will cause a stripped appearance such as this.



This photo depicts a fatty liver. These livers will appear pale, have rounded edges, and may float in water.

B. <u>Examine the abdominal viscera</u>

Remove the spleen. Examine grossly and incise several times.

Examine pancreas grossly.

Incise the duodenum adjacent to the bile duct. Squeeze gall bladder to see if bile enters the intestine.

Remove the stomach and intestines to the rectum:

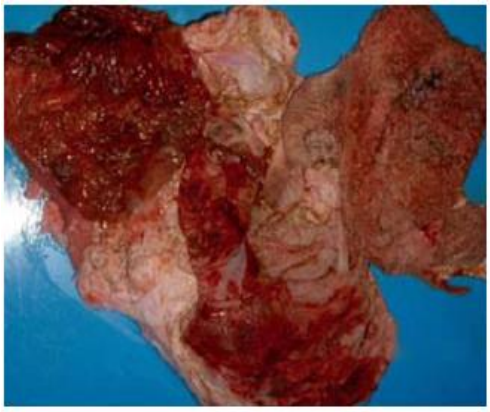
- Place the rectum over the lumbar area when it is cut so that the abdomen will not be contaminated.
- Free the intestine from the mesentery as it is removed and observe its lymph nodes.
- The examination of the gastro-intestinal tract is postponed until last so that instruments are not contaminated.

Examine the adrenal glands before kidneys are disturbed. Cut adrenals in cross section and note cortical-medullary ratio.

Remove genito-urinary organs as a unit, including the vulva, rectum and anus:

- Cut each kidney longitudinally in half from the convex surface to the hilus and note alterations in color, consistency, size, etc.
- Strip off capsule and examine the kidney surface. Note ease with which the capsule comes off.
- Open and inspect the ureters, bladder and urethra. Inspect all mucus and serous surfaces.
- Open vagina, cervix and uterine horns along their dorsal borders and examine carefully all surfaces.
- Examine ovaries for cystes, corpora lutea, atrophy etc.
- Observe male accessory sex organs. Observe size, consistency, inflammation, etc.

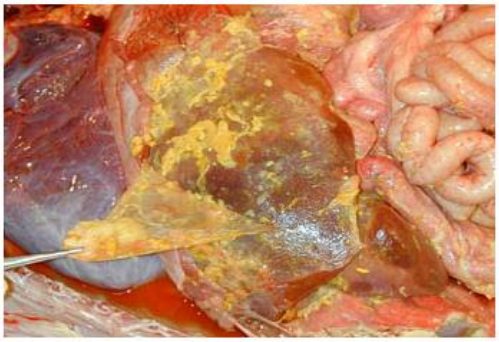
B.1. Common lesions of the Fore-stomach



This abomasum has hemorrhage (bleeding) and ulcers (irregular surface). You may also see air pockets in the abomasum which may be caused by bacterial organisms such as Clostridium.

This is an example of a displaced abomasum. Note that the abomasum is above the rumen when it should be under and slightly in front of the rumen.

The above photos depict an infection in the abdomen, called peritonitis. The yellow material is a fibrin and may be easily pulled off of the tissue surface depending how long the disease has been going on

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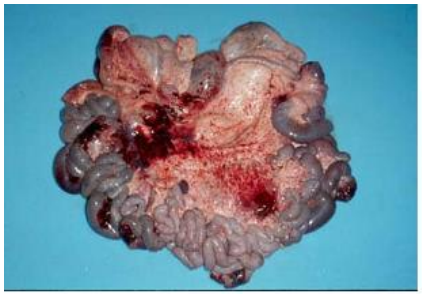
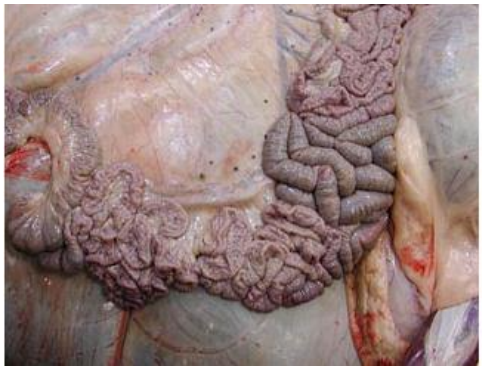
B.2. Common lesions of the Intestine

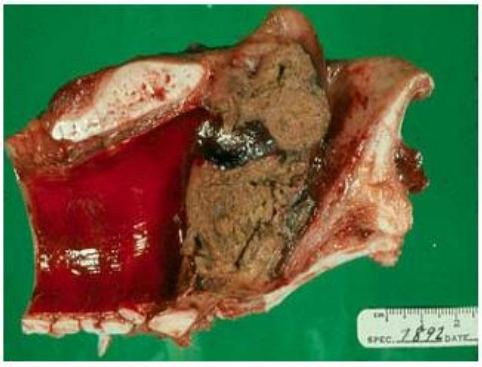


All of these photos demonstrate bowel that is full of clotted blood.



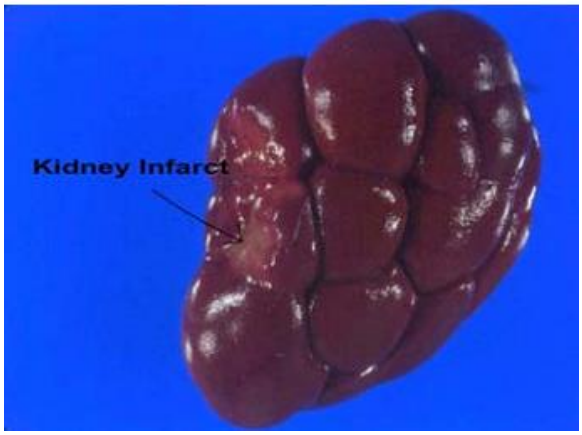

Notice the black dots in the mesentery (tissue connecting the loops of bowel) surrounding the intestine. These are commonly found and are of no significance.

B.3. Common Lesions of the Oesophagus

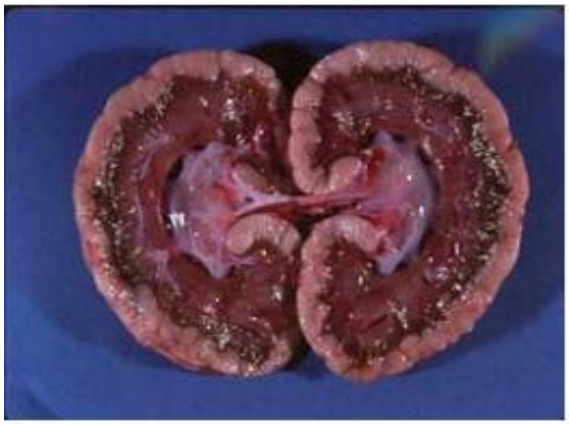



The above photos show foreign material or feed material that is caught in the esophagus (left photo) or the larynx (right photo). You may see some food material in the esophagus as well as the larynx and trachea due to death. Be sure to look closely at the surrounding tissue. If it looks red and inflamed or contains ulcers, it is likely that the food material was there prior to death.

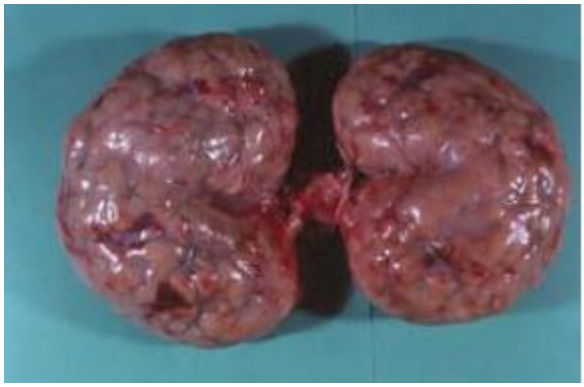
B.4. Common lesions of the kidney



Notice the pale indented area on the kidney. This may be due to a decrease in oxygen or blood to the kidney causing an "infarction"



Notice how the outer layer of the kidney (cortex) looks thin and pale compared to the inner layer (medulla).



This is the outer surface of the kidney above. Here you can see that it looks scarred and small. This indicates a chronic disease of the kidney.

Common Lesions of the Bladder

This bladder has many ulcers in it. Notice that the surface is not light pink and smooth like a normal bladder. The red areas are hemorrhage and the yellow areas are fibrin (inflammation).

This bladder is red to black due to bleeding (hemorrhage) caused by trauma.

Common Lesions of the Uterus

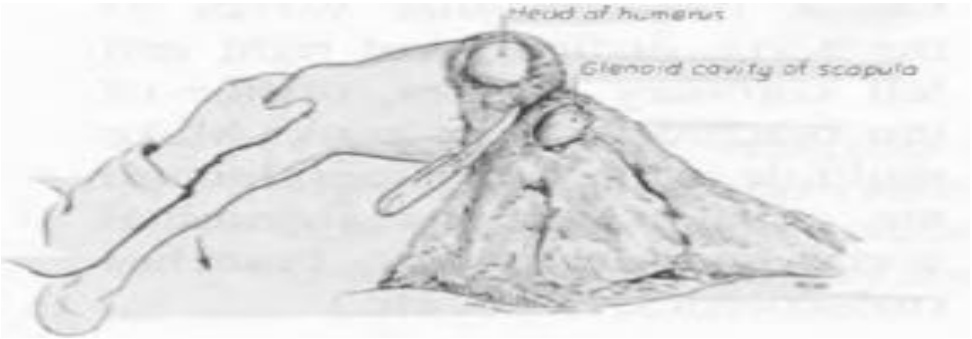
Notice how the uterus is taking up the entire abdomen. This is seen in a condition called Hydrops. The uterus is filled with fluid.

The pink tissue in this photo is normal uterine tissue. The rest of the tissue is the inner part of the uterus that is infected and inflamed.

- Topic 8: Examination of muscles, joints and bones

Consider the following steps:

- Open the stifle, hock, and humero-scapular joints. (To open the stifle cut the straight patellar ligament 1/3 the way proximally to the tibial tuberosity and medial to the trochlea of the femur and reflect the patella). Observe synovia, articular surfaces, articular cartilages and synovial membranes.
- Examination of the muscular system. Examine and incise the muscles of various parts of the body especially lumbar and thigh muscles. Check development, color, etc.
- Examination of the skeletal system:
  - Rib previously examined.
  - Examine body for broken bones or healed fractures.
  - For marrow inspection, saw out the centre of body of a thoracic vertebra, or observe it in the rib, humerus or femur.

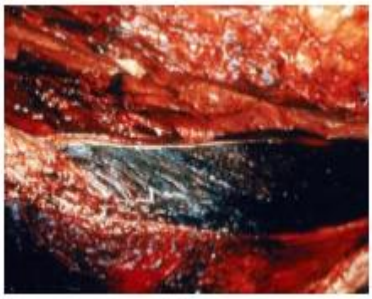


Lesions to be observed are:

- Congestion
- Hemorrhage
- Oedema

- Nodules
- Anemia
- Icterus
- Fat deposit
- Necrosis on muscles, hardening, calcification

Common Lesions of the Muscles and Joints


This photo is of an open joint. The yellow material seen in the middle of the joint is due to infection. This material is thick compared to the normal joint fluid and the black muscle is dead tissue.

- Topic 9: Examination of the head

To examine the head, follow the procedures below:

- Remove the head from body at atlanto-occipital articulation. Incise the spinal cord before excessive traction is placed on the skull.
- Reflect skin and muscles of head and examine skull for traumatic lesions.
- Remove the brain as described below:
  - Make a transverse cut behind orbits (varies in species), using saw, cleaver of axe.
  - Make lateral cuts from ends of transverse cuts just medial to the occipital condyles (leave room for brain to be removed intact.
  - Lift off bony cap carefully with a chiesel. Incise the dura over the dorsal brain surface and incise the tentorium cerebelli.

- Hold the skull with the nose pointing upward and tap it gently on the table. Carefully cut the olfactory tracts and other cranial nerves and allow the brain to slip out. Avoid traction on the brain.
- Remove the pituitary gland by cutting diaphragmatic sella on both sides, clipping the bony projection around the gland with scissors.

- Observe the dura.
- Incise the brain transversely (slices every centimeter) and look for lesions. (When whole brain is to be fixed, make only one transverse cut into lateral ventricles so fixative can enter).
- Use striker saw to expose the spinal cord in small animals (not routine) by cutting through the vertebral column longitudinally, just off center, with band saw or axe.

Lesions to be observed are:

- Congestion, haemorrhage, hematoma.
- Oedema, swelling.
- Abscess.
- Hypoplasia.

L O 3.5 – Interpret necropsy findings

- Topic 1: Analyse necropsy findings

After the systematic examination of all individual organs (skin, musculoskeletal, hemolymphatic, respiratory, cardiovascular, digestive, urinary, reproductive, endocrine and nervous systems, body cavities, and sensory organs), any lesion should be thoroughly described, and if possible, documented with photographs. If necessary, the prosector (especially a less experienced one) can follow a necropsy protocol in order to avoid overlooking a specific organ, writing down the gross findings immediately after the conclusion of the necropsy. The purpose is to describe the lesions observed in the most objective and detailed way, providing elements such as location, distribution, colour, size, shape, consistency and extent, as applied.

Only after the gross description, the prosector provides an interpretation of the necropsy findings. The interpretation of the pathologic process requires experience and is usually best done by a veterinary pathologist, which ultimately presents a morphological diagnosis. A definitive diagnosis can be achieved at this point (based on the available gross descriptions, the animal clinical history, and symptoms), or obtained after the integration of additional analysis, such as histopathology or other laboratory tests.

In fact, if histo-pathological evaluation is performed, the description of the microscopic changes associated with the gross observations represents an ensuing element of the necropsy report. Whenever performed, a list of additional laboratory studies should be provided, such as bacterial and/or viral cultures.

- Topic 2: Make diagnosis

Ideally, a necropsy ought to be performed by a veterinary pathologist; yet, this is frequently not possible and in a large number of cases the necropsy exam is carried out by a clinician, who usually has to pass on its findings to the pathologist in order to obtain a final diagnosis.

Although gross lesions recognized in the necropsy are frequently indicative of a particular pathologic process or disease, necropsy lesions are commonly not specific and oblige to additional diagnostic procedures to confirm or establish a definitive diagnosis. Whenever histopathology is required, the prosecutor is asked to send an objective and accurate gross description of the observed lesions, along with the selected samples. In fact, in most instances, the veterinary pathologist evaluates a rather small tissue fragment, which endows with great importance the macroscopic description, especially if he did not perform the necropsy.

- Topic 3: Write necropsy report

The gross and histo-pathological reports will include written descriptions of what the pathologist saw during each of the examinations and a list of any and all abnormal findings ranked based on the relative importance of each abnormality to the animal and its clinical signs. The final report of the histo-pathologic findings will also include the results of any serologic, microbiological, molecular, or other testing done, and will integrate all the gross, histo-pathological, and ancillary findings to explain, to the extent possible, the disease process in the animal. Interpretive comments may also be included.

Necropsy reports vary between institutions and are not standardized, yet, it is universally accepted that the report should be written in the present tense. The initial sentence should record the identification (sex, breed, age, and approximate weight) and general condition of the animal, considering its nutritional status. The hair coat, body orifices, presence of scars and superficial lesions/tumours, and malformations (especially neonates) should then be considered.

References

- ✓ Graham, D. L. 1992. Checklist for necropsy of the pet bird and preparation and submission of necropsy specimens - A mnemonic aid for the busy avian practitioner. AAV Introduction to Avian Medicine and Surgery, New Orleans, LA, USA, pp. 1-4.
- ✓ Lowenstine, L. J. (1986) *Necropsy procedures,* Philadelphia, Pennsylvania. Pp. 298 - 309.
- ✓ Latimer, S. L., and P. M. Rakich. (1994) *Necropsy examination*, Wingers Publishing, Inc. Lake Worth, FL, USA. pp. 355-379.
- ✓ Dorrestein, G. M. 1996. *Cytology*, BSAVA, London, UK. Pp. 55-62
- ✓ Dorrestein Gerry M. and Wit, Martine de (2005) Chapter 7. *Clinical pathology and necropsy*, 2nd ed. N. Harcourt-Brown and Chitty J. (eds). pp. 60-86.
- ✓ Dorrestein, G. M. 1997. Diagnostic Necropsy and Pathology and Avian Cytology. WB Saunders, Philadelphia, Pennsylvania, USA. Pp. 158-169 and pp. 211-222.
- ✓ https://medicaltools.com/shop/pub/media/catalog/product/cache/image/bcf7ce64d63d93f1f374273bba74938d/v/e/veterinary-post-mortem-kit1.jpg (Retrieved on November 14th, 2020)
- ✓ http://www.vet.cornell.edu/nst/nst.asp (Retrieved on November 14th, 2020)
- ✓ http://www.cdphe.state.co.us/op/regs/solidwastehazmatregs.asp(Retrieved on November 14th, 2020)
- ✓ https://www.quickmedical.com/healthmark-lint-free-disposable-instrument-cleaning-wipes.html?sku=53929(Retrieved on November 14th, 2020)
- ✓ www.aabp.org/euth.pdf(Retrieved on November 14th, 2020)
- ✓ http://www.aun.edu.eg/developmentvet/Internal%20medicine/amly3.htm#:~:text=The%20visible%20mucous%20membranes%20are,of%20certain%20other%20disease%20conditions. (Retrieved on November 14th, 2020)
- ✓ http://www.ufrgs.br/ceua/normas/diretrizes-da-pratica-da-eutanasia-concea-2013(Retrieved on November 15th, 2020)
- ✓ https://lib.dr.iastate.edu/iowastate_veterinarian(Retrieved on November 15th, 2020)
- ✓ https://tuttnauer.com/blog/autoclave-sterilization/preventing-the-spread-of-infection-in-hospitals(Retrieved on November 15th, 2020)
- ✓ https://www.cdc.gov/infectioncontrol/guidelines/disinfection/index.html#r14(Retrieved on November 15th, 2020)

Appendices

The kit is designed for both Small and Large Animals.

Kit Contains:

- Mayo Scissors 23cm Straight
- Bowel Scissors 21cm
- Mayo Scissors 17cm TC Straight
- Dissection Scissors 14.5cm S/B Straight
- Boning Knife Sharp
- Skinning Knife Curved

- Skinning Knife Curved
- Autopsy Knife Curved
- Chopper Stainless
- Bone Saw
- Postmortem Hammer
- Knife Sharpener
- Scalpel Handle #4
- Scalpel Handle #3
- Measuring Tape 2M
- Spine Wrench
- Brain Knife
- Dressing Forceps 16cm
- Liston Bone Cutting Forceps
- Bone Chisel
- Kelly Forceps 14cm Straight
- Kelly Forceps 14cm Curved
- Tissue Forceps 1:2 16cm
- Metal Box

Necropsy Check List

Date_____

Animal ID_____

Pen Number_____

Point in lactation_____

Was this animal euthanized, if so how? _____
_____

Clinical History _____
_____
_____
_____
_____
_____

Other animals similarly affected_____
_____
_____
_____
_____

Blood from nose, rectum, vulva, eyes, etc…_____
_____
_____
_____
_____

Body Condition_____

Systems Review

Oral Cavity_____

Heart_____

_____

Lungs_____

_____

Kidneys_____

_____

Liver_____

_____

Intestines_____

_____

_____

Rumen_____

Reticulum_____

Omasum_____

Abomasum_____

Bladder_____

Uterus_____

_____

Udder_____