RESEARCH PROGRAM ON Livestock

More meat, milk and eggs by and for the poor

Field postmortem examination training module

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Contents

Introduction 1

Section 1. Before the field 4

Unit 1. Overview of postmortem examination 4

Unit 2. Personal safety and site consideration during postmortem 6

Session 2.1 Selecting appropriate sites for postmortem operation 6

Session 2.2 Appropriate time for field postmortem examination .....

Session 2.3 Appropriate application of personal biosafety measures 10

Session 2.4 Postmortem equipment 11

Section 2: Protocols and procedures in the field 15

Unit 3: History taking and external examination 15

Session 3.1 Taking history of dead animals 16

Session 3.2 External examination 18

Unit 4. Body cavity opening, organ examination and identification of common postmortem lesions 21

Session 4.1 Body cavity opening and organ examination 21

Session 4.2 Identification of common postmortem lesions 29

Unit 5. Collection, labeling and preservation of postmortem examination specimens 40

Session 5.1 Sample collection and labeling 40

Session 5.2 Preservation of postmortem examination specimens 46

Unit 6: Examination of fetus and placenta 49

Session 6.1 Examination of aborted fetus 49

Session 6.2 Examination of placenta 51

Section 3. Data documentation, reporting and submission 53

Unit 7. Data documentation 53

Unit 8. Reporting and submission 54

Introduction

Module description

The Field Postmortem Examination Module is designed for animal health professionals with different years and depth of training and experience. A small number of them are diploma holders taking basic animal health courses. Most of them are DVM and BSc in animal health. All targeted animal health professionals have similar backgrounds and tasks.

The module is intended to be used by training facilitators to prepare for training events as well as during training delivery. In addition to providing the curriculum, the module provides learning activities for each learning session to guide training facilitators and provide them with a worked example. Otherwise, training facilitators are encouraged to innovate and adapt the learning process and methodology during the actual delivery of the training.

The training course is organized into three sections (before the field, in the field and after the field) to break the learning down into logical, manageable learning units. Animal health professionals will learn about the process of conducting a postmortem examination in a field setting as a diagnostic tool to improve herd health.

Learning goal and objectives

The goal of the training course in field postmortem examination is to enable animal health professionals to use postmortem examination as a diagnosis tool self-reliantly to improve herd health.

By the end of the module, participants will be able to:

- Correctly apply personal safety measures
- Select appropriate necropsy sites during postmortem examination
- Correctly use recording sheet and record relevant data from individual dead animal and herd
- Undertake physical examination of dead animals by properly applying procedures for physical examination
- Open and inspect body cavity in proper position following correct procedure
- Correctly apply steps for proper organ removal, examination and dissection
- Identify and describe abnormalities based on pathological characteristics
- Make decision on identification of appropriate samples based on lesion
- Take sample using appropriate procedure and sampling materials
- Demonstrate sample labeling using appropriate materials
- Preserve and submit specimens using appropriate preservatives along with recorded information
- Apply correct fetus and placenta examination
- Identify abnormalities (lesions) of major abortion causing diseases
- Demonstrate appropriate data documentation and reporting based on recording checklist and format
- Take and label the photo of lesion and environment with digital camera
- Demonstrate how to destruct the carcass safely

Module content

- Personal safety and site consideration during postmortem
- History taking and external examination
- Body cavity opening, organ examination and identification of common postmortem lesions
- Collection, labeling and preservation of postmortem specimens

- Examination of fetus and placenta
- Data recording and reporting

Training approach and methods

Learning is enhanced when learners have defined learning goals and expected utility of the learning. Self-management tools such as keeping learning logs can ensure that learners work consistently and actively throughout the course. They need to engage in the learning activities and reflect from time to time what they have learnt, and how they can apply it in the work place.

Active learning methods will be applied throughout the course. Learners will be encouraged to reflect on their experiences, to work on case studies, to analyse different scenarios, and to discuss how they can apply the learning in different contexts. Conceptual, practical and assessment phases of the learning process will be integrated throughout the learning course.

The course delivery can take different modes. Primary, the course is delivered in a face-to-face learning delivery approach. Eventually, it can be delivered in a blended learning modality where training facilitators will provide in class support through multimedia as well as online post-training support through job aids and online course materials.

Learning materials and resources

A variety of materials and resources will be available to support learning during and after training such as presentations, handouts, videos, illustrations, job aids, training plan, and learning assessment and self-management tools.

Course duration

The learning course has both theoretical and practical sessions. A complete grasp of the course will take two days training time.

Learning assessment methods

Different learning assessment tools will be used to help learners get the most out of the training process. Learning assessment exercises will be conducted before, during and after the training course. This will help facilitators check progress and level of learning to make corrective measures, provide additional support, or promote new levels of learning.

Pre- and post-training evaluations will be used to establish the baseline and measure learning gains of learners by the end of the training. Knowledge, attitude and skill tests will be developed based on module content and learning objectives. These will be in the form of multiple-choice questions, True or False questions and short answer questions. This will provide some indicators of learning through pre- and post-test differentials.

During the training, there will be formative evaluations to monitor the learning progress. Formative assessments will be used to measure learning of key concepts and processes in each session in the form of short quizzes before moving on the next section. The assessments should be only 3–5 questions for each topic and in a multiple-choice format. Low scores on the formative assessments would prompt the learner to review that section. This will also enable training facilitators to review any low scores and provide learners with additional support.

Additionally, interviews with participants can be conducted after the training event. Key informant interviews will be held with selected trainees later. This timescale will be decided by the estimation of when these skills will be used outside the workplace. A typical timeframe is between three and six months after the training. The data will measure how much perceived transfer of knowledge and skills has occurred. Other elements will also be included to look at more than knowledge retention. It will include measures of their ability to apply the training and opportunities to apply the training.

Table 1. Learning elements and performance criteria

Learning elements	Performance criteria
Prepare to conduct postmortem examination	• The site for the postmortem is selected and prepared. • Correct clothing, equipment and resources are obtained and prepared for use. • The dead animal to be examined is moved to the postmortem area. • All relevant preliminary information about the dead animal to be examined is obtained and collated. • Abnormal characteristics that may indicate the presence of notifiable and potentially hazardous conditions or diseases are identified and appropriate action is taken. • Occupational health and safety hazards associated with the procedure are identified and appropriate action is taken to protect self and others.
Carry out field postmortem examination	• External assessment of the dead animal is carried out and outward signs of abnormalities or injury are noted. • Dead animal is dissected using appropriate techniques and equipment to avoid cutting into organs or stomach cavity. • Organs, tissues and structures are properly examined. • Samples of organs, other tissues and fluid samples are taken, where appropriate, and prepared in accordance with laboratory requirements.
Complete field postmortem examination	• Carcass is disposed of using appropriate equipment and procedures. • Correctly labelled and packaged samples are sent for analysis. • All information about the dead animal examined and the records of observations made during the postmortem are collated and forwarded to the relevant persons for analysis and diagnosis together with captured photos. • Post mortem area and equipment used are cleaned and disinfected. • Personal biosecurity cleanup is completed.

Section 1. Before the field

The section introduces participants to basic concepts and preconditions and prepares them before going to the field. It covers site selection, personal safety, time and equipment for sample collection.

Unit 1. Overview of postmortem examination

Learning objective

By the end of the unit, participants will be able to:

- Explain importance of postmortem for herd health
- Use postmortem as a diagnosis tool

Learning content

- Importance of postmortem for herd health
- Using postmortem as a diagnostic tool

Learning methods and materials

- Brainstorming
- Interactive presentation

Estimated time: 30 min

Learning activities

1. Introduce the topic by asking the following questions: “Why do you perform a postmortem examination?” “What are your questions (purposes), expectations and plans for doing postmortem examination?”

2. Brainstorming. What is the role of postmortem in herd/flock health?

3. In plenary, write down responses on a flipchart paper. Go through the responses and identify communalities and differences.

4. Provide a summary presentation on the purpose of postmortem as a diagnostic tool.

Training notes

Use of postmortem as a diagnosis tool

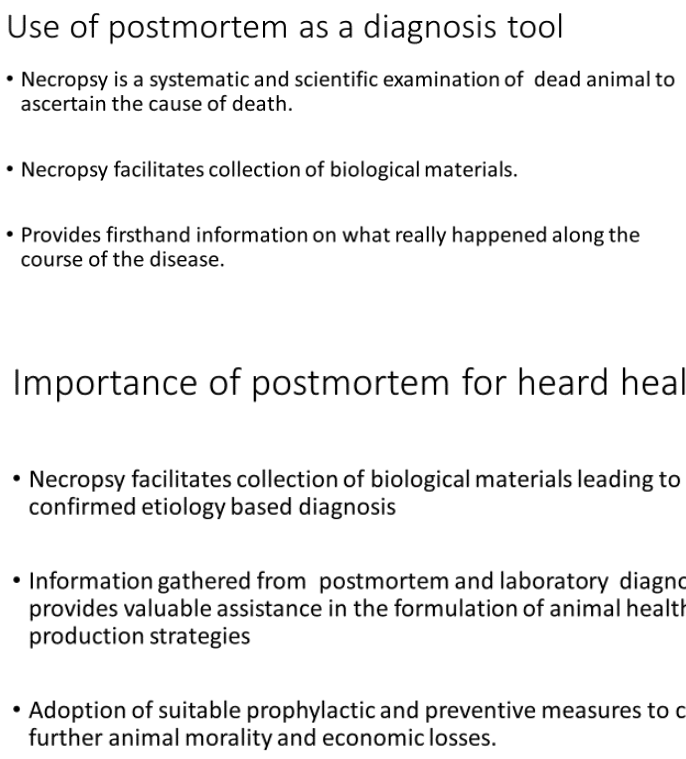
- The primary aim of necropsy is to determine the cause of death of an animal by defining possible etiology and pathogenesis to arrive at diagnosis.
- Determination of the cause of death in small ruminant in field condition is often difficult due to lack of specific clinical symptom and difficulty in collecting suitable biological material from sick animal for laboratory investigations.

- A necropsy may be conducted to gain diagnostic evidence of unknown or suspected antemortem disease.
- Increased mortality or morbidity among a population of animals calls for an investigation into the cause.
- Necropsy facilitates collection of biological materials and provides firsthand information on what really happened along the course of the disease.
- A thorough and systematically performed necropsy with all the information gathered, accurately recorded and interpreted provides valuable assistance in the formulation of animal health strategies aimed to prevent and control animal diseases in a herd or flock.

Importance of postmortem for herd health

- Information about the gross pathological changes in different vital organs facilitates collection of biological materials leading to its confirmed etiology-based diagnosis with subsequent adoption of suitable prophylactic and preventive measures to check further abortion, lamb/kid morality and economic losses.
- Correct postmortem and sampling will increase the likelihood of a definitive diagnosis.
- Postmortem examination is a message of wisdom from the dead to the living.

PowerPoint slides



Unit 2. Personal safety and site consideration during postmortem

The unit covers site selection and preparation, safety procedures, doing necropsy within specific time after death of animals, and preparing required equipment to perform postmortem examination.

Learning objectives

By the end of the unit, participants will be able to:

- Select appropriate necropsy sites for postmortem examination
- Correctly apply personal safety measures
- Make decision for doing necropsy considering length of time after the death of the animal
- Prepare necessary materials and equipment for doing necropsy

Learning content

- Site selection for postmortem operation
- Time factor of postmortem operation
- Personal biosafety measures
- Postmortem equipment

Learning methods and materials

- PPT presentation
- Display and demonstration of equipment
- Group discussion
- Checklist of equipment

Approximate time

Two hours

Session 2.1 Selecting appropriate sites for postmortem operation

Learning objectives

By the end of the session, participants will be able to:

- Explain why postmortem examination should not be conducted near sources of animal feed, water and healthy animals
- Conduct postmortem in places with sufficient light
- Prepare a pit beforehand for carcass disposal
- Select sandy places for doing postmortem examination
- Explain the reason why dead animals should be examined in places where they are dead.

Learning content

- Criteria for selecting appropriate sites for doing postmortem examination

Methods and materials

- Brainstorming
- Interactive presentation
- Site selection checklist for postmortem operation

Approximate time

30 minutes

Learning activities

1. Introduce the topic. In the previous session, we have seen the purpose of postmortem examination. In this session, we will learn about necessary preparations for postmortem examination.

2. Brainstorming: Draw a circle on a flipchart. In the circle, write ''Necropsy site selection''.

Ask participants to brainstorm ideas that come to their mind associated with site selection for postmortem examination.

Ask them to first work individually and then in pairs.

3. Ask small groups to report on their responses. Write responses on a flip chart.

4. In plenary, discuss key features of the responses and give a summary presentation of criteria for site selection for postmortem examination.

Training notes

Necropsy site selection

- Extreme care should be taken in selecting sites for postmortem examination when it is to be done in field condition.
- Ideally dead animal can be examined at the place or close to the place where they were found dead. The dead animal usually must be examined at the place where they are located not to contaminate the environment (biosafety). In such case, the natural orifices of the carcass should be plugged with cotton soaked in a disinfectant solution.
- Select none absorbing area for post mortem or use a tarpaulin as protection under the carcass.
- If a cement floor is available (which is rarely the case), this greatly facilitates subsequent disinfection.
- The site for postmortem examination should be away from sources of feed and water.
- Site should not be on a height, better in a valley.
- Avoid sites frequently visited by other animals.
- Predators and other biological vectors of diseases should not be allowed access to the examination site.

- Necropsy should be done in sufficient light preferably broad day light.
- While doing postmortem examination in the field, restrict yourself from the healthy animals.
- Dig a pit about two meters deep so that predators cannot have easy access to the disposed cadaver at suitable site and minimize the chances of contamination and pollution
- If incineration is to be the chosen method of disposal, fire risks should be considered.

PowerPoint slides

Necropsy site selection

- Dead animal should be examined at the place where they are located.
- Select none absorbing area for post mortem or use a tarpaulin as protection under the carcass
- The site for postmortem examination should be away from sources of feed and water.
- Necropsy should be done in sufficient light preferably broad day light.
- While doing postmortem examination in the field, restrict yourself from the healthy animals.
- A pit may have to be dug to dispose of the carcass, so a site where this is feasible should be chosen.
- If incineration is to be the chosen method of disposal, fire risks should be taken into account.

Figure 1. Pit to dispose carcass after necropsy

Place the animal on its left side on taurpaulin covered table. Dig a pit for carcass disposal (right).

Session 2.2 Appropriate time for field postmortem examination

Learning objectives

By the end of the session, participants will be able to:

- Explain why necropsy should be conducted as early as possible after the death of the animal

Learning content

- Postmortem changes (autolysis)

Methods and materials

- Brainstorming
- Plenary interactive discussion
- Summary presentation

Approximate time

30 minutes

Learning activities

1. In small groups, ask participants to discuss the following question: “When should necropsy be conducted and why?”

2. In plenary, ask small groups to share their responses. Write the responses on a flipchart paper and reflect on key issues.

3. Briefly discuss postmortem changes (autolysis) and explain why postmortem examination should be done as early as possible after the death of the animal.

Training notes

Necropsy should be conducted as early as possible after death to avoid postmortem changes. Whenever possible, an estimate should be made of the time of death. Samples must be collected within 24 hours of death, preferably less in regions with high temperatures.

PowerPoint slide

Appropriate time for field postmortem examination

- Necropsy should be conducted as early as possible after death to avoid postmortem changes.
- Whenever possible, an estimate should be made of the time of death.
- Samples must be collected within 24 hours of death

Session 2.3 Appropriate application of personal biosafety measures

Learning objectives

By the end of the session, participants will be able to:

- Explain why they should wear protective clothing
- Identify and wear required protective clothing during field postmortem operation
- Explain what decisions they should make before handling and dissecting dead animals

Learning content

- Risk of zoonotic diseases including which carcasses should not opened (anthrax)
- Personal protective equipment
- Decisions before handling and dissecting dead animals

Methods and materials

- PPT
- Training notes

Approximate time

30 min

Learning activities

1. Draw a circle on a flipchart paper and write “Zoonotic diseases” in the center. Ask participants to brainstorm ideas related to zoonotic diseases.

   Write responses on a flipchart paper. Highlight risks to zoonoses when handling sick animals.

2. In plenary, ask participants why they should wear protective clothing during field postmortem operation. Brainstorm personal protective equipment. Provide summary by highlighting key issues from the discussion.

3. In plenary, discuss what decisions they should take before handling and dissecting dead animals.

4. Conclude the session by highlighting key points using a PowerPoint presentation.

Training notes

- Before the postmortem examination of a dead animal commences, it is important to consider the circumstances of the illness and death of the animal and to assess the likelihood that the cause may have been a zoonotic or notifiable disease.
- Never open a carcass suspected of have died of Anthrax
- Extra precautions must be exercised when handling and dissecting dead animal, which may have died of a zoonosis.

- One should be aware of the risks involved and should wear appropriate protective clothing to avoid any accidental infection of zoonotic diseases.
- Zoonoses are transmissible to humans and some can result in serious and often life-threatening infections.
- These infectious agents easily spread among animals and humans in all farming systems.
- In view of the above, any person conducting an autopsy on any dead animal should be aware of the risks involved and should wear appropriate protective coverings like gum boots, apron, gloves, face mask and head cover to avoid any accidental infection of zoonotic importance.
- Finger rings, wrist watches and other such objects should be removed before handling the carcass for necropsy examination.
- Wash hands and equipment with soap or detergent after sampling.
- Pregnant women should avoid postmortem examination or sampling of the carcass.
- Great care must be taken to ensure that all specimens taken from a carcass are collected, stored and transported safely and that there is no risk of the escape of infective material.

Figure 2. Necessary precaution before post-mortem examination

Wear appropriate protective clothing to avoid any accidental infection of zoonotic diseases.

Session 2.4 Postmortem equipment

Learning objectives

By the end of the session, participants will be able to:

- Identify and prepare necessary postmortem kits to conduct safe and satisfactory field postmortem examination
- Explain why they need to clean equipment after postmortem operation

Learning content

- Field postmortem kits (dissecting, sampling, personal protection, disinfectant, fixatives)
- Cleaning equipment after postmortem operation

Method and materials

- Presentations
- Display and demonstration of postmortem kits
- Training notes

Approximate time

30 minutes

Learning activities

1. Brainstorming: In plenary, ask participants what equipment they would use to do postmortem.

2. Write responses on a flipchart paper. Review and categorize the responses.

3. In plenary, discuss the use of each of the equipment and why and how to clean them after postmortem operation.

Training notes

Postmortem equipment

Appropriate equipment should be used to conduct a safe and satisfactory field postmortem examination. The postmortem kit should include dissecting and sampling collection instruments, personal protection clothing, and other helpful instruments such as digital camera (Figure 3).

Figure 3. Basic postmortem equipment

Dissecting

- curved and straight knife
- rat-toothed forceps
- a sterile scalpel and blades
- a large pair of bone forceps or bone-cutting shears
- a sharpening stone and steel

Sampling

- sterile disposable 5 ml syringes and sterile needles (20 g)
- culture tubes with sterile swabs
- microscope slides in box
- sterile Universal bottles
- sterile blood tubes
- plastic bags with closure tops (Whirlpack or Ziploc type)
- heavy duty plastic sealing tape
- 300 ml wide mouthed glass or plastic jars
- a measuring tape or ruler
- aluminium foil
- Cigarette lighter
- Labels, string, waterproof marker pen/pencil

Personal protection

- Dissection Short/arm-length gloves
- Disposable gown
- Short/arm-length gloves
- Overalls
- face mask including goggles to cover eyes

Disinfectant

- Bucket plastic and Brush
- Soap
- 70% ethyl alcohol

Fixatives

- 10% buffered formalin
- 70% alcohol for parasites

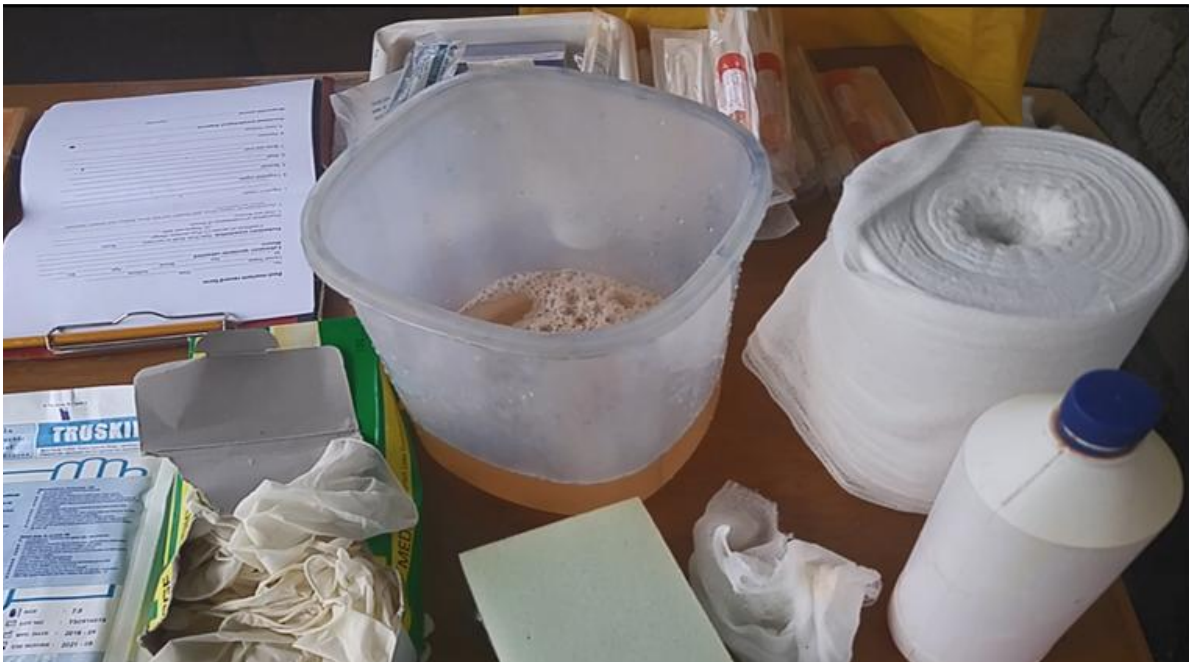
Additional equipment

- digital camera
- Submission form
- a notebook

Figure 4. Dissecting equipment

Figure 5. Sampling materials

Figure 6. Personal protection, disinfectant and recording materials



Personal protection, Disinfectant and recording materials

Section 2: Protocols and procedures in the field

This section has two subsections: a process of field postmortem and specimen collection.

A process of the field postmortem will be assisted by some sort of graphic of the procedural steps that can be referred to in the field, ideally laminated or something like synthetic paper (Polyart) for durability in the field.

The specimen collection subsection will cover general overview of handling specimens and specifically microbiological and histopathological specimens.

Unit 3: History taking and external examination

The unit deals with the importance of history taking, procedures for external examination and body cavity opening, and sample taking.

Learning objectives

By the end of the unit, you participants be able to:

- Conduct interviews with owners regarding history of dead animals and affected flock
- Take notes during the interview
- Conduct a thorough external examination by inspecting the general condition of the dead animal.

Learning content

- History of husbandry condition (housing, feed), treatment and vaccination, changes of feed and introduction of new animals, climate change, clinical signs observed, number of affected animals (age, breed, sex)
- Visual examination of dead animals, inspection of general conditions (appearance, sign of autolysis, examination of visible mucous membranes and pathological lesions)

Learning methods and materials

- Practical demonstration of external examination
- Videos
- Reflection and plenary sessions
- PPT presentation

Approximate time

Two hours

Session 3.1 Taking history of dead animals

Learning objectives

By the end of the session, participants be able to:

- List type of information that needs to be collected before postmortem operation
- Develop checklist and take history of dead animals

Learning content

- Relevant preliminary information before postmortem operation
- Observation and interviewing techniques

Method and materials

- Presentation
- Observation and interview checklist
- Role play

Approximate time

One hour

Learning activities

1. Introduce the topic. Suppose that a farmer requested you to examine their dead animal. What would you do before you begin to examine the dead animal?
2. In plenary, brainstorm the role of history taking and type of information that should be collected before doing postmortem examination.
3. Case analysis. Break participants into small groups and distribute a note describing history of a dead animal taken by an animal health worker. Ask small groups to identify information contained in the report and construct a checklist for taking history of dead animals.
4. In plenary, ask small groups to share their results. Write responses on a flipchart. Go through the responses and identify commonalities and differences.
5. Role play. Divide participants in small groups. In pairs, ask them to interview one another using the checklist developed in plenary. Ask other members to observe and provide feedback to group members.
6. In plenary, ask participants to share their experiences and insights during the interview practices.
7. Provide a summary presentation of why and how to take history of dead animals.

Training notes

History taking of dead animals

- Before commencing a post mortem examination (necropsy), owner must be interviewed regarding the history of the animal and any other affected animals in the flock.
- General information regarding husbandry condition (including housing, feed), treatments and vaccinations undergone, any sudden change in feed or source of feed, introduction of new animals in the flock, change in climate and involvement of more than one species of animals in the area with similar disease manifestation should be noted.
- The history regarding the age, sex, and breed of the affected animal should be obtained. It is important to record clinical sign absorbed and when the animal died.

Interview checklist

- What clinical signs were observed before the animal died?
- Is there any other animal affected by the symptom?
- How many animals affected died with same situation?
- What is the main source of feed and water?
- Is there any feed change recently?
- Is your animal treated recently?
- Is there any current vaccination in your flock?
- Is there any current whether change?
- What is the age, sex, and breed of dead animal?

PowerPoint slide

History taking

Interview the owner regarding the history of the affected animal:

- Age
- Sex
- Breed
- Clinical signs observed
- ...

Session 3.2 External examination

Learning objectives

By the end of the session, participants will be able to:

- Undertake physical examination of dead animals by properly applying physical examination procedures
- Identify outward signs of abnormalities in dead animals

Content

- Step by step external examination of dead animals

Method and materials

- Interactive discussion
- Checklist for external examination
- Practical demonstration

Approximate time

One hour

Learning activities

1. Introduce the topic. In the previous session, you have learnt about history taking. In this session, you will learn how to conduct external examination.
2. Distribute a checklist for external examination. Ask participants to review the checklist individually.
3. Outside the training room, demonstrate step by step external examination of a live animal using the checklist. Observe and address questions during the demonstration.
4. Divide participants into small groups and have them practice external examination.
5. Watch interaction of participants during the practical session.
6. In plenary, ask participants to reflect on their experience and discuss the importance of external examination.

Training notes

External Examination

- Before dissection begins, a thorough visual examination of the carcass should be made.
- The carcass should be thoroughly inspected for general condition like appearance (good, fair, weak, cachectic or hide-bound), signs of autolysis, putrefaction, rigor mortis, condition of the natural orifices (any discharge, prolapse), visible mucous membranes (normal pink, pale, red, yellowish), marks of injury (fresh or old) or any other pathological lesions (abscess, growth, alopecia, exudative dermatitis).
- Inspect the skin, feet, eyes, nose, body condition.

- The position of the body in death and external signs of struggling should be noted, as they may be pertinent to the final diagnosis.
- The anatomical location and actual measurements of the lesion should be described in an easily understandable and non-technical language and take photo to get further description from experts.
- Examine the site where the animal was found for clues: predators (dogs), lightning, poisons and poisonous plants, signs of trauma.

PowerPoint slide

External examination

- Inspect the skin, feet, eyes, muzzle, body condition of dead animal
- The position of the body in death and external signs of struggling should be noted
- Examine the site where the animal was found for clues: predators (dogs), lightning, poisons and poisonous plants, signs of trauma.

Figure 7. A thorough visual examination of the carcass before opening

Figure 8. Examine the teeth, nose, mucus membrane and oral cavity

Figure 9. Inspect the eyes

Figure 10. Inspect the skin

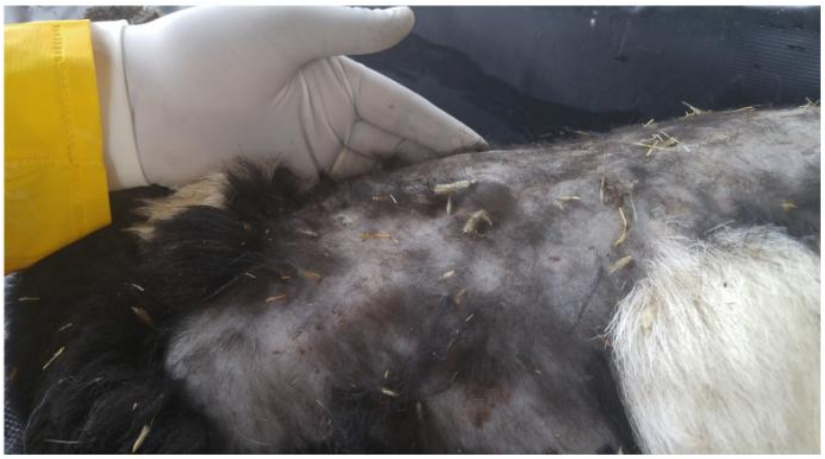
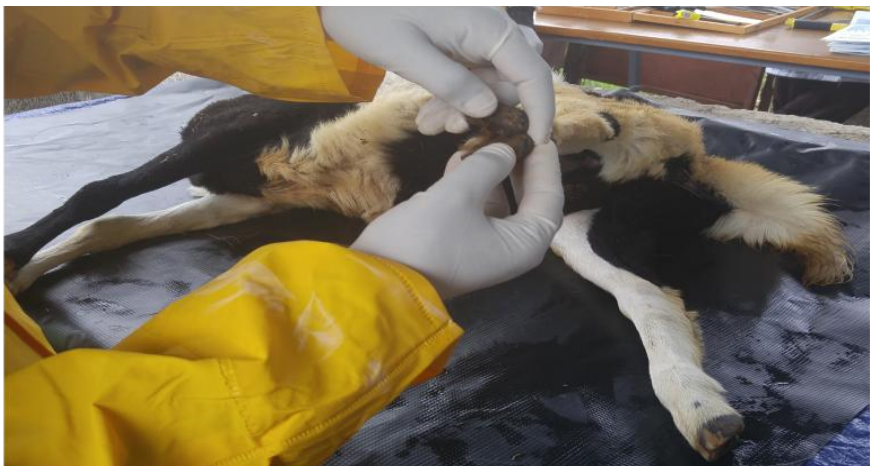


Figure 11. Inspect the legs



Unit 4. Body cavity opening, organ examination and identification of common postmortem lesions

The unit discusses how to perform body cavity opening, organ examination and identification of common postmortem lesions.

Learning objectives

By the end of the unit, participants will be able to:

- Follow and correctly apply procedures for body cavity opening and organ examination
- Examine and dissect organs, tissues and structures using appropriate techniques and equipment
- Explain abnormalities/postmortem lesions of major diseases

Learning content

- Body cavity opening and conducting examination
- Postmortem lesions of major diseases
- Procedures for removal and examination of internal organs

Methods and materials

- Interactive presentation
- Procedural checklist
- Videos
- Practical demonstration

Approximate time

Two hours theory and four hours practice

Session 4.1 Body cavity opening and organ examination

Learning objectives

By the end of the session, you will be able to:

- Open and inspect body cavity in proper position following correct procedure
- Correctly apply steps for proper organ removal, examination and dissection

Learning content

- Body cavity opening and inspecting
- Organ removal, examination and dissection

Method and materials

- Graphic of procedural steps

- Videos
- Interactive presentation
- Carcasses for participants practice

Approximate time

90 min theory and 3 hours practical

Learning activities

1. Tell participants that you are going to show them a video of body cavity opening and organ examination. Ask participants to take note of key points from the video as you screen it.
2. In plenary, ask participants to share what they have learnt from the video. Write responses on a flipchart paper. Review responses and clarify key points.
3. In small groups, ask participants to work on the following questions:
    - How do you position a dead animal for body cavity opening and examination?
    - What procedures would you follow to open and examine body cavity and remove and dissect organs?
4. In plenary, ask small groups to share their results. Write responses on a flipchart paper. Review the responses and clarify major points.
5. Practical session. Tell participants that they are going to practice how to open and inspect body cavity using a graphic of procedural steps.
6. Demonstrate how to position a dead animal, open and inspect body cavity, and remove, dissect and examine organs.
7. Demonstrate how to take photos, including id (use a paper with animal id and date, spot, farm and put it beside everything that is photographed)
8. In manageable groups, allow participants to practice themselves. Observe small groups while practicing and support them as needed. Allow sufficient time for practice and reflection.
9. In plenary session, ask groups to share their experiences and observations.
10. Provide a summary presentation highlighting major points.

Training notes

Body cavity opening and organ examination

Small ruminant necropsy is usually performed with the animal lying on its left side. Grasp and lift the forelimb upward, insert knife into skin in the axilla and cut all attachments of the forelimb and reflect the limb to the dorsum of the cadaver. It is better to leave forelimbs partly attached with the body. Lift hind the limb, insert knife and incise the skin and underlying muscles then insert the knife at the coxofemoral junction, cutting through the teres (or round) ligament and expose femoral head. Reflect the freed hind limb to the dorsum of the cadaver. Reflect mammae or free each testicle separately and make sure to examine the right mamma or right testicle or any right-sided organ of paired organs before the left to help make recollection of which was the affected organ when time for writeup comes. Next, make an incision on the ventral midline of the abdomen and connect the two openings. Reflect the muscle wall downward and expose the abdominal cavity.

The abdomen should now be opened by making a paracostal incision through the abdominal wall just behind the parallel to the last rib. Extend it dorsally to the vertebrae and ventrally to the midline. Pull up the abdominal wall to prevent cutting viscera, use the special knife. Cut with fist protecting blade from distended viscera. Stab the diaphragm near the sternum and note the presence or absence of negative pressure within the thoracic cavity. Listen for inrush of air indicating a negative pressure in the pleural cavity. Cut the entire right side of the diaphragm along the costal arch and observe the thoracic cavity and viscera. If fluid in the abdomen or in the thoracic cavity<, estimate the amount (excessive, moderate, barely/small amount.) Sever the ribs at ventrally with a rib cutters or knife then push back the ribs, breaking them at the dorsal portions. Dissect free one central rib and break to check for generalized bone lesion. The rib cage can be laid over to act as a tray upon which organs can be placed for examination.

Once the thorax and abdomen are exposed, note the color, position, and size of all organs and look for any adhesions or accumulations of fluid within cavities. Detailed examination of the individual organs of different systems should be followed on removal. Take out the digestive organ first and leave them beside the carcass, look at them in the end (because it is easy to get dirty from the digestive organs).

Liver and spleen

Remove the liver from its attachment and examined for color and consistency. Note for necrosis, fibrosis, any cysts and abscesses under the capsule. A large, swollen, hemorrhagic liver indicates subacute fascioliasis. Liver is enlarged and sometimes deformed due to hypertrophy and fibrosis of hepatic lobes with high numbers of adult and juvenile parasites inside the hepatic ducts. In acute cases, scars are visible on the surface of the liver due to the migration of larval stages through the hepatic capsule and parenchyma. The liver is dark and contains distinct paler areas of necrosis up to 3 cm in diameter, distributed throughout the parenchyma. Make multiple slices through the liver and press. If liver flukes are present, dark colored flukes will come out. Open bile duct and gall bladder and examined for adult liver flukes and the quality and color of bile.

Cut the attachments of the spleen to the rumen and set the spleen down in a clean area note for size, shape and consistency. Is it sharp or blunt? A normal spleen is firm, with sharp edges. Feel the consistency. If the spleen is enlarged and soft with a blunt edge, then the cause of death was possibly Anaplasmosis. If the spleen is very swollen and lymph nodes are swollen, suspect Trypanosomiasis or septichemi.

Respiratory tract

To remove the organs in the thoracic cavity, cut throughout the mandibular symphysis to expose the oral cavity. Next, free the tongue manually and pull down and back. Cut the hyoid bones to free the caudal tongue, esophagus and trachea from the pharynx. Then grasp the trachea and esophagus together with tongue apply pressure to pull them backwards. While still applying gentle tension toward the thoracic inlet, the heart and lungs are removed by severing or tearing all attachments holding them in place such as aorta, post cava and esophagus.

Examine the surfaces of the lungs and pleura by visual inspection and gentle palpation. Look for changes in color and consistency of individual lobes, collapsed or dilated lobes and for the presence of abnormal tissue masses. Cut through changed tissue. Open the trachea and check for any mucus, froth, petechiae parasitic worms or bot fly larvae. Remove the upper lung and open the bronchi and bronchioles and note for exudate and parasitic worms. Any hard areas should be checked by incision for parasitic lesions, hydatid cysts, cysticerci, abscesses, tubercular lesions or tumors. The bronchial and mediastinal lymph nodes should be palpated and incised for tubercular lesions.

Common infectious respiratory diseases of small ruminants, postmortem findings, and diagnostic tests are compiled in Table 2.

Table 2. Common infectious respiratory diseases of small ruminants, postmortem findings, and diagnostic tests

Name of condition	Etiological agents	Affected species	PM lesions	Submitted sample	Diagnostic tests
Peste des petits ruminants (PPR)	*Morbillivirus* (family Paramyxoviridae)	Goats and sheep	Congestion of mucosa of respiratory tract, exudates in tract, hardening of lungs mainly in anterior lobes, congestion hemorrhages, and erosion in intestinal mucosa	Lung, swab	Virus isolation, Histopathology, PCR
Ovine progressive pneumonia (maedi-visna)	Oncogenic retrovirus of subfamily Lentiviridae	sheep	The lungs are firm and rubbery, and markedly increased in weight (>2 kg). The lungs do not collapse when the chest is opened, and impressions of the ribs are sometimes seen on the pleural surface. The lungs may exhibit mottled or grey areas.	Lung	Histopathology, PCR
Enzootic nasal tumors, ovine pulmonary adenomatosis	Retrovirus	Goats and sheep	Presence of uni or bilateral tumor growth; firm, hard, grey colored lungs; lungs sink in water, and bronchi are found filled with white frothy fluid	Tumors	Histopathology, PCR
Enzootic pneumonia (Pasteurellosis, shipping fever, and hemorrhagic septicemia	*M. haemolytica* and *Bibersteinia trehalosi (Pasteurella trehalosi) M. haemolytica* and *P. multocida*	Goats and sheep	Extensive ecchymotic hemorrhages in the throat and ribs. Pleural and pericardial exudates, the lungs are swollen and cyanotic, with dark red/purple consolidated patches. The airways contain pink froth. grey/red raised consolidation of the anteroventral lung lobes, with green gelatinous pleural exudate	Consolidated lung Tracheobronchial lymph nodes	Culture, PCR, DNA fingerprinting, and Southern blot, Histopathology
Caseous lymphadenitis	*Corynebacterium pseudotuberculosis*	Sheep and goat	Enlargement of lymph nodes with greenish colored pus	infected lymph nodes	Culture
Mycoplasma	*M. ovipneumoniae*, *M. capricolum*, *M. mycoides* subsp. *mycoides*, and *M. agalactiae*	Sheep and goats,	Consolidation in the anterior ventral lung lobes accompanied by pleuritis, bronchial and mediastinal lymph nodes are markedly swollen		Culture, Immunoblotting, immunobinding assay, growth inhibition, PCR
Tuberculosis	*Mycobacterium bovis*	Sheep and goats,	encapsulated, yellow-grey, caseated, tuberculous nodules in the lungs, retropharyngeal and mediastinal lymph nodes	Nodules, affected lymph nodes	histopathology, smear culture

Sheep and goat Pox	*Capripox (*family Poxviridae)	Sheep and goat	The larynx is inflamed and sometimes ulcerated. Lesions in the lungs consist of depressed grey areas up to 3 cm in diameter and secondary bronchopneumonia.	Lung	Direct fluorescent antibody test, PCR
Nasal myiosis	*Oestrus ovis*	Sheep	Swollen nasal membranes, plugged nostrils, and upper respiratory tract occluded with serofibrinous discharge, living larvae retreat from opened sinuses through the nasosinus aperture into nasal cavity	Larvae	Gross examination
Verminous pneumonia	*Dictyocaulus filaria*, *Protostrongylus rufescens*, and *Muellerius capillaris*	Sheep and goat	Presence of parasites and caseous exudates in lung	Adult worms	Gross examination
Hydatid cysts	*Echinococcus granulosus*	Sheep and goat	Cyst of 5–15 cm in diameter in the lungs (and other visceral organs)	Cysts	Gross examination, histopathology

Heart

To examine the heart, separate it from the respiratory tract at the level of large blood vessels. The pericardium is held by the apex of the heart and an incision of two centimeters is made in its apex to observe the condition of pericardium, presence of fluid/exudates color, consistency, amount and transparency. Identify the heart within the pluck and grasp on one hand and separated by cutting the large vascular trunks, respecting the atria. Observe any disproportion of parts (dilation, hypertrophy, and anomalies) and alterations in shape. Note presence of normal adipose tissue. To examine all chambers of the heart, first open the left ventricle by making a vertical cut from apex to base and then extend the cut up through the left atrium and into the aorta. Examine both left chambers and both left valves on the left side (left a-v valve and aortic valve) at this stage. To open the right side of the heart make C-shaped cut following the outline of the right ventricle. Extend the cut so that all the right ventricle and right atrium are open and exposed. Absorb inside of both right sided chambers and both valves on the right (right a-v valve and pulmonic valve). The aortic valve and pulmonary artery can be examined by dissecting down the great vessels into the heart. Check the heart for fluids inside the outer membrane If a lot of fluid is present, heartwater may have been the cause of death. Inspect the valves for endocarditis. Check the color of the intima of aorta (icterus).

Urogenital tract

Open the pelvic cavity by sawing through the pubis to the obturator foramen, then through the ischium. Remove the kidneys with ureters, and bladder, genitalia, and rectum simultaneously as a unit by gathering all in one hand and pulling them backwards, removing the attachments cautiously by knife. For each kidney, peel away the capsule and note for any abscesses which may be of pinhead size in the kidney cortex; the consistency of the kidney substance should also be recorded (firm or soft and pulpy). Take a tissue cross section to include the cortex, medulla, and pelvic epithelium. Make multiple transverse inspection slices through the organ. Check the kidneys; they will normally start to putrefy 12–24 hours after death. However, if the kidney putrefies within six hours after death, suspect enterotoxaemia (pulpy kidney).

Open ureters and bladder and note the condition of the linings. If hemorrhage, dots of blood found in the bladder suspect Poisoning. Cut the ovaries first longitudinally, then transversely and note for the presence of cysts or corpora lutea. Open horns of the uterus, then the cervix and vagina from the dorsal surface. Note for the presence of fetuses and inflammation. Palpate the testes and incised to look at the parenchyma.

Musculo-skeletal system

Remove the skin completely from the body. Examine the outer surface of the body of the animal for evidence of bruising or wounding, subcutaneous nematodes, bullet wounds and snake bites. Animals struck by lightning sometimes show evidence of burns on the subcutaneous tissues. Examine and incise the muscles of various parts of the body especially lumbar and thigh muscles. oedematous, dark red, crepitous and sometimes rancid smelling when incised are observed in clostridial infections (‘blackquarter’). Identification of Gram-positive rods in smears taken from oedema fluid or the margins of the muscle lesions shortly after death may aid diagnosis. Pale areas in the musculature may indicate ‘sun burn’ or white muscle disease’ (myopathy). Joints may be swollen and affected by septic arthritis. An assessment of the general nutritive condition of small ruminants at the time of death can be made by examining the marrow in one of the femurs. The femur of a well-nourished animal will contain firm, fatty yellowish or white marrow, whereas the marrow of an animal dead of starvation or debilitated by prolonged chronic disease will be soft, watery and orange or red in color or look at the fat around the coronary vessels in the heart. If prolonged starvation, there will be no fat around the vessels, more like gelatinous tissue.

Head

Remove the head at the atlanto-occipital joint. The skin and muscles should be cut at the angles of the mouth and the lower jaw disarticulated. The teeth should be examined for normal or irregular wear and the gums and alveoli for abscesses. The nasopharynx should be opened and checked for bot fly larvae in the retropharyngeal pouches. The head should be skinned, and the temporal muscles removed. These may be embedded in masses of wax. Using saw, make a transverse cut vertically in a line one centimeter rostral to external ear canal and extend the cut through the bone until the cranium hinges apart. Using curved scissors, cut the ventral nerve roots and the olfactory bulbs. Remove the rostral brain. Shell out the occipital lobes in the caudal half of the skull to expose the opaque tentorium cerebelli. Cut the tentorium to expose as much of the cerebellum as possible. Check for evidence of hemorrhaging, bruising, nematodes, tapeworm cysts.

Digestive tract

Arrange the GI tract to display all the parts before removal. Place the small intestine and colon over the right lumbar area, leaving fore stomachs and abomasum in place. Examine fore stomachs and abomasum for position and adhesions. The entire digestive tract should now be removed, first tying off the esophagus above the rumen and the rectum near the anus. Pull out the rumen along with the spleen, reticulum, omasum and abomasum on the left side which are free at this stage. Remove now the whole intestines by cutting the mesenteric roots.

Lay GI tract in relative order to determine the various parts. Observe the small intestine, if there is a dark patch, open that area, if the small intestine appears normal, cut it open at random places. start to open from duodenum and follow down the jejunum, to the ileum, which empties into the cecum at the ileo-cecocolic junction and washed and scraped into half a bucket of water. Observe the serosal and mucosal surface and note for the presence of ulcers and embedded parasites. Open the abomasum first. Look at the contents of the abomasum and examine the mucosal surface. You may need to run some water lightly over the mucosa to get a good view. Then open the reticulum and the omasum. Check the contents of the reticulum for foreign material such as nails, plastic bags, wires, etc. Remove some of the contents and look at the pillars and the papillae.

Common infectious gastrointestinal tract of small ruminants, postmortem findings, and diagnostic tests are compiled in Table 3.

Table 3. Common infectious gastrointestinal tract of small ruminants, postmortem findings, and diagnostic tests

Name of condition	Etiological agents	Affected species	PM lesions	Submitted sample	Diagnostic tests
Johne's disease	*Mycobacterium avium* subsp. *paratuberculosis*	Sheep and goat	Gelatinous atrophy of fat depots and obvious convoluted lymph vessels on the serosal surface of the affected intestines. Small 1 to 2 mm white lymphatic nodules are sometimes seen on the mucosal surface of the intestines and mesenteric lymph nodes are large and pale. Thickening and corrugation of the mucosa of the terminal ileum are sometimes seen.	Thickened ileum Jejunum, cecum, colon	Histopathology, smears, PCR, Johne's culture
Enteric Colibacillosis	enterotoxigenic *E. coli*	Sheep and goat	Loops of small intestine are distended with watery yellowish fluid, as is the spiral colon.	Jejunum, Ileum Cecum, Colon	Culture, fimbrial typing, Histopathology
PPR	*Morbillivirus* (family Paramyxoviridae)	Sheep and goat	Inflammatory and necrotic lesions in the oral cavity and throughout the gastro intestinal tract. "zebra stripes" of congestion on the mucosal folds of the posterior colon	swabs	Virus isolation, Histopathology, PCR
parasitic gastroenteritis	*Haemonchus contortus*	Sheep	Fluid and brown abomasal content, abomasal folds may have diffuse or patchy congestions or no gross lesions at all, small white worms with red spiral pattern attached to the wall	Parasite	Gross examination of the parasite
Enterotoxaemia	*C. perfringens, C. septicum*	Sheep and goat	Petechiae, ecchymoses, paintbrush hemorrhage or diffuse hemorrhage of the serosa and mucosa; excessive pleural and peritoneal fluid, the intestine is distended with gas and hemorrhagic fluid; cooked appearance of muscles; the kidneys usually decompose more rapidly than the other organs and become dark and jelly like, hence the common name 'pulpy kidney'	Intestinal content, Swabs	Smear, culture, toxin detection (ELISA, serum neutralizing tests in mice and guinea pigs)
Coccidiosis	*Eimeria* spp	Sheep and goat	Bloody intestinal content with nodule on the intestinal surface.	ileum, caecum and colon intestinal contents	Histopathology, microscope examination
Contagious ecthyma (Orf),	poxvirus (family *Parapoxvirus)*	Sheep and goat	Macules, papules, vesicles, pustules scabs, scars /crust, and nodules in the corner of the mouth (fauces)	scabs, scars, swab	electron microscopy, PCR
Lactic acidosis/grain overload/rumenitis	Grain feed	Sheep and goat	Watery ruminal contents often abundant grain, brown friable and easily detachable ruminal papillae	Ruminal content	Biochemical test

Session 4.2 Identification of common postmortem lesions

Learning objectives

By the end of the session, participants will be able to:

- Observe and identify pathological changes on each organ of a dead animal

Learning content

Pathological changes on organs of dead animals

Methods and materials

- Brainstorming
- Interactive presentation
- Practical demonstration

Approximate time

One-hour theory and 30 minutes practice

Learning activities

1. In small groups, ask participants to work on the following questions: How do you conduct step by step observation of each organ of a dead animal? What pathological changes could you identify?
2. In plenary, ask small groups to share their responses. Write responses on a flipchart paper. Review the responses and clarify main points.
3. Outside the classroom, demonstrate how to observe and palpate organs of a dead animal that are likely to be observed for any pathological changes.
4. Address questions from participants.
5. Provide a summary presentation highlighting main learning points of the session.

Training note

Table 4. Common postmortem lesions of small ruminant diseases

Name of condition	Etiological agents	Postmortem lesions
Pasteurellosis	Multifactorial Most important are Pasteurella multocida and Mannheimia haemolytica	• Lungs are dark red to purplish red color, very firm and swollen. • Consolidation is evident, and some areas may contain greenish-brown areas of necrosis surrounded by dark, hemorrhagic zones. • The cranio-ventral portions of the lungs are the ones usually affected. • Tonsils and retropharyngeal lymph nodes are enlarged. • The bronchial lymph nodes are enlarged and may have petechial hemorrhages

CCPP	Mycoplasma capricolum subsp. capripneumoniae (Mccp)	• Unilateral sero-fibrinous pleuropneumonia with severe pleural effusion in acute and subacute disease
PI-3 Virus	Family Paramyxoviridiae of order Mononegaviralis	• Pneumonic lung, particularly in ventral parts of the apical lobe
Chlamydiosis	Chlamydophila abortus	• Inflamed and necrotic placental membranes • Aborted lambs appear normal and well developed, but some may show a degree of edema giving rise to a "pot-bellied" appearance. • The fleece may be discolored or covered with a pinkish-brown material that is usually a sign of delayed parturition and originates from meconium. • Milder changes occur in the fetal liver and lung and, in cases in which placental damage is severe, there may be evidence of hypoxic brain damage.
Brucellosis	Brucella melitensis, Brucella ovis	• Granulomatous inflammatory lesions may be present in the reproductive tract, udder, supramammary lymph nodes, other lymphoid tissues • Necrotizing orchitis, epididymitis, seminal vasculitis • Placentitis, with edema and/or necrosis of the cotyledons
Toxolasmosis	Toxoplasma gondii	• In the fetus focal necrotic lesions may be seen in the brain, liver, lungs and in the fetal membranes • The placental cotyledons are bright red and contain whitish foci of necrosis
Listeriosis	Listeria monocytogenes	• No typical distinctive gross changes associated with listerial encephalitis except for some congestion of meninges • Visceral lesions occur as multiple foci of necrosis in the liver, spleen and myocardium in septicemic form and aborted fetuses • Aborted fetuses are usually edematous and autolyzed
Coxiellosis	Coxiella burnetii	• Placenta is typically leathery and thickened and may contain large quantities of white-yellow, creamy exudate at the edges of the cotyledons and in the intercotyledonary areas
Maedi-visina	Maedi-visina virus – a lentivirus of the Retrovirirdae family	• Enlarged and heavy lungs with grey coloration • Marked enlargement of the bronchial and mediastinal lymph nodes • Excess of frothy fluid in the bronchi, • In the Visna form lesions there may be myogenic muscle atrophy and minimal lung abnormalities
Johne's disease	Mycobacterium avium subsp. paratuberculosis	• Gelatinous atrophy of fat depots and obvious convoluted lymph vessels on the serosal surface of the affected intestines • Small 1 to 2 mm white lymphatic nodules are sometimes seen on the mucosal surface of the intestines and mesenteric lymph nodes are large and pale • Thickening and corrugation of the mucosa of the terminal ileum are sometimes seen

Enteric Colibacillosis	enterotoxigenic E. coli	• Loops of small intestine are distended with watery yellowish fluid, as is the spiral colon
PPR	Morbillivirus (family Paramyxoviridae)	• Emaciated and dehydrated carcass • Inflammatory and necrotic lesions in the oral cavity • Enlarged spleen • Engorgement and blackening of the mucosal folds in the caecum, colon and rectum ('zebra striping')
Parasitic gastroenteritis	Haemonchus contortus	• Fluid and brown abomasal content, abomasal folds may have diffuse or patchy congestions or no gross lesions at all, small white worms with red spiral pattern attached to the wall
Enterotoxaemia	C. perfringens, C. septicum	• Petechiae, ecchymoses, paintbrush hemorrhage or diffuse hemorrhage of the serosa and mucosa; flaccid, thin-walled, dilated and often gas filled, gas bubbles can be present in the wall • Often with gastric hyperemia, excessive pleural and peritoneal fluid • Cooked appearance of muscles
Coccidiosis	Eimeria spp	• Bloody intestinal content with nodule on the intestinal surface
Contagious ecthyma (Orf),	poxvirus (family Parapoxvirus)	• Macules, papules, vesicles, pustules scabs, scars /crust, and nodules in the corner of the mouth (fauces)
Lactic acidosis/grain overload/rumenitis	Grain feed	• Watery ruminal contents often abundant grain, brown friable and easily detachable ruminal papillae

PowerPoint slides

Table: Major criteria for macroscopic description of necropsy lesions (Pires et al., 2012)

Criteria	Description
Location	The anatomical position and its relation to other organs: dorsal, ventral, cranial, caudal, lateral, medial, proximal, distal.
Distribution	The distribution pattern of the lesion(s) in the organ/tissue: focal, multifocal, coalescing, miliary, segmental, diffuse, random, symmetrical, bilateral, transmural.
Color	List the primary color(s) of the lesion(s) (e.g. black, red, white), with additional degrees or shades, if needed (e.g. dark, light, brilliant, etc).
Size	Give objective dimensions in metric units and estimate volume in milliliters (mL) or cubic centimeters (cc). If needed, the weight can be provided. Avoid associations with fruits or common objects.
Shape, contour and demarcation	Describe the lesion shape (ovoid, round, spherical, conical, lobular, nodular, discoid, punctate, fusiform, laminated, sessile, stellate, branched), contour (flat, depressed, raised) and demarcation (well or poorly demarcated).
Consistency and texture	Describe the consistency (hard, firm, soft, plastic) and texture (wet, dry, friable, gas-filled, viscous, gelatinous, gritty, rubbery, granular, smooth, rough, grooved, crusted, spongy) to palpation.
Number and extent	Count the number of lesions, if possible, and give an estimate of the percentage of involvement of a certain organ.
Special attributes	Difficult to evaluate, but diagnostically important, in some instances: odor (no odor, ammonia-like odor, apple-cider odor); sound (crepitant, hard)

ILRI CGIAR

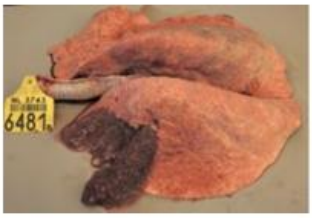
Abnormalities/PM lesions of major respiratory and reproductive disease

Diseases and abnormalities are mostly likely to produce visible or palpable lesions in specific locations

Pasteurellosis

- Lungs are a dark red to purplish red colour, very firm and swollen
- Tonsils and retropharyngeal lymph nodes are enlarged
- The bronchial lymph nodes are enlarged and may have petechial haemorrhages

ILRI CGIAR



Lung with one consolidated lung

(MSD animal health)

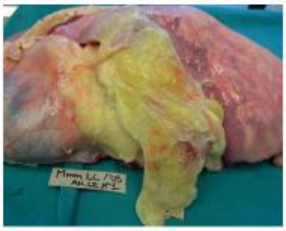
PPR

- Emaciated and dehydrated carcass
- Necrotic lesions in the mouth and nose
- Engorgement and blackening of the folds in the caecum, colon and rectum ('zebra striping')
- Enlarged spleen
- Oedematous lymph nodes associated with lungs and the intestines
- Bronchopneumonia – lungs with dark red or purple areas; firm to touch

PPR lesions on the tongue and dental pad

CCPP

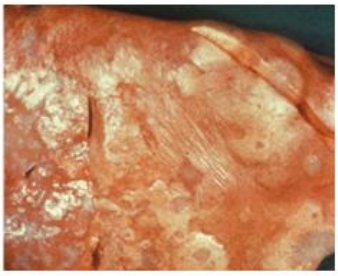
- Unilateral sero-fibrinous pleuropneumonia with severe pleural effusion in acute and subacute disease
- Pleural adhesions
- Enlarged mediastinal lymph nodes



Fibrin deposition and consolidation of lung of goat with CCPP

Robin Nicholas et al., 2008
Mycoplasma diseases of ruminants

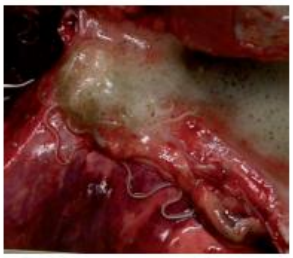
Acute CCPP in goat
Robin Nicholas



Sheep, lung. Lung contains multifocal gray-white nodules/plaques, Maedi-visina

CFSPH, Iowa State University

Lung worm

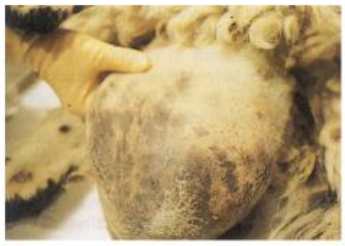


Adult Dictyocaulus filaria worms (lungworms) found in a lamb's trachea during PM examination

Picture, Sian Mitchell

Brucellosis

- Granulomatous inflammatory lesions may be present in the reproductive tract, udder, supra-mammary lymph nodes
- Necrotizing orchitis, epididymitis, seminal vesiculitis
- Placentitis, with edema and/or necrosis of the cotyledons



Edema and swelling of scrotum

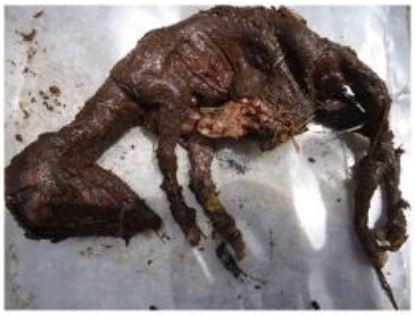
FAO, Manual for meat inspection

Toxoplasmosis

- The placental cotyledons are bright red and contain whitish foci of necrosis

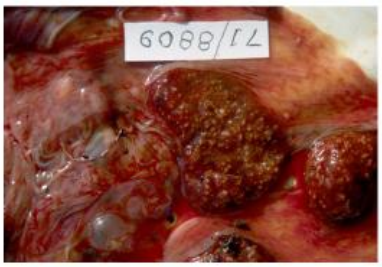
In the fetus

- Focal necrotic lesions may be seen in the brain, liver, lungs and in the fetal membranes
- Fetal mummification, fetal death or abortion
- Weak full term lambs



Mummified fetus

DBARC sheep farm, 2012



Cotyledons show hyperplasia and focal necrosis, lesions 2-3 mm in diameter

John Plant
(sheep.vet@bigpond.com)

Listeriosis

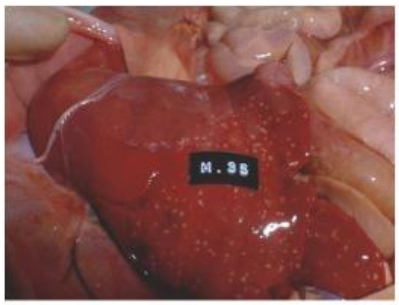
- No typical distinctive gross changes associated with listerial encephalitis except for some congestion of meninges
- Visceral lesions occur as multiple foci of necrosis in the liver, spleen and myocardium in septicemic form and aborted fetuses

Aborted fetus

- Aborted fetuses are usually edematous and autolyzed

- Meconium staining of birth coat indicative of intrauterine foetal anoxia
- Some indication of submandibular oedema indicative of parturient death

John Plant
(sheep.vet@bigpond.com)



- Enlarged liver
- Miliary creamy white liver lesions 1-2 mm diameter in the liver

John Plant
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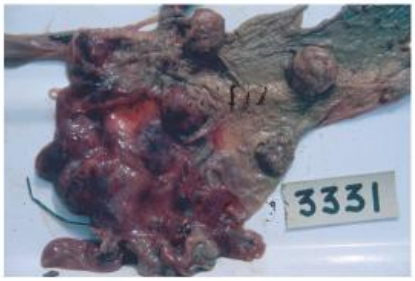

- Necrotic cotyledons
- Thickened leathery chorioallantois, often greyish in colour

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Chlamydiosis

- Inflamed and necrotic placental membranes

Aborted lambs/fetus

- appear normal and well-developed, but some may show a degree of edema giving rise to a "pot-bellied" appearance

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Campylobacteriosis

- Some hypertrophy of the cotyledons
- Foetus shows evidence of abdominal enlargement

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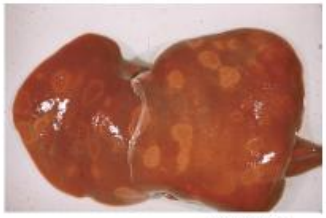
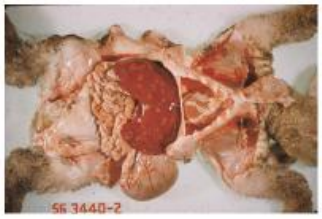
- Livers enlarged with rounded edges
- Pale necrotic foci pathognomic of Campylobacter abortion-seen in a significant number of affected lambs





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Border disease

- Foetal mummification and death
- Lambs with hairy birth coats
- Hairy shaker lambs

Coxiellosis (Q-fever)

- placenta is typically leathery and thickened and may contain large quantities of white-yellow, creamy exudate at the edges of the cotyledons and in the inter cotyledonary areas

Unit 5. Collection, labeling and preservation of postmortem examination specimens

Learning objectives

By the end of the unit, participants will be able to:

- Make decision on identification of appropriate samples based on lesion
- Describe types of sample required for diagnosing diseases
- Follow and correctly apply procedures and methods for taking samples
- Collect appropriate samples for lab diagnosis and analysis
- Identify and use appropriate labeling materials
- Identify storage and transport requirements of microbiological and histopathological specimens

Learning content

- Overview of handling specimens
- Sample types
- Sample collection methods and procedures
- Sample labeling
- Sample storage and transport requirements

Methods and materials

- Presentation
- Checklists of sample collection procedures and storage and transport requirements
- Demonstration
- Videos

Duration

90 minutes

Session 5.1 Sample collection and labeling

Learning objectives

By the end of the session, participants will be able to:

- Explain what sampling includes
- Describe types of samples
- Take samples appropriately
- Label samples correctly

Learning content

- Handling samples
- Types of samples

- Methods of sample collection
- Sample labelling

Methods and materials

- Presentation
- Small group discussion
- Checklists

Approximate time

One hour

Learning activities

1. Brainstorm ideas to identify prior knowledge. Ask participants: What comes to your mind when you think of sample handing?

   Write results on a flipchart paper. Review the results and establish links between prior knowledge and the learning topic.

2. In plenary discussion, put the learning topic into context by discussing the importance of proper sample handling.

3. Divide participants into small groups. Assign the following questions to the groups.
   - What types of samples are required for diagnosing diseases by doing postmortem examination?
   - What methods and procedures would you use to take samples for postmortem examination?
   - What sampling materials would you use to correctly label samples for postmortem examination?

4. In plenary, ask small groups to share their results. Write responses on a flipchart paper. Review responses and clarify key points.

5. Provide a summary presentation highlighting key learnings for the session.

Training notes

Collection of tissue sample

Dependent on the suspected disease, condition of the carcass and facilities available for necropsies, postmortem specimens can be collected from one or multiple organs and submitted to the laboratory as either fresh (no preservative) or preserved specimens for further laboratory testing.

Tissues are collected for histopathology, immunohistochemistry, culture and demonstration of DNA. For histopathology, samples can be preserved by fixation, for all other techniques, fresh samples are required.

The skin may be removed with ordinary equipment, but sterile instruments should be used to open body cavities, dissection and collection of tissue specimens. In the field, instruments can be sterilized conveniently by boiling in a simple instrument sterilizer.

It is always a good idea, when cutting skin, to cut from the inside out because cutting through hair will dull the knife very quickly. Dull knives make the necropsy more difficult and dangerous as you are more likely to cut yourself with a dull knife because of the increased effort needed to cut. A stronger push will cause the knife to go into your hand by accident much more easily.

Each piece of tissue should be placed in a fully labelled separate plastic bag or sterile screw-capped jar. Swabs should always be submitted in appropriate transport media. Sterile instruments should be used for collecting specimens for microbiological culture and care should be taken not to contaminate tissues with intestinal contents. Disinfectants should not be used on or near tissues to be sampled for bacterial culture or virus isolation.

Sampling boxes should be labeled, and the submission forms fill at the time of collection.

Collection of fresh tissue samples

Fresh specimens are required for microbiological culture, demonstration of DNA and immunohistochemistry, attention must be paid to their handling and storage to avoid autolysis and overgrowth by bacterial and fungal contaminants. Samples can be sent with bacterial or virus transport medium depending on the diagnostic technique, the nature of the sample, and the suspected disease.

Commonly used transport medium includes:

- Phosphate buffer (pH 7.6)
- Glycerol-phosphate buffer

Samples should be refrigerated at 4°C and sent on ice. Freezing samples is not recommended unless immunohistochemistry is used. Ideally, freshly collected specimens are kept at a constant cool temperature from collection until processing for testing. Where such a cold chain cannot be provided fresh specimens for some test procedures can be collected into fluids such as ethylene glycol that inhibit the growth of secondary organisms.

Collection of fixed tissue samples

Tissue samples not more than 1 cm x 2 cm and 5 mm thick should be cut and placed into at least 10 times the volume of neutral buffered formalin. Immunohistochemistry can be done on frozen fixed tissues but samples for histopathology should not be frozen.

Placenta

Ground samples of cotyledons or vaginal samples, usually more heavily infected than the foetal organs, should be seeded into selective media for detection of the more common abortive bacteria (Brucella, Salmonella, Listeria, etc). These samples are usually sufficiently infected to produce abundant cultures and do not require the use of enrichment media.

For direct bacteriological examination, smears from cotyledons should be mounted on grease-free slides. Since the cotyledons are unlikely to be uniformly infected, it is best to undertake a single analysis on as many cotyledons as possible (5–10) rather than take multiple samples from a single cotyledon. A smear of the vaginal sample should be made in the absence of the placenta.

Key consideration during collection of specimen for histopathology and microbiology

Histopathology:

- Autolyzed tissues are generally useless for histopathologic examination; prompt necropsy examination and organ sampling are critical.
- Tissue should not be frozen before fixation.
- Other than CNS tissues, samples collected for histology should never be >1 cm thick (preferably blocks of tissue not more than 0.5 cm thick and 1–2 cm long are cut) and must be placed immediately in neutral

buffered 4–10% formalin, which should be at least ten times the volume of the tissue sample formalin to ensure adequate fixation.

- Tissues collected for histologic examination should be representative of any lesions present
- Tissue samples collected at necropsy should include some of the apparently normal surrounding tissue; the interface between normal and abnormal may provide key information.
- Histologic samples should be shipped in unbreakable containers and packed in a manner that prevents spillage during shipment. Fixed tissues should be protected from freezing.
- Specific tissues collected at necropsy require additional attention. Because the GI mucosa decomposes rapidly, short sections of gut collected at necropsy must be opened lengthwise to allow adequate fixation.

Microbiology

- Laboratory techniques and capabilities for microbiologic examination vary; available tests include bacteriologic culture, fungal culture, virus isolation, in-situ hybridization, a variety of PCR methods, fluorescent antibody tests, latex agglutination tests, Western blotting, ELISA, and many others.
- Most tests, including the newer molecular biology techniques, rely on either the growth/visualization of intact viable organisms or the detection of the nucleic acids and proteins of these pathogens.
- Therefore, unfixed specimens (tissue, fluid, etc) should be collected aseptically and shipped promptly to avoid degradation.
- During swab sampling from large organs like lung and liver, burn the surface and cut through the burned area with a sterile instrument and take a sample with a cultrate
- If PCR testing is to be performed, it is particularly important to avoid cross contamination between multiple animals in a submission; this applies to tissues, fluids, and even dissection instruments.
- Furthermore, swabs destined for PCR analysis should not be placed in agar or charcoal-based transport media. Calcium alginate swabs should be avoided. Instead, cotton or dacron swabs should be shipped in a tube with a few drops of sterile saline or viral transport media.
- Some test protocols may permit pooling of organ specimens from an individual, but for the majority, it is preferable that each tissue be collected into separate sterile, clearly labeled bags or tubes for shipping.
- Gut samples must never be pooled in a container with other tissue samples. Tissues and fluids for most microbiologic assays may be frozen before shipment, but generally freezing is undesirable if samples can be chilled and delivered directly to the laboratory within 24 hours.

Table 5. Common respiratory and reproductive diseases of small ruminant, suitable sample, diagnostic method, transport and storage

Disease	Suitable PM sample/specimen	Diagnostic Method/purpose	Transport and Storage requirement
Pasteurellosis	Lung tissue/pulmonary parenchyma, blood, spleen, liver and lymph nodes	• Pathogen isolation	• Chilled and forwarded with water ice or frozen gel packs
PPR	Fresh and preserved samples of tonsil, tongue, spleen, lymph nodes (mesenteric and bronchial), affected areas of the alimentary tract mucosa.	• Ic-ELISA and PCR for virus detection (Antigen/viral RNA) • Virus isolation	• In sterile normal saline, VTM for virus isolation • In 10% formalin for histopathology • Tissue samples and swabs minimum at -20°C or best at 80°C (for longer storage periods)
CCPP	Lung lesions, particularly from the interface between consolidated and unconsolidated areas, pleural fluid, and mediastinal lymph nodes	• Isolation of Mycoplasma	• Duplicate specimens of active lung lesions — one set should be submitted fresh, the other collected into neutral buffered formalin for histopathology
Maedi-visina	Whole blood on EDTA or heparin, specimens of lungs, mediastinal lymph nodes and brain	• Virus isolation or PCR	• Forwarded with ice or frozen gel packs at +4°C • For longer storage at -20°C
Brucellosis	Smears of placental cotyledon, vaginal discharge or fetal stomach contents vaginal mucus, placenta, fetal stomach contents and milk	• Stained using modified Ziehl-Neelsen (Stamp) or Kosters' methods • Culture/isolation	
Chlamydiosis	Smear from placenta material Placental samples Vaginal swabs Foetal organs (e.g brain, liver) and the stomach contents	• Culture and isolation	• Must be collected as soon as possible after abortion
Q Fever	placenta, vaginal discharge, aborted fetal tissue (liver, lung or stomach), milk, colostrum, or feces	• Culture and isolation	• Fresh samples at +4°C
Toxoplasmosis	Aborted fetuses and placentas, tissues (Brain and lungs)	• For immunohistochemical staining, bioassay, tissue antigen ELISA or PCR analysis	
Listeriosis	Brain tissue Cerebrospinal fluid From septicemic cases include fresh liver, spleen or blood Specimens for cases of abortion - cotyledons, fetal abomasal contents and uterine discharges	• Histopathology • Isolation	• Formalin fixed • Fresh samples

PowerPoint presentation

Sample collection at post-mortem

Introduction

Successful Laboratory investigation - critically dependent on:

- Early planning/Preparation
- Proper clinical examination and a detailed case history
- Specimens collected must be
  - appropriate for the intended purpose
  - adequate in quality, volume, and number for the proposed testing

Sample collection at post-mortem

Successful Laboratory investigation…

- Sufficient documentation
- Biosafety and decontamination
- Correct packaging
- Rapid transport
- Accurately performing the tests
- Timely communication of results

The validity of test results largely depends on good practice in the "**pre-test**" stage

Sample collection at post-mortem

During sample collection:

- Consider differential diagnoses
- Decide on test(s) to be conducted
- Decide on clinical samples to be collected to conduct these tests
- Collect samples before administration of any antimicrobial agents

During sample collection:

- The samples collected should be representative of the condition being investigated and the lesions observed
- Also the stage of the disease and lesion development should be considered
- The volume or quantity of specimen must be sufficient to perform initial testing, to perform any subsequent confirmatory testing
- Provide sufficient residual specimen for referral or archival purposes

*Consultation with lab. personnel, epidemiologist, clinicians is very crucial

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Sample collection at post-mortem

- Samples of tissue from a variety of organs can be taken at post-mortem.
- A plentiful supply of containers and tubes of transport media appropriate to the nature of the sample required should be available, along with labels and report forms.
- Containers should be fully labelled with the date, tissue and animal identification. Special media may be required for transport of samples from the field.
- If potential zoonotic diseases are being investigated, an efficient face mask and eye protection should be worn.

ILRI

Session 5.2 Preservation of postmortem examination specimens

Learning objectives

By the end of the session, participants will be able to:

- Explain storage requirements of main pathogens
- Apply appropriate sample transport and storage practices

Learning content

- What sampling includes
- Storage requirements of major pathogens
- Sample storage and transport practices

Methods and materials

- Interactive presentation
- Checklists
- Video

Approximate time

50 minutes

Learning activities

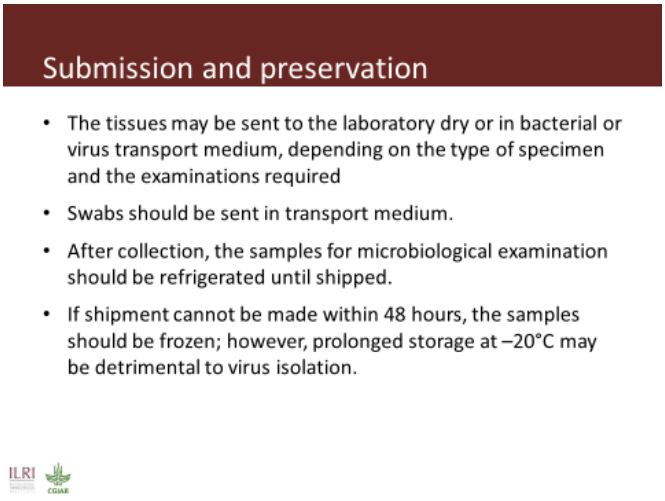
1. Brainstorm ideas to identify prior knowledge.

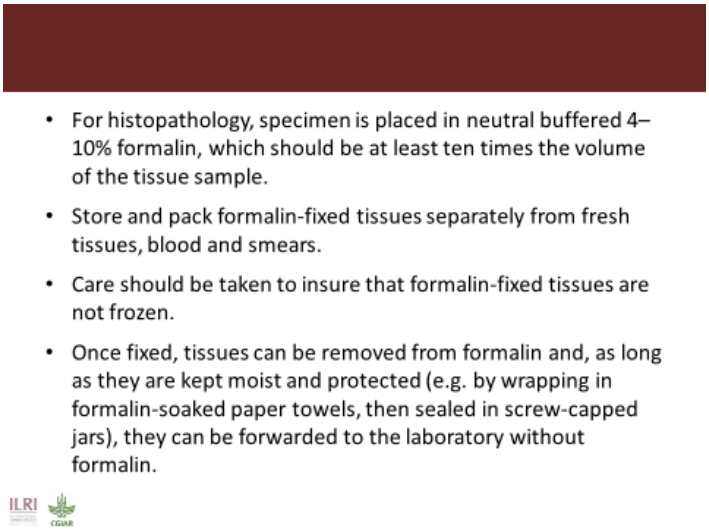
   Ask participants to reflect on the following question: “What are the storage and transport requirements of microbiological and histopathological specimens?”

   Write responses on a flipchart paper. Review the responses and clarify key points.

2. Screen a short video that shows sample storage and transport practices. Ask participants to note of correct and incorrect practices from the video.
3. In plenary, ask participants to reflect on their observations. Write responses on a flipchart paper. Discuss commonalities and differences.
4. Provide a summary presentation of storage and transport requirements and practices of pathogens.

PowerPoint presentation





Training notes

Sampling includes:

- Selection of sample material suitable for analysis
- Sampling at the correct point of time
- Sufficient quantity
- Suitable sampling technique
- Adequate container
- Unique labeling
- Appropriate storage
- Package, transport or handing over of samples with a submission form
- Confirmation of receipt in the laboratory

Unit 6: Examination of fetus and placenta

Learning objectives

By the end of the unit, participants will be able to:

- Undertake postmortem examination of aborted and still birth lambs/kinds self reliantly
- Undertake postmortem examination of placenta
- Identify abnormalities / postmortem lesions of major diseases causing abortion

Learning content

- Postmortem lesions of major diseases causing abortion
- Principles and techniques of fetus and placenta examination

Methods and materials

- Illustrated presentations
- Case study analysis
- Practical demonstration

Approximate time

3 hours

Session 6.1 Examination of aborted fetus

Learning objectives

By the end of the session, participants will be able to:

- Describe aborted fetus examination and dissection procedures
- Follow and correctly apply aborted fetus examination and dissection procedures and practices

Learning content

- Body cavity opening and aborted fetus examination and dissection procedures and practices

Methods and materials

- PPT
- Demonstration
- Aborted fetus examination and dissection procedures

Approximate time

Two hours

Learning activity

1. Brainstorm ideas to identify prior knowledge. In buzz session, ask participants to share their experiences in aborted fetus examination.

   In plenary, ask participants to share their experiences and put the learning topic into context.

2. Distribute jumbled aborted fetus examination and dissection procedures. In small groups, ask participants to rearrange the procedure for aborted fetus examination in a correct way.

3. In plenary, ask small groups to share their responses. Discuss commonalities and differences and reconstruct correct procedures for aborted fetus examination.

4. Tell participants that they are going to practice in small groups aborted fetus examination following correct procedures and practices.

   Divide participants in small groups and ask them to prepare for the practical session. Observe groups during the practice session.

5. In plenary, ask small groups to reflect on their experiences and observations.

6. Close the session with a summary presentation of main learning points.

PowerPoint slides

Examination of aborted fetus

A general examination of the unopened lamb/kid

- Lamb cleaned or not cleaned (showing maternal behavior)
- Presence of meconium staining (foetal faeces may indicate foetal distress during parturition)
- Decomposition
- Congenital abnormalities (particularly of the buccal and perineal regions)
- Membranes of hooves (wear may indicate walking or bird pick)
- Predation – location, severity, species
- Subcutaneous oedema of head or shoulders(showing physical trauma during birth).

Opening of body cavity

- Place lamb/kid on its back and the hind and fore limbs spread laterally to give balance.
- Make an incision so as to begin an anterior movement that removes a broad flap of skin, muscle and peritoneum (and sternum) exposing the abdominal cavity.
- Note the color, position and size of all organs and look for any adhesions or accumulations of fluid within cavities.

Examine the abdominal cavity

- Infection (excessive yellowish fluid - if lamb is <48 hours this is usually due to navel infection)
- Presence of blood and, if so, check liver for punctures/tears (showing a difficult birth)
- Loss of organs resulting from predation
- Presence of a white milk clot in abomasum (evidence of suckling)
- Presence of scattered white substance in the supporting membrane of the intestines containing the lymphatic system (indicates the lamb has fed and digested milk)
- Size and firmness of liver kidneys – amount, colour and firmness of the surrounding fat as a measure of whether metabolised (normal is firm, white, nonvascular; metabolised is soft, gelatinous, pink to red).

Examine the thoracic cavity

- Check whether the lung can sink or float in formalin/Water
- Petechiation (small dark-red spots caused by bleeding, possibly as a result of anoxia)
- Heart is examined for condition of pericardium

Session 6.2 Examination of placenta

Learning objectives

By the end of the session, participants will be able to:

- Explain main changes in placenta
- Examine placenta and inspect major changes

Learning content

- Characteristic changes in placenta

Methods and materials

- Interactive presentation
- Practical demonstration

Approximate time

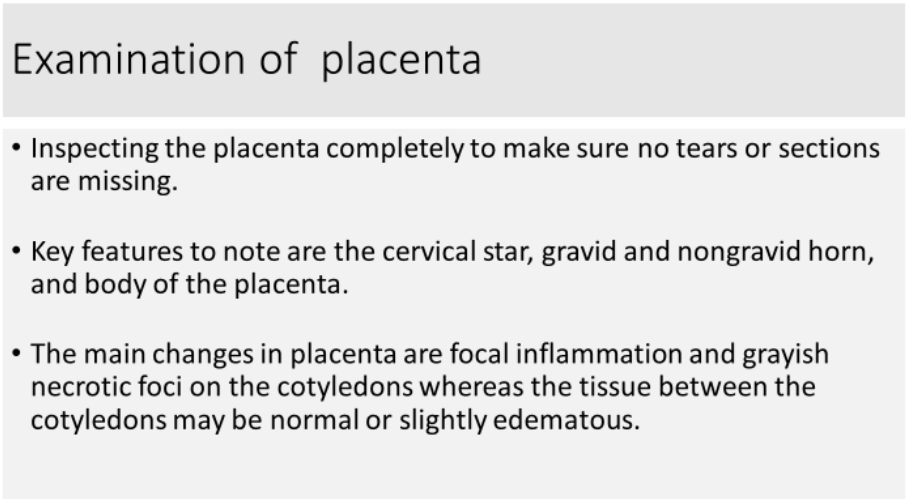
One hour

Learning activity

1. Brainstorm ideas to identify prior knowledge. In interactive discussion, ask participants to share their experiences in placenta examination.

2. Tell participants that they are going to practice placenta examination. Observe small groups practicing placenta examination and inspection of changes.
3. In plenary, ask participants to reflect on their experiences and observations. Write responses on a flipchart paper. Review responses and address questions from participants.
4. Close the session with a summary presentation of characteristic changes in placenta.

PowerPoint slide



Section 3. Data documentation, reporting and submission

This section of the module will focus on record keeping and reporting during and after post mortem examination.

Unit 7. Data documentation

By the end of the unit, participants will be able to:

- Outline reasons for data and photo documentation
- Explain consequences of poor data documentation
- List relevant details for data documentation
- Prepare format and demonstrate proper data documentation practice

Learning content

- Types of data to be collected
- Data format preparation

Methods and materials

- Interactive presentation
- Recording and reporting templates

Duration

30 minutes

Learning activities

1. In an interactive discussion, ask participants to brainstorm type of information (relevant details) that needs to be documented in postmortem examination.
2. Distribute format for data documentation. In small groups, ask participants to review the format.
3. Close the session with a summary presentation highlighting key points in data documentation and management.

Data recording and reporting format

The following information should be recorded:

- Sender's name and location, telephone/fax, date of submission
- Owner’s name and location of the animals with telephone/fax if available
- Suspected disease(s)
- List and description of specimens collected, tests required (transport medium used), date of sampling
- Type and numbers of animals present

- Species affected, breed, age, sex and identity of the animals
- Date of first and subsequent cases
- Description of the spread in the herd or flock
- Number and ages of animals dead and showing clinical signs
- Type of clinical signs and duration
- Medication given to the animal, time of recurrence from any previous treatment
- Description of lesions observed in clinical and postmortem examinations
- Type and standard of animal husbandry/management (including type of feed available)

Unit 8. Reporting and submission

By the end of the unit, participants will be able to:

- Strictly follow reporting and submission format for lab analysis
- Prepare and submit postmortem examination report

Learning content

Report preparation and submission

Methods and materials

- Interactive presentation
- Checklist and format

Approximate time

30 minutes

Learning activities

1. Brainstorm ideas to identify prior knowledge. Ask participants to share their experiences related to reporting and submission in postmortem examination.
2. Distribute a checklist and reporting format. Ask participants to individually reflect and review their experiences in the practical sessions of the module. Ask them to prepare a report using the checklist and format provided.
3. In plenary session, highlight key points related to preparation and submission of postmortem examination reports.

Training notes

Regardless of the type of submission, a detailed case history should be included with the samples to assist laboratory personnel in determining a diagnosis. If a zoonotic disease is suspected, this should also be clearly

indicated on the submission form to alert laboratory personnel. The submission form should be placed in a waterproof bag to protect it from any fluids that might be present in the packaged materials. Waterproof markers should be used when labeling specimen bags and containers. When packaging samples, the use of breakable containers should be avoided.